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PEOPLE, BUILDINGS AND ENVIRONMENT 2010

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FACULTY OF CIVIL ENGINEERING
INSTITUTE OF STRUCTURAL ECONOMICS AND MANAGEMENT
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PREFACE

The International Scientific Conference People, Buildings and Environment enter into the 9th run. Increasing interest of participants shows that interconnection of research themes of the branches of construction economy and management, water management and water structures, landscape formation and protection was correct decision.

The conference brings opportunity to present new results, which are obtained during solving of research projects. Sharing opinions and debates on these results and processes of their achievement are important tools for development of scientific discipline. I am pleased with increasing interest of our colleagues from the Czech and foreign universities, which always enrich our scientific research with new experience or confirm that the development of our researches goes in the same direction that the national economies feel the need to research the same or similar topics.

This year’s conference is extended with the new section University learning and teaching, which extends our discussions with the dimension of knowledge transfer.

I wish to all participants a pleasant stay at this year's conference, which takes place in beautiful premises of castle in Křtiny, acquiring new knowledge, new contacts and personal success in other creative work.

Jana Korytárová

KEYNOTE LECTURE

BUILDING INFORMATION MODELLING (BIM) BASED CHANGES IN THE MANAGEMENT OF CONSTRUCTION PROJECTS

John-Paris Pantouvakis[1]

Abstract

As most construction projects are large and costly, collaborative working through the use of a common information model called BIM may streamline efforts and resources to be used more effectively and efficiently. The usability of such a BIM can be evaluated by considering three interrelated perspectives: the technological, organizational, and social; and of these the key issue is to improve productivity and enable innovation through the empowerment and motivation of people. This paper provides insights for researchers and practitioners in the construction industry into the potential use, development and limitations of current BIM technologies and practices.

Key words

Construction; Construction Management; Building Information Modelling; Collaborative working.

1 INTRODUCTION

Building Information Modeling (BIM) is the process of generating and managing building data during its life cycle [1]. Typically it uses three-dimensional, real-time, dynamic building modeling software to increase productivity in building design and construction [2]. The process produces the Building Information Model (also abbreviated BIM), which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components.

BIM may be used to demonstrate the entire building life cycle, including the processes of construction and facility operation. Quantities, properties of materials and scopes of work can be isolated and defined. Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. BIM goes beyond geometry and addresses issues such as Cost Management, Project Management and concurrency of work on most aspects during the life cycle.

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Implementing BIM goes beyond switching to a new software. It requires changes to the definition of traditional architectural phases and more data sharing than most architects and engineers are used to. BIM requires consistent modeling representations of the actual parts being used to construct a building [3]. This is a substantial shift from the traditional computer aided drafting method of drawing with vector file-based lines that combine to represent objects.

There have been attempts at creating a BIM for older, pre-existing facilities. They generally reference key metrics such as the Facility Condition Index, or FCI. The validity of these models will need to be monitored over time, because trying to model a building constructed in, say 1927, requires numerous assumptions about design standards, building codes, construction methods, materials, etc., and therefore is far more complex than building a BIM at time of initial design.

The American Institute of Architects has further defined BIM as "a model-based technology linked with a database of project information" [1], and this reflects the general reliance on database technology as the foundation. In the future, structured text documents such as specifications may be able to be searched and linked to regional, national, and international standards.

BIM is a relatively new technology in an industry typically slow to adopt change. Yet many early adopters are confident that BIM will grow to play an even more crucial role in building documentation [4].

The Industry Foundation Classes (IFC/ifcXML) are an open specification for BIMs and are used to share and exchange data and information in a neutral format among various software applications. Green Building XML (gbXML) is an emerging schema, a subset of the Building Information.

It is believed that the emergence of BIM together with related technologies (such as virtual prototyping) represents a new way of working in construction which will be widely adopted in the next 15-20 years. BIMs have already been embraced by numerous clients, designers and contractors worldwide. The benefits that may be accrued offer a new paradigm for information management, which although requires a significant effort to set up, it is expected to pay dividents. The new technologies have the potential to revolutionize the construction industry and enhance collaborative working across disciplines, locations and organizations.

In this paper we review briefly the BIM components and present a success story from BIM implementation in an actual project in Hong Kong.

2 BIM COMPONENTS

A building may be thought of as consisting of objects, each of which may have a boundary-spanning role. Such objects include product models, CAD drawings and plans used to describe the *product* [5] and process charts and project management tools used to negotiate the *process* [6]. The different categories of objects that may be useful in different types of knowledge boundaries, and as such as useful in BIMs can be thought of as [7], [8]:

- *Objects, models and maps* such as drawings, engineering calculations and other objects used to describe the product and the process of its delivery.

- *Standardized forms* that allow for standardization of methods in distributed work processes.
- *Repocitories*, i.e. piles of catalogued data as in a library of CAD

Where the latter is addressed by modern database technologies, it has proved the hardest part to address as data and inter-relationships are industry and legislation dependent, both of which are highly fragmented and diverse across different countries (esp. in Europe).

The major issues involved and the strategy for resolution are summarized in Table 1 below.

Tab. 1) BIM issues and strategy of resolution (adapted from [4])

Issues	**Strategy of resolution**
Quantity take-off at different levels of detail.	Consistent model at different levels of detail as design evolves.
Interoperability	Single database schema. Use of IFC to exchange data with external software
Multiple data views	Plug-in technologies to allow different reporting and visualization outputs.
Information digging	Keep consistent views of data and information in different formats so that roles can deal with all related information
Information filtering	Allow users to built different filters (preferably in a high level – almost natural- query language

The major plug-ins required are: An automatic scheduler, a design specification checker, an integrated facilities management module, an automated take-off and estimating module, a design checker and an area calculation module [4]. The underlying data module can be developed in Eclipse Modeling Framework (EMF) which is integrated with UML and W3C Object Constraint Language (OCL) providing rule checking and mapping facilities [9], [10].

3 FROM THEORY TO PRACTICE – A CASE STUDY OF BIM IMPLEMENTATION

The Swire Properties Limited One Island East (OIE) Tower design and construction project in Hong Kong is one of the most substantial BIM impementations ever undertaken. The owner put into place a robust BIM to lower the cost of construction by enhancing efficiency and reducing waste across the entire process. The development of BIM revealed over 2,000 design clashes which were resolved prior to tender. As such, the returned tenders were lower than originally envisaged and withing close proximity to one another.

The winning contractor assumed full responsibility for the BIM during construction and ensured that all 2D information that went to site was first vetted in the virtual 3D prototype. This enhanced coordination and allowed timely drawing production and constuction methodology simulation [11].

During construction, the BIM became the central management tool identifying and coordinating construction sequence issues and clashes prior to the problems reaching the site. All project participants have had timely real-time information and visibility in the entire building lifecycle process.

Once the project was completed (in May 2008), it was found that substantial time and costs have been saved. The BIM was developed during the 12-month period used for finalizing the designs and its cost was entirely justified by the overall cost savings of the project. More specifically, BIM development was equal to 1% of the total construction cost, whereas the accrued construction cost reduction was estimated around 8%.

Fig. 1) The OIE project – BIM model output (*left*) and actual construction (*right*).

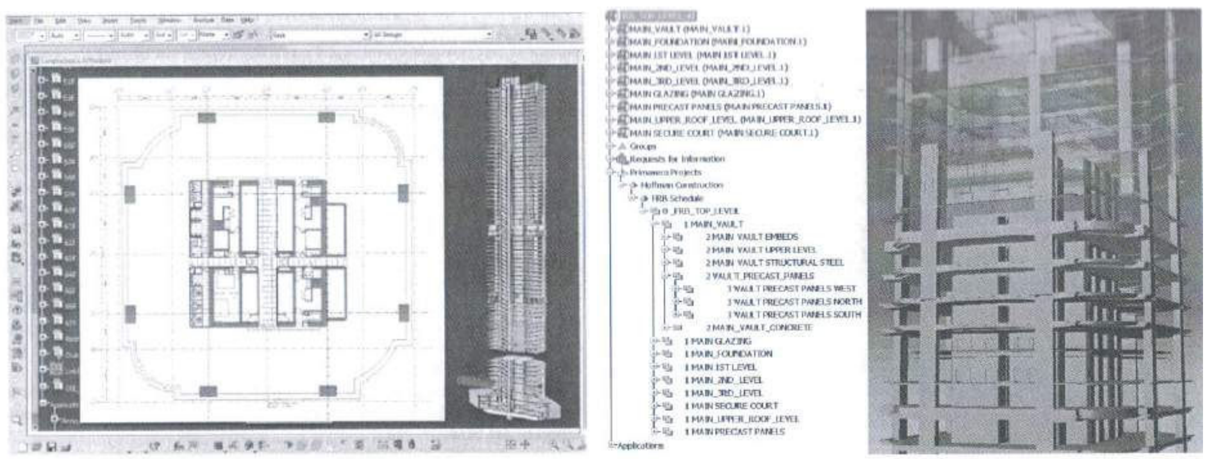

Fig. 2) Example BIM screens where different views of the data (*left*) and objects (*right*) can be seen.

4 CONCLUSION

For champions of building information modeling, the value proposition is clear. The vast majority of users report seeing positive returns on their investment in BIM. For the time and expense put into making BIM part of their practice, users gain a range of benefits that could include improved productivity, enhanced quality, increased opportunities for new business and overall better project outcomes. The more benefits a user reaps, the higher the perceived value.The benefits gained from BIM are greater than many users believe. Those who formally measure ROI on BIM report higher returns than those who estimate returns based on perception.

With experience, users can see more value. Experts prove that, as users gain proficiency, they will find ways to leverage the technology to their benefit. Given that BIM is still an emerging process, this trend should gain momentum as more users master it and software providers develop additional tools [3].

- 63% of BIM users say they see positive ROI on their overall investment in BIM.
- 72% of users who formally measure their ROI on BIM report positive returns, compared to 53% of users who estimate returns based on perception.
- 87% of expert users see positive ROI with BIM compared to 38% of beginners.
- 93% of BIM users believe that, compared to today, there is potential to gain more value from BIM in the future..

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KEYNOTE LECTURE

SCOUR AT ELLIPTICAL GUIDE BANKS UNDER STRATIFIED BED CONDITIONS: EQUILIBRIUM STAGE

Boriss Gjunsburgs[1], Gints Jaudzems[2], Elena Govsha[3]

Abstract

The scour development in time and the equilibrium stage of scour near abutments and guide banks with a uniform layer and stratified bed conditions have been studied. At present, no methods are available for computing the depth of a local scour near the bridge crossing structures under complex geological conditions. The tests in flume were made with uniform layers and with two layers with different grain size. The sequence of layers can increase the scour depth and lead to damage or failure of bridge structures. A new method for computing the equilibrium scour depth at elliptical guide banks in the stratified river bed conditions is presented. The method is confirmed by test results.

Key words

Scour, stratified conditions, elliptical banks, scour geology

1 INTRODUCTION

Streamline concentration, local increase in velocity, circulation and vortex structures, an increased turbulence, and a scour hole are observed at the head of guide banks. According to different authors, the depth of scour at bridge structures depends on the grain size of the surface layer of the river bed. But this approach does not reflect the complexity of the geological structure of river bed, which can increase the scour depth and cause damage to bridge structures.

The influence of river bed stratification on the depth of scour was mentioned by Rotenburg et al. [1], Ettema [2], Raudkivi and Ettema [3], and Gjunsburgs et al. [4, 5], but there is no method for computing the local depth of scour near bridge structures under stratified bed conditions. In this study, a new method for computing the equilibrium depth of scour at elliptical guide banks under stratified bed conditions is presented. According to experimental

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and calculation results, in the stratified bed conditions, the grain size of a layer at which the scour stops is the main parameter for predicting the scour depth. If the surface layer with a grain size d_1 is scoured and the process is continued in the second layer with a grain size d_2, where $d_1<d_2$ and $h_{equil} < H_{d1} + H_{d2}$ (the scour stops at the second layer), the scour depth in the case of two layers is the same as that in one layer with d_2. If the scour stops in the second layer and $d_1>d_2$, $h_{equil}<H_{d1}+H_{d2}$, its depth is greater than in the case of a uniform layer with a grain size d_1. The sequence of layers with different diameters of grains is illustrated in Fig.1. The value of d_1 can exceed d_2 or vice versa.

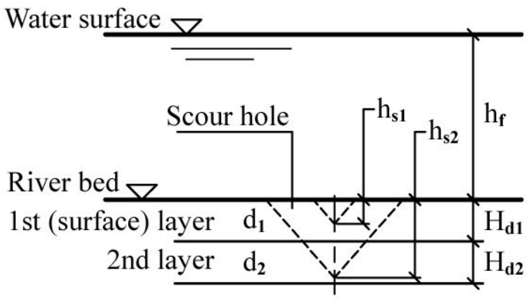

Fig. 1) Geology of the river bed formed by layers with different grain sizes

2 EXPERIMENTAL SETUP

The tests were carried out in a flume 3.5 m wide and 21 m long. The flow distribution between the channel and the floodplain was studied under open-channel flow conditions (Table 1). The rigid-bed tests were performed for different flow contractions and Froude numbers with the purpose of investigating the changes in velocity and water level near the embankment, along it, and near the modeled elliptical guide bank.

Tab. 1) Some experimental data for open flow conditions in a flume

Test	*L* (cm)	h_f (cm)	*V* (cm/s)	*Q* (l/s)	*Fr*	Re_c	Re_f
L1	350	7	6.47	16.60	0.780	7500	4390
L2	350	7	8.58	22.70	0.010	10010	6060
L4	350	7	8.16	20.81	0.098	10270	5590/5660
L5	350	7	9.07	23.48	0.109	11280	6140/6410
L6	350	7	11.10	28.31	0.134	13800	7550/7840
L7	350	13	7.51	35.48	0.067	13700	9740
L8	350	13	8.74	41.38	0.076	16010	11395
L9	350	13	9.90	47.10	0.088	14300	14300

During sand-bed tests, the time-dependent changes in velocities and scour depth, the effect of different hydraulic parameters, the flow contraction rate, the grain size of bed materials, and the scour process were studied. The tests were performed in a flume of width L = 350cm for the following bridge-model openings: 50, 80, 120, and 200 cm. The flow contraction rate Q/Q_b (where Q is the general discharge and Q_b is the discharge through the bridge opening under open-flow conditions) varied from 1.56 to 5.69 for the floodplain depth h_f = 7 and 13 cm, respectively; the Froude numbers varied from 0.078 to 0.134, R_c — from 7500 to 16010, and R_f — from 4390 to 14300, where R_c and R_f are the Reynolds numbers for the channel and floodplain, respectively; the slope of the flume was 0.0012. The sand was placed 1 m up and down the contraction point of the flume. The grain sizes were 0.24 and 0.67 mm, and the tests were performed with a uniform layer or with two layers of different thicknesses and grain sizes.

3 METHOD

3.1 Equilibrium depth of scour at elliptical guide banks

The scour depth at elliptical guide banks is equal to the equilibrium depth in the conditions when the local velocity becomes equal to the critical one. The local velocity at a plain river bed is found by the Bernoulli equation for two cross sections of the extreme unit streamline [6]. The discharge across the width of a scour hole before and after the development of scour is $Q_f=kQ_{se}$, where Q_f is the discharge across the width of a scour hole with the plain bed and Q_{se} is that with a depth h_{equil}

$$m \cdot h_{equil} \cdot h_f \cdot V_{l\,el} = k\left(m \cdot h_{equil} h_f \frac{m \cdot h_{equil}}{2} h_{equil} \right) V_{lt} \qquad (1)$$

where m is the steepness of the scour hole, h_{equil} is the depth of scour at the equilibrium stage, h_f is the depth of flow at the floodplain, $V_{l\,el}$ is the local velocity, and k is a coefficient of changes in discharge because of scour, which depends on the flow contraction [4]. The local velocity V_{lt} at an equilibrium stage of scour is determined from Eq. (1)

$$V_{lt} = \frac{V_{l\,el}}{k\left(1 + \frac{h_{equil}}{2h_f}\right)} \qquad (2)$$

The critical velocity V_{0t} at the equilibrium stage can be determined through the mean depth of flow $h_m = h_f(1+h_{equil}/2h_f)$ near elliptical guide banks at that stage:

$$V_{0t} = \beta \cdot 3.6 d_i^{0.25} h_f^{0.25} \left(1 + \frac{h_{equil}}{2h_f}\right)^{0.25} \qquad (3)$$

where β is a coefficient of reduction in the critical velocity due to vortex structures, d_i is the grain size of the bed materials, and $V_0=3.6d_i^{0.25}h_f^{0.25}$ is the critical velocity at the plain bed [7].

The scour at the equilibrium stage stops when the local velocity V_{lt} (Eq. 2) becomes equal to the critical velocity V_{0t} (Eq. 3)

$$\frac{V_{l\ el.}}{k\left(1+\frac{h_{equil}}{2h_f}\right)} = \beta \cdot 3.6 d_i^{\ 0.25} h_f^{\ 0.25} \left(1+\frac{h_{equil}}{2h_f}\right)^{0.25} \tag{4}$$

From Eq. 4, the equilibrium depth of scour at elliptical guide banks is found

$$h_{equil} = 2h_f \left[\left(\frac{V_l}{\beta V_0} \right)^{0.8} - 1 \right] \cdot k_\alpha \cdot k_m \tag{5}$$

where k_α is a coefficient depending on the flow crossing angle and k_m is a coefficient depending on the side-wall slope of guide banks.

According to Eq. (5), the equilibrium depth of scour depends on the floodplain depth, contraction rate of flow, backwater value, and the grain size of river bed. With increase in the grain size, the equilibrium depth of scour reduces.

3.2 Equilibrium depth of scour at elliptical guide banks under stratified bed conditions

The geology of the river bed is complicate and usually is formed by layers with different thickness and grain sizes (Fig. 2).

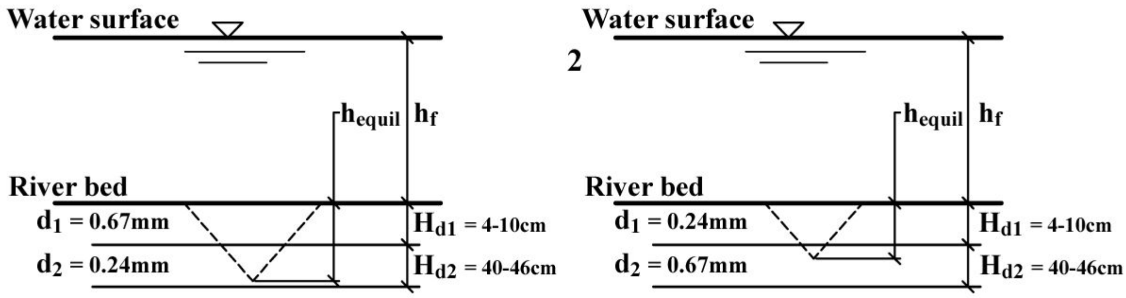

Fig. 2) Two layers with different test grain sizes

When the scour depth $h_{equil}<H_{d1}$, equation (5) can be used; however, when $h_{equil}>H_{d1}$, the scour develops in the second layer with a grain size d_2. If $h_{equil}>H_{d1} + H_{d2}$, the scour develops in the third layer with a grain size d_3, and so on. Then, the equilibrium scour depth is different from that in the uniform layer. At the initial stage, the equilibrium scour depth h_{equil} is calculated by Eq. (5). When $h_{equil}>H_{d1}$, the scour develops in the second layer with d_2. Now, to determine the equilibrium depth of scour the local and critical velocities on the top of the second layer must be calculated. The local velocity on the surface of the second layer is found by the formula

$$V_{lt1} = \frac{V_{l\ el}}{k\left(1+\frac{H_{d1}}{2h_f}\right)} \tag{6}$$

where H_{d1} is the thickness of the first layer of the river bed.

The critical velocity is determined from the medium depth of flow $h_{mid}=h_f(1+H_{d1}/2h_f)$ on the floodplain with a scour depth equal to the thickness of the first bed layer,

$$V_{01} = \beta 3.6 \cdot d_2^{\;0.25} h_f^{\;0.25} \left(1 + \frac{H_{d1}}{2h_f}\right) \tag{7}$$

where $V_0=\beta 3.6 d_2^{0.25} h_f^{0.25}$ is the critical velocity of flow for the grain size d_2, since the layer with exactly this diameter lies on the top of the river bed.

Then, the scour depth in the second layer is determined as

$$h_{s2} = 2h_f \left[\left(\frac{V_{lt1}}{V_{01}}\right)^{0.8} - 1\right] \cdot k_\alpha \cdot k_m \tag{8}$$

At $h_{s2}<H_{d2}$, the scour stops, and the equilibrium scour depth is

$$h_{equil} = H_{d1} + h_{s2} \tag{9}$$

If $h_{s2}>H_{d2}$, the calculation could be continued using Eq. (8).

4 RESULTS

The test results are presented in Table 1. The EL 4-6 tests were performed with one uniform layer with a mean diameter of 0.24 mm, the EL16-18 tests with a mean diameter of 0.67mm, and the EUL 1-6 tests were carried out with two layers of different thickness with grain sizes d_1= 0.24 mm and d_2= 0.67 mm.

Tab. 2) Test results for elliptical guide banks

Test	$\frac{Q}{Q_b}$	d_1 (mm)	d_2 (mm)	H_{d1} (cm)	H_{d2} (cm)	t (h)	$h_{s\,test}$ (cm)	$h_{s\,calc}$ (cm)	$\frac{h_{s\,test}}{h_{s\,calc}}$	h_{equil} (d_1) (cm)	h_{equil} (d_2) (cm)	h_{equil} (*layers*) (cm)
EL4	3.66	0.24	-	50	-	7	7.6	8.40	0.905	10.43	-	-
EL5	3.87	0.24	-	50	-	7	11.0	11.00	1.000	14.10	-	-
EL6	3.78	0.24	-	50	-	7	14.0	13.51	1.036	17.65	-	-
EL16	3.66	0.67	-	50	-	7	6.1	5.60	1.084	5.90	-	-
EL17	3.87	0.67	-	50	-	7	8.4	8.35	1.005	8.91	-	-
EL18	3.78	0.67	-	50	-	7	12.2	10.50	1.162	11.78	-	-
EUL1	3.66	0.67	0.24	4	46	7	8.2	8.48	0.966	5.90	10.43	10.43

EUL2	3.87	0.67	0.24	7	43	7	10.7	10.85	0.986	8.91	14.10	14.10
EUL3	3.78	0.67	0.24	10	40	7	12.4	11.97	1.035	11.78	17.65	17.65
EUL4	3.66	0.24	0.67	4	46	7	5.6	5.74	0.975	10.43	5.90	5.90
EUL5	3.87	0.24	0.67	7	43	7	8.6	8.44	1.018	14.10	8.91	8.91
EUL6	3.78	0.24	0.67	10	40	7	11.4	11.03	1.033	17.62	11.78	11.78

The opening of the bridge model was 80 cm and the floodplain depth was 7 cm. The tests lasted for 7 hours. The scour depth developed in 7 hours was prolonged to an equilibrium stage by using the method elaborated by Gjunsburgs et al. [4]. The equilibrium scour depth in tests with uniform layer was respectively 10.43, 14.10, and 17.65 cm with mean grain-size diameters 0.24 mm and 5.90 cm and 8.91 cm and 11.78 cm with a 0.67 mm diameter. The Froude numbers of the open flow were 0.078, 0.104, and 0.124. The tests with two layers were performed for different thicknesses and grain sizes of layers. In the EUL1, EUL2, and EUL3 tests, the first and the second layers had grain sizes of 0.67 and 0.24 mm, respectively (Fig. 2). When the layer was scored and $h_s>H_{d1}$, the equilibrium scour depth, both determined in tests and calculated by Eq. (8), was the same if one layer had d_1 = 0.24 mm. This fact evidences the important role played by the grain size of the second layer, d_2 = 0.24 mm; the depth of scour increases rapidly in the second layer ($d_2<d_1$) in spite of the presence of the upper layer with diameter d_1 = 0.67 mm. The calculated depth of scour with the grain size existing on the bed surface gives smaller values. In the EUL4, EUL5, and EUL6 tests, the first layer had the grain size d_1 = 0.24 mm and the next layer had d_2= 0.67 mm. When the first layer was scoured and $h_s>Hd_1$, the equilibrium depth of scour became equal to that found for one layer with the grain size 0.67 mm. The determined equilibrium depth of scour was smaller than that used in the formulae with d_1 = 0.24 mm on the surface.

5 CONCLUSIONS

The scour development in time and the equilibrium stage of scour at abutments and guide banks under stratified bed conditions have been studied. The method for computing the equilibrium depth of scour under these conditions is presented (Eq. 8). The method is confirmed by test results (Table 1).

According to the method and test results, the equilibrium depth of scour at elliptical guide banks strictly depends on the sequence of the bed layers with different grain sizes.

When the first uniform coarse sand layer is scoured $h_s>H_{d1}$ (Fig. 2), the equilibrium depth of scour becomes equal to its value achieved in the second uniform fine sand layer with a grain size d_2. If the first fine sand layer is scoured (Fig. 2), the equilibrium scour depth is equal to that in the second coarse sand layer (Table 1).

In the stratified bed conditions, the use of grain-size parameters of the river bed material on the surface for calculating the equilibrium scour depth yields incorrect results.

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SECTION I

CONSTRUCTION ECONOMICS AND MANAGEMENT

ECONOMY IN THE BUILDING MATERIALS INDUSTRY BY WASTE MANAGEMENT

Claudiu Aciu[1], Nicoleta Cobirzan[2], Anca Popa[3], Mariana Brumaru[4]

Abstract

In the current framework of sustainable development, waste management represents an increasingly delicate issue, especially regarding the storage of waste materials and their impact upon the environment. Using waste materials in the production of building materials is an efficient means of reducing the consumption of natural resources and, at the same time, substantially lowering the negative impact on the environment. This paper aims at raising awareness on the recycling possibilities of some products and industrial waste materials which could be used in construction and in the technology of building materials, thus highlighting some of the directions in the approach of some specific economic, technical and ecological problems.

Key words

Economy, sustainable development, building materials, waste management

1 INTRODUCTION

Mankind is currently confronted with special problems regarding both raw materials and environmental pollution.

Sustainable development is a strategy that provides a framework by which communities seek to find possibilities of economic development based on efficient use of resources, to find new business activities to strengthen the economy while protecting and improving the environment.

The reuse of waste material is one of the solutions adopted at international level which is intended to contribute in the first place to the valorization of waste material and

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environmental protection and in the second place to the solution of the problem of energy sources and the reduction of production costs in the field of construction.

2 RECYCLING WASTE MATERIALS RESULTED FROM CONSTRUCTION AND DEMOLITIONS

The waste materials resulted from construction and demolitions (WCD) weighs considerably in the category of waste materials. At the world level, it is estimated that approximately 13% of the amount of deposited waste materials and excavations are produced by construction.

The construction and demolition waste re-use grade in Europe in the beginning of 90's is given in the Figure 1.

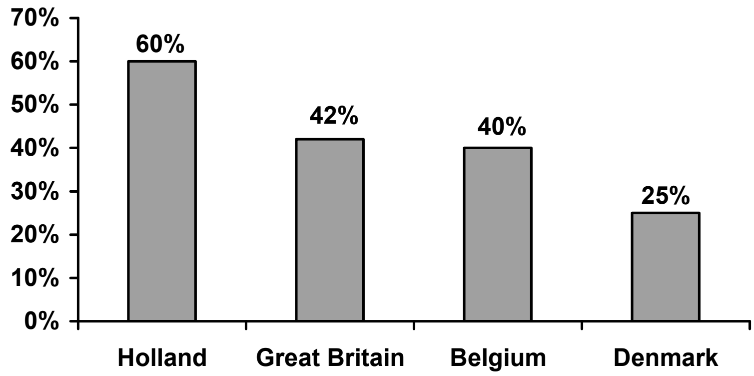

Fig. 1) Re-use grade of waste (%)

Reusing building materials in their current state, without reducing or processing them, is the most advantageous option from the point of view of the environment for construction projects. There are massive resources of materials from demolitions or from temporary works. There are two positive aspects linked to the usage of recycled building materials:

- it avoids the storage of waste materials, generating a market for those materials whose disposal entails money and land;
- it replaces the need to use new materials.

The recycling of materials which come from construction may lead to a substantial recovery of the embodied energy, which means a considerable reduction of the production costs related to materials and to the actual building process; this is illustrated in Table 1, (Source: Roberta Forsell Stauffer of National Technical Assistance Service (NATAS), published in Resource Recycling, Jan/Feb 1989).

Tab. 1) Production Energy Savings of Recycled Materials

Material	Energy required to produce from raw material (million Btu/ton)	Energy saved by using recycled materials (%)
Aluminium	250	95
Plastics	98	88
Newsprint	29.8	34
Corrugated cardboard	26.5	24
Glass	15.6	20

Aluminium, whose production requires much power, has the advantage of not being damaged by oxidation, thus allowing for it to be recycled.

Recycled steel is used on a large scale worldwide and has only half of the embodied energy of the new steel. The environment profile of BRE [1] showed that the ecological impact of crushed concrete aggregate is by 50% lower than that of the new aggregate. Also, the ecological impact of sand obtained from crushed glass represents 5% of the new sand.

Recycling materials, by reprocessing them, has highly different effects, ranging from 20% for glass to 95% for aluminium, as can be noticed in Figure 2, (Source: „Australian Commonwealth Scientific and Research Organization”).

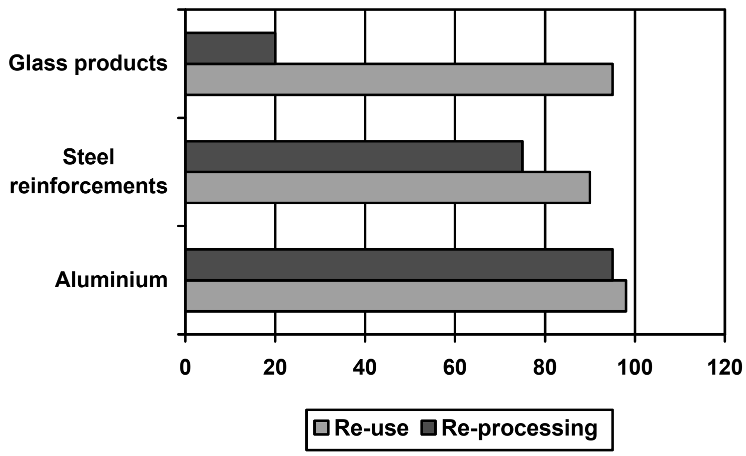

Fig. 2) Embodied energy reduction by reusing and reprocessing materials (%)

3 USE OF WASTE MATERIALS IN CONCRETE PRODUCTION – ENVIRONMENTAL PROTECTION AND SAVING

In constructions, an extremely frequently used material is concrete. This is obtained using embodied energy which is found in the highest proportion in Portland cement. As it is shown in Table 2, although its proportion in the recipe is only 12%, the embodied energy in it is as high as 92% of the energy required for the manufacture of concrete.

Tab. 2) Energy required for the manufacture of concrete

Component	Percentages by weight	Energy %
Portland cement	12%	92%
Crushed stone	48%	6%
Sand	34%	2%
Water	6%	0%

Given this, the attention of specialists has focused on two aspects: finding substitutes for Portland cement and finding solutions for the manufacture of cement with an as low as possible energy consumption, without affecting environment.

A solution in this sense is the use of waste material as an alternative fuel for the manufacture of cement.

The replacement of the main fuels (coal, gas, fuel oil) used to obtain cement with alternative fuels derived from waste materials or from different tehnological processes contribute on the one hand to the conservation of fossil fuels and on the other hand to protect the environment. The secondary or alternative fuels used include: used tires, various solid or liquid waste materials, plastic materials, as well as waste derived biological fuels.

Shortage (absence; scarcity) of natural aggregate in many urban areas and shortage of cement in many of the developing countries has encouraged researchers to find new concrete materials. Some of the organic, inorganic and industrial wastes have been tried with some success either as aggregates or as binder materials to partially replace Portland cement.

A wide range of waste can be used to manufacture concrete by the partial replacement of one of its three major components: aggregates, cement and water.

The concerns about the use of waste materials in the manufacture of concrete have been focused mainly on the use of two types of waste: organic and inorganic (municipal waste).

3.1 Inorganic wastes

Coarse aggregates may be replaced with recycled crushed concrete. The easiest method is to use 30% recycled aggregate for structural concrete. There are no perceptible differences at the workability and strength between the concrete with natural stone aggregate and the concrete with up to 30% recycled aggregates. Under controlled conditions, in the concrete composition can be used up to 100% recycled coarse aggregates, but the concrete containing more than 30% recycled concrete aggregates requires a larger amount of water is less workable and resistant.

Fine aggregates resulted from crushed concrete can be used to reduce the quantity of natural sand as can be used other industrial wastes such as frosted glass, slag sand. The properties of these products may affect the workability, strength and can lead to cracks due to shrinkage.

Substitutes for Portland cement are fly ash, rice husks ash, etc. There are available different mixtures of cement, some with high quantities of replacements for Portland cement (up to

85%). The small quantity of Portland cement results in a significant reduction in greenhouse gas emissions that cause greenhouse effect.

3.2 Organic wastes [8]

The organic wastes that have been used in making concrete are mainly of plant origin and include rice husk, coconut pith, saw dust and cork granules. Other organic wastes such as groundnut husk, wheat husk and coconut shell of plant origin, and leather wastes of animal origin are worth researching.

Sawdust is available abundantly in most places and has been used in some places for making low cost lightweight concrete for low-demand applications. Sawdust contains considerable quantities of water-soluble cement poisons which retard the hydration and hardening of cement paste. Physico-chemical treatments are necessary to neutralise the cement poisons which add to the cost of saw dust concrete appreciably. In the tests carried out at the National University of Singapore sawdust was pretreated by soaking and washing with water before mixing was done to ensure that extractable materials in the saw dust do not interfere with the hardening of the concrete.

Rice husk has been used in Brazil as an aggregate in concrete mainly for making precast blocks and slabs. Rice husk contains relatively small amount of water soluble cement poisons compared with saw dust and has a low bulk density of 100 to 150 kg/m^3. The bulk density of rice husk concrete is about 600 kg/m^3 or more depending on the proportions of husk and cement, and the compression force. The compressive strength ranges from 3 to 12 N/mm^2.

Coconut pith is a waste product which falls as granules and dust when fibres are separated from the coconut husk. Large amounts of pith are obtained during the dehusking operation in the coir industry which can be used as lightweight aggregate in concrete.

Retted coconut pith has a bulk density of 80 to 90 kg/m^3 in the air-dry condition and the concrete produced from it has densities ranging from 432 to 768 kg/m^3. Coconut pith concrete has a low thermal conductivity ranging between 0.052 and 0.110 W/m°C which makes it an excellent low cost material for thermal insulation.

Coconut pith concrete has been used in Brazil to make building panels for use in partitions, ceiling and non-loadbearing wall panels in low-cost housing.

Rice Husk can be put to better use by producing Rice Husk Ash (RHA) and using it to replace part of the portland cement as binding material in concrete. 85 to 97% of RHA consists of amorphous silicia, the reactivity of which depends on the burning process used. The ash produced by burning of rice husk in open fields or as a fuel in boilers is mostly inert and is ineffective as a binder in concrete. The activity of RHA depends on the burning temperature, duration of burning, condition of air supply during burning, cooling rate of resulted hot ash and grinding time. The best RHA produced so far has been by Mehta and Pitt. Blended cement containing 20% RHA and 80% cement produced a mortar having a compressive strength of 61.3 N/mm^2 at 28 days compared with 43.6 N/mm^2 for the control mortar in which no RHA was added. It is interesting to note that even when the blended cement contained as high as 70% RHA, the mortar produced was slightly stronger than the control mortar at all ages.

Cork granules of commercial packing variety were used in their research at the National University of Singapore to produce lightweight concrete for various civil engineering applications. Depending on the proportions of cement and cork granules, compressive strength ranging between 4.2 and 12.0 N/mm^2 were obtained for a dry density range of 475 to 890 kg/m^3. Because of its lightness and permeability, cork granule concrete may be used to replace earth fill in trenches over burried pipes and for backfills behind retaining structures and abutments. Insulating screeding and blocks for internal partitions are other potential uses for cork granule concrete.

4 CONCLUSION

Waste materials from construction are efficiently reused as one of the most advantageous method of achieving sustainable development, and construction industry offers many possibilities of recovering materials and, at the same time, of reducing power use, therefore ensuring the environment. This practice presents significant advantages, as follows:

- to waste generators, it provides the guarantee of a total elimination, relatively cheap, under entirely safe conditions for the environment, of the closure of the life cycle of products and it also ensures that environments problems and corresponding penalties are avoided;
- to cement producers, it ensures the partial substitution of traditional fuels and raw materials, as well as an active involvement in the environment protection as depollutant and provider of environmental services.

The entire society and the environment will have, nonetheless, the greatest benefits, as the method will have the following results:

- preserving natural resources: coal, fuel oil, gas, plaster, limestone, clay, etc.;
- indirectly reducing gas emissions, which would be produced in case the waste materials were processed by disposal or by incineration in specially created areas;
- reducing environmental risks (uncontrolled disposals, soil and water pollution, etc.);
- avoiding over-piling of controlled stocks (dumps);
- improving the image of the environment.

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MONITORING OF ECONOMIC CHARACTERISTICS OF CONSTRUCTION OBJECT

Petr Aigel[1]

Abstract

The article attempts to describe the possibility of monitoring the prices of the building as its economic characteristics. Because it is a complex system based on monitoring of technical-economic characteristics affecting (among other influences) the price of the building, scope of article , I will try, at least a brief outline.

Key words

Price, costs, estimating, material

1 INTRODUCTION

Determination of price of building is a complex problem, which everybody meets in his life. Whether, it is for the purpose of a mortgage, inheritance, insurance, etc. It is always an effort to make the best possible price for the building followed the situation on the market in any period of time, therefore, should be monitored throughout the life cycle of the building. Since, the implementation phase through a phase of operation to phase of disposal. In the implementation phase, the object is designated object value of contracts for extra work or cancelled work appreciation of the investor and other environmental influences (they can also be reduced price of the house). In the operational phase, the price impact costs incurred by the repair and maintenance costs or revenues from the operation of the building as well as environmental influences. The liquidation phase is no longer possible to talk about the price of the house, we can only talk about the costs of disposal and the proceeds from the sale of reusable and recyclable materials..

2 INVESTMENT PHASE

For the purpose of monitoring prices in the investment phase (mainly in the implementation phase) is necessary isolate material costs. Material costs are the costs of material, which becomes for investor a real tangible property with which he treated according to their needs. Just in the material cost is much information related to the technical-economic characteristics of the object.

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To obtain information on materials, it is possible to use classification system based on functional parts, which allows you to sending demands to suppliers of construction materials, and bring the estimating up to them. On the supplier side is only to calculate the quantity of materials needed to carry out the construction work (as long as this statement has been prepared by the investor).

In this system are estimated only main materials. Price of additional materials are calculated using the percentages from the price of the main material or using product of the quantity and the price, which is calculated over the rate of consumption to the unit of measure used by the main material. This will significantly speed up the processing of tenders.

Other implementation costs are the costs associated with the incorporation of materials into the construction. From an investor perspective, it is the intangible costs. This includes wage costs, costs of machinery, other direct and indirect costs and supplier's profit, which is also the cost for the investor. A prerequisite for the maintenance of information of construction object is that the investor will have information of prices of main materials available (to a certain level of classification).

This method of classification and estimating is different from the present in several points. For example, unlike the existing method of estimating of construction output directly estimate concrete materials, labor, and machinery and not another represented in items. So we estimate the exact materials, workers and machines that we use. Moreover, the evaluation of the time of activities is more realistic because we know from personal experience how long some work will take according the terms on the site. And it is not possible (as it is in the present, for example, in the analysis of the item of shifts of materials) that materials, workers and machinery in the analysis of the items, does not corresponding with reality (in the sense of time and content). For other individual calculations are also inappropriate. In addition, overhead costs and profits are estimated in individual items using percentage of the direct processing costs, although their total amount is comparable to the total direct wage costs, which are unnecessarily identify for a very small time periods.

So in the system, which is described in the article, the material side of construction object is emphasized. The whole system is based on the principle of determining the minimum cost of building its own facility or quantification of all direct costs. Mostly accurate calculation of material costs. Wages and salaries and the costs of the machines can be identified at longer intervals than individual work. Overheads and profits derived from market prices.

Thus the bid price is created and then adjusted on the contract price. This is adjusted of extra works and cancelled works, and thus we get the price of the object in the implementation phase. After the handover of construction object, it comes into the hands of investor, who can invest additional costs and so increase the object price. If the investor is not the user, he mostly sold object to someone, who will use it.

Tab. 1 Example of classification method for materials

NAME	U	AU	SPECIFIC.	PROPERTIS [U]	QUANTITY [MJ]	UP [Kč/U] ([Kč/AU])	TOTAL PRICE [Kč]
GENERAL CONSTUCTION							**0,00**
FOUNDATIONS							**0,00**
CONCRETE							***0,00***
Concrete	M3	M3					0,00
Concrete blocks	Piece	M2					0,00
Additional material	%	%			1	0,00	0,00
METALLURGICAL MATERIAL							***0,00***
Mesh	Piece	T					0,00
Round bars	M	T					0,00
Additional material	%	%			1	0,00	0,00
GRANULAR MATERIAL							***0,00***
Gravel	T	M3					0,00
Sand	T	M3					0,00
ISOLATION							***0,00***
Asphalt coating	Kg	Pack					0,00
Insulation sheet	Pack	M2					0,00
Insulating foil	Pack	M2					0,00
Glue	Pack	kg					0,00
Additional material	%	%			1	0,00	0,00

Tab. 2 Example of pricing of material for waterproofing

NAME	U	AU	SPECIFIC.	PROPERTIS [U]	QUANTITY [MJ]	UP [Kč/U] ([Kč/AU])	TOTAL PRICE [Kč]
ISOLATION							**13 620,37**
Asphalt coating	kg	Pack					616,50
	Pack	***m2***	*Penetral ALP*		*150*	*4,11*	*616,50*
Insulation sheet	Pack	m2					12 313,10
	Pack	*m2*	*Bitagit 40*	*tl. 4 mm*	*17*	*724,3*	*12 313,10*
Insulating foil	Pack	m2					0,00
Glue	Pack	Kg					0,00
Additional materiál	%	%			1	690,77	690,77

Tab. 3 Example of use of time performance indicators of construction machine

TYPE OF MACHINE / LEVEL OF AVAILABILITY	U	QUANTITY	TPI [U/hod]	TPI TOTAL [hod]	MACHINE TYPE	RATE [Kč/h]	TPI SHARE [hod]	TOTAL PRICE
MACHINES FOR HANDLING THE EARTH								**11 974,05**
Excavator	*m3*							*11 974,05*
Very good availability	m3	61,779	0,219	13,53				11 974,05
					Excavator 1	*850*	*13,53*	*11 974,05*
Good availability	m3		0,257					0,00
Bad availability	m3		0,323					0,00
Very bad availability	m3		0,379					0,00

3 OPERATIONAL PHASE

Individual materials are due to work incorporated into the construction. To these constructions they give certain parameters that affect the construction as a whole. The basic element of any construction is the main material. This gives to the construction most of its properties. Additional material is linked to the main material and its value is irrelevant for estimating. In order to materials in the construction and construction generally perform its best function, needs to perform it well, regularly maintained and, if necessary, repaired to a sufficient extent. We can talk about the costs, providing a proper function of the construction object (main functional costs).

In the construction object incurs additional costs beyond main functional costs. These are costs associated with comfort in use. For properly work of construction object you need to invest the water delivery costs, electricity delivery costs etc. (additional functional costs). Finally, costs providing the legal existence of the object (fiscal and administrative costs).

In addition to construction object costs, there are also revenues. Revenues from the construction object sale or rent. Or due to the modernization it can lead to lower costs and thus savings.

All these economic characteristics influence construction object price, as the characteristics of its own object. The effect on the price of construction object also have technical characteristics (life) and not forgetting the marketability and surrounding influences associated primarily with the location of the object (same in the implementation phase). These factors need to determine the price of the object into account. First, we determine the price of own object and then adjusted of the above-mentioned factors.

Price of the construction object we obtain by recalculating materials on current price level and adjusted of wear. The rest of the price of the object (consisting of labor, machinery, overhead and profit), we get by using of the indexes, that we obtain from the representative object as a proportion of materials costs and the total price of the object in the current price level. Thus obtained price we modify by using of indexes reflecting the costs, needs to providing proper function of the object, and surrounding influences. Now we get final price of the object.

Tab. 4 Example of the conversion price of the material for waterproofing

TYPE OF MATERIAL	TOTAL PRICE [Kč]	LIFE	TIME IN USE [roky]	WEAR [%]	STRESS	MATERIAL PRICE INDEX	MATERIAL PRICE INDEX CONVERS.	AKTUAL. PRICE [Kč]
ISOLATION.	13 644,81	50	4	9,6	1 - NORMAL	1,0109	0,91385	12 469,40

Start of construction	1st year	2nd year	3rd year	4th year	Materiál price conversion index
1,0000	0,7632	1,0000	1,24081	1,0674	**1,0109**

4 PHASE OF LIQUIDATION

In the phase of liquidation the construction object is removed. The construction object is broken, and most material changes in the so-called rubble. These are materials that are incorporated into the construction in such a way that:

1. from their separation we have not any benefit. On the contrary, in some cases they can cause a financial expense. Such materials cannot be reused, materials like plastic windows, insulation sheets, thermal insulation etc.
2. their separation from the construction is very difficult. Costs are higher than benefit from this material. In addition, if some materials are not separated carefully, can be irreversible damaged. Examples of such materials are steel rods in concrete structures.
3. their separation from the construction is impossible at all, since their implementation in the structure is formed in combination with other materials. Due to the chemical process are materials connected. Examples include plastering, painting.

On the other hand, there are materials that can bring benefit in the phase of liquidation. You can reuse them into the construction or you can also sell them for a variety of purposes. These are primarily metal elements metal, which can be easily removed from the construction (steel beams, heating pipes). Furthermore, it can be wooden elements (boards, planks, wooden beams) and some clay elements (use of these materials must be carefully considered).

At the phase of liquidation arising generally the costs of liquidation, which outweigh revenues from the liquidation or sale of certain types of materials. Liquidation of construction should be done according to the documentation of the removal of the structure created by the authorized person. Furthermore, there should be strict compliance rules of occupational health and safety.

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SYSTEM TRANSFERABILITY OF FACILITY MANGEMENT - INTRODUCTION OF A NEW MANAGEMENT SYSTEM AND IMPLEMENTATION OF A MASTERCOURSE IN IRAN

Mandana Banedj-Schafii[1]

Abstract

The globilization offers large opportunities to expand not only the international product but also the service markets worldwide. This is also valid for the Facility Management, a young but fast growing market which is being established in Germany. (has been being established in Germany in the last decades)

This paper presents the results and experience achieved during the transfer and introduction of FM in Iran, beginning with the establishment of the first FM-department in the Building and Housing Research Center in Tehran toward to the realization of the research project OPIK-Iran [Optimization and alaysis of the processes in hospitals], the cooperation project "FM for health objects" supported by German Academic Exchange Service (DAAD) and the Phd-thesis „System transferability of public hospital facility mangement between Germany and Iran“.

Key words

Facility Management, system transferability, hospital, globalization, process, optimization

1 INTRODUCTION

1.1 The beginning – Building and Housing Research Center (BHRC)

The need to transfer FM from one country to another started in 2003 when a civil engineer educated in Germany went to Iran and started to build up the first FM-department in the BHRC in Tehran.

In order to implement this new management system in Iran it immediately became clear that fundamental research work was necessary.

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1.2 First trainings - The World Bank project

Concurrent to the research work the World Bank project "Facility Management and Healthcare Management" was realized at the University of Karlsruhe (TH) in 2004 and 2005. This post graduated trainee course was designed for 250 high-ranking employees of the Iranian Ministry of Health and Medical Education (MOHME). Beside the content of the different lectures held in these courses, the acceptance, the handling and transfer of the participants helped to understand transferability of new ideas and systems.

Fig. 1) The World Bank project 2004/05 *[University of Karlsruhe, 2005]*

2 SYSTEM TRANSFERABILITY

2.1 The research project OPIK-Iran

In 2001 the research project OPIK (Optimising and analysing of the processes in hospitals), iniciated by the University of Karlsruhe (TH) and the the professional union for hospital technology (Fachvereinigung für Hospitaltechnik (e.V.) (FKT)) started.

The huge cost pressure on the German hospitals, especially with the introduction of the "Diagnosis Related Groups" (DRG) in 2003, made the detailed analysis of the hospital processes necessary.

Fig. 2) The research project OPIK *[based on Lennerts, K., Abel, J. and Pfründer, U., 2002]*

To find out the differences betweeen the same processes in different countries the OPIK-Iran project started in February 2006. Tthree representative processes [Maintenance of the medical equipment, maintenance and repair of technical facilities and laudry management] were reviewed. For this task three hospitals in Teheran (Vali Asr Hospital, Shariati Hospital and the Tebie - Children's Hospital) were chosen as pilot objects.

In general and specific workshops that were accompanied by long, intensive and suggestive discussions the theoretical part was elaborated. Here the current status of the processes (single process steps, interfaces, responsibilities, Iranian laws and regulations) and the current management and organisation were analysed.

After the data collection the comparison of the processes began. The "Iranian processes" split in the single steps, the analysis of the interfaces, the characteristic variables and responsibilities were compared with the German ones. In this way the differences could be seen in detail and discussions started regarding these differences.

2.2 Development of a "system transferability model"

To generalize the results achieved by the comparison of the OPIK project a system transferability model was developed with the help of the system theory. Based on this theory a macro and a micro- level were defined in which the system [FM-process in the hospital] is located.

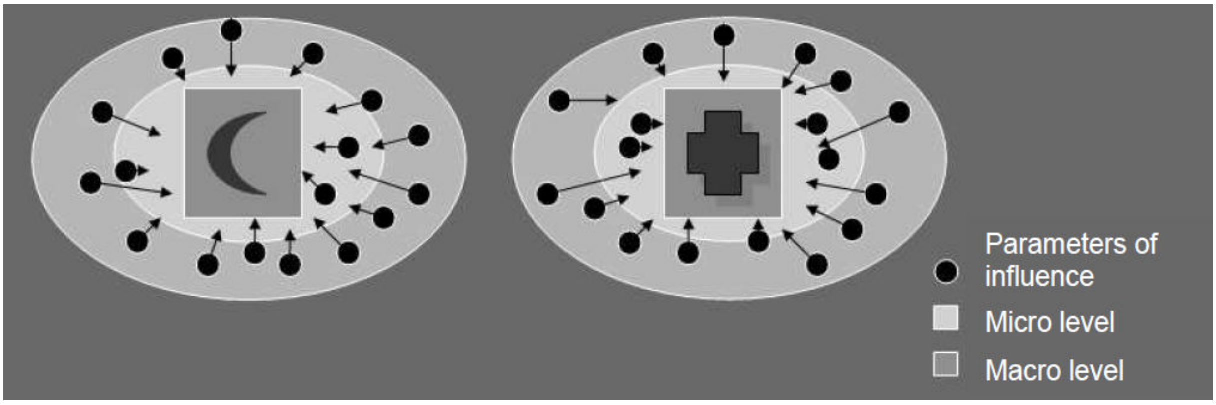

Fig. 3) The system transferability model *[Banedj-Schafii, M., 2009]*

Due to the results of the OPIK project nine parameters2 of influence were determined in order to make it possible to analyse their effects on the system and their interactions with each other. The parameters were both quantitatively and qualitatively measurable and rateable as can be seen examlary for the parameter „culture" in Tab.13.

After that different models (the matrix model, share model) and methods (parameter of influence, indicator analyse, expert opinion) were analysed to find the best approximation for a ranking or a "trend barometer". The level of the ranking indicates the degree of importance. It gives a direction which parameters should be considered for the successful transferability of

[2] nine main parameters management, economy, politics, culture, judicative, education, public and private institutions, infrastructure and geography

[3] mostly based on OECD and WHO indicators

a FM-system. It must be considered that the systems are dynamic and especially the expert analysis runs the risk to have a subjective opinion that does not give back the real situation.

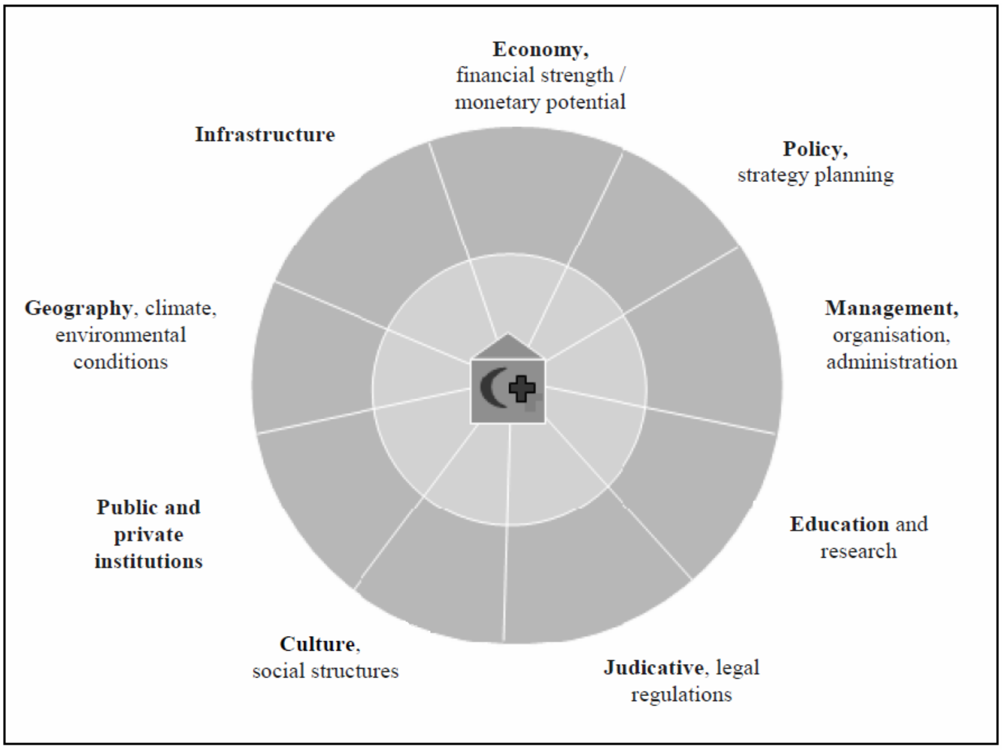

Fig. 4) The main influence parameters based in the share model *[Banedj-Schafii, M., 2009]*

Tab. 1) Parameters of the indicators *[Banedj-Schafii, M., 2009]*

Indicators of the macro level:	
Country	*Health sector*
• GDP (per capita) in US $	• Portion of the expenditures for health of GPD in %
• Economic growth to sectors (real, %)	• Per capita government expenditure on health at average exchange rate US $
• GDP – emergence (%)	• Expenditures for medicine (per capita) US $
• Unemployment rate (%)	• Cost structure of ambulant health facilities
• Inflation rate (%)	• Expenditure for rehabilitation
• Foreign depts. (Bil. US $)	• Total expenditure for health in US $ per capita
• Export/ import	
• Currency, monetary value	
Indicators of the micro level:	
Hospital	*Department (e.g. medical equipment)*
• Costs of the hospitals according to cost type and hospital size range	• Expenditure of material, personnel, training
• DRG-case-based lump sum, revenues and benefits	• Budget of the department • Budget for maintenance/ repair
• Income	• Budget of purchase

2.3 Results

As can be seen in figure 5 the introduction or realization of a management system has the highest rank. The next step was to think about how the introduction or implementation of this new management system could take place.

Rank	**Transferability parameters**		
high	Management	Economy	Politics
middle	Culture	Judicative	Education
low	Infrastructure	Public and Private institutions	Geography

Fig. 5) The result of the ranking *[Banedj-Schafii, M., 2009]*

There were two possibilities. One of the ways was to start with the job, to found service providers, consultancies and companies that offer FM- services. Or the other way, first bring the theory and the education and the knowledge of FM into the country by establishing the first Master course at the university.

In the case “Iran” the second possibility was selected.

3 CONCLUSION

3.1 The Master Course FM and the FM-Competence Centre in Iran

In 2009 the cooperation project "FM for health objects" supported by German Academic Exchange Service (DAAD) started. The development of the Master course FM is taking place in three steps.

Additionally a German-Iranian Competence Center should be implemented that supports the knowledge exchange and information transfer between universities, research centers, public authorities and the economy (industry, service suppliers, ..) within the country and across the borders.

Fig. 6) The DAAD-Project *[Banedj-Schafii, M., 2009]*

The start is done, the implementation is in action, the filed is very stony but the first offspings are growing and will hopefully develop to a strong and fertile plant.

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IMPACT OF ENVIRONMENTAL COSTS AND BENEFITS ON PROJECT ECONOMICS

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Abstract

Economics of a project depends on the ratio between the project output and input into the project. The output of the project should include also benefits and costs of the project impact on the environment. Environmental impact assessment (EIA) is a primary tool for achieving this objective, by inserting critical environmental information into the process of project assessment and preparation. Adverse environmental impacts are part of the costs of a project, and positive environmental impacts are part of its benefits. Consideration of environmental impacts should be integrated with the other aspects of the project in the economic analysis. The impacts identified in the EIA process have not often been converted into monetary terms, however. The paper describes some useful methods that can be applied for this purpose and explains the process of incorporating environmental impacts into the project analysis as a two-step process.

Key words

Environmental impact assessment, cost benefit analysis, indirect methods, project economics

1 ENVIRONMENTAL VALUES

From scenic beauty and recreational opportunities to direct inputs into the production process, environmental resources provide a complex set of values to individuals and benefits to society. Coastal areas, for example, offer scenic panoramas and radiant sunsets. Fish and other edible sea life caught in coastal areas provide a rich and nutritious source of food to consumers. Use values, such as fishing and hiking, are the more direct and quantifiable category of environmental values, but they capture only a portion of the total economic value of an environmental asset. There are also values that are not directly tied to use, such as climate modulation, physical protection, and stewardship for future generations. Indirect-use values and non-use values are both associated with preserving environmental resources. Total economic value of environmental assets is represented by the following equation [1]:

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Total economic value = direct-use value + indirect-use value + non-use value (1)

Direct use value, also known as extractive, consumptive, or structural use value, derives from goods which can be extracted, consumed, or directly enjoyed. In the context of a forest, for example, extractive use value would be derived from timber, from harvest of minor forest products such as fruit, herbs, or mushrooms, and from hunting and fishing. In addition to these directly consumed goods, direct use values can also be non-consumptive. For example, people who enjoy hiking or camping in the same forest receive a direct use value, but do not actually "consume" any of the forest resource. All of these benefits are real, can be measured, and have values, even if the consumption by one individual does not reduce the consumption by another. Consumptive use is generally the easiest to value, since it usually involves observable quantities of products whose prices can usually also be observed. Non-consumptive use is often more difficult to value since both quantities and prices may not be observed.

Indirect use value, also known as non-extractive use value or functional value derives from the services the environment provides. For example, wetlands often filter water, improving water quality for downstream users, and national parks provide opportunities for recreation. These services have value but do not require any good to be harvested, although they may require someone's physical presence. Measuring indirect use value is often considerably more difficult than measuring direct use value. Moreover, many of these services often do not enter markets at all, so that their "price" is also extremely difficult to establish.

In contrast to use value, non-use value derives from the benefits the environment may provide which do not involve using it in any way, whether directly or indirectly. In many cases, the most important such benefit is *existence value*: the value that people derive from the knowledge that something exists, even if they never plan to use it. Thus, people place a value on the existence of blue whales, or of the panda, even if they have never seen one and probably never will. Non-use value is the most difficult type of value to estimate, since in most cases it is not, by definition, reflected in people's behavior and is thus wholly unobservable. Non-use values are less direct, less tangible benefits to society and include *option* and *existence values*. The *option value* is the value an individual places on the potential future use of the resource, for example, benefits a beach would offer during future trips to the coastal area. *Existence values* include *bequest*, *stewardship*, and *benevolence motives*. *Bequest motive* is the satisfaction gained through the ability to endow a natural resource on future generations. The *stewardship motive* is derived from an altruistic sense of responsibility toward the preservation of the environment and a desire to reduce environmental degradation. The *benevolence motive* reflects the desire to conserve an environmental resource for potential use by others.

Finally, the *intrinsic value* of nature may also be included into the equation. It reflects the belief that all living organisms are valuable regardless of the monetary value placed on them by society.

2 VALUATION TECHNIQUES

2.1 Direct Methods

Economists generally prefer to rely on direct, observable market interactions to place monetary values on goods and services. [2] Markets enable economists to measure an individual's willingness to pay to acquire or preserve environmental services. In turn, consumers reveal their preferences through the choices they make in allocating scarce resources among competing alternatives. There are a number of market-based or direct methods of environmental valuation as described further.

Change in output of marketable goods. In many cases, the environmental effects of projects manifest themselves (at least in part) in changes in output of marketable goods. In cases such as these, the value of the unintended benefits and costs can be estimated by using the simple technique of valuing the change in output caused by the project. Even when prices cannot be observed, there are generally-accepted and reliable ways to estimate the value of the products. The biggest difficulty in valuing such impacts arise from measuring the amounts of goods produced and in predicting how these amounts will change with and without the project.

Cost of human capital. Many environmental impacts, such as air and water pollution, have repercussions for human health. Valuing the cost of pollution-related morbidity (sickness) requires information on the underlying damage function which relates the level of pollution to the degree of health effect as well as information on how the project will affect the level of pollution. The costs of an increase in morbidity due to increased pollution levels can then be estimated using information on various costs associated with the increase in morbidity: any loss of earnings resulting from illness and medical costs. This approach is symmetric: the benefits of actions that reduce the level of pollution and hence of morbidity are estimated in the same way. Costs associated with pollution-related mortality (death) is referred to as the *human-capital approach*. Because it reduces the value of life to the present value of an individual’s future income stream, the human-capital approach is extremely controversial when applied to mortality.

Cost-based approaches. When a given environmental impact cannot be estimated directly, information on costs can be used to produce valuable information. For example, an order of magnitude estimates of the potential costs (or savings) to society from a change in an environmental problem, can be obtained by using the cost of reducing or avoiding the impact, or the cost of replacing the services provided by the environmental resource. The major underlying assumptions of these approaches are (i) that the nature and extent of physical damage expected is predictable, and (ii) that the costs to replace or restore damaged assets can be estimated with a reasonable degree of accuracy. The *replacement cost* technique is particularly useful to assess the costs associated with damage to tangible assets, the repair and replacement costs of which are easily measurable. The technique is less useful, however, for very unique assets, such as historical or cultural sites and unique natural areas, which cannot be replaced and cannot easily be restored, and about which restoration costs are uncertain. The *relocation cost approach* uses estimated costs of a forced relocation of a natural or physical asset due to environmental damage.

Opportunity cost. In some cases it is decided to protect a particular resource and forego other development options. The term *opportunity cost* refers to the value of these lost economic opportunities due to environmental protection. It is, therefore, a measure of the cost of environmental protection in terms of development benefits foregone.

2.2 Indirect Methods

Often, the environmental good or service being valued is not traded per se in the market place. A number of valuation techniques exist that can be used to place monetary values on these resources and this information can be incorporated into a conventional cost-benefit analysis.

Hedonic analysis. We know that environmental quality affects the price people are willing to pay for certain goods or services. Ocean front hotels, for example, charge different rates depending on the view. Hedonic models have been widely used to examine the contribution of different attributes to prices for housing and to wage levels, including the contribution of environmental quality. [3] This approach is of interest because many environmental dimensions are likely to be embodied in property values. Hedonic techniques allow this effect to be measured, holding other factors such as size and amenities constant. Hedonic methods require observations of the prices of goods and of the attributes of these goods.

Travel cost. The travel cost (TC) method is an example of a technique that attempts to deduce value from observed behavior. [4] It uses information on visitors' total expenditure to visit a site to derive their demand curve for the site's services. The technique assumes that changes in total travel costs are equivalent to changes in admission fees. From this demand curve, the total benefit visitors obtain can be calculated. [5] The TC method depends on numerous assumptions, many of which are problematic in the context of international tourism. The basic technique generally assumes that travel cost is proportional to distance from the site and that people living at the same distance from the site have identical references. The technique also assumes a single-purpose trip and encounters difficulties when trips have multiple purposes.

Contingent valuation. Unlike techniques which use observed data, the Contingent Valuation (CV) technique relies on direct questioning of consumers (actual or potential) to determine their willingness-to-pay (WTP) to obtain an environmental good. [6] A detailed description of the good involved has to be provided, along with details about how it will be provided. The actual valuation can be obtained in a number of ways, such as asking respondents to name a figure, having them chose from a number of options, or asking them whether they would pay a specific amount (in which case, follow-up questions with higher or lower amounts are often used). CV can, in principle, be used to value *any* environmental benefit.

Benefits transfer. Benefits transfer is not a methodology *per se*, but rather refers to the use of estimates obtained (by another method) in one context to estimate values in a different context. [7] For example, an estimate of the benefit obtained by tourists viewing wildlife in one park might be used to estimate the benefit obtained from viewing wildlife in a different park. This approach also has considerable risks, however. For many reasons, estimates derived in one situation can be inappropriate in another. The likelihood that benefits transferred from another area will be appropriate is, therefore, extremely low.

Random utility models (RUMs). [8] These are econometric models that, among other uses, permit the estimation of preferences among different recreational areas with varying characteristics. Based on the data collected through surveys of various sites, the RUM estimates the probability that an individual will visit one site out of several sites based on site characteristics. Varying the quality of those characteristics (e.g., water quality, landscape features) permits the analyst to assess how recreational travelers value changes in environmental quality at particular sites. RUM is an estimation procedure that can be combined with surrogate and non-market techniques used in valuing, for example, recreational areas and wetland area restoration.

3 IMPACT ON PROJECT ECONOMICS

3.1 Evaluation criteria

Once the various environmental impacts have been identified and the benefits and costs of various alternatives assessed, these values should be set in the context of the economic analysis framework of the project. This is usually done in a cost-benefit analysis, whereby the streams of benefits and costs of the project (including direct project inputs and outputs, as well as environmental impacts to the extent that they can be identified and monetized) are compared over some period of time. However, values derived from EIA need to be adjusted to economic prices to make these values consistent with other values used for the economic analysis of the project.

The three main decision criteria used in benefit-cost analysis are: *net present value* (NPV), *internal rate of return* (IRR) and *benefit-cost ratio* (BCR). All of these criteria rely on the concept of discounting a stream of benefits and costs which occur at different times over the duration of the project being evaluated. Discounting puts all of these costs and benefits into a common time frame to allow for more accurate comparison. In this regard, the choice of the appropriate *discount rate* is also an important decision, since a high discount rate effectively reduces to zero the present value of benefits and costs that occur many years in the future. [8] This *does not* imply that a different discount rate should be use when environmental impacts are important; in fact, it is always wrong to mix discount rates within one analysis. Given the importance of the discount rate, however, it is important to do sensitivity analysis using different discount rates. This can yield useful information to the decision maker when comparing alternatives that have very different time profiles of benefits and costs (including environmental ones). Adding environmental costs and benefits does not change the method of analysis.

3.2 Temporal Boundaries

Since environmental impacts extend long beyond the normal life of the project, it is important to extend the time horizon of the analysis so as to include all the benefits and costs associated with environmental impacts, even if they go further into the future than the normal life of a project. The effective length of the time horizon of an analysis is determined by both the number of actual years included in the analysis and the discount rate used. Using too short a time horizon effectively ignores many environmental impacts, both positive and negative. For example, an activity that results in the permanent loss of a fishery should include in the analysis the present value of the entire future loss of that resource, even if the activity itself only lasts for a few years. Two approaches are possible to incorporating long-term environmental effects. One approach is to extend the time horizon of the entire analysis to cover a period long enough to include all environmental effects (at least to the point where, given the discount rate, any additional environmental impact has no further effect on the analysis, typically after 50-100 years). Alternatively, the present value of the entire future stream of environmental impacts (benefits and costs) can be computed, and then incorporated in the normal project analysis framework in the same way that a residual value estimate for a long-lasting capital good would be.

3.3 Spatial Boundaries

When environmental effects are present, careful thought must also be given to the appropriate *spatial boundary* of the analysis. The analyst often has to look far beyond the geographical boundaries of the project itself, especially when water or air pollution is involved. In other cases, global aspects may be important and require a further expansion of the "accounting stance" of the analysis. With both spatial and temporal externalities, the important rule is to be transparent in the assumptions being made, and explicitly state the adjustments that have been used in defining the analytical boundaries for the project—both in space and over time.

4 CONCLUSION

Incorporating environmental impacts identified in the EIA into the project analysis is a two-step process. First, one has to understand what the impacts are. This information is provided by a traditional EIA. Second, one has to estimate the value of the impacts (where feasible and appropriate) in monetary terms to determine their relative economic importance, and assess the benefits and costs of various alternatives. Three important conceptual problems need to be addressed at the outset. First, it is necessary to choose a technique for valuing the environmental impact of the project. Second, it is necessary to define the boundary of the analysis. Since most environmental impacts include externalities, how far to expand economic analysis is an important issue. Third, it is also necessary to define an appropriate time horizon. For those cases where impacts go beyond the project life, an extended analysis covering the time period for the environmental impact can be attempted, or, alternatively, the concept of capitalized value of net benefits at the end of the project life can be included, a form of salvage value.

Whatever the actual techniques used to estimate the value of environmental benefits or damages, an important point that should be borne in mind is the likelihood of underestimation. Inevitably, some types of value will prove impossible to estimate using any of the available techniques, either because of lack of data or because of the difficulty of extracting the desired information from them. To this extent, any estimates of value will underestimate the total value; the estimates of project benefits will, therefore, be conservative, while estimates of costs will be optimistic. That some environmental benefits cannot be quantified, however, does not mean that they should be ignored. Rather, any un-quantified benefits should be described qualitatively to the extent possible.

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NUMERICAL ANALYSIS OF THERMAL BRIDGES USING FEM

Meri Cvetkovska[1], Todorka Samardzioska[2], Cvetanka Filipova[3], Ana Trombeva-Gavriloska[4]

Abstract

Thermal bridges are critical regions in the buildings where the heat easily flows. For their correct solving, knowledge of the building materials for thermal insulation is necessary, as well as knowledge of the heat transfer process and forming of the temperature field. As standards for thermal performance become increasingly stringent, particularly at passive house levels of performance, understanding and accurately modelling thermal bridging is becoming absolutely critical for predicting the heat loss of a building. A case study of a connection wall-beam-floor structure has been analyzed and numerical 2D analysis was performed using computer codes based on the methods with finite elements (FEM) as a possible numerical method for solution of the heat transfer.

Key words

Numerical analysis, thermal bridges, heat transfer

1 INTRODUCTION

Thermal bridges are critical regions in the buildings where the heat flows and they significantly increase the building energy demand for heating and cooling. Therefore, they should be avoided or brought to minimum in the early design phase. We cannot live in pure insulated boxes without windows and doors; nor can we ignore the fact of gravity. From that point of view, the thermal bridges in buildings are inevitable. As standards for thermal performance become increasingly stringent, particularly at passive house levels of performance, understanding and accurately modelling thermal bridging is becoming absolutely critical for accurate prediction of the heat loss of a building. For correct solving of

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the thermal bridges, knowledge of building materials for the buildings construction is necessary, especially of the materials for thermal insulation and their thermal properties, as well as knowledge of the heat transfer process and forming of the temperature field. This paper presents the Finite Element Method (FEM) as a possible numerical method for solution of the heat transfer.

2 THERMAL BRIDGES

Thermal bridges are defined as 'regions of relatively high heat flow conductance in a building envelope' and they are weak points in the building shell where heat escapes significantly faster to the outside than for an insulated component. Heat will flow the easiest path from the heated space to the outside - the path with the lowest resistance. And this will not necessarily be the path perpendicular to the surfaces. Very often heat will "short circuit" through an element which has a much higher conductivity than surrounding material, which can be described as a thermal bridge. This creates temperatures that are locally lower on the inside and warmer temperatures outside. This causes higher energy consumption, problems with moisture (condensation, danger of mould) and can cause structural damage due to frost.

Thermal bridges can seriously interfere with the performance of buildings. The temperature of the inside surface over a thermal bridge is lower than that of the adjacent construction during the heating season, and may even be lower than that of double glazing; consequently, it may be impossible to maintain the desired relative humidity without surface condensation. The difference in the temperature gradient through the bridge and adjacent construction will cause thermal stressing that may result in structural damage. The corresponding exterior surface temperature over a thermal bridge is higher than that over the adjacent wall. This can result in increased wetting of the wall by melting of wind-driven snow, thereby increasing the possibility of damage on subsequent freezing. Thermal bridges result in higher building heat losses, although this is not usually regarded of itself as a major problem. In designing a curtain wall to meet a specified maximum over-all heat transmission requirement, however, thermal bridges at structural ties and joints are usually the major obstacle. The lower surface temperatures over thermal bridges can also lead to dust marking. Thermal bridges increase the building energy demand for heating and cooling. This energy loss can even be higher than for example the energy benefit provided by thermal solar collectors for domestic hot water. The public awareness of this fact is however very low.

The final aim is that the design and the realization of component joints in buildings will be further developed in order to reduce the transmission losses and the danger of moisture and mould. Buildings of the future should have no additional thermal losses due to thermal bridges. In order to avoid thermal bridges a computer simulation of the envelope is recommended at the beginning stages of design planning. It is also recommended that the standard (one-dimensional) calculation of the thermal-coupling coefficient, which does not take 2D and 3D heat flows into consideration sufficiently, should be amended as soon as possible. Thermal bridges are characterized by multi-dimensional heat flow, and therefore by the fact that they cannot be adequately approximated by the one-dimensional models of calculation typically used in norms and standards for the thermal performance of buildings, which still help in the identification of the eventual heat problems.

3 NUMERICAL EXAMPLE

In order to elaborate the problem of the thermal bridge, a case study of a connection wall-beam-floor structure has been analyzed and numerical 2D analysis has been performed. The analysis was performed with software using FEM, see [4], and the obtained results are presented with isotherms and graphically. Four models have been analyzed: non-insulated all, outside wall insulation (Fig. 1a), insulation in the middle of the wall (Fig.1b) and inside wall insulation (Fig.1c). Analyzed structure comprises of: brick wall (d=30 cm, except in the case with insulation in the middle when d=24cm), reinforced concrete beam 30/40cm and floor structure (reinforced concrete floor slab d=12cm, EPS d=3cm, cement screed d=4cm and parquet d=1.5cm). The interior temperature in the upper room is T_{upper}=+20°C (for air moisture of 50%, the critical condensation point is 9.3°C), while in the lower room is T_{lower}=10°C (for air moisture of 50%, the critical condensation point is 0.1°C). The exterior temperature is assumed to be Te=-15°C.

a) *b)* *c)*

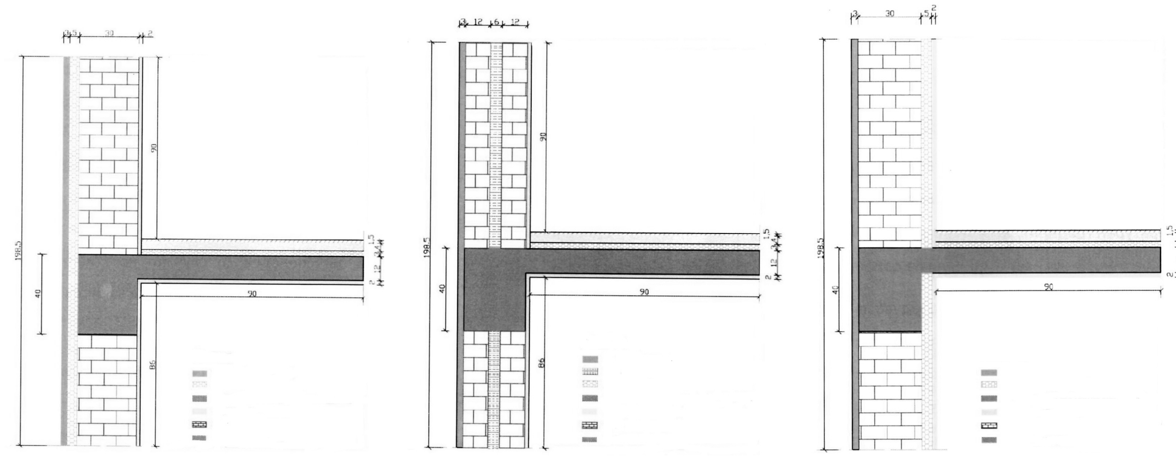
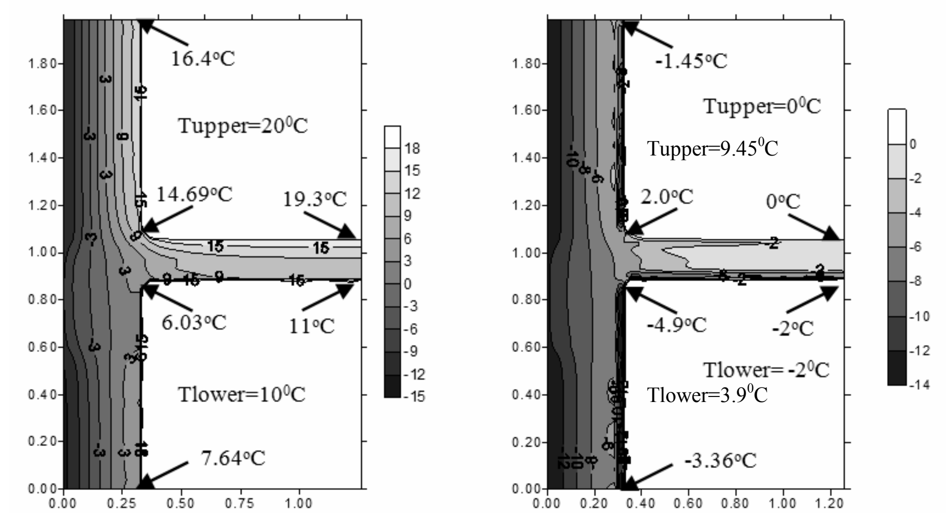


Fig. 1) Vertical section through the structure: a) outside insulation; b) insulation in the middle; c) inside insulation

For each example, the analysis has been performed for two cases. First, a stationary analysis has been performed when the air temperatures in the rooms and the exterior temperature are constants. The aim was to define the influence of the thermal insulation on the formation of the temperature profile in the structure, as well as the possibility of appearance of thermal bridges. Furthermore, another analysis has been performed from the moment when the heating in the rooms is set off and cooling begins. The analysis lasts up to the moment of finished cooling, when the steady state is obtained. The influence of the thermal insulation on the cooling time and level of the final temperature in the rooms has been compared for all different cases. The results of the performed analysis are presented in the following figures.

Fig. 2) Isotherms - outside insulation: a) constant thermal conditions (T_{up}=20°C, T_{low}= 10°C); b) time t=168h, finished structure cooling (heating off in the upper room)



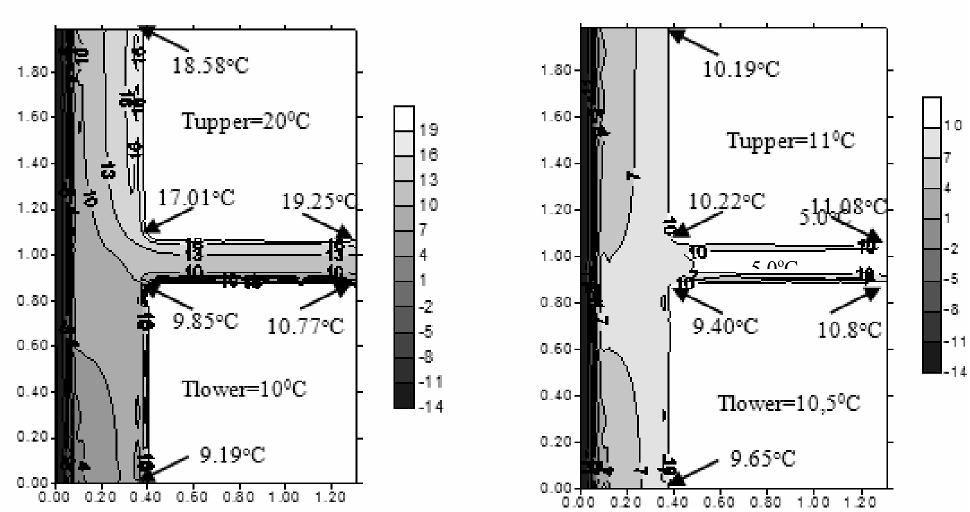


Fig. 3) Isotherms – middle insulation: a) constant thermal conditions (T_{up}=20°C, T_{low}= 10°C); b) time t=106h, , finished structure cooling (heating off in the upper room)

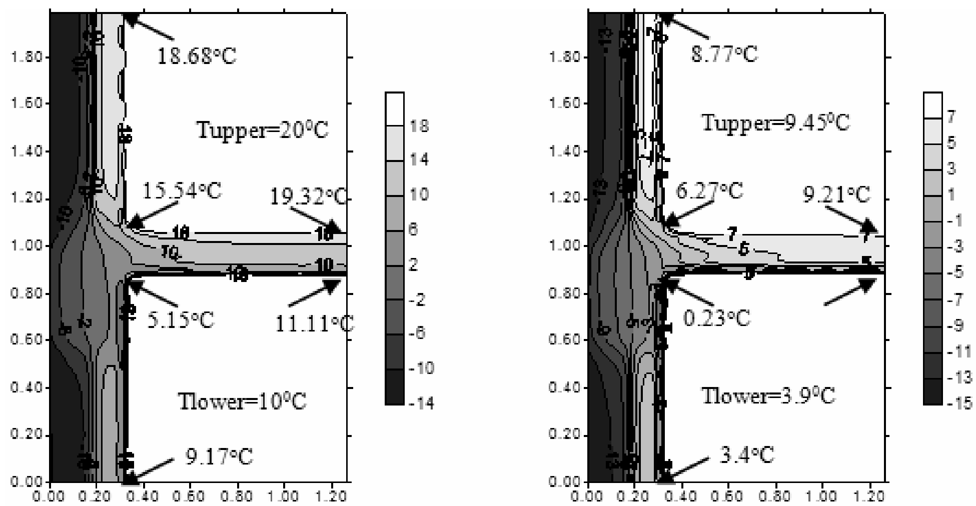


Fig. 4) Isotherms – inside insulation: a) constant thermal conditions (T_{up}=20^{o}C, T_{low}= 10^{o}C); b) time t=94h, , finished structure cooling (heating off in the upper room)

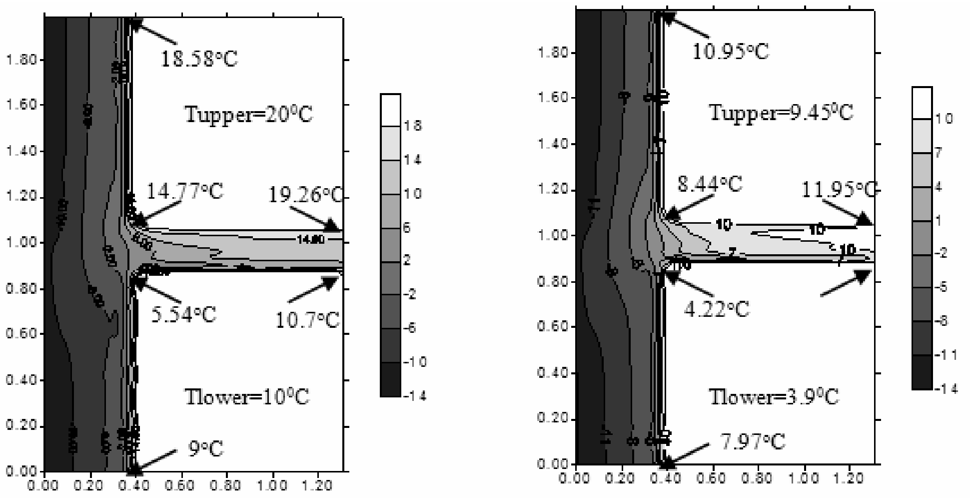


Fig. 5) Time-temperature diagrams: a) wall without insulation; b) outside insulation

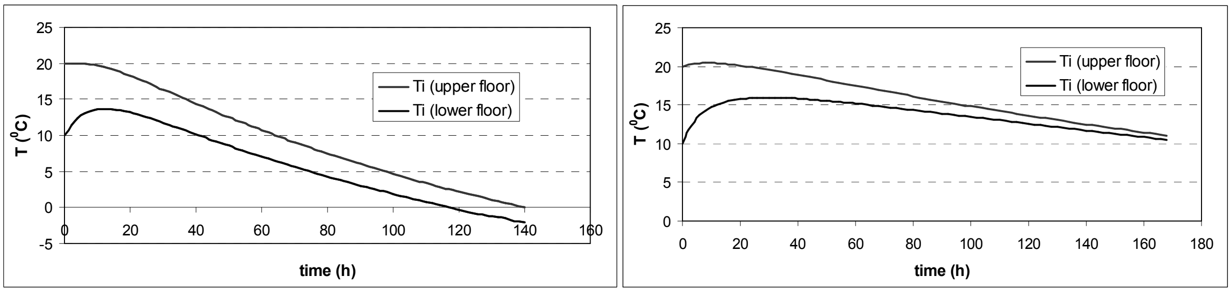
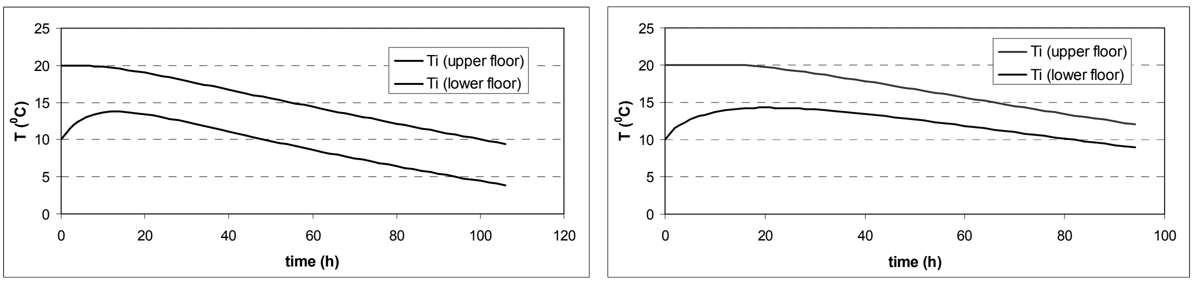
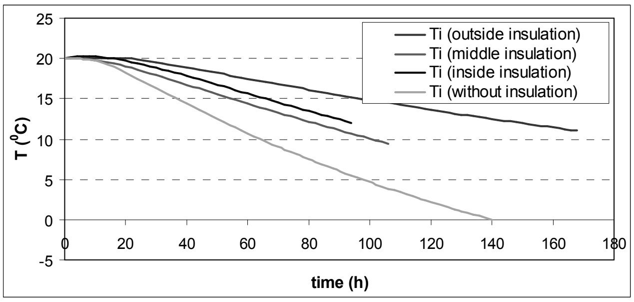


Fig. 6) Time-temperature diagrams: a) wall without insulation; b) outside insulation



Comparison of the time needed for cooling of the upper room depending on the location of the thermal insulation is given in Fig.8.

Fig. 7) Comparison of the time needed for cooling of the upper room depending on the insulation location



The analysis in winter conditions presents that the best way for insulation is placing the insulation material on the outside of the wall. Thermal bridges appearance is avoided at the connection wall-beam-floor structure. In all other cases, thermal bridge appears in that part of the structure.

The steady state analysis shows that the surface temperature in the upper room in the sections distanced from the connection wall-beam-floor structure is high for all cases of insulation. The difference in the temperature appears in the internal angle, which represents the influence of the thermal bridge. A surface condensation in the upper room does not appear for the steady state analysis for the defined micro-climatic conditions for neither of the cases.

The insulation and its location obviously influence the time and the level of the structure cooling, see fig. 8. The longest time for cooling of the structure, when the heating is off, was obtained for the case of outside insulation (t=168h).

4 CONCLUSION

Thermal insulation placed on the exterior side of the wall is absolutely the best case; it avoids appearance of a thermal bridge, provides the longest time for cooling of the upper room and the highest temperature in the lower room when the steady state is reached.

Thermal bridges are not always treated adequately, although they are well known problems in the buildings. All insulated building components need to be designed and built in a way to work as an integral system, which will provide continuous barrier of the heat transfer through the building envelope. In order to obtain the maximal potential of the used materials and measures, coordination of the civil engineers and architects is necessary in all design phases.

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A ROLE OF SMALL BUSINESS IN REFORMATION OF COMMUNAL ECONOMY IN UKRAINE

Viktoriia Deviatka[1] Olena Dolgalyova[2]

Abstract

The article analyzed the development of communal services in Ukraine, found out failings, which keep down communal economy and suggestions are borne in relation to co-operation of organs of executive power, public organizations and representatives of small business, which deal with activity of communal sphere directly. A communal economy is a big area for a small enterprise. Level of profitability in this sector of economy not very much high, but stable. But in an order to endeavor in a job, small business needs support of city authority more frequent all, including financial.

Key words

Communal housing, small business, association of apartment, industry, municipal infrastructure, problems, partnership.

1 INTRODUCTION

Communal housing - a huge arena for small businesses. The level of profitability in this sector is not very high, but stable. But in order to start their own businesses, small businesses often need support of municipal authorities, including financial.

Modern domestic communal housing it is outdated, and often, and no, technology and equipment, most costs heat and water, poor system of transportation to consumers, etc. For all became obvious crisis areas vital for everyone without exception. Human communal services have long recognized a priority to implement programs to support local small businesses.

Most have heard of entrepreneurs on the loss of communal housing areas. Noted that the communal services may be unprofitable in the current system, which inherited a legacy from the past. The leading sector is great, and utilities in many countries are an attractive sector of economy.

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One of the main reasons for the slow flow and controversial changes in communal housing and communal sphere is that the reforms initiated and implemented «top», on the initiative of the State. So many people contribute to the transformation as imposed and economically impractical [5]. The only way to make real reforms in communal housing and communal sphere - initiate their «bottom», to support small businesses engaged in utilities. Manifestation of this method should be Association of apartment. Association of apartment called in different ways: and community organizations and public bodies themselves. Communal services are one of the most stable areas of business, because the services offered by the population, are needed. Maybe this should become the main incentive for entrepreneurial activity. It turns out that the field of Communal services does not do without private investment. At the same time for entrepreneurs communal housing country very attractive.

2 RESULTS

Consider the state of the housing stock in Ukraine. Housing - a set of living quarters, regardless of forms of property, including residential and special buildings (residences, homes for elderly citizens and disabled people - adults and children, orphanages, boarding schools), flats, offices and other accommodation in the buildings, suitable for habitation. The fund does not include non-residential premises in residential buildings designed for commercial, residential and other needs of non-nature. In the housing stock is also not accounted cottages, garden houses, sporting and tourist bases, hotels, camping sites, sanatoriums, rest homes, residential homes, houses for visitors, railroad cars, buildings and other facilities designed for seasonal and temporary residence.

Housing Fund of Ukraine is more than 10.1 million homes with total area of 1,046.2 million m2, including the stock of communal property - 250.8 thousand houses with total area of 97 million m2, or 9.3% of housing the country (Figure 1).

The pace of housing was not positive. In recent years, housing receive each year, only 1,5% of citizens who are on the waiting list for housing. When saving the pace of construction at the current level for the provision of housing to current standards must be over 50 years. 75% of the number of families that have improved conditions for accommodation, living in Kiev and regional centers (Kharkiv, Donetsk, Luhansk, Zaporogie, Dnipropetrovsk), while in smaller towns and villages of Ukraine housing is a very slow pace or not conducted. All of this leads to a significant increase in the price of accommodation throughout Ukraine. Thus, according to statistics, from 2004 to 2007, prices of flats and houses in the country as a whole increased by 5 times. Average cost of one square meter of housing in new homes is 1500-2500 dollars in Kiev and 800-1500 dollars in the regional centers [3].

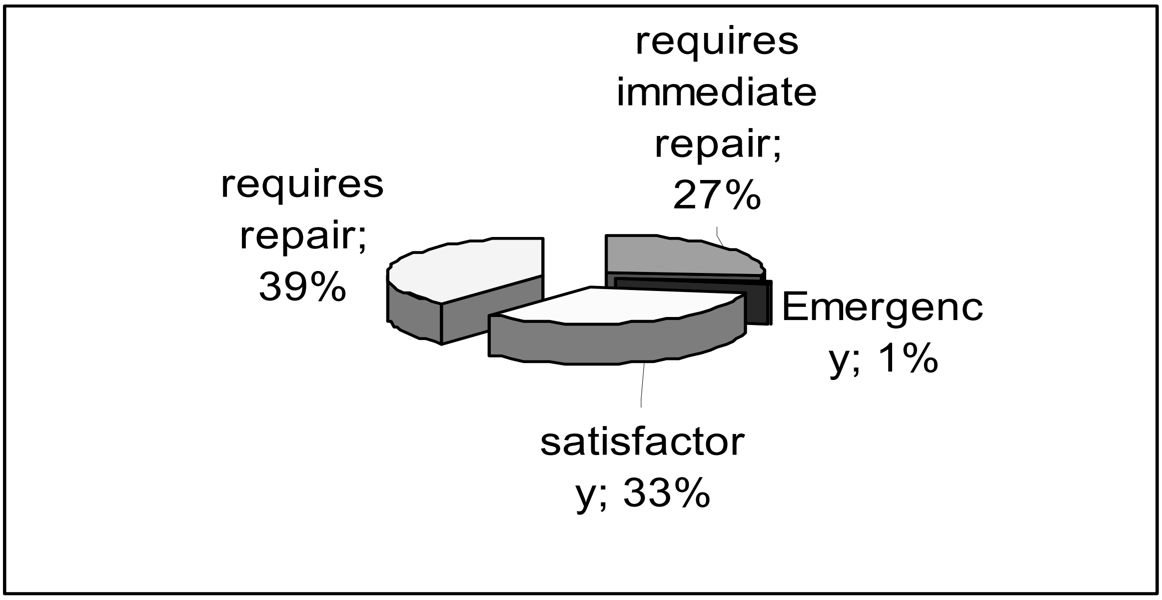

Fig. 1) Figure 1: The state of the housing fund of Ukraine

The need for reform of economic relations in the housing and communal services are felt for many years. The transition in housing and communal services of the administrative economy to a market economy, privatization and restructuring of state enterprises led to the need for changes in the management industry, in the relationship between the parties. The main characteristics of the modern state system utilities are:

1) pronounced dominance of public ownership of housing;
2) command-administrative management of the industry through a bureaucratic structure that is characterized by low efficiency;
3) way of planning for all the indicators - from the costs, rather than the result (expense planning and operation).

The main objective of reform is the creation of efficient market functioning housing sector and increasing customer service. Changes in housing and utilities required to improve the relationship between schemes and their customer service operators.

The leading sector is great, and communal housing in many countries is an attractive sector of economy. The introduction of market mechanisms will make investment in communal housing cheaper. Today in Ukraine the share of private business communal housing is 17%. The emergence of commercial initiatives in the coming municipal sector first private operators create real prerequisites for carrying out the planned system improvements in communal services, more large-scale investments.

Experts estimate one of the main causes of the prevailing situation is the insufficient funding for communal housing. Arrears in the communal housing and communal sphere is the source of the chain of defaults that covers virtually all areas of the city economy and is a source of threats to the socio-economic development of the capital.

For example, England and Chile went towards full privatization of life. This option in Russia is not even considered. In Germany, used a scheme where the industry become joint-stock enterprises, the basic package which owns the municipality. It is to the domestic environment is not suitable, because business is not in danger «invest» company, which through strong influence on government can not establish an effective system of personal control [2].

Consider the statistics of communal housing and communal services and find the most serious problems. Forestry and old houses live of 202.4 thousand people. More than 10 thousand lifts served his time and require replacement. The same emergency condition is a quarter of all treatment plants and fifth each pump station. In the emergency state is 35% water and 31% of sewer networks. In total, only for these items are urgently needed to replace more than 47 thousand kilometers of pipes. More than half of cities with a population of more than 100 thousand people receive drinking water on a schedule. In some areas the water does not meet the requirements of state standards, but because of the poor condition of pipes going on her re-contamination after cleaning. The Cabinet Ministers of Ukraine, said that every year more and more changing dates of beginning and end of heating season. In many cities, providing a centralized hot water non-existent, and in some regions served only in winter. Throughout the country access to a centralized hot water supply is only 70% of the population. One of the urgent problems of the region is that of the population and industrial and municipal water facilities. One of the main problems of the communal housing industry of Donetsk Region is the poor technical condition and a significant depreciation of fixed assets. The fourth part of water treatment plants requires rehabilitation or improvement, and every fifth pumping station spent a normative term amortization [3].

Thus, one can distinguish two large groups of problems [4]:

1. Problems of communal housing industry. Experts estimate that one of the main causes of the prevailing situation is the insufficient funding for communal housing. In recent years, under the communal housing was about 20% of the necessary means to increase accumulated more debt in the communal housing and communal sphere.

Lack of budget financing of communal housing and communal complex to implement targeted programs of renovation and development led to a sharp increase of wear of fixed assets. The technical condition of municipal infrastructure is characterized, first, a high level of wear, and secondly, high accident rate, third, low-efficiency power and, finally, greater loss of energy [2].

The current unpleasantness of urban private investment is due to lack of budgetary commitments and lack of effective and transparent procedures for the formation and changes in tariffs. Meanwhile, most communal housing projects and upgrading of municipal infrastructure, transport areas are potentially commercially viable. Creating conditions for private investment could dramatically change the financial situation of the industry.

Therefore, households, with all the stability, frighten modern entrepreneur for the following reasons: 1) greater costs production; 2) high cost of capital construction; 3) long term return on investment projects; 4) instability of the tariff policy; 5) lack of transparency of financial flows; 6) the risks of loss from investments unpredictable policy of regional authorities.

Such problems of private investors that decided to enter into public business. That is a problem that exists in a long time, problems, and solutions which business must take on. All this indicates the presence of system crisis in urban and cross-sectored nature of the problems.

2. Problems in the communal housing business:

1) insufficient number of customers. Apparently, this is the main problem facing small business in the area of communal housing. Today in Donetsk 11 927 houses with total area of 11743.47 thousand sq. m. house. The largest number of such communal housing has also Horlivka, Donetsk, Makiivka, but of which only three were created thousands of condominium communal housing [2]. Actively working with small businesses less than half of them;
2) to the apartment building (which is the main object of reform) are relevant for about 20 different agencies;
3) burdensome taxation;
4) absence of acceptable credit conditions;
5) Corruption tender organizations;
6) existing Association of apartment formality, ie lack of documentation of the true situation.

Despite calls by the authorities, entrepreneurs do not seek to manage the newly created Association of apartment because it is disadvantageous in terms of business. Experts in the field of communal housing assert that control building, where less than 800 apartments, unprofitable, it will lead to bankruptcy. Also, if its own funds to start there, the company is doomed to failure.

3 CONCLUSIONS

Today, quite clear that the main resource that should be used to review the situation in communal housing and public sector - is determining the rules of relationships and optimal proportion between the government and the business sector and creating motivation for this area was attractive to business.

It is possible now to talk about creating a system of social partnership, which will include the following components [1]: executive power, acting as a representative of national interests, local governments, which act as local representatives of communities, public organizations, representing the interests of certain groups, small businesses.

Partnership provides the following benefits to all sectors - public, private and public: 1) sending special skills, capabilities and interests of each of the sectors to identify common to all problems and ways to address them through the potential legality and transparency, which are not inherent in any sector alone; 2) resource mobilization through the combining of human, technical, information, material and financial capacity of all sectors; 3) greater awareness of the priorities, needs and roles of each of the sectors that contribute to creating more integrated and stable society; 4) create dynamic contact networks, offering channels of influence to attract the wider society and influence the political program; 5) replacing conflict cooperation for all participants.

In order to ensure the conditions for attracting private business in the residential and communal areas must be:

financial recovery of enterprises and organizations of communal housing-municipal complex;

legislative agenda setting single tariff regulation;

translation of certain types of services to self-pay;

conduct a detailed analysis of management and public communal housing complexes of municipal formations;

establishment of market relations in the management of communal housing.

Regions have the largest communal housing and communal potential. It is at the regional level, communal housing reform should occur. And then, based on the regions, communal housing will convert all Ukraine.

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IMPROVEMENT OF THERMAL INSULATION CHARACTERISTICS OF EXISTING FACADES ON RESIDENTIAL BUILDINGS IN NOVI SAD

Jasmina Dražić[1], Igor Peško[2], Vladimir Mučenski[3], Milan Trivunić[4]

Abstract

High energy costs, global warming and environmental protection have imposed the passing of a set of regulations in the area of heat protection of a structure and have influenced the consciousness on justifying the investment into a qualitative thermal insulation of newly built structures, as well as adequate thermal insulation repair of already existing buildings. A survey of the façade conditions of multi-storey residential buildings in Novi Sad has confirmed the necessity for an intervention in the form of façade reconstruction and revitalization. The paper considers the possibilities for improving thermal insulation characteristics of façade elements on these buildings.

Key words

façade, thermal insulation, characteristics, improvement, energy savings

1 INTRODUCTION

Rapid development of Novi Sad is linked to the period of the 1970s. Centralization of the housing fund assets on the level of the city, initiated mass construction of residential buildings. This period was marked by various building technologies (prefabricated, semi-prefabricated as well as classic systems), with types of facades which differ in the method of realization as well as materials [1], without taking into consideration energy efficiency. Having in mind that energy usage in buildings reaches 50% of energy produced in total, according to priorities stated in the Strategy for Development of Energetics of Republic of Serbia until 2015, it is essential to take all the measures in order to improve the energy efficiency of both newly-built and reconstructed buildings as well.

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Shooting of façade conditions in multi-storey residential buildings in Novi Sad in the stated period, visual examination, thermovision shots and calculations of thermal characteristics of façade walls according to relevant technical regulations, proved the necessity of interventions in the form of improvement of thermal-insulation characteristics of façade elements [2]. Improvement of thermal insulation and construction according to energy efficiency principles can largely reduce energy requirements and justify necessary interventions.

2 REGULATIONS IN THE FIELD OF ENERGY EFFICIENCY

In the Republic of Serbia (former Yugoslavia) measures for achieving energy efficiency were first introduced in the late 1960s. The set of regulations on minimal technical conditions for constructions of flats was first published in 1967. It introduced the first conditions for the external building envelope from the thermal aspect, with respect to a climate zone in which the building is constructed. The set of technical measures and conditions on thermal protecton of buildings brought up in1970, presented the first normative act which was concerned with thermal protection problem only. A turning point in the field of thermal protection was the act of regulation-standard with mandatory application, brought up in 1980. All the standards in this area that followed later on in 1987, 1997 and 1998 presented to a certain extent a stricter form of this regulation, but not a radical change in the approach towards the total energy usage in a building and the possibility of its rationalization [3].

On the European level, *The Directive on Energy Performance of Buildings (WPBD-2002/91/EC)* presents the major legal instrument for achieving energy efficiency of buildings. According to this directive, the member countries are obliged to meet minimal requirements on energy efficiency of both newly-built as well as the existing buildings, by introducing certificates of their energy performances [4].

Energy efficiency of materials combined in a single constructive component is marked by heat transfer or the overall heat transfer coefficient U [W/m^{2}K]. Lower levels of this coefficient indicate a better solution in terms of thermal insulation and energy saving. Table 1. [8]. shows minimal levels of the U coefficient for Serbia and the region, set by standards.

The criteria in the EU countries are far stricter, hence in the majority of those countries the maximum level for the U coefficient for facade walls amounts to 0,45 W/m^{2}K, or even lower. The strictest regulations relate to "passive houses", where all the components of the external building envelope must be insulated in such a way, that the level of this coefficient does not exceed 0,15W/m^{2}K.

Tab. 1) Standard values of the heat transfer coefficient in Serbia and the region

COUNTRY	CITY	WALL U [W/m^{2}K]
Serbia	Novi Sad	0,90
Croatia	Zagreb	0,90
Bosnia and Herzegovina	Sarajevo	0,80
Slovenia	Ljubljana	0,60
Macedonia	Skopje	0,90

Hungary	Budapest	0,45
Romania	Bucharest	0,70
Bulgaria	Sofia	0,50

3 THERMAL INSULATION

Solving the problem of heat conductivity and heat loss of all the materials as well as the building on the whole, presents one of the major requirements of the energy efficiency concept. The most important building measure, aimed at reducing energy losses, is the optimal insulation of all the elements. This paper considers problems only related to insulation of the construction of the building envelope.

Reduced heat loss of façade walls is achieved through low values of heat transfer coefficient of materials for thermal insulation (λ<0.3W/mK), and is provided by the choice of adequate materials and systems (real thermal-insulation materials whit values λ<0.06W/mK or insulation materials with construction properties 0.06W/mK<λ<0.3W/mK). Various materials can be applied for thermal insulation of façade walls:

- Materials of mineral origin (stone wool, glass wool)
- Of organic origin
  - polymers (expanded polystyrene, extruded polystyrene, polyurethane, or polyurethane) or
  - natural materials (reed, mineral-bonded wood fibres, recycled cellulose)
- Thermal-insulation mortars and concrete.

The values of heat transfer coefficient for different thermal-insulation materials are given in table 2.

Tab. 2) Coefficients of heat conductivity for various materials

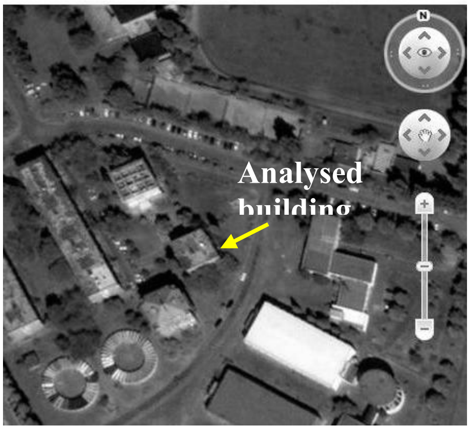
	THERMAL INSULATION MATERIALS	**λ [W/mK]**
1.	Stone (mineral) wood	0.035-0.041
2.	Glass mineral wood	< 0.041
3.	Expanded polystyrene	0.028-0.040
4.	Extruded expanded polystyrene	0.025-0.035
5.	Polyurethane	0.030-0.037
6.	Reed	0.045-0.073
7.	mineral-bonded wood fibres	0.08-0.14
8.	Cellulose-based thermal insulation	< 0.04

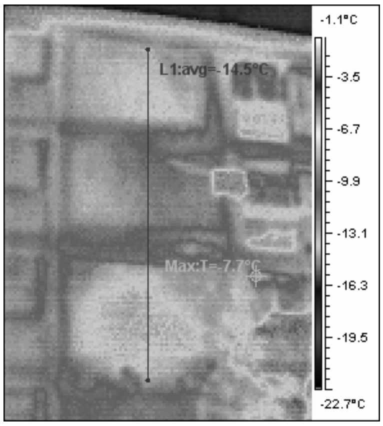
4 IMPROVING THERMAL-INSULATION PROPERTIES – AN EXAMPLE

Results of façade-condition shooting, gained through visual examination of damages (defects), thermovision shots and analysis of thermal properties of a large number of residential buildings in Novi Sad, indicated the need for intervention in the form of improvement of thermal-insulation properties of façade walls [2]. Using an example of a residential building with its properties given in table 3, a possible solution for improving the thermal-insulation properties of façade walls is suggested, by varying three types of thermal-insulation materials.

By examining the project documentation of the building, the structure of facade walls construction was defined (types, position, width of materials). For each of the wall types, the values of the total heat transfer coefficient as well as its proportion in the total facade area were calculated. The structure and the current condition of façade walls of the analyzed building are given in table 4.

Tab. 3) Residential building information

<table>
<tr><th colspan="2">INFORMATION ABOUT OBJECT Four-storey residential building – type NS 1</th></tr>
<tr><td>Novi Sad, Jirečekova No 1, Liman 1

</td><td></td></tr>
<tr><td>Structure data
Building years 1962-1965
Height Gr+4
Overall gross area 268.15m²</td><td>Façade data
Total façade area 999m²
Opening area 259.44m²
Façade area without openings 739.56m²</td></tr>
</table>

<table>
<tr><th colspan="2">FACADE DAMAGES</th></tr>
<tr><td>Visual examination – a shot</td><td>Thermovision shot</td></tr>
<tr><td></td><td>
</td></tr>
<tr><td>By examining the building visually, various kinds of damages (defects) were noticed. These damages were classified and grouped into three levels – minor, medium and severe [2].</td><td>By comparing thermovision [5] and regular facade shots, the damages of facade panels which are not visible on the surface itself were noticed.</td></tr>
</table>

Tab. 4) Structure and the current condition of façade walls of the analyzed building

CURRENT CONDITION				
No.	**WALL TYPES**	**WALL CONSTRUCTION**	**U [W/m^2 K]**	**AREAS [m^2]**
1.	**TYPE 1** **Assembly façade parapet** Width 25cm	Concrete 3.5cm Block (hollow) 20.0cm Gypsum plaster 1.5cm	1.695	514.535
2.	**TYPE 2** **Assembly panel** Width 25cm	Concrete 3.5cm Block (hollow) 20.0cm Gypsum plaster 1.5cm	1.695	172.1
3.	**TYPE 3** **Intercolumns**	Tarolit 2.5cm Mineral wool 3.5cm Chipboard 2.0cm	0.612	52.925
TOTAL				**739.56**

Analysing the offer of thermal-insulation materials on the market, three possibilities for improvement of the facade wall properties for the observed building were suggested, by choosing three different materials. For all three possible solutions for contact facade application , based on the materials chosen, the values of the total heat transfer coefficient as well as facade repair costs were calculated. The data are givn in table 5.

Tab. 5) Possible solutions for improvement of façade thermal-insulation properties for the analyzed building

IMPROVEMENT OF THERMAL-INSULATION PROPERTIES - POSSIBILITIES				
No.	**FACADE TYPES**	**Insulation width d[cm]**	**U [W/m^2 K]**	**expenses [€/m^2]**
1.	Thermal insulation in the facade– stone wool (Frontrock Max E), λ=0,036	6.00	0.429	28.00
2.	Thermal insulation in the facade – expanded polystyrene (AUSTROTHERM EPS AF), λ=0,037	6.00	0.420	25.00
3.	Thermal insulation in the facade –cork panels (ROFIX CORKTHERM 040), λ=0,041	8.00	0.389	51.00

With the accepted width of thermal-insulation materials, adjusted to production programmes of manufacturers, the calculated values of the total heat transfer coefficient, meet the currently valid regulations in Serbia, but are below the borderline values for some of the EU member countries (U<0,45 W/m²K). The expenses given in table 5 include facade repair costs only. Displayed unit price facade repair costs include the following: installation and removal of scaffolding, removal of final layer of the damaged facade, materials and labor depending on the type of thermal insulation material.

5 CONCLUSION

In this paper, by using a multi-storey residential building in Novi Sad, a suggestion for a possible solution of improving thermal insulation properties was given, for three different thermal insulation materials witihin contact facade. Comparing numeric values of the total heat transfer coefficient of the facade wall, a conclusion can be drawn that option 3, the facade with cork panels insulation has the lowest value, which makes it the most optimal solution from the perspective of thermal-insulation properties and energy losses. On the other hand, the facade repair costs give advantage to the second type of facade. Inconsistency of the conclusion drawn through individual observation of both criteria, introduces the adequate method [6] in the choice of optimal solution. The method of compromised programming, with equal consideration of both criteria in the process of optimization, gives advantage to the second type of facade. Facade with thermal insulation AUSTROTHERM EPS AF, 6cm wide, makes an optimal solution for the observed building, according to material and work costs on the market of Novi Sad. For the assessment of justifiability and the period of cost efficiency of the investment [7] for the improvement of thermal-insulation characteristcs of facade walls, essential for the accepted solution, financial analysis should also include the effect of energy loss reduction, i.e. their related expenses.

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CITY AND TOWN IMPROVEMENT AND ARRANGEMENT OF GREEN SPACES: NORMATIVE DOCUMENTS REVIEW

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Abstract

Judging by the number of normative (standard) acts which in this way or another concern the city improvement and arrangement of green spaces can arrive at a conclusion that everything is all right with these issues in Ukraine. Unfortunately, the reality overturns this conclusion. What most of us see in city and town streets are far from being ideal, if to say the least of it. So, availability of the normative documents rather indicates that the government organs do understand the significance of this questions than that we have great successes in this sphere.

Key words

Improvement, Business entities, Normative documents

1 INTRODUCTION

A city dweller's life today has turned into running along dusty streets and sitting in stuffy offices. Green places in cities are more and more replaced with building, highways, and enterprises. And people forget that green plants make the microclimate in a city or town better, create favourable conditions for the outdoor rest.

The government position is clearly formulated in Law # 28071: improvement is a common concern, and it means that not only the central executive offices and local government agencies should be occupied with it. Every entity as well as common citizens should do their best to improve their territories and to arrange green spaces round. They can either do some works on the improvement and arrangement of green spaces or act as balance holders of individual objects of improvement. In these cases the "improvement" activity is regulated by the corresponding normative acts and its specific character does not much influence the accounting policy. [1]

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But most entities have to provide the improvement of their own territories. And in many cases that is not only a duty but a wish of the enterprise owners and managers and their employees. Trying to meet their engagement and to implement their wish, these are the entities (or in other words, ordinary enterprises) that face problems and difficulties including accounting ones. First of all, that is connected with the fact that an absolute majority of normative documents in force are not assigned to them.

At the same time, the accounting and tax legislation does not comprise any special norms, and a specific character of expenses connected with the improvement and arrangement of green places does not always allow coordinating them definitely with these or those general norms. So, accountants have to seek for analogies, to draw parallels, to construct logical chains in order to find a place for these expenses in balance sheets and to prove them to be reflected in the tax accounting. It can be easily done if one knows special terminology, understands a specific character of works and expenses, can be guided by norms and normative documents in force in the sphere of the improvement. As it is impossible to publish all of them (many of them are rather bulky), let us analyze the most important of them focusing on what can be of interest for an accountant of a general enterprise which either own or rent the improvement objects.

2 NOT OBLIGATORY, BUT USEFUL

One of the most interesting documents (in the context of the subject under study) is "The Procedure of repair and maintenance of the objects of the city improvement" adopted by the order of the Ministry of the state housing and communal services of Ukraine # 154 of September 23, 2003 and registered in the Ministry of Justice of Ukraine on February 12, 2004, # 189/8788. In the preamble to this document it is clearly said that its requirements "are obligatory for all organizations irrespective of their official attachment and the form of property which are engaged in the repair and operation of the objects of the city improvement", that is they act as contractors. But it is this document in which the description of the concepts "capital repairs", "current repairs", "maintenance work" are given with regard to the objects of the improvement. Besides, in the appendices to the "The Procedure" the following information is given:

- a list of operations concerning capital repairs;
- a list of operations concerning current repairs;
- a list of operations concerning maintenance work;
- a list of operations concerning the maintenance of the objects of the city improvement and man-made structures. [2]

Should we say how important this information is for the tax accounting of a general enterprise? (Of course, if the most principal question – either the enterprise is ready to prove the "economic" character of the operations on improving its own territory or not – has been solved.) For example:

- "restoration of lawns, flowerbeds, and rose gardens and planting of perennial flowers" belong to capital repairs; and "opening of perennial flowers and waste removal, extra nutrition, tying up of plants, covering of plants for the winter period, grubbing out and storage of bulbous and tuberous plants" belong to the maintenance work, though in both case perennial flowers are meant;

- "recovery, full or partial replacement of fountain and swimming pool covering" are capital repairs; and "fountain and swimming pool cleaning" belongs to the maintenance work.

And there is no difference where the fountain is – in the central square or in front of the factory building, – there must be no difference between the costs of repair (improvement) and maintenance.

But that is not all yet. Other appendices of "The Procedure" can be also useful for all enterprises, among them:

- Appendix 2 "An inter-repair life for capital repairs of roadway coverings";

- Appendix 4 "An inter-repair life for current repairs of roadway coverings";

- Appendix 6 "An inter-repair (average) life of the objects of the city improvement (except roadway coverings)".

The last Appendix will, in particular, help to fix the time of a beneficial use for business accounting, and two other appendices – to confirm a necessity of making definite expenses and to ground their reflection in the tax accounting.

If caring after green planting is financed at the expense of the local budget, then the planned net cost of such operations is determined in accordance with the Procedure of determining the cost of jobs for caring after green planting in Ukraine adopted by the order of the Ministry of the state housing and communal services and registered in the Ministry of Justice of Ukraine on 31.08.2005 and numbered # 958/11238. If there is another source of financing the above operations, for example, an entity own funds, the application of this document is not obligatory.

As to price setting, customers can become interested in the document aimed for contractors, that is the Order of the Gosstroi (the State Construction) of Ukraine # 94 of 13.06.2005 "On the clarification of the indices of the general manufacture and administration expenses" which, in particular, specifies the average indices in the investor estimate documents for determining:

- some kinds of the general manufacture expenses (including expenses for the arrangement of green spaces, shelter-belt forests, perennial fruit planting;

- administration expenses per one man-hour of the general estimated building and assembly jobs including the arrangement of green spaces, construction and repair of the improvement objects.

There is one more interesting document more – "Standards for tree and bush acclimation rate in the arrangement of green places in cities and towns and other settlements of Ukraine" adopted by the order of the Ministry of the state housing and communal services # 32 of 25.02.2005 and registered in the Ministry of Justice of Ukraine on 24.03.2005 and numbered

329/10609. This is a kind of a natural loss allowance. On the base of this document one can justify losses inevitable in the arrangement of green places.

One can suppose that not all entities know these documents, a necessity of their application is fixed in the documents themselves but the control of the implementation of the requirements is not very strict. These documents include the Regulations of maintaining green planting in cities and towns and in other settlements of Ukraine adopted by the Ministry of the state housing and communal services # 70 of 29.07.94 (hereinafter referred to as The Regulations # 70). In accordance with point 12 of the Regulations, they are "obligatory for performing by all enterprises, organizations, institutions (hereinafter referred to as enterprises) and citizens engaged in designing, constructing, operating, repairing and maintaining all kinds of green planting on the territories of cities and towns and other settlements including tree (bush) planting into holes as well as maintaining small (about 0.05 hectares) landscaped places – small islands, lawns, flowerbeds along highways, streets, passages, embankments".

According to point 1.3, "a responsibility on the accomplishment of these Regulations when maintaining green planting is directly laid on leaders of the enterprises which have green planting on their balance-sheet".

The Regulations (point 3.4) make the owners of green planting have a certificate on each green plant in which "on November 1 they are to register all current changes which occurred on the plant (amount of growth and destruction of green places, planting and decreasing a number of trees, bushes etc.)".

Despite a long duration, the Regulations are still in force with the exception of point 6.8 which concerns the procedure of making an inventory of green planting. This point was replaced with the Instruction on making an inventory of green planting in cities and towns and in urban settlements of Ukraine adopted by the order of the Gosstroi (the State Construction) of Ukraine # 226 of 24.12.2001 and registered in the Ministry of Justice of Ukraine on 25.02.2002 and numbered # 182/6470. According to point 1.3 of the Instruction, it "is obligatory to make an inventory of all plants within cities, towns, and urban settlements, namely in public accommodations, restricted accommodations, and special accommodations".

As a matter of fact, this formulation means an obligatory execution of this Instruction by all and sundry entities which have green planting. According to point 1.4 of the Regulations # 70, "by their functional features green planting are divided into three groups:

- common-use green planting – city and district parks, amusement parks, gardens belonging to residential districts, public gardens, boulevards, embankments, recreational forests, meadow-parks, hydro-parks etc.;

- restricted-use green planting – planting on the territories belonging to public and residential buildings, schools, kindergartens, sport facilities, public health institutions, industrial enterprises, storehouses etc.;

- special-purpose green planting – planting along streets, in sanitary-hygienic zones, fenced-off areas, on the territories of botanical and zoological gardens, exhibitions, cemeteries and crematoriums, high-voltage power lines, forest reclamation planting; nursery-gardens, floricultural farms; roadside planting within cities, towns and other settlements". [3]

Two last documents are indicative of a succession, in any event, a terminological one, between different normative acts.

3 SPECIAL NORMS OF THE “BRANCH” DOCUMENTS

Many norms which are expressly or by implication connected with the requirements for the improvement are “hidden” inside the branch-wise normative acts. These norms can be useful to prove an economic direction of the improvement works and arrangements of green places. That is why some of them are given here.

Accountants of budget institutions should pay attention to two points of the Instruction of accounting non-negotiable assets of budget institutions adopted by the order of the State Treasury of Ukraine # 64 of 17.07.2000 and registered in the Ministry of Justice of Ukraine on 31.07.2000 and numbered # 459/4680. According to point 1.18 “capital investment into perennial planting annually enter into non-negotiable assets as expenses for the operation of an area regardless of the completion of all works”, and point 6.12 describes the order of fulfilling the “Registration card of accounting fixed assets in budget institutions (for animals and perennial planting)” (model form O3-8 (budget). Besides, in letter # 07-04/2485-10920 of 13.12.2004 [4] the State Treasury clarifies the order of wear (aging) charge for some kinds of non-negotiable assets noting, in particular, that wear is charged only on those perennial plants which have reached an operational age.

Accountants and other concerned people who would like to know the official position of taxation authorities as to how to reflect expenses on the improvement in a tax accounting will face that … there is no such a position. In any event, it had not been fixed in the tax interpretations or the letters which had been published. But a growing interest to the questions under study may require their additional clarification in the near future.

The letter of the National Commission of controlling electric power in Ukraine # 05-34-13/55of 06.01.2005 is of a definite interest. It touches some questions connected with the maintenance of perennial plants in fenced-off areas of power lines. In particular, the NCED (National Committee of the Economical Development) prompts that according to the Regulations of power line conservation adopted by the Cabinet of Ministers of Ukraine of 04.03.97, # 209 owners of ground areas which are within fenced-off areas are not allowed planting perennial plants. Any violation of these Regulations is penalized in accordance with the legislation of Ukraine. [5]

4 CONCLUSION

In conclusion we should note that only some – the most important and interesting – documents have been covered in this review. Their application as well as the application of other legislative acts makes it possible to create the most acceptable for a concrete enterprise approach to the reflection of the expenses for the improvement and arrangement of green places in the business and tax accounting. Let the accounting operations not become an obstacle in such a noble and necessary for everybody cause as improvement of cities and towns and arrangement of green places.

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COST ANALISYS OF THE USE OF NORMAL AND SELF-COPACTING CONCRETES

Jacek Gołaszewski[1], Dawid Stolarczyk[2]

Abstract

The paper presents cost analysis of the use normal and self-compacting concrete of wall structures using normal and self-compacting concrete from identical categories. This article aims to estimate performance to what extent the SCC property increases the price of concrete and to what extent it reduces expenditure connected with consolidation.

Key words

Normal concrete, self-compacting concrete, the expenditure on concrete

1 INTRODUCTION

According to European standards normal concrete is a material having an oven-dry density greater than 2000 kg/m^3 but no exceeding 2600 kg/m^3 [6]. By the use of longer definition concrete can be named each material minimum prepared by the 2 composition which one of them will be a granular, mineral material and the second one acts as a hydraulic binder to joining the aggregate as a one whole [1].

However self-compacting concrete (SCC) can be each concrete which concrete mixture will perform special kind of requirements regards [3]:

- High-liquidity ensures easy, quick and precise filling form (shuttering), regardless of amount reinforcement arrangement and elimination - on the principle of buoyancy undesirable bubbles in short time after placing concrete mixture.
- Ability to penetrate the reinforcement which means ease movement between the reinforcement bars, without loss of homogeneity of concentration variation of large aggregates of grains on both sides of a layer of reinforcing bars in the direction of flow of the mixture

A typical application example of Self-compacting concrete is the two anchorages of Akashi-Kaikyo Bridge opened in April 1998, a suspension bridge with the longest span in the world (1,991 meters). The volume of the cast concrete in the two anchorages amounted to 290,000

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m3. A new construction system, which makes full use of the performance of self-compacting concrete, was introduced for this. The concrete was mixed at the batcher plant beside the site, and was pumped out of the plant. It was transported 200 meters through pipes to the casting site, where the pipes were arranged in rows 3 to 5 meters apart. The concrete was cast from gate valves located at 5 meter intervals along the pipes. These valves were automatically controlled so that a surface level of the cast concrete could be maintained. In the final analysis, the use of self-compacting concrete shortened the anchorage construction period by 20%, from 2.5 to 2 years [4]. It means that using self compacting concrete has a lot of technical and economical advantages allow to obtain, even under difficult technological conditions, construction with high strength, durability and quality finish. Through the application it is possible also to correct execution of complex parts, which could not be done using traditional methods. In addition, significantly improved working conditions are the concreting and the smaller is the impact of concrete work on the environment. Before using self-compacting concrete it’s necessary to make an economcal calculation. Due to specification of technology and its properties the use of SCC is also associated with a significant impact on the total cost of such a direct and indirect construction which is made from it. In the case of direct costs especially where the cost of materials (because of the specificity of the composition), workload and equipment in the various processes of its production, implementation and the need for increased control, improve working conditions and environmental protection, quality construction, especially in terms of finishing it surface and greater opportunities for architectural design and construction.

2 SPECIFICITY TECHNOLOGY OF THE NORMAL AND SELF-COMPACTING CONCRETE AND ITS COAST.

There is a difference between composition of self-compacting concrete and the traditional one. Basically in SCC there is less water content, increased of powder content (binder and aggregate fraction < 0,125 mm), less amount of coarse aggregate and higher of sand modulus. Differences in the composition are particularly clear in the case of concrete of the lower classes and disappear with increasing grade of concrete. Self-compacting concrete requires increased spending at the same time during the design and constant supervision and correction of the composition during manufacture.

Table 1 summarizes the production costs of SCC and conventional concrete of various grades, calculated on the basis of information gathered directly from producers of ready-mixed concrete (the price level - the second quarter of 2010). It shows that the difference in cost of production of conventional concrete is concrete in the case of the lower classes. With the increase the class the differences of the cost between normal SCC disappear. In some cases, self-compacting concrete may be cheaper but it mainly depends on special composition of the concrete mixture . This is mainly due to the replacement of cement and/or aggregate cheaper materials such as fly ash or rock dust.

There are also some limitations associated with the use of self compacting concrete. Production of SCC requires the use of high-tech label (eg, equipped with automatic moisture control aggregates), the creation of additional surface storage (more components, the need for separate storage of different batches of materials) to mix with high intensity (increased energy consumption of the mixing process and / or extended mixing time) and increase the frequency of cleaning the mixer. All these increase the production cost of SCC. In addition, the need to increase the cycle time of mixing may reduce productivity.

Tab. 1) Summary of the cost of 1 m3 of normal and self-compacting concrete.

Specification	Unit cost	J.m	PRICE OF m3 NORMAL AND SELF-COMPACTING CONCRETE											
MATERIALS			C25/30		C25/30 SCC		C30/37		C30/37 SCC		C35/45		C35/45 SCC	
			Quantity t/m3	Price	Quantity t/m3	Price	Quantity t/m3	Price	Quantity t/m3	Price	Quantity t/m3	Price	Quantity t/m3	Price
Cement CEM I 42,5 R	67,80	€/t	-	-	-	-	0,345	23,39	0,345	23,39	0,380	25,77	0,370	25,09
Cement CEM II/B-S 32,5 R	60,49	€/t	0,325	19,66	0,360	21,78	-	-	-	-	-	-	-	-
Fly ash	9,76	€/t	-	-	0,130	1,27	0,055	0,54	0,120	1,17	-	-	0,110	1,07
Aggregate - Sand 0-2 mm	9,76	€/t	0,630	6,15	0,704	6,87	0,688	6,71	0,717	7,00	0,659	6,43	0,677	6,60
Aggregate - Gravel 2-8 mm	11,22	€/t	-	-	0,433	4,86	-	-	0,464	5,21	0,485	5,44	0,448	5,03
Aggregate - Gravel 2-16 mm	10,73	€/t	1,226	13,16	-	-	1,102	11,83	-	-	-	-	-	-
Aggregate - Gravel 8-16 mm	11,22	€/t	-	-	0,541	6,07	-	-	0,549	6,16	0,665	7,46	0,548	6,15
Water	2,10	€/m3	0,167	0,35	0,160	0,34	0,158	0,33	0,151	0,32	0,163	0,34	0,166	0,35
Plasticizer 1(%mass of cem.)	0,33	€/kg	0,55%	0,59	-	-	-	-	-	-	-	-	-	-
Superplasticizer (%mass of cem.)	0,49	€/kg	-	-	1,10%	1,93	-	-	1,0%	1,68	-	-	1,0%	1,80
Plasticizer 2 (% mass of cement)	0,49	€/kg	-	-	-	-	0,95%	1,59	-	-	1,15%	2,12	-	-
Amount of material	-	-	-	39,90	-	43,11	-	44,39	-	44,92	-	47,56	-	46,09
Production coast	-	€	-	6,37	-	6,61	-	6,37	-	6,61	-	6,37	-	6,61
Laboratory service	-	€/m3	-	1,00	-	2,00	-	1,00	-	2,00	-	1,00	-	2,00
Total costs	-	€/m3	-	47,27	-	51,72	-	51,76	-	53,53	-	54,93	-	54,70
Profit	-	%	-	10%	-	10%	-	10%	-	10%	-	10%	-	10%
Calculation price	-	€/m3	-	51,99	-	56,89	-	56,93	-	58,89	-	60,42	-	60,17
Price rounded	-	€/m3		**52,00**		**57,00**		**57,00**		**59,00**		**61,00**		**60,00**
1 EUR	4,10 PLN													

The other negative side effect is that speeding up the casting rate is the potentially high form pressure that might occur. The risk of high form pressures must be considered in planning process and reflects documented knowledge in regard of the type of concrete going to be used (at actual temperature, batch age and casting rate). Alternatively, that the form pressure can be monitored during casting in order to secure the integrity of the formwork. Monitoring form pressure is especially important for high wall columns or other high structures. The formwork surveillance can check impressions and deformations in clam ties. When there are such signs of high pressure a brake should be making in the casting [2]. This means that it also increases the cost of implementation of formwork, which include increasing the number of formwork elements and their mounting workload. Besides, as shown by practical experience, the use of self-compacting mixtures is often necessary additional sealing formwork, which leads to additional workload at the assembly, disassembly and cleaning (up to 5%) and increased consumption of materials (up to 1% of the formwork). However, due to the requirement to ensure continuity of concreting, organizational requirements should be increased and ensure provision of hardware for the duration of his conduct. This requires increased organizational effort. In addition, the pumping of certain mixtures it is necessary to use elevated pressure, and thus the increased amount of energy.

Eliminatation of the vibration compaction results in a significant reduction in the number of workers engaged in processes of laying and compacting concrete mix, is also generally shorter duration of these processes. Based on previous experience it can be estimated that the use of self concrete up to five reduces the workload on the performance of construction compared to traditional concrete. Elimination of vibrators process reduces the cost of equipment and energy needed to form and concrete density.

3 COSTS OF WALL STRUCTURES BY THE USE OF NORMAL AND SELF COMPACTING CONCRETE.

Analyzing the merits of the application of normal or self-compacting concrete we can use an example of wall structures 21 cm thickness in a stright formwork and height of 4 m using SCC and normal concrete the same class. Workload for the item include both the assembly associated with setting the formwork, as well as the implementation process of concreting. However in the case of SCC, will occur much more higher hydrostatic pressure even 150 kN/m2. In some cases it is necessary to use totally different formwork than traditional concrete. Adequately to the increasing cost of carrying out the formwork, which include increasing the number of formwork elements and their mounting workload. Generally formworks used in wall structures are projected for hydrostatic pressure from 40 to 80 kN/m2 due to the widely used concreting technology which provides reduced rate of concreting 1-4 m/h. It should also be noted that in the case of SCC there is also increased workload (about 5%) for the corresponding formwork preparation by setting additional supports, couplers, tie rods, seals pins and holes, which may leak through the concrete mix. Increased labor inputs for the formulation result in additional costs associated with sealing materials (about 1%) that may occur in the form of special PVC tapes, silicones, cork on the holes after the screws or other sealing materials. It means that the reduction of labor for thickening process of elimination will be offset by these processes, as shown Table 2 and 3.

Tab. 2) Reinforced structure in formwork system 21 cm thick and 4 m height, volume of 500 m^3 ordinary concrete

A	Labor	Unit	Quantity	Price/hour	Value
1	Concrete placers II group	man-hour	220,96	€ 3,50	€ 773,36
2	Carpenters III group	man-hour	1275,74	€ 3,50	€ 4 465,09
3	Carpenters II group	man-hour	2717,20	€ 3,50	€ 9 510,20
		Amount	**4213,9**	**€ 10,50**	**€ 14 748,65**
B	**Materials**				
4	Normal-weight concrete C30/35	m3	500,00	€ 61,00	€ 30 500,00
5	Bale edged needle II class	m3	0,43	€ 243,90	€ 104,88
6	Antiadhesive liquid	kg	476,20	€ 1,61	€ 766,68
		Amount	**€ 976,63**	**€ 306,51**	**€ 31 371,56**
C	**Equipment**				
7	Formwork system	man-hour	1301,93	€ 8,65	€ 11 266,46
8	Internal concrete vibrator	man-hour	152,86	€ 0,73	€ 111,85
9	Truck concrete pump 60 m3/h	man-hour	55,56	€ 85,37	€ 4 742,93
		Amount	**€ 1 510,35**	**€ 94,75**	**€ 16 121,23**
				AMOUNT L+M+E	**€ 62 241,44**

Tab. 3) Reinforced structure in formwork system 21 cm thick and 4 m height, volume of 500 m^3 self-compacting concrete

A	Labor	Unit	Quantity	Price/hour	Value
1	Concrete placers II group	man-hour	110,48	€ 3,50	€ 386,68
2	Carpenters III group	man-hour	1339,53	€ 3,50	€ 4 688,36
3	Carpenters II group	man-hour	2847,81	€ 3,50	€ 9 967,34
		Amount	**4297,82**	**€ 10,50**	**€ 15 042,37**
B	**Materials**				
4	Self-compacting concrete C30/35	m3	500,00	€ 60,00	€ 30 000,00
5	Bale edged needle II class	m3	0,43	€ 1 000,00	€ 430,00
6	Antiadhesive liquid	kg	476,20	€ 6,61	€ 3 147,68
7	Seals materials				€ 2 081,38
		Amount	**€ 976,63**	**€ 1 066,61**	**€ 35 659,07**
C	**Equipment**				
8	Formwork system	man-hour	1301,93	€ 18,52	€ 24 110,22
9	Truck concrete pump 60 m3/h	man-hour	13,89	€ 85,37	€ 1 185,73
		Amount	**€ 1 315,82**	**€ 103,88**	**€ 25 295,95**
				AMOUNT L+M+E	**€ 75 997,39**

However, concrete mix vibration in the reinforced wall thickness of 21 cm and a height of 4 m can be very time-consuming activity, because of both occurring reinforcement, and the need for compaction layers, especially in the bottom, when the length of the flexible shaft vibrator with a baton is length of 4 m. In the case of self-compacting concrete, the process of concreting takes place in a continuous manner, since the concrete is compacted under its own weight so that we do not take our time. There is also shorter time neccesary to unloading one truck concrete mixer (9m3) using SCC than ordinary concrete. This means that lower costs, both for the elimination process of compaction in the absence of the need concreting layers, as well as inputs for the pump to the concrete, which globally reduces the time associated with the implementation of concrete works [5].

4 CONCLUSIONS

As shown in the article self compacting concrete can be cheaper than traditional one. However, the improoving to the production of concrete also affects the implementation of the indirect costs of materials and construction. The most important aspects of this impact are:

- No compaction vibration causes the conditions which significantly improve safety and health at work - very harmful vibration is eliminated and noise is reduced greatly. In addition, less noise during placement and compaction mixture

- Additional special training is needed because of the specificity of self-compacting concrete technology. The scope of the dissemination of technology as the SCC concrete scope of such training will become smaller and therefore its cost will less expensive

- During the implementation of the concrete application of SCC it may be necessary to attract a new fitting to examine the properties of concrete mixtures and the modernization of the (additional storage bins and dispensers, devices for continuous determination of moisture content of aggregate).

- In the prefabrication lower cost of the forms that do not have to be designed taking into account the burden of vibration.

- The elimination of compaction process opens the possibility of introducing robotics/automation, especially in the production of prefabricated elements.

- The use of SCC to design concrete structures with complex shapes, large quantities of armaments and a well-finished surface, and at the same slimmer and lighter than traditional concrete. This allows reduce of material consumption in construction and thereby reducing its cost.

- Improving the durability of concrete SCC due to the specificity of the formulation allows the extended life cycle of construction and reduce expenditure on its maintenance.

The article presents a broader look at the technology traditional vibrated and self-compacting concrete what in Polish literature is unusual. However, before using SCC it’s necessary to make a detailed calculation of how profitable it is to use of this material.

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INVOLVEMENT OF SMALL BUSINESS IN THE HOUSING AND COMMUNAL ECONOMY

Oleksandra Griekhovodova[1],Valeriia Gorchynska[2], Olena Dolgalyova[3]

Abstract

The article reviews the state of small business in Ukraine, the level of small business development, the concept of housing and the possibility of functioning of small enterprises in the market for utility services. It was considered the main problems that arise in small businesses entering the market for utility services, and activities designed to promote interaction and small business sector housing.

Key words

Small business, housing utilities, public policy, legislation, development, proposals.

1 INTRODUCTION

Small business as an independent and indispensable element of a market economy is one of the most effective levers to solve these economic and social objectives as promotion of the structural transformation of the economy, strengthening the economic base of regions, the rapid saturation of the market goods and services, reduce monopoly and promote competition, introduction of scientific achievements technological progress, increasing export opportunities for countries, employment much of the population.

The current stage of development of market relations in Ukraine is characterized by increasing role of small businesses. This problem is especially acute in housing, social and economic sector, development of which directly affects the quality of life.

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2 RESULTS

The current stage of development of market relations in Ukraine is characterized by increasing role of small businesses. Compliance with quantitative measures of small business in Ukraine, the average level of similar indicators of small business development in member countries of the European Union leads to the conclusion that Ukraine had achieved the objectives of the quantitative development of small business and therefore need to move to a new stage of state policy on development of national small business [1]. This problem is especially acute in housing, social and economic sector, development of which directly affects the quality of life.

Market housing and communal services is a huge arena for small business. The level of profitability in this segment of the economy is not very high but stable.

On 01.07.08 were involved 411 private enterprise to housing maintenance s, most of them in Donetsk (97) Sumy (36), Odessa (26). However, in Cherkasy, Lviv, Volyn, Chernivtsi, Zaporozhye, Transcarpathian, Khmelnytsky Oblast and Sevastopol neglected to this issue [2].

The study specific problems of small business development in many households are devoted to research, but a comprehensive analysis of their interaction is carried out either in theory or in practice.

Scope of housing has long recognized the priority for implementing a regional program to support small business. Therefore, creating conditions for development in the field of housing is one of the major problems of public policy. Small business wants to work in housing, which is very promising for the development businesses. The experience of the Donetsk region, it is every year more and more small businesses pay attention to market for utility services. Providing funeral services, removal of solid waste, provision of individual heating system and gas supply, provision of planting and decorative lighting, laying sidewalks, playgrounds has become commonplace for many small business [3]. However, the share of private companies in the total production and sales services Housing insufficient.

Speaking about the legal framework that regulates the output of small business to market for utility services, it almost does not exist. Small business in this area is invited to participate in creating a single customer service. To date, projects for the management of communal housing in 1961 established a single customer service. Most common customer service functions in Donetsk (34), Sumy (8) regions and in Kyiv (8) [2]. Deterrent in the development of market relations is weak support from local governments and imperfection of the current legislative framework. Because smaller business in the area housing is still the local government. To resolve this issue locally developed program of social and economic development programs and small business support.

The most significant problems of small business in the market for utility services are listed below.

1. Despite the fact that the number of existing management companies is increasing, to date no regulations under the Law governing the activities of management companies - provisions, typical contracts, the financing, etc.

2. To date no methods that determine the relationship manager or customer service providers in the calculation of tariffs cost subscription service users included in the tariff corresponding producer services.

3. Many problems arise when determining the quality of housing services: on the matter of artists and consumers often contradictory views.

4. One of the negative aspects that cause non-payment consumers are tax profit utility companies. Not getting timely payments to customers for utility services do not allow time to undertake the necessary cost of maintenance and repair of houses that can not cause a deterioration of their technical condition. Due to the fact that income tax is calculated on accrued income, there is a paradox: the less money for the current period will receive a housing company, the more profit and, hence, taxes.

5. Basic materials and financially costly repairs houses for objective reasons are held in warm weather. In winter months, residential enterprises could portion of the funds coming from the population to accumulate or collect materials stocks. However, the current tax system is accumulating makes it impossible, as these funds are converted into taxable income, no credit for the VAT.

3 CONCLUSIONS

Market housing and communal services is a huge arena for small business. The level of profitability in this segment of the economy is not very high but stable.

Most acute problems of small business in housing - lack of financial resources and all those concerned with: low wages, and hence a lack of qualified personnel, significant deterioration of housing and material-technical base of small businesses.

Almost all small and medium businesses need government support at all stages of development. Most essential is a clear legal framework that would regulate the responsibilities of all participants in the housing and communal reform.

To attract small business sector in the housing must meet the following objectives:

1) the formation mechanism of real partnership between government and business, effective regulatory policies;

2) creation of a modern infrastructure for small and medium businesses, including financial, targeted area housing;

3) revitalization of the business associations to represent and protect their interests through lobbying and legislative tools initiative.

The realization of these objectives will improve small businesses entering the sphere of housing and transfer it to another level.

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PLANNING AND MONITORING OF LARGE-SCALE INFRASTRUCTURAL PROJECTS IN HUNGARY

Miklós Hajdu[1]

Abstract

In Hungary the National Infrastructure Development Corporation (NID) coordinates all major highway and train network development projects. Their contracted value is continuously well above EUR 5.000.000.000, and the number of ongoing projects is continuously above 200. During the years NID has developed a standardized way of planning and monitoring these large scale infrastructural projects. In the paper the main concept of this standardization and the project planning and monitoring system will be shown, through the case study of a EUR 300.000.000 new Danube bridge projects. Finally the conclusions will be drawn from the last three years of operation, and the plans for the future will be shown.

Key words

Project management, planning and monitoring

1 INTRODUCTION

The National Infrastructure Development Corporation, hereafter referred to as NID), which is a 100 percent state-owned company, was established in 1998. Its main tasks are to manage the whole process of the state-initiated highway development projects, to represent the state's interests during the realization and to enforce them. 100-200 billion Euros worth projects and highway restoration worth less than 1 million Euros can also be found among the elements of the project portfolio. The project durations vary between 2-3 months and 3-5 years. Since 2006 the NID has been managing the railway development projects as well.

The NID is responsible for the management of the whole project, from the designs, the acquisition of land to the selection of the contractor and the control of the realization and finally the tracking of the project in the warranty period. One portion of the projects are state-funded, others are financed by the EU, by mixed sources, by private investors or in a PPP scheme.

The diverse financing backgrounds, the wide range of participants of the project and the differences in the technical aspects of the projects have raised the need for the creation of a

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standardized, flexible project management system that is capable of not only satisfying the requirements of the different organizations of the NID but also the informational demands of the state supervisory bodies. At the beginning, the NID created a standardized project management system whose requirements were satisfied by the application of the Primavera system to a certain extent. A decade ago this solution was not at that state of development where it could entirely satisfy the needs of approximately 300 users, plus the special requirements stemming from the unique demands of the highway construction projects defined by the NID's project manual. Consequently, in 2005 the NID replaced their existing project management system with a new one that had been developed locally and that satiated their requirements better. It was also believed that the development team would be better at reacting to the emerging needs.

The system of the NID handles the projects from the decision of the state to ordain the realization. In this article we are going to follow the process from the point where the designer creates the bill of quantities as part of the tender documentation. The described system is the one that is set out in the project manual of the NID, however the full-scale realization has not happened till this day. In spite of this, it can be stated that the IT solution supporting the project management, implemented by the NID, covers the majority of the functions described below.

2 CREATING THE BILL OF QUANTITIES

The unpriced bill of quantities is created by the Designer as a part of the tender documentation. This involves all the work that has to be performed, the code, the description, the quantity and the precise specification of every item. When making this document, it is compulsory for the designers to use the NID's own database, to which they gain access for that period of time. The other option of the Designer is to use a system which has been approved by the NID and that is able to handle the NID database and the completed bill of quantities can be loaded into the NID's project management system.

The contracted prices of the database's items are constantly updated with the prices of the same tasks from the latest projects, thus creating the opportunity for the NID to be able to estimate the expected contracted price automatically right after the creation of the bill of quantities. From now on we are going to call this price the engineer's price because the Engineer appointed by the NID for the project is responsible for the calculation of the expected price.

The bill of quantities is not only used during the making of the bid, but later, when scheduling the project, this is going to be the basis of creating the list of activities, when controlling the realization, the basis of monitoring and of issuing the invoices as well. Due to the above-mentioned points, the bill of quantities made by the Engineer does not only serve the sole purpose of creating the basis for the bid, but also satisfies the following needs that occur during the execution:

- creating the task list of the schedule
- tracking the performance during the construction
- updating the schedule
- satisfying the diverse reporting requirements of the different participants of the project

In order to entirely satiate the demands described above, the NID has made a manual that specifies the points that should be followed in the bill of quantities. One part of the technical orders concerns the structure of the budget chapters, another one is about the complementary information that all items should be provided with, so that the items could be grouped arbitrarily when reports are made and that the schedule's task list can be done as well.

These complementary pieces of information are called dictionaries. The NID applies 10 dictionaries, which have predefined elements. The designer assigns these predefined elements to the items. This means that if the project has 5000 budget items, then one element of each dictionary should be assigned to every item of the budget, which equals to a total of 50 000 elements. (5000 items is a usual amount. In case of larger highway construction projects, the author has met bills of quantities consisting of more than 16 000 items.)

The following dictionaries should be applied:

- Construction Group: This information could be used when we would like to select the items, contracted price and completion etc. of the given branch. Examples for the elements of the Construction Group Dictionary

  2.... Public Utility Lines

  2**1**... Telecommunication Lines,

  21**0** Telecommunication Lines

  2**2**... Electric Lines

  22**1..** High Voltage Lines

  etc..

  3.... Highway Construction Main Group

  3**1**... Construction Works of the Main Course

  31**1**.. Main Course

  31**2**.. Junctions

  31**3**.. Rest Stops

- Construction Number: The 3-digit-long Construction Number identifies the specific construction (building, bridge, road, public utilities etc.) within the specific Construction Group. The numbering goes from 001 continuously.

- Branch: The Branch dictionary shows which branch the given item belongs to. Its elements are the following:

  1 General Items

  2 Public Utilities

  3 Highway Construction

  4 Water Construction

  5 Bridge Construction

6 Building Construction
7 Traffic Engineering
8 Environmental Protection

- Trade Packages: The Trade Packages dictionary comes from further breaking down of the Branch dictionary, thus giving a more detailed grouping by trades.
- Amortization: This dictionary facilitates the activation of the complete project based on different descriptive keys at the time of the inauguration.
- EU indicator: This dictionary helps meeting the reporting obligations towards the EU. It is based on the specifications of the EU. The items are grouped according to the elements of this dictionary.
- Task Dictionary: It plays an important role in the creation of the automatic task list (WBS) when making the schedule.
- Contractor Dictionary: The Contractor fills it in. They can give which contractor (consortium partner, subcontractor) is responsible for the execution of the given item.
- Contract Dictionary: Here it can be given which contract modification the given item appeared in, whether it is cancelled, additional or supplementary.
- Railway indicator (in case of railway projects)

Except for the Contractor Dictionary, it is the designer who assigns the elements of the above-mentioned dictionaries to the items.

The NID's norm database works in such a way that, apart from the elements of the Construction Group and Construction Number dictionaries, the elements of the dictionaries are automatically assigned to the items, because the database for creating the bill of quantities also contains these data.

The Engineer representing the interests of the NID is the one who first evaluates the created bill of quantities. The approved version is sent to all contractors in an electronic form as part of the tender documentation during the tender process.

3 DETERMINING THE OFFERING PRICE

The contractors determine the material and labour unit cost of each item of the bill of quantities intended for them. Afterward these costs are multiplied by the quantities thus creating the offering price. The bidders use the system specified by the NID, which ensures that the contractors cannot modify the bill of quantities and that the file containing the bid is going to be stored by the NID's system. The material cost equals to the sum of the procurement price of the material and the price of transportation to the construction site. The labour price is the sum of the price of the living labour and equipment used. Both prices involve the essential margins as well. The finished bids are then sent to the NID in an electronic form too. Thereafter, the NID evaluates them with the help of the Engineer in its project management system, and at the end of the public procurement process the winner is announced.

4 CREATING THE PROJECT PLAN

The winning contractor has 30 days after the announcement of the results to create the schedule, the resource and financial plans of the project, all of which should be approved by the Engineer. The method of creating the task list and the logical relationships between the tasks, the degree of detailedness of the resource and financial plans, and the format of the plans that should be sent electronically and in a printed version are all specified by NID's manual for the contractors.

The Contractor is supposed to make a network plan with the adequate degree of detailedness, where the task dependencies are described by the logical relationships. Constraints can only be used in case of milestones, otherwise the early and late dates of the tasks ought to be calculated based on the logical relationships.

Important aims of the specifications are that the schedules of the different projects get into the project management system in a standardized way, that these can be handled similarly during the realization, and that standardized reports can be created concerning both unique projects and a part or the whole of the project portfolio.

In some cases the NID may require not only a Gantt chart but also a cyclogram of the project. Figure 1 shows a part of a Gantt chart, while Figure 2 displays a cyclogram.

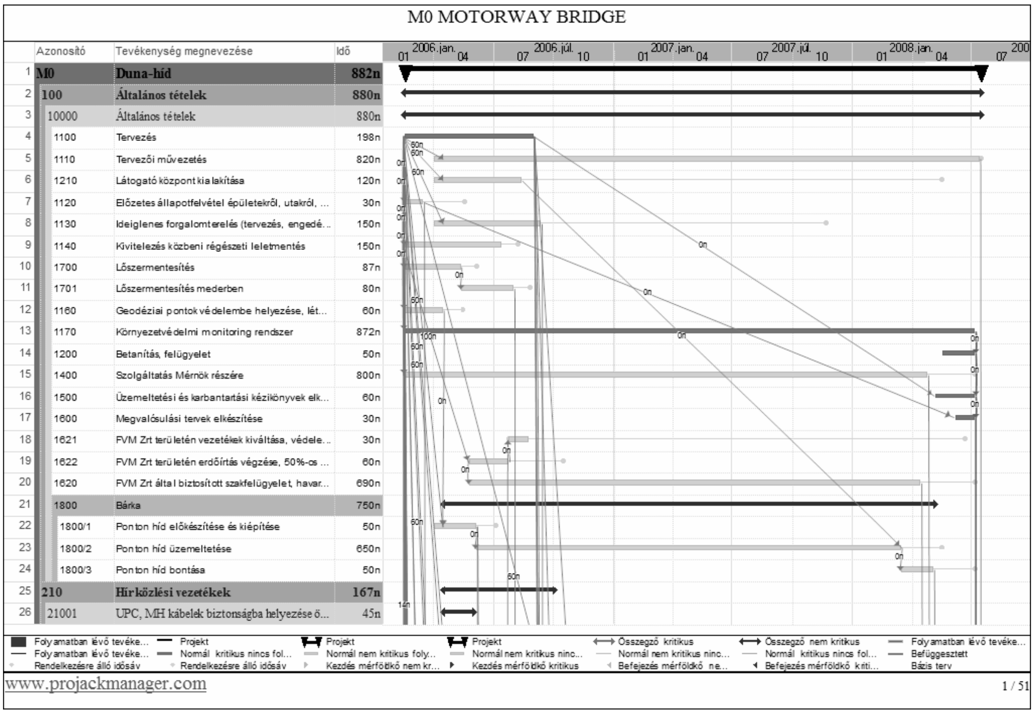

Fig. 1) Gantt Chart Representation of a Project (extract)

The interesting thing about the elaborate methodology is that the task list of the schedule is generated automatically from the budget using the Construction Group, Construction Number, Branch, Trade Packages and Task dictionaries assigned to the budget. In the course of this process, the Contractor arranges the budget items according to the above-mentioned dictionaries, and creates the tasks with the help of this.

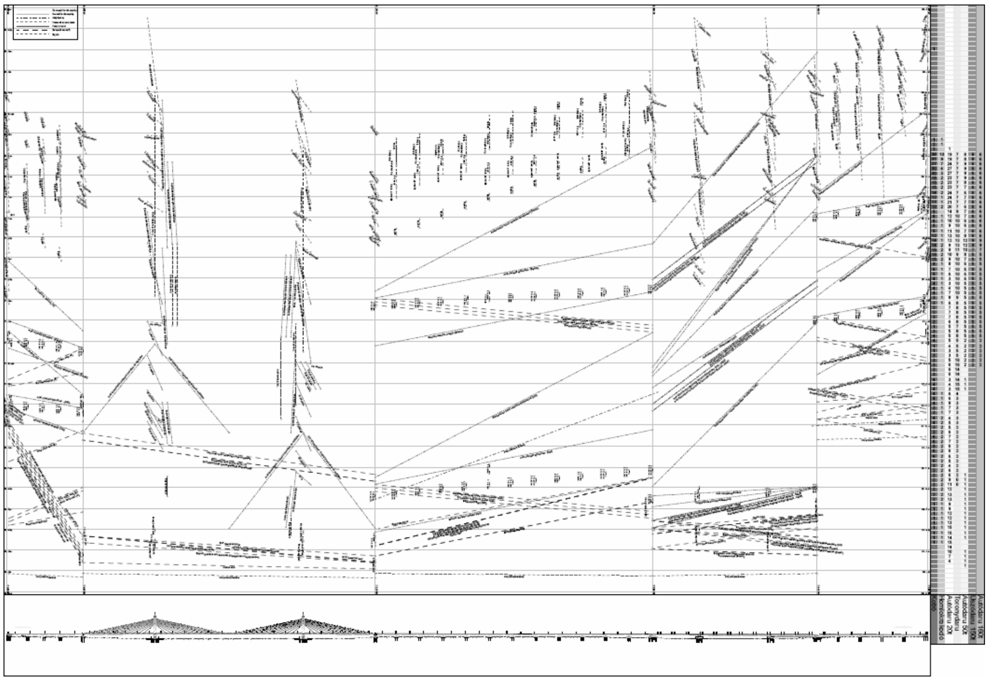

Fig. 2) Linear Scheduling Representation of a Highway Bridge Project

The complete and submitted schedule is then checked by the Engineer from several angles proceeding in accordance with the instructions of the manual. If the schedule does not meet the requirements, it is sent back to the Contractor for correction, on several occasions if necessary. Until the documentation of the baseline plan approved by the Engineer is not ready, the Contractor will not be paid for its performance.

5 TRACKING OF PROJECTS

Reports ought to be made about the progress of the project every month by the Contractor. Creating this survey documentation is the condition of the acceptance of the certificate of performance for the given month. As part of the tracking the Contractor surveys the percent of work completed in case of all items of the budget, and determines the actual start of the tasks that were zero percent complete in the previous month but started this month. Due to the fact that tasks are automatically derived from the items, the actual start and percent of work performed of the ongoing activities and the actual finish of the finished tasks unfold automatically. Based on the above-mentioned data, the system estimates the dates of the remaining tasks automatically, which could be greater than the deadline in some cases. On these occasions the Contractor should revise the schedule and indicate the measures it would like to take in order to realize the new plan. The demands for payment are submitted together with the updated documents. After receiving these documents, the Engineer evaluates them and decides about the approval. If the reported performance corresponds to the actual, then the payment is approved. If the measures, which the Contractor would like to take in order to handle the delay, seem appropriate, then the documentation is accepted. If the Engineer reckons that the planned steps would prove to be insufficient for keeping to the deadline, and that the deadline in the submitted schedule does not correspond to the baseline plan, then the

Engineer informs the NID that the expected finish is greater than the deadline. This leads to negotiations between the Contractor and the NID, which can result in the termination of the contract, but generally it ends with imposing penalty.

During the tracking, the entire documentation should be created in a way that is compatible with the system of the NID. This way the NID's only task in keeping its project management system updated is to accept the baseline plans, which are created by the Contractor in accordance with the specifications, and the monthly updated plans.

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COMPREHENSIVE INSURANCE COVERAGE OF CONSTRUCTION PROJECTS

Tomáš Hanák[1], Vladimír Rudy[2]

Abstract

Investors looking to construct a new building or structure (e.g. water structure, road structure) or renovate the existing one have to seek for adequate builder's risk insurance. The most used product is CAR/EAR insurance on the Czech insurance market. Paper introduces especially the content of typical CAR/EAR insurance policy with practical notes for both investor and contractor. Main goal of the paper is to accent important enactments providing comprehensive cover. The paper presents outputs achieved by examination of insurance contracts and insurance terms and conditions achieved during preliminary phase of university research project “Modelling of Risk Related to Delivery of Building Object”.

Key words

Investor, Contractor, Risk, Insurance, Construction, Builder, CAR/EAR

1 INTRODUCTION

Insurance, generally, is defined as a form of risk management hedging against the risk of a uncertain and contingent loss. Merits of the case lies in the equitable transfer of the risk of a loss from one entity (insured) to another (insurer) in exchange for premium. Insurance is the one of the ex ante risk financing tolls (*Menzinger & Brauner, 2002*). This paper is focused entirely on one special type of commercial risks insurance.

The paper introduces especially the content of typical CAR/EAR insurance policy with practical notes for both investor and contractor. Main goal of the paper is to accent important enactments providing comprehensive cover. The paper presents outputs achieved by examination of insurance contracts and insurance terms and conditions on Czech insurance market achieved during preliminary phase of university research project.

Technical literature uses term "Builder's Risk Insurance" defined by *D. Malecki (2009)* as "*coverage that protects a person's or organization's insurable interest in materials, fixtures*

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and/or equipment being used in the construction or renovation of a building or structure should sustain physical loss or damage from a covered cause". In this case the term “builder” is confusing because insured can include not just contractor performing the works, but also investor, final owner as well as subcontractors if negotiated.

Insurance products covering the builder's risks are usually called CAR/EAR. CAR (Construction All Risk) insurance covers the loss arising from any source, other those explicitly excluded, in connection with the construction of a building or structure, or the formation of the construction site including all construction materials being used within the building or structure.

EAR (Erection All Risk) insurance covers the loss arising from any source, other those explicitly excluded, in connection with the erection or testing the objects insured.

Although CAR/EAR is based on the All Risk principle, the cover does not comprehend explicitly excluded risks. Exclusions are stated in the insurance policy or in respective insurance terms and conditions.

2 UNDERWRITING THE CONSTRUCTION PROJECTS

There are two ways how to insure construction project in Czech Republic. First alternative is called "Insurance of Investment under Construction" - a type of property insurance. Considering the fact that mentioned type of insurance is not suitable for bigger construction projects the paper will focus just on the second alternative.

The second alternative is CAR/EAR, providing property coverage for a building or structure during the course of construction. CAR/EAR insurance policies are regulated by Act No. 37/2004 Coll. - Act on Insurance Contract. In addition to the coverage for physical loss the CAR/EAR policy includes third party liability coverage too. Third party liability coverage is applied for accidental loss of property belonging to third parties as well as accidental injury or illness to third parties caused by an insurance event at the construction site.

Beside the Act on Insurance Contract the insurance market in Czech Republic is regulated by following legal acts in force:

- Act No. 168/1999 Coll. - Motor Third Party Liability Insurance Act
- Act No. 38/2004 Coll. - Act on Insurance Intermediaries and on Independent Loss Adjusters
- Act No. 277/2009 Coll. - Insurance Act.

3 IMPORTANT ENACTMENTS IN CAR/EAR INSURANCE POLICY

Even builder is familiar with CAR/EAR it is recommended to find a broker that is experienced with mentioned type of insurance product. Seeing that work of broker requires knowledge in law, economy and civil engineering, just the right broker is able to be a shark at intricacies of policy and insurance terms and conditions. Builder has to take into account that imperceptible nuance should significantly affect the range of negotiated coverage.

The insurer (the broker in consequence as well) will require detail information about the project. Such information are processed by insurer's experts to assess the risk exposure that influences the insurance rates for particular perils (e.g. fire, flood).

Builder has to check the policy to be sure all involved insured are named, including subcontractors, equipment owners, building owners of existing property and surrounding existing property and mortgage companies.

Specified object insured (building or structure in construction) has to be estimated. Project costs are stated e.g. in locatio operis (Contract for Work); such costs include costs for all relevant construction works including costs for materials, transport, customs, wages and erection works. It is important to provide the most up-to-date cost estimates to the broker. If stated in insurance policy and if extra premium is paid, additional insurance coverage covers also:

- construction site installation,
- construction and erection machines, tools and equipment,
- existing property (on which construction or erection works are performed),
- surrounding existing property,
- and costs for demolition, cleaning and residue removal.

Mentioned additional insurance is arranged as first risk insurance. First risk coverage means that the policyholder and provider must agree upon maximum coverage per occurrence of damage since it is very difficult or even impossible to estimate the insurance value or the insurance value varies considerably during insurance period. In such case the insurance value is higher than sum insured and in case of damage benefits are not reduced due to underinsurance.

Insurance benefit limits become important enactments during last decades. Increasing frequency and gravity of consequences of natural disasters, connected with global warming, requires attention within the context of large loss burden resulting from mentioned disasters. Since the loss burden becomes inadequate to the total received premium (Czech Republic is threatened especially by floods and windstorms, remember floods 1997 & 2002) insurers and reinsurers apply insurance benefit limits to keep the insurance economic viable; see e.g. flood damage curves for real property and consequential evaluation of the damage in *Korytárová & Hromádka, 2010*. Risks are assessed, e.g. natural hazards can be described by classification system (Tropical cyclone classifications or Beaufort scale for windstorm etc.). Special flood zones system for Czech Republic was created in cooperation with Swiss Re and Intermap Technologies during 2002-2003.

Insurance benefit limits are applied especially for following perils:

- flood,
- windstorm,
- landslide,

- theft (the range of coverage depends on the level of security),
- temporary storage,
- fire,
- performing construction works in phases (e.g. for water supply systems).

Insurance company will need to know beginning and end dates of construction/erection works for the whole building or construction as well as for particular phases since some phases (e.g. ground works) provide more risk than others.

The amount of premium paid should be affected by safety measures which allow to apply deductions. The level of fire protection (affected e.g. by amount of fire-extinguishers, fireproof walls) affects the price for fire insurance; fencing, night lightning of construction site, electronic alarm system etc. affects the premium paid for theft insurance.

The last but not least enactment is range of deductibles for particular objects insured. Range of deductible affects the amount of money paid off to cover insured losses from builder's own pocket. Deductible is often unavoidable condition of insurance. See in *Hanák, 2010* [3] how to optimize the range of deductible.

4 CONCLUSION

CAR/EAR insurance is complex product based on the all risk principle. Negotiation of the CAR/EAR insurance policy requires experience because policy is intricate and includes economic, technical and juristic enactments.

Authors recommend to cooperate with experienced broker, provide high quality project documentation, be sure all involved insured are named, estimate the project costs precisely, consider available additional insurance, keep in mind the distinctness of first risk insurance, take into account insurance benefit limits, consider the level of safety measures to get deductions and ponder on deductible range.

Above 9 mentioned recommendations can be designated as general. Seeing that objects insured by CAR/EAR insurance are unique also particular insurance contracts will be unique and will take into account unique conditions of construction site, location, contractor's experience, local legislation, technical parameters, environmental conditions and others.

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ELMER 1.0 – UNOFFICIAL ENERGY AUDIT METHOD FOR EXISTING SINGLE FAMILY HOUSES IN FINLAND

Martti Hekkanen

Abstract

Energy use is the greatest environmental burden and cause of occupancy costs during one's lifetime. The choices made during planning and constuction have an impact for decades to come. A good house is build according to a family's needs, is energy efficient and its indoor air is good and healthy. At this moment at least half million single family houses needs repairs in Finland. In many cases a significant reduce of energy consumption can be achieved. To find out the best result we can use simple spradsheet application called ELMER. At the same time we can get energy audit for the house. It is not official – but the results are reliable.

Key words

Energy efficiency, energy repairs, energy consumption, energy serficate

1 THE BACKGROUND AND TARGET

Final consumption of energy measures the consumption of final energy products, i.e. fuels used for electricity, district heating and space heating, and transportation fuels and industrial processing fuels. The difference between total and final consumption is lost through transformation and transmission losses of energy. (Source: Motiva: http://www.motiva.fi/en/energy_in_finland/energy_use_in_finland/final_consumption_of_energy)

According to Statistics Finland's preliminary data, final consumption of energy declined by 1.9 per cent from the previous year (figure 1)

Final consumption of energy in 2008 (provisional data)

- 1 110 PJ (26.5 Mtoe)
- 208.4 GJ/capita (4.98 toe/capita)

Final consumption of energy in 2007

- 1 132PJ (27.0 Mtoe)
- 213.5 GJ/capita (5.10 toe/capita)

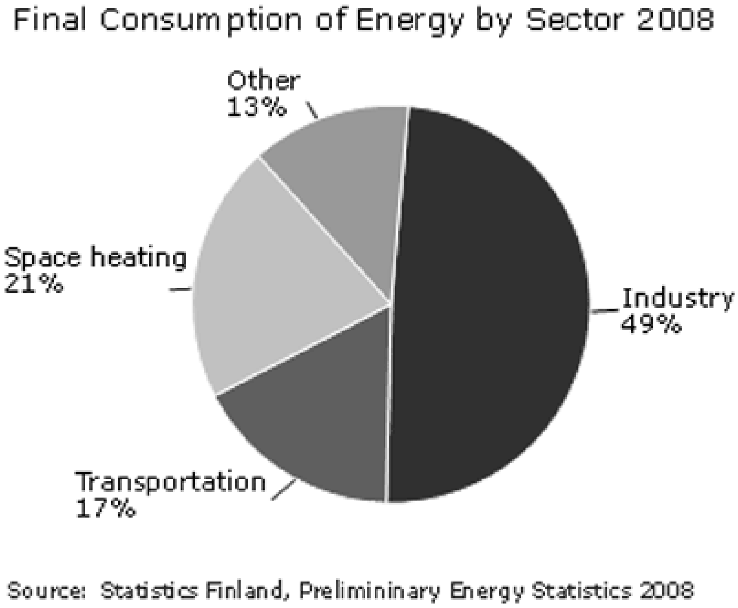

Fig. 1) Total energy consumption in Finland 2008.

In my presentation I'll give a short review of our energy audit system. To day it is emphasized very much for new construction. Any way the medium age of our residential building stock is today over 45 years. Huge renovations are needed in the near future.

Some years ago a simple energy audit system was made for single family houses. We tested it on housing exhibition in Oulu 2005. Afterwards we developed application for existing houses. ELMER 1.0 was born. In my presentation I'll show you how we use ELMER in our educational operation environment.

2 ENERGY AUDIT SYSTEM IN FINLAND

An energy audit assists the buyer to compare the energy efficiency of buildings. The familiar classifications of home appliances provide an overall picture of a house's energy efficiency in a simple way. The aim of an energy audit is also to make energy efficiency one of the design criteria of buildings. (http://www.motiva.fi/en/building/energy_audit/)

Legislation on energy auditing came into force on 1 January 2008. Existing building legislation was applied from 1 January 2009. Before the law entered into force, in other words before 1 January 2008, energy auditing for small dwellings, or small houses, and blocks of flats with a maximum of six apartments was voluntary. (http://www.motiva.fi/en/building/energy_audit/)

An energy audit is needed when a building or its rooms are sold or rented, with the exception of small dwellings built before 2008.

An energy audit for new buildings is drawn up when the building permit is being dealt with. An energy audit is part of a broader energy report, which in addition to the energy audit generally contains the following observations in accordance with section D3 of the National Building Code of Finland:

- Comparative calculation of heat loss and the indication in accordance with the stipulations;
- The specific electrical capacity of the air ventilation system;
- The building's heating capacity;
- An assessment of summertime indoor temperature and the required cooling capacity; and
- The building's energy consumption at its location.

The energy report and energy audit are tools that are worth utilizing at the design stage. With the energy audit it has to be checked before the building is taken into use whether it is possible that during the construction time some of the data needed in the calculation has altered.

3 ELMER 1.0 AS AN ENERGY AUDIT SYSTEM IN EXISTING BUILDING STOCK IN FINLAND

At this moment we have more than 1 000 000 single family houses in Finland. In these houses large renovation have to be done in the near future. These houses do not have energy audit based on law.

The amount of energy saving potential is estimated recently (/3/). The highest saving potential is among single family houses and in block of flats. For apartment houses energy renovation concepts is made earlier (/1/). For single family houses at this moment there are no desant official quides even the need is very well known.

In renovation planning process we can use simple spreadsheet application called ELMER . By ELMER we can find out the best renovation consept and at the same time get energy audit. It is not official, but tests have shown that the accurancy of ELMER is very good.

The use of ELMER (/2/) :

1. Give the basic data (figure 2)
2. Estimate energy and electricity consumption before renovation and you'll get energy audit before renovation (figure 3)
3. Start planning of renovation program (concept) and try to find most economical alternative
4. Print Energy Audit (made by Elmer, not official)

In educational environment we use Elmer as a tool by which students can understand how structural repairs, heating, plumbing and air-ventilation repairs have mutual affects.

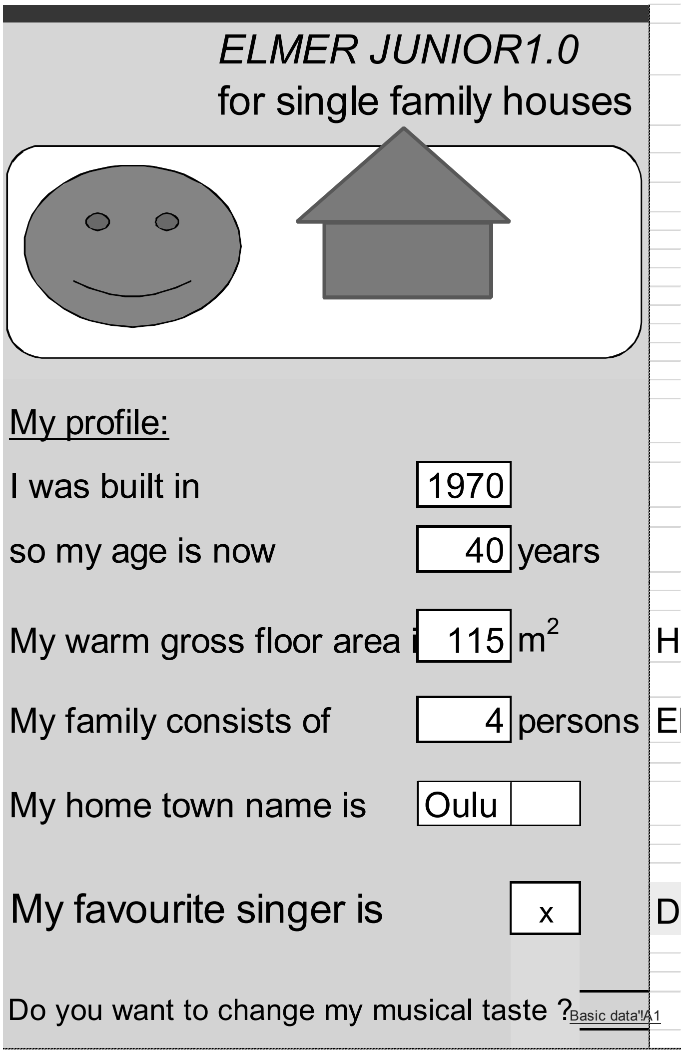

Fig. 2) The basic data

There are two steps by giving the data. First you'll give only the age and floor area, the number of inhabitants and the community where the house is situated. Elmer gives you a rough estimation for energy consumption. Secondly you'll give more information (the amounts of walls, floors, roofs, windows,u-values etc) and you'll get the energy audit before renovation (figure 3).

Thirdly you start planning and choose different repairs. You'll get the price and affect for energy consumption. And finally you'll get the nee energy audit (figure 4).

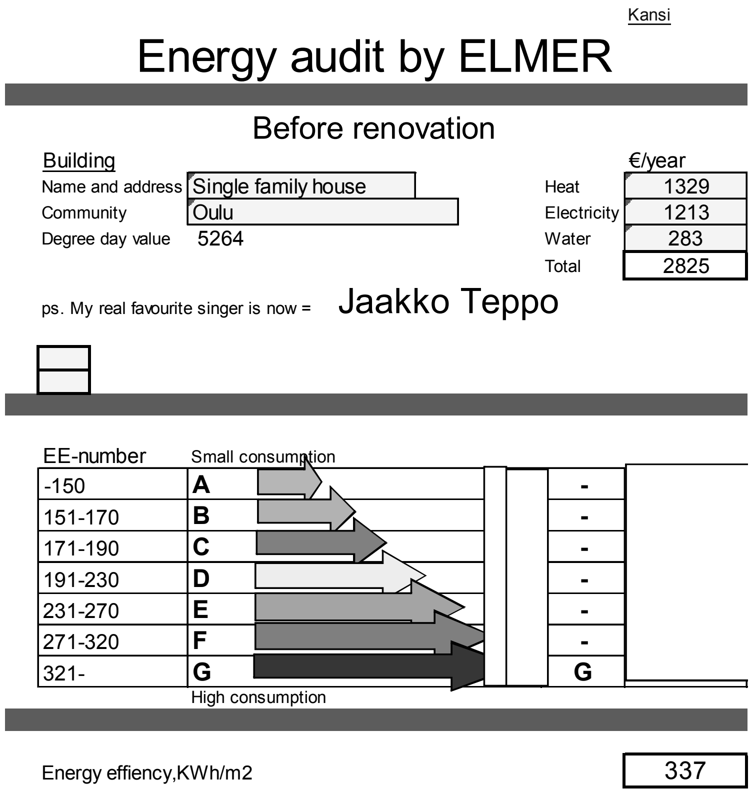

Fig. 3) Energy audit before renovation

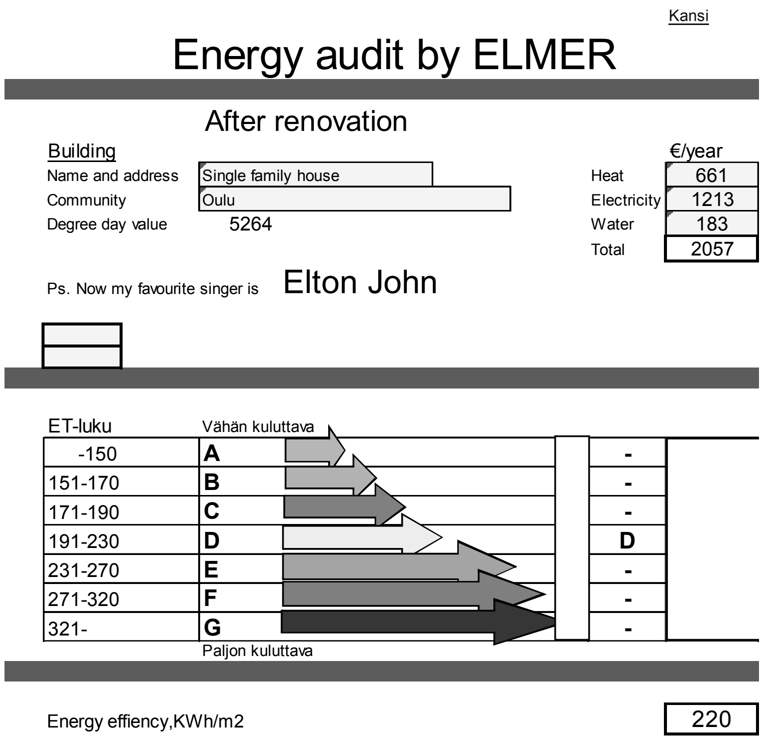

Fig. 4) Energy audit after renovation.

4 CONCLUSIONS

It is not easy to optimize energy consumption in existing buildings. In several cases to substitute the building by new construction is absolutely the best way. If the building is situated in high classified suburban area, the price of the land is so high that the residual value means nothing.

Sometimes the condition of the building is very poor. Necessary repair works have been postponed for toon many years. In these cases it is economically reasonable to improve energy efficiency at the same time Because of the political agreements, we have to affect strongly to the energy consumption also in our existing building stock.

Elmer 1.0 is a very simple spreadsheet application for decision making. By Elmer we can

- set the target level for energy and domestic electricity consumption
- compare the measured energy consumption to the targets
- estimate how different repairs effect to the consumption
- to find out the most economical renovation consept step by step

At this moment Elmer 1.0 is used only in educational environment. In Finland energy consumption have to estimate by official energy consumption calculation method (D5-method), which is quite complicated. Elmer is based on theoretically a little bit simple calculation system. The results do not differ from each other, but as a energy audit it is not allowed to use ELMER.

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SOFTWARE RISK ASSESSMENT OF THE CONSTRUCTION OF ENERGY-SAVING BUILDINGS

Václav Hrazdil[1]

Abstract

Construction projects of energy-saving buildings are linked to time and cost-risks in the phases of preparation and construction execution. Compliance dates and contract costs are important for construction companies. The solution allows the use of appropriate software products based on the evaluation time and cost variations of construction process. These variations must be assessed in relation to the quality of construction works and in accordance with the level of project documentation.

Key words

Project management, risk analysis, energy-saving buildings, envelop constructions, quality requirements

1 INTRODUCTION

The aim of this article is to submit information for solving project risk and uncertainty in initial phase of project. Risk management has to consider both internal and external threats and opportunities as a source for cost, schedule and technical risk as soon as possible is important because it is typically easier, less costly and less disruptive to adjust work and project in the right direction rather then during the later phases of the project. The external and internal sources of risk can be split up in the following way:

- Contractual agreements (business partners, subcontractors, etc.)
- Technical
- Schedule
- Cost

Moreover, it should be noted that in the Czech Republic, state financial support for the construction or reconstruction of buildings in low-energy or passive standards is only

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available if the building meets the required energy parameters [1]. From this point of view, the low-energy and passive energy houses construction brings greater risks than so far conventional construction without these project targets. Of course the loss of financial aid for the reason of the failure to comply the building in accordance with strict criteria is not only one financial loss for the investor. Economic losses will be also reflected in the phase of the use of building in the cost of the heating of house.

Higher demands will be also put on architect and designer and further on building contractor, the choice of construction materials and technical equipment of building. All of these aspects should be taken in consideration for evaluating of the schedule risk and cost risk of the project.

1.1 Use of appropriate software

In order to address the problem, computer program Oracle's Primavera Risk Analysis may be recommended. The program provides a means of determining confidence levels for project success together with the techniques for determining contingency and risk response plans.

The solution of a "risk adjusted schedule" comes from the deterministic model of the construction progress elaborated in Primavera Project Management or Microsoft Project.

The software Primavera Risk Analysis offers an objective view of required contingency to account for cost and schedule uncertainty as well as analyzing the cost effectiveness of risk response plans [2].

2 RISK IDENTIFICATION WITHIN A CONSTRUCTION PROJECT

Generally, we can define the following categories of risk and the risk of certain activity of planning network.

Design

- Mistakes in drawings
- Delays of design
- Architectural versus Structural drawings
- Failure of drawings

Financial risks / payments

- Wrong estimation of price
- Late payment
- Extortion
- Changes in exchange rate

Risks in initial phases

- Wrong cost and duration estimating
- Over-estimating or under-estimating of time and cost

- Unprofitable or non-profit project

Unforeseen conditions

- Ground conditions
- Weather
- Latent threats

Restrictions during execution

- Restrictions from public
- Restrictions from client
- Health and safety conditions of work
- Governmental
- Environmental
- Working legislation

Staff and labour

- Injuries
- Illnesses
- Strikes and protests

Material, equipment, work and technology

- Quality
- Wrong selection

Logistic

- Lack of storage space on site
- Delayed delivery of materials or machinery needed

Management

- Incorrect contract and the consequent risk
- Errors in project planning
- Missing data for operational planning and controlling
- Insufficient instruction for the implementation of new building technologies
- Incorrect execution of work

Handover

- Failure to meet contractual and technical requirements
- Delayed removal of defects and deficiencies

- Delayed handover
- Delayed payments of the investor

The critical reviews of methods of risk management and risk mitigation in Czech Republic are also presented by the authors of the articles listed in references from [3] to [8]. There are also evaluated standards requirements and national regulations.

Introduction of the teaching of the above-mentioned computer programs are expected not only in English study subjects of the Faculty of civil engineering, but in the frame of the whole new field of study "Construction execution". It should be noted that this field of study includes also "traffic constructions", where the likelihood of the negative risk is obviously the greatest [8].

3 RISK PROBABILITY AND RISK IMPACT

Integral part of the risk assessment process is the qualitative risk analysis. This analysis assigns a probability and impact of the identified risk.

The potential probability that a given risk will occur is assessed and an appropriate risk probability may be pointed out on the base of the following table 1):

Tab. 1) Risk probability definitions

Probability Category	Probability	Description
Very High	0.90	Risk event expected to occur
High	0.70	Risk event more likely than not to occur
Probable	0.50	Risk event may or may not occur
Low	0.30	Risk event less likely than not to occur
Very Low	0.10	Risk event not expected to occur

3.1 Risk impact definitions

The table 2) shows risk impact definitions across each of the potentially impacted project areas (cost, schedule, scope, and quality). During risk analysis the potential impact of each risk is analysed and an appropriate impact level (0.05, 0.10, 0.20, 0.40, or 0.80) is selected (see [2] and [8] for more details).

Tab. 2) Risk impact definitions

Project Objective	Very Low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very High 0.80
Cost	Insignificant cost impact	< 10 % cost impact	10-20 % cost impact	20-40 % cost impact	> 40% cost impact
Schedule	Insignificant schedule impact	< 5% schedule impact	5-10 % schedule impact	10-20 % schedule impact	> 20 % schedule impact
Scope	Barely noticeable	Minor areas impacted	Major areas impacted	Changes unacceptable to investor	Product becomes effectively useless
Quality	Barely noticeable	Only very demanding applications impacted	Investor must approve quality reduction	Quality reduction unacceptable to investor	Product becomes effectively useless

3.2 Risk probability and impact matrix

The risk probability and impact matrix in the table 3) represents the combination of risk impact and probability, and is utilised to decide the relative priority of risks. Risks that fall into the darker cells of the matrix are the highest priority, and should receive the majority of risk management resources during response planning and risk control. Risks that fall into the white cells of the matrix are the next highest priority, followed by risks that fall into the less shaded cells. The method was used for risk management of the family house designed in passive energy standard. As the highest risk seemed the air-tightness of the building envelope built in new technology.

Tab. 3) Risk probability and impact matrix

Probability	**Threats**				
0.90	**0.05**	**0.09**	**0.18**	**0.36**	**0.72**
0.70	**0.04**	**0.07**	**0.14**	**0.28**	**0.56**
0.50	**0.03**	**0.05**	**0.10**	**0.20**	**0.40**
0.30	**0.02**	**0.03**	**0.06**	**0.12**	**0.24**
0.10	**0.01**	**0.01**	**0.02**	**0.04**	**0.08**
	0.05	**0.10**	**0.20**	**0.40**	**0.80**

4 MEASUREMENT OF ENVELOPE AIR-TIGHTNESS OF THE BUILDING AFTER COMPLETION OF CONSTRUCTION

The figure 1) shows the measuring of the air-tightness of the building after completion of the building, according to EN 13829. Unfortunately, this construction did not meet the strict requirements of applicable standards.

Fig. 1) Measurement of the building envelope air-tightness

5 CONCLUSION

The submitted article documents possibilities of applying the principles of risk management in practice. Presented method allows better understanding the use of software for risk analysis and how to ensure the input data of this computer program.

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MODEL SOLUTION FOR DEVELOPMENT, FINANCING AND OPERATING OF SOCIAL RENTAL HOUSING

Eduard Hromada[1], Radka Vašíčková[2], Iveta Střelcová[3], Kateřina Servítová[4]

Abstract

The paper informs about student research project that is focused to propose the economical sustainable model of social rental housing. During years 2010-2012 will be finished the rent regulation and other related protection measures of renters. At short notice will grow up extensive group of people, whose will not be competently allowed to buy or to maintain living because of their low income. Municipalities will have to (especially for their older inhabitants) expeditiously look for the solution of this unfavourable situation. Presenting project proposes to municipalities sustainable economic method, how to ensure financing, development and operating of low cost rental housing without marked negative financial effects to municipalities budged.

Key words

Social rental housing, development, financial model

1 INTRODUCTION

The lack of affordable rental housing for the underprivileged population currently represents an important and yet unsolved problem for all big cities, but also smaller communities in the Czech Republic. From a macroeconomic point of view, the lack of affordable rental housing significantly reduces, if not completely obstructs, labour mobility in the Czech Republic and supports the so-called grey economy (unauthorized and illegal public housing rentals and the subsequent tax evasion).

There is not a mechanism in the Czech Republic which would provide housing depending on the living condition of an individual or a family and effectively prevent from a complete loss

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of housing. The absence of such a mechanism is particularly alarming in the current economic crisis, when more and more people are getting near the poverty line or even cross this boundary, mainly during the time of the continuing rent deregulation.

2 CURRENT STATUS OF PROBLEM

In terms of property development and capital investment projects, rental housing is almost entirely neglected as a segment of housing construction at present. There are a number of reasons for this situation and they are often of a broader socio-political nature. Here are only the basic reasons (even though we could surely find more):

- Developers are not interested in executing business plans for social rental housing. Investments into social rental housing have not paid off so far (small profit, high risk). In respect of development housing projects for immediate sale, the investor realizes an immediate high profit, there is not any long-term tying of capital and in several years, the investor/contractor ceases to be responsible for the quality of work performed and the resulting consequences.

- There is a high business risk when entering long-term lease contracts. The current version of the Civil Code does not allow the lessor to terminate the lease relationship freely. In the legislative amendment there is an institute called a change of apartment leases.

- As a result of rent deregulation there is a significant price distortion of rental housing. This prevents from creating a single market with rental apartments with rational prices for rent.

- Inadequate housing supply structure. Particularly in large cities, many tenants occupy a big, old and poorly maintained housing, for which (due to the large floor area) they pay a high rent. There is a significant lack of small flats usable mainly for single-person households in the housing market.

- The government approved material called The Concept of Housing Policy. At the present time however, the Ministry for Regional Development of the Czech Republic has stated that the intents which it contains still have not been implemented. Works on creating the social housing legislation have remained unfinished; the funds of the State Housing Development Fund have been greatly reduced; contrary to the original prognoses, unanticipated effects of the Act on unilateral increase of the rent threaten a part of tenants. The number of homeless people increases, one tenth of the population in our country has found itself below the poverty line. There is a lack of a standard act on rents and services associated with the use of a dwelling. Affordability of housing for households with below-average incomes has changed for the worse.

3 PRESENTATION OF RESEARCH PROJECT

This research project originated, because the present situation is rather unsatisfactory and this serious problem has not been solved in the long term on the state and municipality levels. The main objectives include:

- Creating an economically sustainable model of social rental housing. The model will include initial, implementation and operational phases of the investment project.
- Increasing the availability of cheap rental housing for low-income populations.
- Supporting the construction of municipal rental housing with rent cost.
- Reducing the negative effects of rent increase on underprivileged tenants.
- Motivating private capital to rental housing development.

The sub-project outputs include architectural study (floor plans, views, visualization), technical composition (design of the main structures, design of the method of heating and hot water), itemized project budget, project feasibility study, financial, risk and sensitivity analyses of the project and the project legal and technical documentation for the operational phase.

4 INDIVIDUAL RESULTS OF THE RESEARCH PROJECT

4.1 Technical and Architectural Solution of Residential Building

The building was designed as basementless with two floors and an attic. The building is divided into different sections that can be used separately or jointly, depending on the needs. Individual sections are of rectangular ground area and measure approximately 18.5 m x 18.5 m and 15 m x 18.5 m.

The architectural design is based on traditional architectural elements and shapes in Czech municipalities. Traditional materials will be used – brick, mortar and burnt roof covering, in order to avoid disrupting the municipality appearance. The flats proposed are of various sizes and interior layout. The whole concept is designed so that the total construction life cycle costs are minimal. In the operation phase of the project, energy costs will be reduced by designing the overall building concept (shape, cardinal points orientation, size and window shading), limiting heat loss and using solar collectors for heating water.

The building consists of three sections – two borderlines and middle. The building is of a rectangular layout and its longitudinal axis should be oriented approximately to north-south. The main facade is broken up by a retreating mid section, attic and entrance. The entry and the whole first floor are designed for disabled people. Storm lobby is created by recessed entrance with a marquise. Each apartment has a balcony, loggia or terrace, forming links with the surrounding nature. For a better year-round use, the balconies are glazed, which is important especially for disabled people. The facade is plastered by the combination of two neutral colours (white and grey), which, combined with a gable roof with an inclination of 22° from baked roofing and brick paving used on balconies, terraces and glazed balconies, will fit into the existing built-up areas of smaller municipalities.

All sections are two-storey with an attic. Due to the accessibility for disabled people and better thermal effect, the building is basementless. To reduce costs, the sections are not equipped with elevators therefore the barrier-free apartments are located only on the first floor. In the aboveground part of the third floor, which is designed for sleeping in individual apartments, the ceiling height is reduced down to 1200 mm. The staircase area is lit and ventilated directly. The end section consists of flats ranging from a one room with a kitchen corner (1+kitchen corner) to three rooms with a separate kitchen (3+1). In the entrance floor there are two barrier-free apartments: one 1+kitchen corner and one 2+kitchen corner. In addition, there are all common facilities of the house – a boiler room, cellars, and a bicycle room with a baby-coach part and a lounge. The lounge is intended to support the initiation and functioning of a residents' community and possibly to be used by other people of the municipality. On the second floor, there is one 1+kitchen corner apartment, three 2+kitchen corner apartments and one 3+kitchen corner apartment. On the third floor (loft), there are two 1+kitchen corner apartments, one apartment with two rooms and one separate kitchen (2+1) and one apartment with three rooms and a separate kitchen (3+1). The central part of the house has apartments of the 1+kitchen corner type and the 2+kitchen corner type. The entrance floor includes three barrier-free apartments of the 1+kitchen corner type, cellars and a bicycle room with a baby-coach part. On the second floor, there are four 2+kitchen corner flats and on the third floor there are four 2+kitchen corner flats.

Fig. 1) View of apartment house – end section.

Fig. 2) View of apartment house consisting of three sections.

4.2 Financial Project Model

The enclosure of the apartment house with three sections is 8130.8 m^3. The built-up area of the object is 924 m^2. The total floor area is 1969.2 m^2. The total investment costs were set at CZK 35 445 600. The cost per 1 m^3 of a build-up area is therefore CZK 4 360/m^3.

The low-cost house-building will be realized through a bank loan with equal repayments over 20 years.

The revenue of the project will consist of rent from tenants and regular grant from the municipality to cover a part of operating costs. In determining the rent amount, two basic issues were examined. What is the maximum amount that can be paid by the underprivileged people as a rent? What is the minimum income of the apartment building owner to maintain the building in an acceptable condition? Finally, the project revenues were set as follows:

- Monthly rent for 1+kitchen corner free of services: CZK 3 350
- Monthly rent for 2+kitchen corner free of services: CZK 4 420
- Monthly rent for 3+kitchen corner c free of services: CZK 5 250
- Annual operating grants from the municipality: CZK 2 600 000

The project operating costs will include the costs of managing the building, the costs of inspection, insurance costs, creating the repairs fund and other operating costs. The total annual operating costs were set at CZK 1 080 000. [1] [2]

The project cash flow clearly shows that project financing will be very tight. Without regular operating subsidies from the municipality or state the project is not feasible. Despite all austerity measures, the monthly rent amount is set quite high however, if lower rent amounts were set, the municipal budget would be burdened unbearably.

5 CONCLUSION

The need of social rental housing for low-income people will continue to grow in the following period. There already exists a large group of people who are fully dependent on social housing and their situation at the moment of rent deregulation is not resolved satisfactorily.

It is therefore necessary to solve this problem and seek for meaningful solutions. It is clear that the public sector cannot move the problem of ensuring socially affordable rental housing to the private sector. On the other hand, the public sector is able to solve this problem effectively by using the potential of the private sector (private capital looking for opportunities, the market behaviour of private parties, know-how, knowledge and skills of private parties applied for the design, construction and operation of buildings).

ACKNOWLEDGEMENT

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ANALYSIS OF COSTS FOR THE REALIZATION OF THE BUILDING OBJECT

Vít Hromádka[1], Tomáš Kindermann[2]

Abstract

Paper deals with the identification of basic risk factors, which can influence basic economic characteristics of a building object. Attention is given mainly to costs for the realization of a building object. Each building order has own financial plan, mostly in the form of the item budget created in dependence on the project documentation using directive prices of building works. However own realization of the building object can bring a lot of expected or unexpected complications, which can cause lower or higher difference between real costs taken from the operating evidence or accounting system and planned costs. The main objective of the paper is to identify and to describe basic risk factors, which can lead to the increasing of expected cost for the realization of the building object.

Key words

Building Object, Economic Risk, Costs, Prices, Building Production, Building Materials

1 DETERMINATION OF THE RISK AND ITS MANAGEMENT

The risk is in some form connected with any human activity. It is an element of uncertainty, which more or less influences expected result of the human work. In the literature there exist a lot of ways of explanation of this term; however the basic sense is still the same. The risk it is possible to characterize e. g. like:

- probability, with which some event arises with the result different from the result expected, when at least one of possible results is unwanted, or
- probability of the result or the event different from the asked result, when at least one of the results is unwanted, or

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- possibility of the rise of the unwanted result of the event different from the result expected.

The risk can exist in a lot of different forms and it can have very different impacts. The paper is focused mainly on the risk of investment projects; from this aspect it is possible to define e. g. the technical and technological risk, the production risk, the economic risk, the market risk or the financial risk. [2]

Regarding the high amount of possible risks, which can be met during the planning and the realization of investment projects, it is necessary to manage particular risks. The main objective of the project's risk management is to increase the probability of the success of the project and to minimize the danger of its failure. The steps of the project risk management are following:

- determination of risk factors of the project,
- assessment of the importance of risk factors,
- the project risk assessment,
- valuation of the risk of the project and the suggestion and the acceptance of operations for its decreasing,
- preparation of the plan of correction operations.

2 BUSINESS RISK - INCREASING OF INVESTMENT COSTS

In the first part of the paper there were mentioned basic areas of risk connected with the realization of the investment project. The paper is focused mainly on the valuation of risks connected with the increasing of the purchase price, so the attention will be paid mainly to the economic risk. „Economic risks include mainly the wide range of cost risks, which are caused with the increase of materials and raw materials prices, prices of energy, services or other cost items. In consequence to these risks it can occur the exceeding of the planed amount of costs and not reaching the supposed economic result and the economic efficiency of the project“([1], page 139).

2.1 Determination of Factors of the Economic Risk

Basic step for the determination of risk factors is the dividing of the project into particular phases, which allows more easily characterizing sources of the risk in particular parts of the project. In this case it is possible to divide the project into pre-investment phase, investment phase, realization phase and liquidation phase. For needs of the analyses of the economic risk in the form of the increasing of investment costs will be taken into account only pre-investment (before the subscription of the contract for work) and investment phases.

Factors of the economic risk in the pre-investment phase:

- incorrectly prepared project documentation,
- incorrectly prepared job logging,
- incorrect use of unit prices of building works and material,
- incorrect solution of the responsibility for vice-costs in the contract for work.

Factors of the economic risk in the investment phase:

- increasing of prices of materials, human recourses, energy and material,
- bad climate conditions during realization of construction,
- limitation of the construction in the consequence to the public interest or other objective reasons.

2.2 Assessment of the Importance of Risk Factors

Assessment of the importance of risk factors is very important step of the risk analysis. Importance of the specific risk factor gives the information about necessity of the next more detailed analysis, which defines the total amount of the risk, or if it concerns only about the residual risk, which can be accepted by the subject and will not be next analyzed. For the assessment of the importance of the risk factor can be used mainly expert valuation and the sensitivity analysis.

Expert valuation

The principle of the expert valuation consists in the calculation of the probability of the occurrence of the risk factor and the intensity of the negative influence. For the assessment of the importance of risk factors it is possible to use the aggregate or the detailed way of valuation. Aggregate way of the expert valuation of the importance of risk factors collectively valuates impacts of risk factors on results of the project and its efficiency (the realization of the object of the investment, indexes of the efficiency, the financial stability). Probabilities of the occurrence of risk factors and their intensity can reach five degrees from very low, low, middle, high and very high. Important are the factors, whose probability of the occurrence and the intensity of the negative influence reach at lest middle degree, and the factors, whose probability is low, however the intensity of negative impacts is high or very high.

Detailed approach to the expert valuation of the importance of risk factors valuates impacts of risk factors on results of the project for each impact on the result separately. Generally it could be in the interest of the investor to valuate the influence of particular risk factors e. g. on results in the form of quality of the supply of the object of the investment, the time of realization, the difficulty of the maintenance during the operation etc.

Risk factors are mainly the inputs into the investment project, „threatened“ results are mainly outputs of the project (partial results, whose have to be during the project solution achieved). In the case of problems solved in the frame of the paper will be researched the impact of identified risk factors on the output in the form of the fulfillment supposed costs for the realization of the building object.

2.3 Investment Projects Risk Assessment

Risks, for that it was in previous analyses proved that the importance of their impact on valuated criteria of investment projects can be high, it is good in the suitable way to quantify. The risk can be assessed in the numeric form or indirectly using special managerial characteristics. The assessment of the risk in the numeric form consists in the calculation of statistic characteristics (the mean, the variance, the standard deviation, the variation coefficient), whose in the financial management express the rate of the risk. The basic principle is the assessment of the probability distribution of the valuation criteria of the project (NPV, IRR, profit, etc.). The indirect assessment of the risk comes out from the definition of managerial characteristics, whose in their summary provide information about higher or lower rate of the risk of the project. It concerns about easier way then the first one, basic information about the risk already provide outputs of the expert valuation of the importance of risk factors and the sensitivity analysis. Methods are based mainly on the valuation of the resistance of the project or its flexibility and it concerns mainly about the break point analysis, the operational leverage analysis and the diversification rate analysis.

3 ANALYSIS OF THE INFLUENCE OF THE CHANGE OF THE PRODUCTION FACTORS PRICES ON THE FINAL PRICE OF THE BUILDING OBJECT

The basic step of the analysis, which is in detail solved in the paper, is the assessment of the average monthly increase of prices of building works and products used in the civil engineering according to the data provided by the Czech Statistical Office. This increase is in the next step in model case study projected into the change of the price of the specific building object. Basic input for the mentioned analysis is information about the development of prices of inputs into the building production (building works, materials).

Outputs assessed with the utilization of the data from the Czech Statistical Office it is possible in the next step to compare with the data from real buildings. Assurance of information about the price development on real buildings consists in the identification of differences between planned (budgeted) and real (accounting) prices for particular building objects, building parts or functional parts. Next it is possible to continue in the finding of the percentage rate of particular building or functional parts on the total difference between the planned and the real price. In the case of building or functional parts with the highest rate on changes it is possible to realize the detailed analysis of reasons for the increasing and to delimit critical costs for the specific building order. With the application of the defined approach on more building orders it is possible to assess average deviations at particular building or functional parts and also to assess the probability of expected price.

4 DEVELOPMENT OF PRICES IN CIVIL ENGINEERING

Prices in the civil engineering in the last years passed, as well as prices in other branches of national economy, trough many changes, in the frame that, except some special cases, it concerned mainly about their increasing. With the increasing of prices it is necessary to calculate also during the planning of the realization of the building project, because in the dependence on the difficulty of the planned action can the duration of the realization take from some weeks or months to several years. In the time between the creation of the budget of the building and its finishing can arise the changes not only in the technical solution or used material, whose can the price of the realization (mostly negatively) to influence, but there arise also changes in prices of works or materials, whose have been already valuated in the budget. This increase of prices can in better case decrease the efficiency of the whole order with the decreasing of the total profit, in worse case can this increase cause the loss of the order or financial problems of the whole company. For smaller companies in the civil engineering can be higher amount of those orders very dangerous, then it is necessary the risk of the negative development of the price to take as a threat, for that it is necessary to prepare itself and that it is necessary in suitable way to involve into the valuation process of the order and into the creation of the offer budget in the case of participation on the tender for its realization. In next tables it is realized brief summary of the development of prices in the civil engineering during last years.

Tab. 1) Addition of prices between months for building works in % (previous month 100 %)

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
1997	1,5	1,1	1,1	1,0	0,9	0,8	1,0	1,0	0,7	0,8	0,8	0,7
1998	1,3	0,9	0,3	0,7	0,8	0,4	0,5	0,6	0,4	0,4	0,3	0,2
1999	0,6	0,5	0,5	0,3	0,2	0,1	0,3	0,3	0,3	0,2	0,2	0,1
2000	0,6	0,4	0,4	0,5	0,4	0,4	0,4	0,3	0,4	0,4	0,3	0,3
2001	0,5	0,4	0,3	0,3	0,3	0,3	0,3	0,2	0,3	0,3	0,2	0,1
2002	0,4	0,3	0,2	0,2	0,2	0,2	0,2	0,2	0,1	0,2	0,1	0,0
2003	0,5	0,3	0,2	0,2	0,2	0,1	0,2	0,1	0,2	0,2	0,2	0,1
2004	0,6	0,4	0,2	0,7	1,0	0,4	0,2	0,2	0,1	0,2	0,2	0,2
2005	0,5	0,3	0,2	0,2	0,1	0,2	0,2	0,3	0,3	0,1	0,2	0,1
2006	0,5	0,2	0,1	0,3	0,4	0,4	0,4	0,3	0,2	0,2	0,2	0,2
2007	0,6	0,4	0,2	0,4	0,4	0,3	0,5	0,5	0,4	0,4	0,3	0,2
2008	0,7	0,5	0,4	0,4	0,4	0,4	0,3	0,1	0,2	0,0	0,1	0,1
2009	0,2	0,1	0,1	0,0	-0,1	0,0	0,0	0,0	-0,1	0,0	0,0	0,1
2010	0,1	-0,1	0,0	*-0,1*	*-0,1*							

Source: Czech Statistical Office [3]

In the table there are described the additions of prices of building works in percentage expression, presumptions of the monthly development are just after the quarter of the year retroactively corrected according to the direct quarterly examination of prices in the civil engineering [3]. For the simplification of the analysis there was for the mean of the monthly price addition taken into account its arithmetic average, from which was in the second step calculated the standard deviation and the variance. Values of statistical characteristics of the chance quantity are in the table 2.

Tab. 2) Values of characteristics of the percentage monthly price addition for building works

Sign	Name of characteristic	Value
E(X)	Mean	0,33 %
D(X)	Selected variance	0,07
σ(X)	Selected standard deviation	0,27 %

The similar detailed overview was also realized in the case of changes of unit prices of products used in the civil engineering. For particular groups of products were, using data from the time period from 2000 to 2010 published by the Czech Statistical Office, calculated statistic characteristics of percentage monthly price additions in the form of the mean (arithmetic average), the selected variance and selected standard deviation The example of statistic characteristics is in the following table 3.

Tab. 3) Values of characteristics of percentage monthly price additions for products in the civil engineering (the example)

Level	*Sign of Group*	*Name of Group*	**E(X)**	**D(X)**	**σ(X)**
2	C	PRODUCTS OF PROC. INDUSTRY			
3	CC	WOOD, PAPER, PRINT			
4	**CC 16**	**Wood and wooden products (not furniture)**	**0,05**	**0,73**	**0,86**
5	CC 161	Wood, sliced up, planed	-0,01	1,14	1,07
5	CC 162	Wooden, cork, wickerwork, straw products	0,11	0,32	0,57

Source: Czech Statistical Office [3]

5 INFLUENCE OF PRICES´ CHANGES IN THE BUILDING PRODUCTION ON THE BUILDING OBJECT PRICE DEVELOPMENT

Statistic data mentioned above it is possible for example to apply on the model case study of building object. Model building object is a new family house. The building object it is possible to characterize with the load-bearing structure from the cavity concrete blocks and with the saddle roof with the wooden frame and the ceramic roof cover. The budgeted price of the building object including works of main and subsidiary building production and all assembly works was assessed using the program Build Power in the amount of 2 365 750 CZK. Respecting the price development of building works and building materials expected according to the analysis it is possible to predict the supposed addition of the budgeted price of the building objects per one month in the amount of 5 170 CZK to the total sum 2 370 920

CZK (0,22 %). During the calculation was for particular building works applied unit coefficient of the increase from the table 2 (0,33 %) and for building materials there were depending on the character of material used coefficients mentioned in the table 3. But it is necessary to pose the impact on the fact that mentioned values are relevant only for the solved example of the family house characterized by the specific utilization of materials and technologies. For other objects the change will be different, however totally the change can be in the similar relation.

6 CONCLUSIONS

The main objective of the paper was to describe the problem of price changes of the building production and building materials as one of the most important risk factor in the frame of the business risk. First there is in brief described the general problem of the risk, its identification, assessment and analysis. The highest attention is paid to the economic risk; the practical analysis is in the next part applied on the problem of the price development of building works and building materials in time and its impact on costs and the price of the building object. On the model example it is possible to demonstrate the influence of the price changes of building works and building materials on the total price of the building object.

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ELIMINATION OF MARKET RISKS ASSOCIATED WITH INTERNATIONAL TRANSACTIONS IN THE CONSTRUCTION INDUSTRY

Libor Jedlička[1], Bohumil Puchýř[2]

Abstract

The aim of this work is the characterization of reducing market risk possibilities associated with the construction project financing of foreign currencies and the construction output export. Financial derivatives are used during the dealing with market risks, especially forwards, swaps and sometimes options. This is the reason why I deal with it in a specific research which is called "Elimination of market risks associated with international transactions in the construction industry." There is a special characteristic situation. The Czech Rep. has still CZK as a currency but surrounding states, except Poland and Hungary, use EUR. The assessment of available strategies using financial derivatives that reduce currency risks is the logical result of the current situation.

Key words

Risk, underlying asset, forwards, swaps, options, hedging, settlements,

1 MARKET (CURRENCY) RISK ELIMINATION – INTRODUCTION

In these days, the construction market in the Czech Republic is subjected to great tests. I do not think that it is different in other countries. Construction companies are looking for ways to keep and strengthen their position. Now, the most of the largest construction companies give themselves the questions: Is the market in the Czech Republic able to maintain us? Is it able to retain all the big players? What is the probability that the market will maintain just us? There is a lot of questions. The recent suspension of government procurement makes these problems more important. When our market is not able to retain our firms, the international market has to take care of them. It does not mean that the international market makes it itself. Czech companies have to try hard a lot but foreign markets give them at least a good opportunity.

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Also, new risks are hidden in new opportunities. In general, every company in this country is confronted with market risks. Risks are split up into the basic groups: interest rate, commodity and equity risk. Not many construction companies in the country are confronted with the currency risk. It almost does not matter what kind of action is whether the company has developed a project abroad, purchased of foreign material, or realized project in the Czech Republic for a foreign investor, the Firm always takes the currency fluctuations risk and always either pays or collects money in the foreign currency. If the company gets in to this stage, the questions arise: What influence does the exchange fluctuations of EUR and USD have on cash-flow of projects or company? How is it possible to avoid or reduce this risk? Financial derivatives, which are used in the process of the project and company financing, help to deal with this questions.

2 FINANCIAL DERIVATIVES (FDS)

The group of FDs and their similar investment certificates is the one of the less used and less known ways to reduce the risk, also to obtain the funding for construction investment financing. A lot of people do not know the term "financial derivative" or don't know what this term represents. They figure out, after closer inspection, that the financial derivatives are nothing new and nothing unknown. In fact, it is just another form of businesses than they can usually see. This paper can be regarded as a closer inspection.

2.1 Common features of FDs

People know the concept "Derivative" and "Derivatives" from the chemistry. This refers to substances whose basis is other substance. This analogy is also true to financial derivatives which are derived from the so-called underlying assets. The one of the common and main characteristic feature is that there is the time difference between the closing trade and its settlement. In essence, we only negotiate the conditions of the trade for its realization. The realization comes after a year or several months, weeks or days. It is called the agreed period of maturity. Each participant assumes the opposite market trend, otherwise the closing trade could not be realized. Their economic substance is a "bet" as well as in a horse racing or sport betting. The first participant expects that the horse No. 1 will win and the second waits for victory of horse No. 2. But only one may win and what one loses, the second gets. Now we can change CZK instead of horse No.1 and EUR or USD instead of horse No. 2.

FDs have several types of classification, the first by species

- Fixed forward dealings (forwards, futures, swaps),
- Options (option futures contracts).

Next classification is by the type of underlying assets

- interest rate derivative,
- currency derivative,
- equity derivative,
- commodity derivative,
- credit derivative,
- other derivatives.

The fixed forward dealings concern forward, future, swap, we can also incorporate among them their later variations, CFD (Contract For Difference), SFD (Straight Forward Dealing), Spread, Warrant. We can also include in this category the investment certificates. Also they are derived from underlying assets. Their purpose is mainly the investment as the title suggests, but that is not subject of this paper.

Before you close some deal, it would be also good to know in what position you are or for what purpose financial derivative is concluded. You can keep two position in the banking language.

- "long position", otherwise it is also called shopping. If you are in long position, you expect that the value of the underlying asset will rise, you will buy FD labeled "call".

- "short position", it is the selling position. It indicates the direction of speculation that the value of the underlying asset will fall. You buy a derivative which is labeled "put"

2.2 History

It may sound strange but the ancient civilization had something to do with derivatives. The First Code, we called Chammurabi Code, contained a part which was strikingly similar to some elements of today's derivatives. Origin of today's derivatives, as we know them today, apparently found in the ancient world when the Romans had bought grain in this way from Egypt.

We can consider Chicago as Mecca for the modern derivatives. There were two long-largest derivative exchanges in the world already in the 19th century (1848 and 1874). The first forward contracts were realized in 1851. They called it "to arrive". There was laid down the rules for trading and the control of trading products. There was specified and made a system of margins. There was also introduced a group of traders who are known today as a "speculators" today. Their contribution was significant. The speculators assumed the risk in the expectation of profit from the price movements. The Options were created at the end of the 19th century. They gave the owner the right to decide whether he wants to realize the trade. The owner had to pay the option premium at the beginning of the trade.

The turn of the century (19th and 20th) was in the sign of the development in the area of non-agricultural commodities and financial instruments. The start of trading with options was in 1973, first call options, then put options in 1977. The Formation of swaps and functioning of swap market is dated at the turn of the 70's and 80's. The credit derivatives followed in 90's and weather derivatives were created at the turn of millennium. The Options and futures have been also traded on the Prague Stock Exchange since 2007.

2.3 Purpose of FDs

FDs have one interesting feature from the perspective of the laity. And this is the fact, that the one product is able to expose its user to risk of loss, give him the possibility of high returns and on the other side, this product can be used for reducing the risk which the user is exposed. It depends on what effect of this product the user requires. The second variant is much more interesting. It is apparent from the principle of economic activity of construction company.

The reason is that speculating company pushes its development project to the same level as a speculation. All construction companies and developers work on the opposite principle, reducing the risk and removing as many unknowns as possible which are undesirable in planning the project and company development. We know 3 kind of using of FDs

- Speculation,
- Hedging – external hedging deals with direct input to financial markets with using FDs in order to reduce risk.
- Arbitration

The arbitration in the Word of finance indicates the use of price differential of same goods in different markets to achieve risk-free profit. This can be realized also with use of FDs.

We can meet FDs in several markets. The one of them is the exchange market. But this serves mainly to make money. Especially, OTC ("over the counter") market is important for construction industry. The bank is the main partner for the construction company. Special OTC market is FOREX. There are traded exclusively in the foreign currency.

2.4 Forwards (FWD)

The most used OTC derivative for risk reduction is the Forward. Underlying asset of forward may be:

- currency,
- interest rate (for example PRIBOR Prague Interbank Offered Rate),
- equity,
- commodity,
- the so-called credit FWD – more assets in one product.

The currency and interest rate forwards (FX FWD and IR FWD) are the two most used derivatives. FX FWD is for an exchange of a fixed amount of cash such as CZK for a fixed amount of cash EUR or USD at the date of forward maturity. It is determined the fixed exchange rate. There are several ways to fix the exchange rate. We provide monetary operations against the negative trends by FWD. Although it does not participate in any positive trend, it brings certainty element into the cash-flow of project and it is a very important effect in term of planning. It is similar by IR FWD in projects where the financing is provided by loans. It is not necessary to fix exchange rate in a constant value. It is possible to fix the variable rate and partly to participate in the negative and positive trends. We called this as structured forwards.

- Corridor FWD,
- Knock in FWD,
- Z FWD,
- Double step up FWD,
- Bonus FWD,

  are several types of FWDs used in our country.

Swap works on the same principle. In essence, it is the more piled forwards in a row. It is not so simple in the Czech Republic. In this case, the main risk factor can be the paying customer moral. When the customer does not pay, we have to cancel the swap contract, it means that we have to create again all new transactions during the realization. And this is not cheap.

2.5 Options

The option is OTC derivative with the right of one partner, its owner, for the settlement of both the underlying asset in the one moment in the future (European option) or during the specific period in the future (American option). The cost is the option premium for this right of choice, so this transaction is more expensive, than the others. Therefore, the options are less used in the external hedging. We split up the options into the same group as FWD. The Options are more popular in these days. Even so, this segment misses the offer of "zero cost" options which the company could reasonably use when they give the offers for tenders. Also in this tenders it could be very advantageous to fix the interest rates and exchange rates without paying a lot of money for high option premium.

The best will be that we show their use in the already implemented project.

2.6 Project

The class A office building realization in Prague was initiated on the basis of the future rental contract with the renter from USA for the basic period 15 years plus 3x10 years options for the rent's prolongation. The future renter has bought in advance a right for 30 years prolongation of rent. The rent was negotiated as a payment at the beginning of the period for the date of a year in USD. The source of financing was 350 millions CZK of equity, the rest was the Development Loan in amount of 1.200 millions CZK. It was drawn against the invoices in 2007 and 2008 plus the tranches for the VAT financing during building up. Then the refinancing followed. The development loan was replaced by the Investment loan of 55,250 millions USD.

It was necessary to ensure the course CZK/USD. That was realized by the purchase FX FWD with the fix exchange rate of 26,000 CZK/USD to the content 60,000 millions USD. The Investment loan, 55,250 millions USD, was drawn by the developer in the day of finishing. The developer made the conversion by FX FWD in the content 60,000 millions USD which was composed by the Investment loan and the first rent payment. Then the payment was proceeded in the CZK.

It was used option and FWD during the realization. The fluctuation currency risk was removed. The rent was paid in USD as well as installments of the Investment loan. The last risk was the movement of interest rate. That is why the developer bought 15 years "plain vanilla" interest rate swap (USD IRS) which copied the rate payments and of course also the investment loan installments. It is possible to buy the product like this in the Czech Republic. In that moment, none of the Czechs banks have a similar product in their offers. The reason was that they were afraid of high interest rate fluctuation. The five years swaps were available. But it was too short time for this project. That is the reason why the investor bought this IRS in the foreign bank.

That was a very nice example of using all classic OTC derivatives, the Option, FWD and Swap and even in the Czech conditions.

3 THE CURENT SIUTATION – CONCLUSION

The fall of demand of hedging products was not noticed in the period of so-called financial crisis or depression. But it was not true in the speculator sector. Nowadays the fluctuations are not so striking. The CZK exchange rate, under the current analysis of banks has slightly strengthened against the both euro and USD and also against other currencies. There may be short-term fluctuations but then the CZK would come back to its original level and moderate growth. That indicates that it will be appropriate to future income, associated with construction output export, was ensured by the fixed exchange rate. The reason is that there are no losses due to rising CZK. For example, a developer, or some other enterprise, enters into a contract for 10 millions EUR. It is about 255 mil CZK. If the forecasts is true in thus the exchange rate will be 23,500 CZK/EUR in two years and it means income of 235 mil CZK and it is loss of 20 millions CZK against a planning incomes. It is a really big amount which makes a lot of problems in the cash-flow of project or company. You must agree with me that the idea of removing the risks is more than good.

At the end, it is important to resume and recall the already mentioned facts. FDs are very good instruments for removing of currency and interest rate risks. These their features can be used also in construction industry. The Czech market offer is quite large except the offer of "zero cost" options. This is a grate shortage. Their use as a source of financing for construction project planning is totally inappropriate. And as common in other situation, we have to know what we expect from this products and why we actually want them.

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CONCEPTION OF COST INFORMATION MANAGEMENT IN CONSTRUCTION PROJECTS USING DATABASE APPROACH

Michał Juszczyk[1], Krzysztof Zima[2]

Abstract

Current approach applied in Poland resolves cost calculations to preparing a document. In consequence there is not enough flexibility in cost information management. Development of cost estimation from the document to the database approach broadens capabilities of analysis and cost information management. The purpose of the article is to present a conception of database approach for construction project cost calculation. The aim of using cost databases in place of documents is to make the use of information more efficient. Databases provide tools like queries, forms and reports which could be used for cost information management.

Key words

Cost estimation, database, document

1 INTRODUCTION

Knowledge and skills in cost analysis and cost estimation, with all of the tools, methods and techniques are essential in construction projects. Cost analyses allow architects to match the design of the object to the investor needs and economic abilities. The investor is able to estimate cost which is necessary to bear due to construction project realization. Contractor specifies bidding price of project realization (including costs and profit) to investor needs.

Cost estimation is a source of information which is essential for the successful completion of the construction project. Estimates of the cost and time are prepared at many stages throughout the project cycle. As the design develops, the accuracy of the estimates should improve [5].

Both investors and contractors make cost estimations and analyses during design phase as well as construction phase. Although database approach can be useful along the whole project cycle, in this paper authors focused on the estimates made at the point of tendering.

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2 DATABASE MANAGEMENT SYSTEM (DBMS)

According to literature [2, 6, 7] a database may be defined as a collection of organized information. The data stored may be used by many users simultaneously - it can be accessed, managed and updated. The most widespread type of database is relational database where the information is stored in related tables. Tables are two dimensional structures composed of rows and columns. Tables and connections between them (called relations) make an organizational architecture for storing information in a database. Diagrammatic structure of a simple relational database is shown in figure 1.

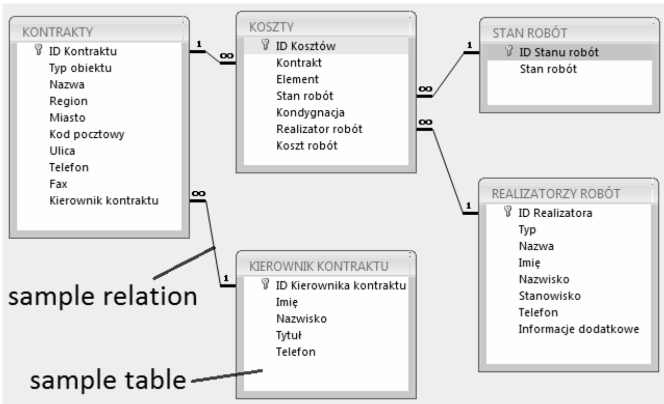

Fig. 1) Scheme of simple database structure.

A database management system (DBMS) is a system that provides: adding information in the database, deleting information in the database, updating information in the database, various ways of presenting information (either on computer screen or paper). User communicates with database using query language. Query language is a computer language used to make a precise request (query) for information retrieval into databases. Very useful for database end users are forms and reports. Forms allow to view, add and update data in tables. Reports are used either to present or print data in a specific layout or analyze information stored.

Actions that can be performed on a database that would be difficult or impossible to perform on a document (or spreadsheet) are: retrieving information that match certain criteria defined by user, massive updating of information, performing complex aggregate calculations, cross-referencing information stored in different tables.

3 DOCUMENT FORM OF COST ESTIMATION

Software applications commonly used in Poland to aid cost estimating exploit database technology in some way. Binding together input data (like prices and output of labour, plants and materials) with calculated quantities of different kinds of construction work needs database technology. However, a document is always the final product of estimating process.

Important notice is that cost data may be considered as hierarchically structured. Figure 2 below shows the hierarchical structure of cost data [1] in construction housing project.

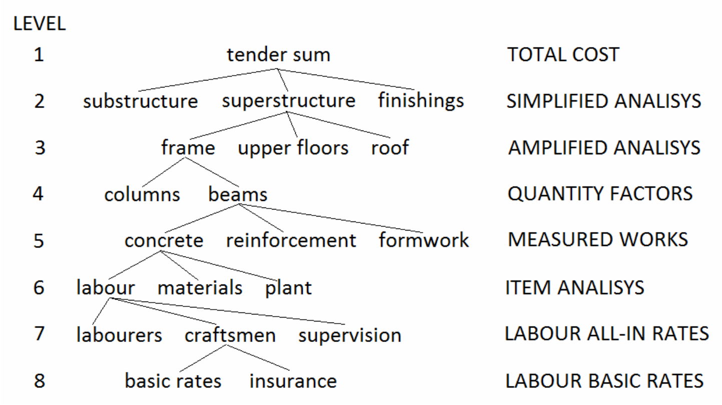

Fig. 2) Hierachical structure of cost data.

Every level presented on figure x contains some information about building object corresponding with cost. The lower level is the more detailed information becomes. Opposite the higher level is the more aggregated cost becomes. In Poland documents containing cost estimation are prepared using hierarchically organized information. Successive levels are shown in figure 3.

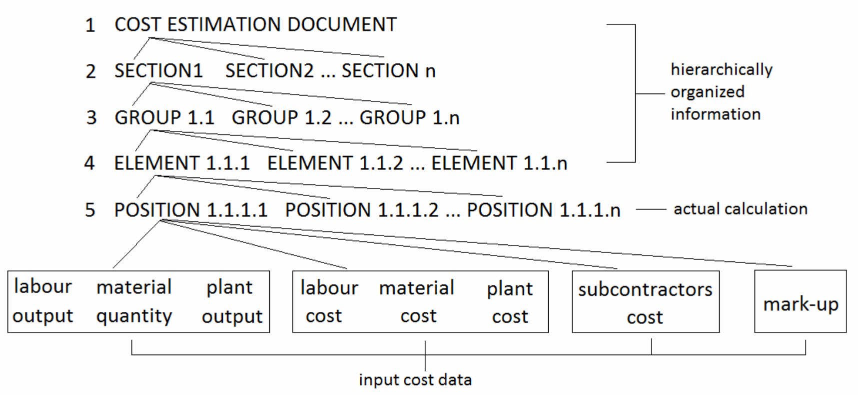

Fig. 3) Hierarchically organized cost information in cost estimation.

In Poland cost estimation is usually prepared using two ways of information aggregation. First way is to set up construction works and their quantities showing technological order of erecting a building. On successive levels there are works, simple elements of construction, complex elements of construction, stages of construction etc. Second way is to set up construction works and their quantities in order of different types of works. Further levels may show specified type of work output and cost at the stages of construction, complex and simple elements of construction etc. Choosing one of the approaches mentioned above implies the structure of the cost estimation document in the beginning of estimation process. In consequence information about building object and its cost is stored depending on adopted hierarchical structure of document. Information is rigidly ordered due to applied in cost estimation levels of aggregation. Main drawbacks of document approach appear during managing cost information. There is not enough flexibility in presenting gathered information (especially while different criteria are needed) or transferring the cost information to the schedules.

4 CONCEPTION OF DATABASE APPROACH FOR COST ESTIMATION

Database approach in cost estimation for building objects may prove improvement in storing and managing cost information. Main idea is to change the way of storing cost information. Information in database is stored regardless of the structure or levels of aggregation applied to cost estimation. Parts of information (locating cost in project stages, complex elements of building and elements of building or construction works) are stored in related tables. Figure 4 shows the idea of organizing information in cost estimation database.

Information may be retrieved from database in lots of configurations due to parallel organization. Some advantages of database approach that can be pointed at are:

- possibility of presenting cost information in different configuration exploiting different criteria,
- possibility of making many independent cost specifications using different criteria,
- possibility of preparing cost specifications for chosen stage of project, chosen construction elements, chosen construction works or chosen type of resources,
- convenience in resources analysis and assignment to scheduled tasks,
- possibility of analyzing cost on different levels of aggregation,
- possibility of preparing sets of cost indices or aggregated prices for construction project,
- better communication between contractor and investor in cost matters.

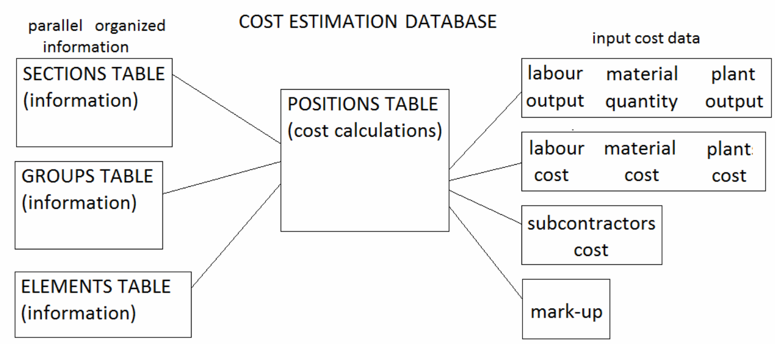

Fig. 4) Exemplary simple database structure for cost estimation.

All the advantages mentioned above are possible owing to queries – specific commands used for retrieving information needed from database.

5 PRACTICAL IMPLEMENTATION OF DATABASE APPROACH IN COST ESTIMATION

Simple implementation of database for cost estimation problem of a residential building is presented below. The structure of the database is very complex as the database consists of several tables containing descriptive information about building and input cost data. Due to clarity of presentation only some chosen features are shown.

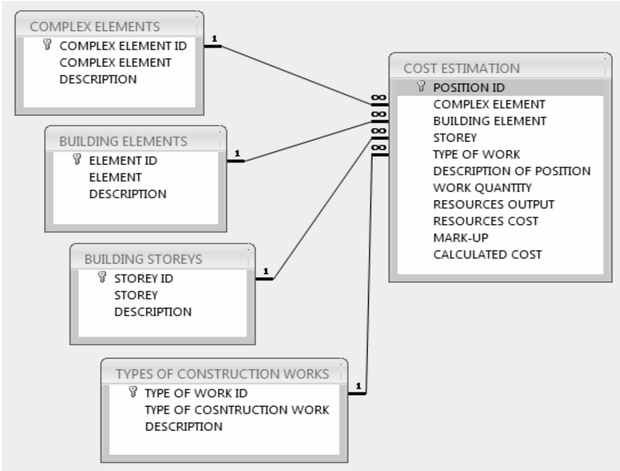

Fig. 5) Cost estimation database structure. [own source]

Figure 5 introduces simplified structure of the database with 5 tables. Tables named COMPLEX ELEMENTS, BUILDING ELEMENTS, BUILDING STOREYS, TYPES OF CONSTRUCTION WORKS contain descriptive information. Table named COST ESTIMATION bundles descriptive information with cost input data – cost estimation for particular calculation positions takes place in this table. Cost input data tables are not presented in this picture. The most important aspect which should be recorded is that the descriptive data is organized parallel not hierarchically.

There are exemplary forms of the database in figure 6. BUILDING ELEMENTS form is used to add, view and either change or correct descriptive information of building elements (foundations, walls, columns, beams, ceilings, roof etc). Similar forms (not presented here) are functioning for description of: complex elements (e.g. substructure, superstructure), building storey, types of construction works (earth work, brickwork, concrete, formwork, carpentry etc). With COST ESTIMATION form user is able to perform cost estimation. Due to relative structure of the database stored information about building is available during estimation. Open combo box in TYPE OF WORK with chosen “formworks” position is shown.

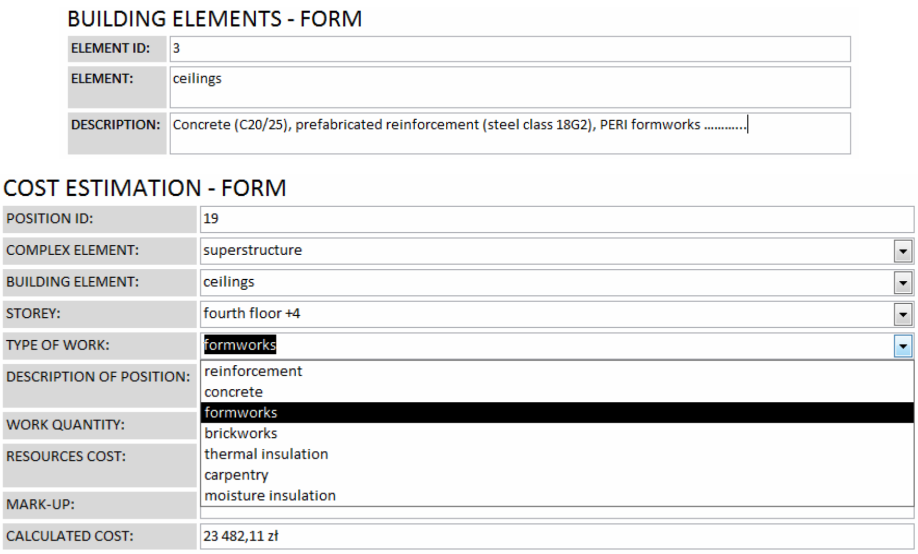

Fig. 6) Exemplary database forms. [own source]

In authors opinion the most essential advantage of database approach for cost estimation is ability to retrieve ordered information in different manners. It gives user much more flexibility in managing cost information than commonly employed document approach. Two different types of queries as an example are presented in figures 7 and 8.

ELEMENT	STOREY	SumaOfCALCULATED COST
ceilings	basement -1	287 123,12 zł
ceilings	basement -2	285 213,11 zł
ceilings	fifth floor +5	125 123,12 zł
ceilings	first floor +1	129 689,01 zł
ceilings	fourth floor +4	130 456,19 zł
ceilings	ground floor 0	130 668,03 zł
ceilings	second floor +2	131 078,22 zł
ceilings	third floor +3	128 231,11 zł

ELEMENT	TYPE OF COSNTRUCTION WORK	SumaOfCALCULATED COST
ceilings	concrete	768 121,70 zł
ceilings	formworks	242 564,73 zł
ceilings	reinforcement	336 895,48 zł

Fig. 7) Exemplary database selection queries. [own source]

There are two selection queries presented in figure 8 above. Selection query retrieves data from one or more tables using criteria specified by user and then displays them in the desired order. Examples in figure 8 present totaled cost of ceilings ordered by storey (upper picture) and type of work (bottom picture).

Figure 8 presents cross-tab query. Crosstab query retrieves data from tables and displays summarized values (different mathematical operation is available) from one field (column) of a table. Values are displayed on intersections of rows and columns. In the example shown below elements and complex elements appear down the left, types of construction works become fields, and the intersection shows the total cost of particular construction work in the element and complex element. As an example summary for ceilings is made.

ELEMENT	COMPLEX ELEMENT	concrete	formworks	reinforcement
ceilings	substructure	326 231,65 zł	103 020,52 zł	143 084,06 zł
ceilings	superstructure	441 890,05 zł	139 544,21 zł	193 811,42 zł

Fig. 8) Exemplary database cross-tab queries. [own source]

In figure 9 exemplary report is presented. Cost summary for certain element (ceiling) in substructure of the building is prepared.

COST SUMMARY - REPORT

COMPLEX ELEMENT substructure

STOREY basement -1

ELEMENT	TYPE OF COSNTRUCTION WORK	CALCULATED COST
ceilings	formworks	51 682,16 zł
ceilings	reinforcement	71 780,78 zł
ceilings	concrete	163 660,18 zł

STOREY basement -2

ELEMENT	TYPE OF COSNTRUCTION WORK	CALCULATED COST
ceilings	reinforcement	71 303,28 zł
ceilings	concrete	162 571,47 zł
ceilings	formworks	51 338,36 zł

Fig. 9) Exemplary database report. [own source]

6 CONCLUSIONS

A database containing detailed information about costs allows to:

- better costs control,
- improvements in the design phase, planning and construction process, as a result of using tools like queries, forms and reports to show cost analysis outputs,
- easy storage of complete information about costs,
- gathering information in one place for easy access.

Using database for storing information in cost analysis process cause than more efficient use of information. Database approach in cost estimation for building objects may prove improvement in storing and managing cost information. Information may be retrieved from database in lots of configurations and presented in different configuration exploiting different criteria. This may simplify and shorten the process of project preparation and cost control.

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BALANCED SCORECARD IN CONSTRUCTION

Dragan Katic[1], Ladislav Bevanda[2]

Abstract

This paper shortly presents a possibility using the balanced scorecard (BSC) in performance measurement system of construction projects. The construction in general has a bad rating due to un-efficient execution of projects. It is proved that BSC is robust tool for implementation strategies and effective measurement of organizational performance. The balanced scorecard (BSC) of construction company represent basis for development (in cascading procces) particularly balanced scorecard at the project's level known as Project scorecard (PSC). PSC is methodology of translating the project goals in criteria success through financial and non-financial indicators. Contribution of PSC application is in efficiency execution construction company strategy through their projects.

Key words

Performance measurement, balanced scorecard, construction projects

1 INTRODUCTION

This paper shortly describes project scorecard to measure the performance of construction projects from the standpoint of construction companies. Traditional performance indicators (time, cost, quality) are not sufficient for balanced view of project success or fail. They are lagging indicators because they constitute results of project execution and do not show drivers performance indicators of construction projects.

Rapid increase in global competition has accentuated the role of continuous performance improvment as a strategic and competitive requirement in many organizations world-wide [1]. Throughout the last two decades a number of industries have introduced new methods and techniques (concurrent engineering, lean production, TQM, etc) to improve their performance. The main driver behind those philosophies is the optimization of an organization's performance both internally and externally within its respective market place. Inevitably, this has led to the rethinking of performance management systems through effective performance measurement [2].

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Organizations traditionally have measured their performance solely in financial terms. This limited approach of measurement the performance success is not sufficient because it show the results of decisions made in paste, have no impact on improving current performance and don't show causes of such results. It is very important to see how to measured organizational performance, as has the impact on market share, so this may be accepted from potential investors, employees and customers. For these, the most important is system that represents balance between financial score and drivers for further performance. At the same time that system beam intangible assets potential and help organizations in enforcement different strategies.

All organizations today create sustainable value from leveraging their intangible assets such as human capital, databases and information systems, high quality processes, customer relationships and brands, innovation capabilities and culture. Because an organization's intangible assets may easily represent more than 75 percent of its value, then its strategy formulation and execution need to explicitly address their mobilization and alignment [3].

The new research's area has developed, whose objectives were to identify the correct number and types of performance measures in ways that are integrated into company strategy. At the beginning of 1990-those years in the development of tools for performance management developed the balanced scorecard (BSC) of the author R. Kaplan and D. Norton, as one of the most important inventions in the field of management. The BSC results in helping organizations work through effective measurement of organizational performance, increase intangible assets and implementation strategies through financial and nonfinancial measures.

BSC methodology is based on identifying key success factors essential for improving business processes. In order to successfully carry out organization strategy to every level of business must understand and act in accordance with it. In order to improve efficiency and construction companies business systems highlights the need to improve the execution of construction projects. It is therefore necessary to develop a performance measurement system of construction projects consistent with the performance measurement system of construction companies system.

2 PERFORMANCE MANAGEMENT IN CONSTRUCTION

Performance management has defined as the use of results performance measurement to achieve a positive change in organization's culture, a business system and processes, set agreed objectives, effectively utilize resources, informed the management about the need for changes strategic goals demand and results could be exchanged in order to stimulate continuous system improvement [4].

The subject of performance measurement is vast and numerous authors continuously add to the body of literature on the subject. Most authors agree that managers measure for two main reasons. Either they want to know where there are and what they have to improve or they want to influence their subordinate's behavior [5]. In 2005 Neely took the surveys about citation analysis of work in the field of performance measurement to explore developments in the field globally. According to this research, through analysis of citation data, it is obviously dominance of Kaplan and Norton and BSC. Between 1991 and 1995 the 10 most frequently cited works are cited 514 times. 56,8 per cent of these 514 citations are work from Norton on the balanced scorecard and that has increased in the last few years (60 per cent of 2002 citations, 58 per cent of citations in 2003 and 59 per cent citations in 2004) [6].

The BSC examines organizational strategy and make it clearer through prism of different perspectives. Measures selected in the BSC represent tool that senior management can use to help employees and external stakeholders by the results and performance drivers that help organizations achieve its mission and strategic goals [7].

The BSC supplemented traditional financial measures with nonfinancial measures that allocated inside three additional perspectives. The BSC allows managers to look at the business from four important perspectives. It provides the answer to four basic questions [8]:

- Customer perspective: How do customers see us?
- Internal business perspective: What must we excel at?
- Innovation and Learning perspective: Can we continue to improve and create value?
- Financial perspective: How do we look to shareholders?

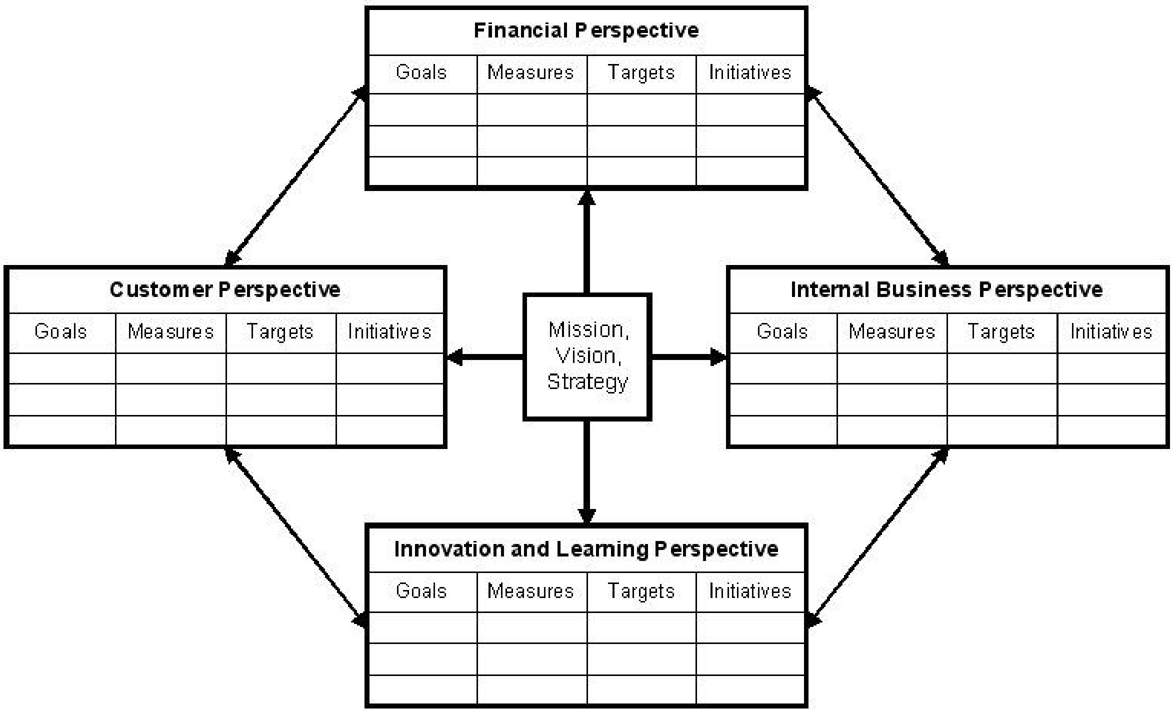

Fig. 1) The BSC Model

The following keywords are most important in the BSC:

- Goals: Briefly statements that describe what must we do in each of four perspectives how to achieve our strategic plan.
- Measures: Indicators that we use for monitoring our success in achievement ours goals.
- Targets: Quantitative values that determine success of measurement.

- Initiatives: What do we have to do get given goals.

The BSC is a framework linking objectives, activities and results in an integrated management process. BSC helps refine the organization's objectives, strategy formulation, plans generation and budgets and the establishment an information system for monitoring and performance management.

The BSC could be extend with new perspective such as projects and suppliers and adapt for construction industry. The main problem of the BSC is finding the optimal model choice of key performance indicators and the inability of benchmarking [9].

In the construction business systems senior management using the BSC to measure performance at the enterprise level. In order to implement the construction companies strategy need to make a cascading BSC at a lower level or project level (the execution level of construction) which defines the measures to monitor the execution of the project.

3 BALANCED SCORECARD IN CONSTRUCTION PROJECTS

In the transformation process of mission, vision and strategy for the construction company as a business system has defined measurable goals are essential for the success of business. Construction business companies implement their activities through construction projects.

Project success is almost the ultimate goal for every project. However, owners, designers, consultants, contractors have their own project objectives and criteria for measuring success. It means different things to different people [10]. Time, cost and quality (iron triangle) are the basic criteria of project performance but they are not enough for balanced view of project performance or success.

The BSC at top level represents the starting point for concerted particularly balanced scorecard at lower organization’s level. The BSC in a construction company at the construction project level (project scorecard - PSC) is a methodology for performance measurement of construction projects. Cascading processes strategically adjust project strategy and business strategy of construction companies through the identification of strategic objectives and measures that departments at lower levels are used to track their development while contributing to the overall objectives. The objectives within the perspectives of PSC describe what we do well if we want to successfully implement its strategy. Selected measures in the PSC arising from the project strategy and the need to support the business strategy of the construction company.

Project scorecard (PSC) is based on technical specification requirements and the requirements related to project management. PSC is a way to manage and implement the project through a set of measurable project’s goals essential to the project success. These measurable goals are determined through a set of key performance indicators (KPIs).

The KPIs are compilations of data measures used to assess the performance of a construction operation. For each set of goal has defined critical success factors with appropriate performance measures (indicators). The set of key performance indicators contain lagging and leading indicators. The leading indicators diagnose current performance and enable forehand corrective actions toward deviation of given target during project execution. Each performance measures need to contain title, purpose, relates to, target, formula, frequency of measurement, frequency of review, who measures, source of data, who owns the measure, what do they do, who acts on the data, what do they do, notes and comments [11].

As the result of processes cascading mission, vision and strategy in the balanced scorecard and after that in project's goals through performance measures or the KPIs is created the project scorecard of construction project shown in the table 1.

Tab. 1) The PSC

PROJECT SCORECARD					
Perspectives and Indicators	**Decription**	**Weight**	**Performance**	**Targets**	**Initiatives**
Financial perspective		W_F			
Indicator IF_1		W_{F1}	P_{F1}		
Indicator IF_2		W_{F2}	P_{F2}		
Indicator IF_n		W_{Fn}	P_{Fn}		
Performance of Financial perspective P_F					
Customer perspective		W_C			
Indicator IC_1		W_{C1}	P_{C1}		
Indicator IC_2		W_{C2}	P_{C2}		
Indicator IC_n		W_{Cn}	P_{Cn}		
Performance of Customer perspective P_C					
Internal Business perspective		W_{IB}			
Indicator IIB_1		W_{IB1}	P_{IB1}		
Indicator IIB_2		W_{IB2}	P_{IB2}		
Indicator IIB_n		W_{IBn}	P_{IBn}		
Performance of Internal Business perspective P_{IB}					
Innovation and Learning perspective		W_{IL}			
Indicator IIL_1		W_{IL1}	P_{IL1}		
Indicator IIL_2		W_{IL2}	P_{IL2}		
Indicator IIL_N		W_{ILn}	P_{ILn}		
Performance of Innovation and Learn. perspective P_{IL}					
Performance of construction project P					

The PSC shows the performance measurement of individual indicators, the the performance of the individual perspectives of the overall performance measurement of the construction project. Weights of each indicator within a perspective depends on the importance of each indicator and its contribution to the implementation of the set design project's strategy.

The choice of weights individual perspectives W_i (W_F, W_C, W_{IB}, W_{IL}) determined in the process of adjusting project strategy with construction company business strategy.

Performance of construction project (P) represents the sum of products of weights and performance of each of the perspectives PSC.

$$P = W_F \times P_F + W_C \times P_C + W_{IB} \times P_{IB} + W_{IL} \times P_{IL} \quad (1)$$

Realized achievement of performance measurement at project level represents input data for performance evaluation at construction company level through the balanced scorecard.

4 CONCLUSION

The aim of this paper was to presents a possibility using the balanced scorecard (BSC) in performance measurement system of construction projects. The project scorecard (PSC) is methodology of translating the project plans and goals in criteria success through performance measures (indicators) in performance measurement system. Performance measurement of construction projects through project scorecard providing efficiency execution construction company strategy through their projects.

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SUSTAINABLE CITY

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Abstract

The world's climate is changing. The scientific evidence is incontrovertible: most of this change is due to human activity, and the process is speeding up as more and more carbon dioxide, methane and other greenhouse gases are pumped into the atmosphere.

The next decades are critical. Carbon dioxide emissions must be cut rapidly. If they are, according to the Intergovernmental Panel on Climate Change, we may limit the rise in global temperatures to two degrees centigrade. This could trigger mass extinction of many plants and animals, a complete loss of ice sheets, rising sea levels and significantly altered weather patterns. There is no luxury of time.

As more and more of the world's population crowds into cities, the urban environment needs to become a better place to live: a place that improves health, well-being and economic prosperity while simultaneously and dramatically reducing greenhouse gas emissions. The Plans are about more than protecting the environment; they also provide maintenance or better level of services with reduced resources and budgets; help citizens save money and increase the quality of life.

Sustainable development means that contractors, designers and real estate developers aim to create buildings and communities that minimize the depletion of natural resources and use renewable resources so as not to compromise for future generations. Sustainable development practices emphasize efficient use of resources such as energy, water and building materials. The practice addresses building sitting, design, construction practices, construction materials, operation, maintenance and removal. It also includes an emphasis on renewable resources generated from sustainable sources, including solar power, hydroelectricity, wind generators and harnessing the earth's geothermal sources to generate energy. A sustainable city is one that practices sustainable methods and works with citizens and neighboring communities to integrate sustainable practices into daily life.

Key words

climate change, environment, sustainable city, sustainable development, urban form.

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1 INTRODUCTION

A Viable Alternative Sustainability is an old term that has appeared in many guises from time immemorial. Whenever communities of human beings have approached the earth, their built environment, and social relations with a sense of reverence, the foundations of sustainability have surfaced and woven nature and community into a whole cloth through the loom of sustainability.

Sustainability means meeting today's needs without compromising the ability of future generations to meet their own needs. A sustainable development is a development whose patterns of production and consumption can be reproduced indefinitely without doing irreparable damage to essential natural ecosystems. Sustainable development is achieved through adhering to the triple bottom line; environment, economy and social equity.

A sustainable city, or eco-city is a city designed with consideration of environmental impact, inhabited by people dedicated to minimization of required inputs of energy, water and food, and waste output of heat, air pollution - CO_2, methane, and water pollution (Register ,1987).

2 THE CLIMATE CHANGE AND CITIES

For towns and cities to be economically competitive, socially progressive and environmentally responsible, they must reduce their inefficient use of finite resources. Every place can become better by (Brown,2009):

Understanding and nurturing its unique qualities as the basis of its response to a changing climate

Each town and city is different, shaped by the geography of the place itself, the passage of time and the people who live there. The best solutions for one place may not suit another. It is therefore essential to understand what physically shapes your town or city the land, water and wind and how that can contribute towards resilience, for instance to extremes of weather.

Using the planning system to target interventions at the most appropriate scale

Good spatial planning should shape our urban environment. It allows us to respond to complex needs at the most appropriate scale whether regional, city or neighborhood. The planning system has struggled to distribute activities in a sustainable way.

Forging a new city vision and infrastructure through civic leadership and collective action

Creating sustainable places will require the public, private and voluntary sectors to collaborate effectively. Reliance on the market to deliver essentials, even banking or housing, has evident shortcomings. What is needed is a new market model which endures over the long term because it delivers sustained value.

Knowing your starting point, setting targets, and celebrating progress

At the heart of the challenge is a requirement to reduce the ecological footprint of our towns and cities. A reliable baseline is essential. City-wide consumption of all natural and man-made resources should then follow the rule of the four Rs: reduce; re-use; recycle and recover.

Leaders who can think long term

Climate change needs leaders in the public sector who act as stewards of the city's environmental resources, and champion quality of design and quality of place.

Working across administrative boundaries

Climate change has wide-ranging environmental, social and economic impacts. It cares nothing for administrative boundaries or professional disciplines. Each priority fits into a single strategic to make a place where people want to live their lives, bring up their children, and feel part of a prosperous and healthy community:

- Energy – reducing carbon emissions and ensuring security of supply.
- Making buildings more comfortable, safer and cheaper to run.
- Making streets fit for people.
- Rethinking waste.
- Planning for a shortage or excess of water.
- Moderating the heat island.
- Making green spaces work for people and wildlife.

3 ECO CITY

Eco City is a secured and gated complex, with the internal roads 80 feet wide, there are naturally shaded walkways and biking zone as well. The place has green, clean and pollution-free and garbage-free zones, separated by multiple-use tracks, having loads of oxygen generating zones, and low-density housing only adds up to its charm.

The ecological cities are achieved through various means, such as:

- Different agricultural systems such as agricultural plots within the city (suburbs or centre).
- Renewable energy sources, such as wind turbines, solar panels, or bio-gas created from sewage. Cities provide economies of scale that make such energy sources viable.
- Various methods to reduce the need for air conditioning (a massive energy demand), such as planting trees and lightening surface colors, natural ventilation systems, an increase in water features, and green spaces equaling.
- Improved public transport and an increase in pedestrianization to reduce car emissions.

- Optimal building density to make public transport viable but avoid the creation of urban heat islands.
- Solutions to decrease urban sprawl, by seeking new ways of allowing people to live closer to the workspace.

4 URBAN FORM

There has been a considerable amount of research that defines and characterizes the form of the sustainable city, and which urban forms may most affect sustainability. The physical dimensions of urban form may include its size, shape, land uses, configuration and distribution of open space , a composite of a multitude of characteristics, including a city's transportation system and urban design features (Llewelyn-Davies, 2000).

This internal physical spatial structure is mirrored by the housing tenure and demographic patterns. Younger people with few children live primarily in the higher density inner areas while older households and families are predominantly in low density suburban areas. Private rented housing is focused in the inner areas and outer rings are often mainly owner occupied.

4.1 Environmental Sustainability

Environmental benefits are claimed to accrue from more compact urban forms where concentration of uses means less need to travel and therefore lower emissions from vehicles (see Transport below). In addition, claims about higher densities suggest benefits in energy savings through combined heat and power (CHP) provision, but that benefits might be outweighed by the loss of open space. In assessing aspects of environmental sustainability the research focused on the different patterns of provision of open, and especially green, space (Jenks , 2010).

The environmental benefits of open green spaces include: reduced surface and air temperatures, due to solar shading, free radiation to the night sky from trees leading to improved summertime thermal comfort (Vu et al., 1998).

4.2 Elements of Urban Form

The term 'urban form' can be used simply to describe a city's physical characteristics. At the broad city or regional scale, urban form has been defined as the spatial configuration of fixed elements (Anderson et al., 1996). Features of urban form at this scale would include urban settlement type, such as a market town, central business district or suburbs. However, urban form is closely related to scale and has been described as the 'morphological attributes of an urban area at all scales' (Williams et al., 2000).

The elements of urban form have been identified on the basis that they are claimed to influence sustainability and human behavior. They are considered in more detail below. These elements relate to developed, and not developing, countries (Dempsey & et al , 2010).

4.3 Density

Density is a deceptively complex concept with a number of inter-related dimensions. While it may provide an objective, spatially-based, measure of the number of people (living) in a given area, it is also assessed subjectively; it is a social interpretation dependent on individual characteristics and so may differ from resident to resident .Density is also closely associated with other elements of urban form, such as land use and access to services (Churchman, 1999).

4.4 Land Use

Broadly speaking, the term land use is used to describe the different functions of the environment. Within the urban context, the dominant land use tends to be residential but a functional urban area requires industrial, retail, offices, infrastructure and other uses. The spatial (micro) pattern of land uses is crucial to the arguments about the efficiency of a city and potential 'sustainable' urban forms in influencing urban travel patterns and the quality of life, for example through the existence of green space. There are also certain 'locally-unwanted land uses' such as prisons, airports, or landfill sites claimed to be undesirable in residential mixed-use(Grant, 2002).

4.5 Accessibility and Transport Infrastructure

Transport infrastructure is closely associated with accessibility as it determines the ease with which buildings, spaces and places can be reached. The level of accessibility describes the area residents and users are able to reach, as well as the extent to which they have the means to access places, services and facilities that are outside their local area (Talen, 2003).

It is closely linked to land use and layout: the services, facilities, open space, how they are arranged within a city or neighborhood and the means of getting to them all contribute to how accessible a place or service might be described.

4.6 Urban Layout

Layout describes the spatial arrangement and configuration of elements of streets, blocks and buildings, often referred to as the street scale, such as grid or tree-like (cul-de-sac) street patterns. Layout has an important influence on pedestrian movement and the way in which different places and spaces are connected to each other (ODPM, 2005).

4.7 Housing and Building Characteristics

The characteristics of housing and other buildings in urban settlements can have an important bearing on everyday living: it has already been noted that residents living in low-density detached dwellings with large gardens will have a distinct experience of the urban environment from high-rise city centre apartment dwellers.

However, the influence of building characteristics extends beyond the density of urban living. Factors such as building type, height and age may have an effect on a number of issues. These might include a building's orientation and exposure to sunlight and daylight (Mardaljevic, 2005)

5 CONCLUSIONS

Global movement toward sustainable development, as every region in the world faces the need to protect and enhance its natural resources and ecological life support systems so that future generations can continue to meet their needs.

The two-part strategy involves: first, making sustainability an overarching concept, integrated into all City activities, programs and functions by creating a cross-departmental Office of Sustainable Development with an overarching guiding principal on sustainability. Second, establishing a set of implementation plans to: (a) green the City's own buildings and operations; (b) promote private sector energy efficiency, renewable energy and green building; and (c) facilitate green partner organization programs, educate; and communicate.

A sensitive management of urban intensification that is targeted on key urban areas, especially related to accessible public transport. It means that where higher densities are achieved, the management and incorporation of both public and private green space needs to be maintained, perhaps through green corridors and smaller, but useable private gardens. It suggests that, where family homes are to be built, forms need to be designed to discourage urban sprawl at the same time as fulfilling family aspirations, and some of the medium density schemes illustrated.

The influences on the elements of urban form are argued to be the outcome of the operation of real estate markets within a framework set by a city's transport infrastructure and moderated by local planning policies. They reflect a myriad of private choices, whether by individual households seeking a home (balancing affordability and access against a wish for more space) or by developers looking at the optimal mix for developments within constraints set by planning.

However, these decisions also have pervasive external or 'public' effects: each new development changes the outlook for existing residents, reduces or changes green space, increases congestion, and has consequences for urban sustainability. There are inevitably contrasts between the private and public perspective on urban form that planning policy has to manage.

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FINANCING AND EFFECTIVENESS OF INNOVATIVE PROCESS

Gabriela Kocourková[1]

Abstract

Innovations are lately much discussed theme, because without innovations the economy will not be able to compete to the foreign production. With regard to the situation where investments into the research, the development and innovations are mostly very risk, there are not many people or companies interested in the financing of innovative research projects. The innovation in enterprises and also the whole national economy spend lots of money. And so it is important to determine whether these funds are spent effectively and efficiently.

Key words

Innovation, success of innovation, evaluation

1 INTRODUCTION

The innovation and creativity are in the recent years discussed a lot and not just in business circles, but also at Government and European Union. It is natural, becouse the business, which is not based on innovation, has a little chance of success. This, of course, aware of the government and seeks to promote innovation in business.

What it actually is innovation? This concept has undergone a long historical development. It first began using the JA Schumpeter, who developed the theory of innovation. He was followed by other authors, for example, PF Drucker, F. Valenta, M. Svejda. According to experts, the innovations she defined as follows:

- Innovation is a series of scientific, technical, organizational, financial, trade and other activities aimed at creation of new or significantly improved products (goods, services or technology) effectively placed on the market. Research and development is one of the following activities. [1]
- Innovation is a renewal and extension of the range of products and services and related markets, creating new methods of production, supply and distribution, introduction of change management, work organization, working conditions and workforce skills. [2]

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- Innovation is the change and innovations, such as the introduction of scientific and technological progress, new kinds of products. As a result, innovation leads to savings in labour and natural resources. Innovations are divided into product innovation (product) - is about 70% of all innovation, technological innovation - about 28%, material innovation - about 2%. [3]

2 SOURCES FOR INNOVATION FINANCING

Investment in R & D and innovation are characterized wih high levels of risk and uncertainty, which reduces the possible number of people interested in funding innovative research projects. They are usually dealt with issues of funding research and development specifically and separately the issue of financing the introduction of research results into practice. This approach is reflected in the Czech legislation, where the basic legal standard - the law č.130/2002 Coll. Research and development support from public funds is addressed only the issue of promoting research and development.

According to EU recommendations from Barcelona in 2010 should be issued in the share of R & D 2% of GDP. Businesses in developed countries, the EU and the U.S. Currently they are releasing 3-5% of turnover. Unlike the Czech companies have much smaller percentage (0.5 - 1%). That does not guarantee that we will fulfil Barcelona's recommendations [1].

Picture of the main sources of funding gives the following picture:

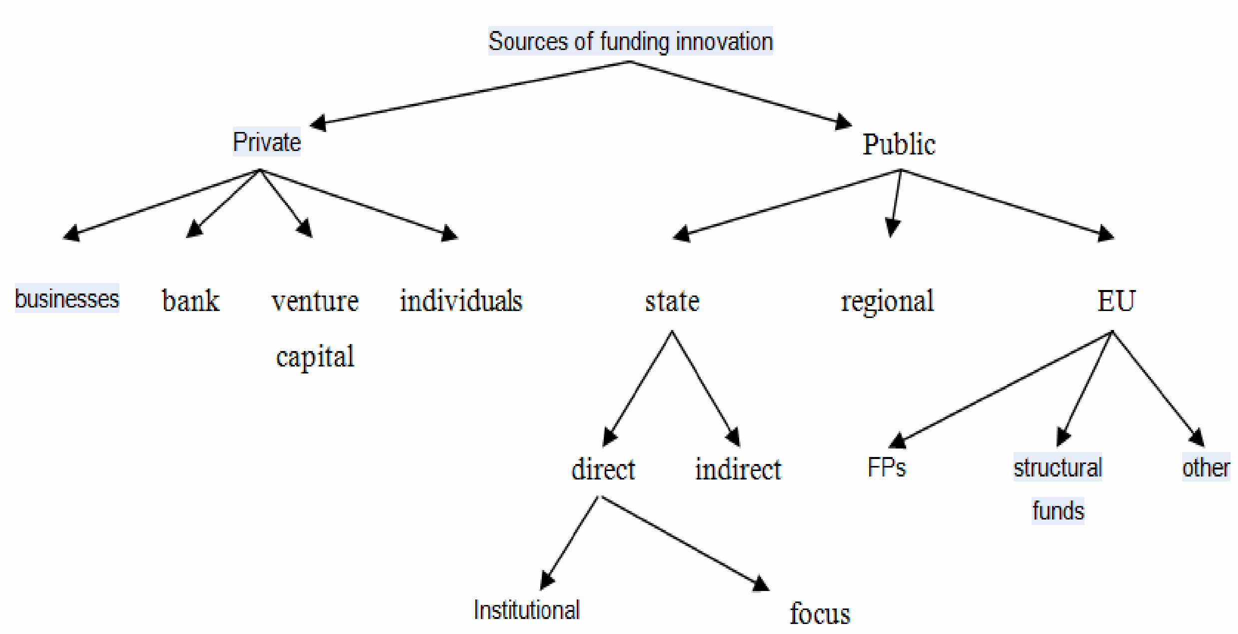


Fig. 2) Main sources of funding

3 INNOVATION AS AN INVESTMENT

Innovation in enterprises, but also the whole national economy, spends lots of money. And so it is important to determine whether these funds are spent effectively and efficiently. Whether it leads to new knowledge or new knowledge that led to new technologies, products, or to reduce costs. It is necessary to determine what economic benefits are brought with new products and in what proportion are these benefits to cost.

In most important manufacturing sectors is for purposes of research and development spent 4-10 % of turnover, and in low-tech industries this percentage is even higher. [1] With the implementation of innovations are related other costs, therefore, there are determined as an indicator of the overall cost of innovation, which, depending on the sector, amounts to 10-20% of turnover.

Detection efficiency of innovation is similar to the detection efficiency of investment. Result is shown after a certain period. Just for innovation is much different.

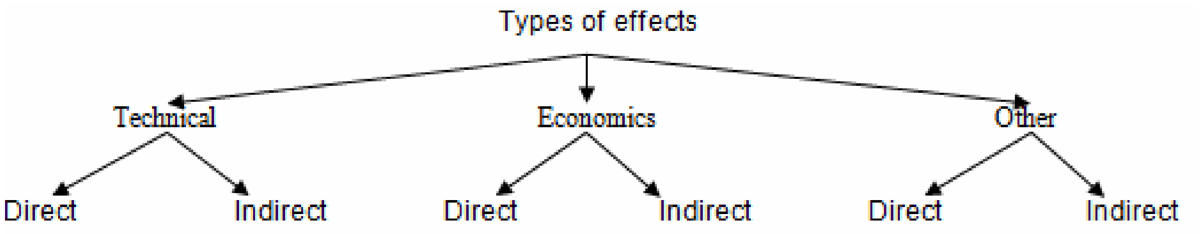
The biggest difference is mainly in the fact that innovation to the production of a prototype is intangible. While such may be protected by a patent or trademark, but the risk is much greater than for investment. Especially in basic research and development may not be entirely clear if it ever will have any practical use. Therefore, the failure can not be understood as a total failure, but just one of the resulting opportunities. Based on the research it is indicated that only about half of the projects aimed to promote new products to market. 46 % of the expenditure is invested in unprofitable projects. Even greater is the loss of selection of ideas for new products, which of the seven themes to promote the further development of only one. From the projects that have gone through stages of development, one third of them will fail in the marketing [1].

The problem with measuring of the effectiveness of innovation is also mainly due to complicated relating of costs and effects for a specific project. Innovative project is not always precise and clearly defined and time determined. Especially in the beginning when it is realized the selection of ideas for innovation. According to research experts is a major problem in the company to separate accurately the specific innovation activities from other activities within the company and even if you succeed, companies are not always able to quantify the costs from the early stages. According to specific research is so clearly define the cost of doing only about 13% of the projects.

The same problem is also quantification of the profit from each innovation. Experience in the USA shows that less than half of the firms was able to quantify the contribution of individual products for the profit creation. It appears that the credibility and the ability to quantify the benefits are directly dependent on the depth of their investment. In the case of evolutionary innovation, the costs and revenues reliably detect total, the revolutionary technology it is almost impossible.

4 METHODOLOGICAL APPROACH TO ESTABLISHING SUCCESSFUL INNOVATION

In assessing innovation it is necessary to choose the kind of criteria by which innovation will be judged. It is recommended to use this division: technical, economic and other effects. By evaluating each of the criteria of innovation, we can assess the overall success of the investment.



For direct technical criteria they are used for measuring the specific technical parameters (energy intensity, fuel consumption, air resistance). Among the indirect we can include: improving collaboration, gaining experience, understanding of vulnerabilities. Whether these effects actually contribute to increased efficiency, it appears in the progress of other projects.

As the most important direct economic effects they are considered the quantification of the profit or gross margin gross margin. The assessment of these indicators, especially in the initial stage, is very difficult or not possible at all. In these cases it is possible to detect such an indicator of turnover or market share. So we assume that if the product is well received by the market, it has a chance to become effective and in terms of profitability. The assessment of these indicators is used in the product innovation. In process innovation we try to determine, whether there was such as to reduce costs by increasing quality and reducing scrap. An indirect effect can be seen the impact on competition - limiting the market share of competitors or increase their costs.

Other effects can be divided into systemic or individual. Among the system can include for example the impact of innovation on the environment or to achieve certain humanitarian objectives. Individual effects are meant primarily to achieve scientific recognition, gaining the prestigious and self-actualization.

In assessing of the effectiveness is also important to choose the correct criteria due to the time when we pursue innovation. Determination of profitability or market share is made possible after a new product on the market or the use of new technology in practice. And so the question is how many years after deployment. The closer we are at the beginning of the innovation process, the greater will be the criteria rather technical.

Another problem is with what we found our data to compare. Either we can compare the current situation and alternative innovation, both their own and from competitors, or compare the results with predetermined objectives. This of course assumes that they were realistic and sufficiently ambitious.

Not always we are able in a particular project to see exactly all costs and revenues. Therefore, such projects are assessed using checklists, or other evaluating system. This means to evaluate such systems using variety answers, which can be answered or in the concrete way evaluated. Regarding that innovation processes are very diverse the valuation can not be uniform.

In the most of these checklists it concerns about the effort to evaluate, using to form of questions, hope to innovation effectiveness, at the stage of their preparation for taking decisions on innovation. Well, actually, rather than efficiency investments detect whether innovation has a chance to be successful.

Assessment of the content of individual factors and their valuation is primarily a matter for further research. Individual evaluating systems are only specific instructions, how to build a system for a particular innovation process so that most accurately could approach the success of investments.

5 CONCLUSIONS

As the previous pages shows the effectiveness of finding funding invested in innovation is usually very complex and not always easy to manage it. Quantifying benefits is often impossible due to the inability to quantify all the costs associated with innovation. The result will often show up after a certain time and there is great risk that the invested funds do not return back at all.

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ECONOMIC EFFICIENCY OF FLOOD MEASURES

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Abstract

The paper is engaged in assessment of economic efficiency and financial feasibility of investments in the area of the flood protection. Realization of flood measures or potential liquidation of damages after the flood is very capital intensive. The decision about realization of anti-flood arrangements should be consider also in the frame of the wide context of public investments and general social utility. Efficiency of the investments into the flood protection arrangements it is necessary to research from sight of the values of potential flood damages, costs of the various types of the flood protection and also the value of general social benefits.

Key words

Flood Measures, Efficiency, Benefits, Cost Benefit Analysis

1 INTRODUCTION

In the past years, the Czech Republic has been afflicted by floods which have caused damage of millions including casualties every year. Damage caused by flooding this year has exceeded CZK 8 billion. Floods have been recorded in the Czech territory since the beginning of the 12th century. In the 20th century, with the exception of 1903 in Silesia, the Czech territory was not afflicted by larger floods. Therefore, larger interventions in the landscape started, areas that had been free for centuries due to repeated disasters were developed, watercourses were regulated and forests retaining water disappeared from the surroundings of water courses.

In 1997, after decades of peace, a large part of the territory was damaged by flooding caused by continuous rains. Damage was caused mainly in the basins of the rivers Morava and Dyje. Continuous precipitations in the summer of 2002 raised river levels; water flooded the capital city and a major part of central Bohemia.

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Floods in the Czech Republic are currently more devastating than before. Our ancestors counted on floods more than us and built their constructions in such a way that water damaged residential and linear constructions as little as possible. For example, on railways, tracks were always built on embankments at such elevations where, by their experience, water did not reach. However, in the 20th century, development extended. In the places of former fields there are buildings now. Waterways are concreted; water has no place to discharge, so it flows lower to residential areas where it then causes large damage.

Therefore, all regions must consider investments in flood measures which should, within technical and financial capabilities, prevent watercourses particularly from further spreading during floods.

2 AREA PROTECTION AGAINST FLOODS

The issue of area protection against floods can be found, for example, in the building law, in which Section 18 says: "The aim of land-use planning is to create conditions for building development and for the sustainable development of the area consisting in a balanced relationship of conditions for the favorable environment, for economic development and for cohesion of the area community, and in satisfying the needs of the present generations without threatening the living conditions of future generations." [1]

The aim of land-use planning is also to create conditions for reducing dangers of ecological and natural disasters and for elimination of their consequences.

The land-use plan in selected areas and corridors may place a duty to check changes in their utilization by a territorial study or acquiring a settlement plan as the condition for decision making on changes in the territory; in such case, it sets conditions for its acquisition and for its issue which are the settlement plan specifications. [3]

Section 61 of the building law [1] states that the settlement plan determines conditions for public utility constructions or public utility measures. The settlement plan may replace the plan of common installations of complex land improvements according to a special legal regulation.

2.1 Land Improvements

At land improvements, lands are arranged spatially and functionally, they are integrated or divided and they provide accessibility and utilization of lands and arrangement of their borders so that conditions are created for rational management of the land owners. In these connections, ownership rights and related easements are arranged. At the same time, conditions are provided for improving the environment, protecting and improving land resources, for water management and improving the ecological stability of landscape. [2]

Land improvements can be summarized in several basic goals:

- Soil protection from erosion,
- Ecological stability,
- Cart-road network,
- Water management measures.

Land improvements are becoming the most important tool for defending interests of landscape creation and protection. It means that from the view of the solved issue they are very important. From the financial point of view it is important that a substantial part of the costs for the entire land improvement process is taken by the state.

2.2 Flood Measures

It is very important that the territory is protected by flood measures which, in the case of a disaster, prevent great property damage from occurring. These measures can include [4]:

- Construction and restoration of polders, reservoirs and dams, provision of their operation, maintenance and repairs,
- Increasing the flow rate of watercourses, provision of the operation, maintenance and repairs of related facilities or equipment,
- Working out a proposal for determining flooded areas and for determining areas threatened by extraordinary floods,
- Working out studies of drainage conditions including provision of the necessary data, details and models,
- Restoration and increase in the accumulation capacities of fishponds,
- Increasing the flood flow rate of the territory by lowering the ground level in the vicinity of watercourses to the form close to landscape,
- Constructions of flood land-guards to increase the capacity of river beds in the manner close to landscape in the currently built up communities,
- Increasing the flow rate of channels,
- Construction of coffer-dams,
- Construction of release channels,
- Revitalization of watercourses with an emphasis on their flood protection function,
- Removal of silted up objects which worsen the drainage conditions or can clog the flow profile.

3 EFFICIENCY OF FLOOD MEASURES

A Cost Benefit Analysis (CBA) can be used to assess the economic efficiency of investment projects of the flood-measure character. CBA works with monetarily evaluated benefits and costs which, in relation to the project implementation, occur in the entire life cycle of the flood measure project. Within flood measures, the benefit is defined particularly as a prevention of damage on both immovable and movable assets and a loss for people in the area potentially afflicted by flooding. Costs are represented by investment costs for flood measure acquisition (e.g. costs for project documentation, tenders, construction and technological parts of project), and also costs for operation and maintenance, reconstructions and modernizations during the operating stage of its life cycle.

The amount of damage on immovable assets in the territory depending on the technical parameters of the potential flood can be quantified based on the methodology and database of damage curves shown, for example, in literature [5], [6]. With an assumption that such quantified damage does not happen with a certain probability during the flood measure implementation, this value can be understood as one of the project benefits. Prevention of damage on movable assets, human health and lives can be stated in the same way. Other benefits will be all activities that can be carried out in the territory thanks to a safer space.

Decision making on the efficiency of implementation of a proposed flood measure can be supported by the project economic efficiency indicator – Economic Net Present Value (ENPV), which can be determined based on the following relation:

$$ENPV = \sum_{i=0}^{n} \frac{1}{(1+r)^i} \left[\sum_{j=1}^{u} B_{ij}^I \times p_{ij} - \sum_{k=1}^{v} C_{ik}^I \right] \tag{1}$$

where:

ENPV is Economic Net Present Value, B_{ij} is j^{th} benefit in the i^{th} period of time, p is benefit occurrence probability (damage prevention) in the i^{th} period of time, C_{ik} is k^{th} costs in the i^{th} period of time, r is discount rate, n is length of project evaluation period (in years), u is number of benefits identified in the flood measure solution, v is number of costs identified in the flood measure solution

4 CONCLUSION

Determination of the economic efficiency value is important data for decision making on the concept, scope and possible implementation of a flood measure. It is very important to examine the process in the entire life cycle of construction work that becomes a flood protection. From the view of economic consideration, it is also necessary to work with the time value of money, to model the entire process in the whole period of the flood measure life and also to consider that for its quality utilization the construction work must be always kept in good condition.

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RISK MANAGEMENT IN THE PRE-INVESTMENT PHASE OF THE STRUCTURAL PROJECT

Jana Korytárová[1], Pavel Stehno[2]

Abstract

The paper deals with the process of risk management in the pre-investment phase of the structural projects life cycle. Each structural project is being implemented under different conditions and includes also other dangerous places, but generally it is possible to say that all construction projects face some common risks. The paper describes two main steps of work with risk in the structural projects area, the risk analysis and risk management. Risk analysis contains risk identification and monitoring, determination of the significance of the impact of risk and risk measurement. Risk management consists risk assessment and decision making about risk and preparation and implementation of risk reduction.

Key words

Risk Classification, Risk Management, Monte Carlo Simulation,

1 INTRODUCTION

Risk management represents a systematic and coordinated method of working with risk and uncertainty applied within the entire project of building construction. The risk management process can be divided to the following phases: risk identification and monitoring; determination of the risk significance; risk measurement; risk evaluation and decision making on risk; and preparation and implementation of risk reduction measures.

Each construction project is implemented under different conditions and so it contains different points of risk. Despite this it can be said that all construction projects face some common risks. By their material content, construction project risks can be divided to external and internal risks. Specification of these general categories is shown in Table 1.

In their parts of the research project the authors of the paper focused on the methods of risk measurement in the pre-investment phase of a construction project. Risk can be expressed by statistic characteristics of the selected criterion which are, for example, variance, standard deviation or the coefficient of variation.

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Risk measurement can be supported significantly by Monte Carlo simulation. The Monte Carlo method enables to test the impact of multiple input variables on the project effectiveness taking into account also their mutual dependence (correlation). Input variables are entered into the model with the appropriate probability distribution following analogical experience from other tested projects or historical data.

Tab. 1) Classification of construction project risks by material content [1]

EXTERNAL SOURCES OF RISK IN PROJECTS				
LEGAL	POLITICAL	ECONOMIC	SOCIAL	NATURAL
Local regulations Permits, approvals Changes in law Standards	Change in politics Elections War Treaties	Economic politics Prices, taxes Financing conditions Currency value	Education, culture Seasonal work Strikes Fluctuation in population	Climate Foundation Fires Earthquakes Floods
INTERNAL SOURCES OF RISK IN PROJECTS				
MANAGEMENT	PROJECT DOCUMENTS	PEOPLE FACTOR	SUPPLY AND LOGISTICS	CONTRACTS
Unrealistic goals Poor control Technology Organization	Superficiality Inaccuracy Incompleteness Updated documents	Productivity Illness Motivation Errors	Shortages Availability Reliability of equip. Insufficient workers	Type of contract Short time frames Unrealistic prices Party relations

2 CASE STUDY

This paper presents an example of a profit analysis of a multifunctional building with a concert hall. The basic function of the building will be a multifunctional concert and congress hall with a capacity of 1,500 people with the appropriate technical and operating facilities, and large-scale parking garages built on underground storeys. The remaining structure capacity will be used for commercial, service and administrative facilities including social areas usable as congress lounges. The internal block will be ended with a public garden.

The basic data to achieve the value of economic effectiveness indicators is the value of profit before tax. For this reason, the model Monte Carlo simulation is focused on this particular output. In the evaluated project, the following variables were selected to be the most risky:

- estimated commercial exploitation of the concert hall – variable P;
- estimated utilization of parking places – variable K.

For simulation, both variables are defined by normal statistic distribution with the mean value and standard deviation parameters.

The aim of simulation was to find out the probability of achieving the estimated profit in the first year of the project operation and to find out the amount of a possible loss.

The basic equation for the Monte Carlo simulation in the Crystal Ball program was defined by the following relation [3]:

$$Z = (C_1 \times Q_1 \times K) + (C_2 \times Q_2 \times P) + V_O - Var - Fix$$

Where: C_1 is the average price for 1 parking place; *Q1* is the number of places x number of days in year; *K* is the estimated daily occupancy rate of parking places; C_2 is the price for lease of the large concert hall; Q_2 is the designed area; *P* is the estimated exploitation of the concert hall P;

V_O is other designed revenues; *Var* is variable costs (operating + staff costs); *Fix* is fixed costs (depreciation); *Z* is profit.

The following Fig. 1 represents the probability distribution of profit in the model project; Table 1 shows estimated values of risk parameters.

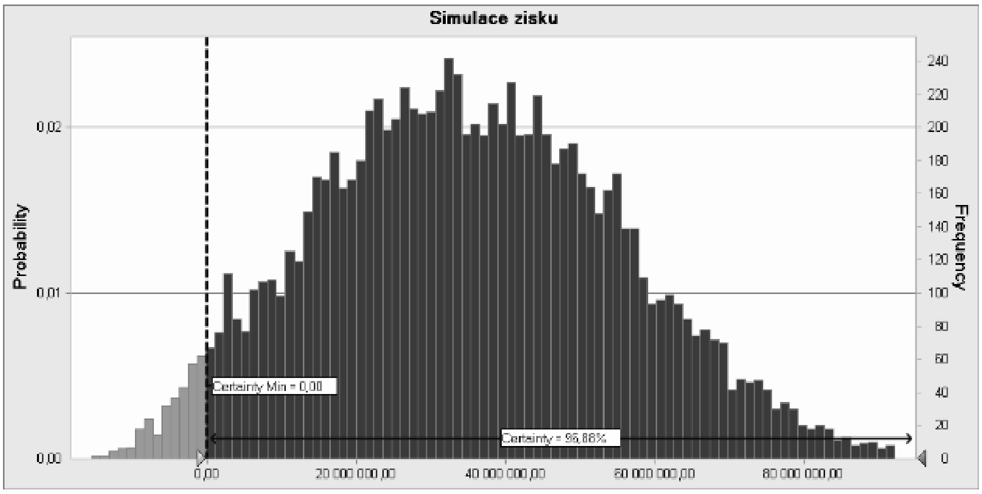

Fig. 1) *Probability distribution of the investment project profit*

Notice: Simulace zisku means Profit simulation

Tab. 1) *Estimated value of risk parameters*

Statistic	Forecast values
Base Case	33,608,059.87
Mean	35,378,227.36
Median	34,552,509.42
Mode	---
Standard Deviation	20,277,700.49
Skewness	0.2160

Kurtosis	2.72
Coeff. of Variability	0.5732
Minimum	-15,475,850.82
Maximum	115,280,601.31
Range Width	130,756,452.13
Mean Std. Error	202,777.00

The above-mentioned simulation indicates that the expected profit value in the first year of the project operation, while following the entered criteria variables (Mean), is CZK 35,378,000, the risk size represented by Standard Deviation is CZK 20,277,000.

The simulation outputs show that the project can be considered relatively risky. Profit may range from a loss of CZK –15,475,000 up to a profit of CZK 115,280,000.

The results further show a high probability of achieving the turning point value (i.e. balance of revenues with costs or revenues exceeding costs = profit) at the value of 96.88%. The probability of achieving a loss is 3.12% (1 - p = 1 – 0.9688).

3 CONCLUSION

The Monte Carlo method extends risk analyses with another dimension – simulation. The analysis output is not only the point estimate of profit, but also its probability distribution which provides a much comprehensive view of the project risk level.

In conclusion, it can be stated that the evaluation of the economic effectiveness of investment projects represents a varied range of techniques, methodical instructions and possible views. It is on the investor's or the financial resources provider's consideration what outputs and in what structure they will require. We think, however, that simulation methods will be one of the directions which this economic sector will follow in future.

Acknowledgments

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FORECASTING BUILDING PERMITS FOR HOUSING: THE AUSTRIAN CASE

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Abstract

Accurate forecasts of building permits are a valuable instrument for housing policy makers and economic forecasters as housing permits are a leading indicator for the construction industry and thus for the whole economy. Most of the forecasting literature on housing focuses on housing starts relying on the close link to actual building activity. Given that the link to building permits is nearly as tight, the lack of Austrian housing starts data comes as an advantage: The forecast lead to other indicators can be expanded exploiting the time lag between permit issuance and actual start. Following the Box-Jenkins approach to forecast Austrian building permits, an AR(1)-model with population and real income growth has the best model fit and yields good forecast accuracy for up to two years.

Keywords

Forecasting, Housing, Building permits, Construction;

1 INTRODUCTION

Building permits are an important leading indicator for new housing construction activity. Additionally, housing policy makers can base their decisions concerning a wide range of policy goals (availability, affordability, quality) on the development of building permits. So far, most of the relevant literature is concerned with forecasting housing starts (even though permits have an even longer lead) with structural econometric and time-series models. It seems that simple time-series models based upon the Box-Jenkins approach forecast similarly accurately as full structural models. In this paper, the advantages of both model types are combined: Instead of setting up a structural model for Austria, we enhance a simple ARIMA (auto-regressive-integrated-moving-average) model with explanatory variables (such as demographic, financing or labor market conditions). Concerning model fit and forecast accuracy, the enhanced ARMAX model with an auto-regressive term is more suitable than a simple ARIMA model for forecasts of building permits up to two years in advance.

A brief review of the literature (chapter 2) is followed by a discussion of how the Box-Jenkins ARIMA approach can be applied to the Austrian housing market between 1970 and 2009

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(chapter 3). The data used are described in chapter 4, results are shown in chapter 5. A summary and conclusions can be found in chapter 6.

2 LITERATURE REVIEW

An abundant literature on forecasting housing markets is available, which supports the importance of housing as leading indicator of overall economic performance. Reviewing some of the housing forecasting literature, Hendershott and Weicher (2002) stress the importance of housing finance (instruments and institutions), inflation and government policy and demographics as most obvious driving factors of housing demand and supply. They also contest how difficult it is to forecast all these explanatory variables to generate accurate housing forecasts in structural models. This is why many authors apply time-series forecasts next to structural models.

Puri and van Lierop (1988) consider credit market conditions, prices, demography and public housing policy in their multi-equation stock-flow model of housing starts, but find that these models are generally biased and outperformed by ARIMA models except for one-period ahead forecasts. They see the advantage of structural models in the ability of the forecaster to provide judgmental adjustments. Demers (2005) also compares forecasts by a structural model and leading indicator models for housing investment and finds that time series models based on permits or starts slightly outperform the structural model in the short-run. In the long run, the structural model is preferred, where he considers house prices, age distribution, wealth, and labor and credit market indicators as particularly important. Fan et al. (2010) also compare a structural model (taking population structure, income and savings, financial market information, home prices, and labor markets into account) to a Box-Jenkins time series approach for construction output. They find that the time-series model yields accurate forecasts for up to 10 quarters in the residential sector even in times of economic upheaval, but does not fully capture peaks and troughs. In a time-series approach, Weber and Devaney (1996) incorporate consumer sentiments successfully to improve housing forecasts for single-unit housing as there appears to be a rather long (9 months) lead structure between housing start and confidence. Thomas and Stekler (1979) also forecast single-unit housing in a pooled regional dataset and consider migration, age structure, interest rates, income and existing stock as important impact factors for housing starts. In contrast, Fullerton et al. (2001) find it hard to forecast single-family housing on a regional scale, but ARIMA models outperform structural models for multi-family housing. Generally speaking, it might not necessarily be the type of housing (single vs. multiple) that is relevant, but housing markets might have different influence factors dependent on whether housing is owner-occupied or for rental use as suggested e.g. by Puri van Lierop (1988) or by Crone and Mills (1991), who find that the age distribution is especially useful in predicting owner-occupied housing stock and starts. However, this information is difficult to obtain for permits.

Last but not least it should be noted that most of the housing literature sets a focus on housing starts, some of the literature also take other housing indicators under consideration. Coulson (1999) supports the view that housing completion more accurately represents the actual housing supply, but his interest is housing market fluctuations rather than forecasting. For the UK, Tsoukis and Westaway (1994) find that given the lag between housing start and completion, not just the current (house) prices and costs, but also expectations are important for housing supply. Generally, they find that the proportion of started, but never completed housing remained constant over the period of 1970-1990. This is in line with the results of

Somerville (2001), who also contests that most permitted housing plans are actually realized and that permit to completion times is longer for multi-family homes. In forecasting, permits are only considered by Demers (2005), who recognizes that it has an additional lead of at least 3 months (more in multi-family housing) to actual construction and overall economic activity.

3 MODEL AND METHOD - THE BOX-JENKINS APPROACH

Relating to the aforementioned housing market concepts and the additional lead of permits to construction activity, I develop a time-series model also considering factors identified by others relevant for new housing. These include demographic, price and financing aspects. Other factors are income or the labor market situation. Population growth should have a positive impact on new housing, while larger households limit the demand for new housing.[2] Housing demand could also be affected by the age distribution as new homes are generally required by people founding families, Demers (2005) suggests that this is most likely for the cohort of 25 to 44 year-olds. Wealth and disposable income are further factors influencing new housing positively. Disposable income growth additionally reflects business cycle developments (and thus also to some extent the labor market situation). Labor market development is also represented by the unemployment rate. Inflation is expected to promote real estate investments (rather than financial assets), and if house prices are a driver of inflation, this also would lead to new housing. Since housing is an investment that is often financed with outside capital, high interest rates should lower new housing development. Often, public housing provision is another factor that should not be neglected.

Such a model would be nice, but unfortunately, data limitations do not allow for a structural model for Austrian housing building permits. Luckily, next to structural models a multitude of other forecasting tools and methods are available to economists, ranging from expert knowledge to surveys to time-series models (Clements and Hendry, 1998). In this paper, forecasts are based on the Box-Jenkins ARIMA approach. This is a univariate time-series method, where the data generating process is parsimoniously modeled using auto-regressive and moving-average processes – thus, only past information is used to make forecasts. Besides the aforementioned data limitations, the Box-Jenkins approach was chosen for several reasons: This approach is simple to implement because data requirements are low. A time series of length 40 to 50 units is generally adequate to provide forecast results of similar accuracy as larger-scale structural models and ARIMA models adjust more quickly to structural changes (Diebold, 1998; Newbold and Bos, 1990; Granger, 2007). Compared to structural models, which require additional explanatory variables, no forecasts of these variables are necessary and other typical problems of large-scale model building (e.g. identification and endogeneity) can be avoided. Finally, results can be complemented by expert knowledge, but this is not a necessity, making forecasts useful to a wide range of practitioners.

Of course, there are also downsides of the Box-Jenkins methodology. The predominant one is that it is not related to economic theory in any way and that other influential factors are entirely ignored. Without formulating a full model, this can be overcome by identifying factors of influence and extending the ARIMA model with these variables. Such a model is often called ARMAX, where the X indicates that explanatory variables are used. Next to

[2] It should be noted that reverse causality could be an issue here as household size could be also influenced by the stock of housing available (Puri and van Lierop, 1988).

theoretical considerations, cross-correlations (including lags) can help identifying appropriate explanatory variables.

The Box-Jenkins approach is iterative: In a first step an ARIMA (p, d, q) model is selected based upon correlograms. This means that the number of p auto-regressive (AR) terms and q moving-average (MA) terms as well as the number of differencing (d) (for stationarity) are determined (for differencing, an augmented Dickey-Fuller test can be used). In a second step, parameters are estimated (with non-linear least squares techniques). The model is evaluated in a third step applying Akaike and Schwartz Information Criteria, over-fitting and residual tests. This procedure is potentially followed by the first step again. Throughout, the principle of parsimony is observed as usually small orders of p and q yield satisfactory results and it is common to carry forward several models simultaneously (Newbold and Bos, 1990). Since it is uncertain whether additional variables enhance forecast quality, these models are compared with respect to model fit and forecast accuracy. In this analysis, out-of-sample forecast are evaluated based on standard measures, which should be as low as possible: root mean squares error (RMSE), mean absolute error (MAE) and mean absolute percentage error (MAPE).

4 DATA

The analysis is based on official total (no separation in rental and owner-occupied is possible) annual housing permit data between 1970 and 2009 published by Statistics Austria. Because ARIMA models require a long enough time series without structural breaks, it is important to note that the survey method was considerably changed in 2005. It is now based on administrative registers and suffers from (1) under-coverage and (2) rather large revisions especially for more recent data (Vollmann, 2009). Estimates from other data sources were incorporated to avoid any structural breaks concerning under-coverage, such as data for the number of new housing subsidy grants (which require a permit), housing investment and estimates from the European construction forecast network Euroconstruct. Even though no structural break is visible, ARIMA forecast quality is adversely affected by relatively lower data quality of more recent observations. This can be only partially overcome by using other data sources, as this is an intrinsic problem of most data sources with short publication lags. Additional data were required for the impact factors considered important for housing permit development. Historical data are from Statistics Austria as well as population forecasts, while other forecasts are from the most recent WIFO economic forecast in July 2010 (Rünstler, 2010). To ensure stationarity, (first) differences of all time-series were taken accordingly.

5 RESULTS

The correlograms of building permits in levels and first and second differencing strongly suggest that the data is integrated of order I(1) and that first differences should be taken to ensure stationary data (Fig. 1). This is also supported by an augmented Dickey-Fuller test (not shown). Concerning the auto-regressive and moving-average processes, the correlograms are less clear and models of type (1,1,0), (0,1,1) and (1,1,1) seem likely. Based on Akaike and Schwartz Information Criteria, an AR(1) model should be selected and the ARMAX model is preferred (Tab. 1a). Over-fitting with a (2,1,0) model confirms this result and the residuals do not show any remaining systematic pattern (not shown). That the AR(1) term in the ARMAX model is only on the verge of significance should not be seen as a bothering, since the analysis is also a bit low on the minimum number of observations. The choice of the ARMA structure is independent of the inclusion of explanatory variables (namely real income growth and population growth). Out of the aforementioned variables, these two variables (lagged one period) turn out to be the only ones to significantly influence building permit development in Austria. Both have the expected positive impact on new housing.

Forecasts were made for 2006 (*4-step*, 3-step, 2-step, 1-step), 2007 (*3-step*, 2-step, 1-step), 2008 (*2-step*, 1-step) up to 2009 (*1-step*)[3]. The ARMAX model appears to have a strong advantage over the ARIMA model for 1-step-ahead forecasts, but ARIMA models seem to perform better for longer forecasts (especially 3- and 4-step). For 2-step forecasts, performance of ARIMA and ARMAX model are quite similar (in absolute terms, the errors differ by less than 1.000 units of permits) and seem to depend at least to some extent on the forecast time period chosen. Since for most applications 2-step forecasts should be adequate, the ARMAX model is preferred.

Still, at this stage of analysis, it seems that forecast quality is particularly influenced by the peak of permits in 2006, followed by a decrease in 2007 and a plunge in 2008 and 2009 – the ARIMA model picks up the downturn quicker than the ARMAX model, which is more strongly influenced by the overall economic upswing with a lag of one year (real income growth of 2 to 3% per annum). It would be necessary to look into more detail into the possibility of the variation of forecast accuracy at different stages of the housing and business cycle. For Hong Kong, Fan et al. (2010) find evidence that ARIMA models perform well in times of economic turmoil, but do not fully grasp peak and troughs. Overall, the ARIMA and especially the ARMAX model seem to do quite well in forecasting and thus, seem suitable to be carried forward to an analysis on their lead concerning housing investments.

Fig. 1) Taking a look at the data: Levels and first differences.

Source: Own illustration. a) Levels and first differences of building permits, population and real income. b) Correlograms of building permits: Levels and first differences.

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[3] Only forecast evaluations for forecasts in *italics* are shown in Tab. 1c.

Tab. 1) ARIMA and ARMAX comparison: Model fit, estimation and forecast results.

a)	Akaike Information Criterium				Schwartz Information Criterium			
	(1,1,0)	(0,1,1)	(1,1,1)	(2,1,0)	(1,1,0)	(0,1,1)	(1,1,1)	(2,1,0)
ARIMA	19.25	19.31	19.28	19.29	19.34	19.39	19.41	19.42
ARMAX	19.15	19.22	19.20	19.17	19.32	19.39	19.42	19.38

b)	ARIMA (1,1,0)		ARMAX (1,1,0)	
	Coeff.	p-value	Coeff.	p-value
Constant	-830	0.459	-3768	0.003
Population growth (-1)			63	0.023
Real Income Growth (-1)			837	0.036
AR(1)	0.47	0.001	0.23	0.153
R2 / Adj. R2	0.26	0.24	0.40	0.34
Akaike / Schwartz IC	19.25	19.34	19.15	19.32
F-test / p-value	12	0.001	7	0.001
Observations	38		38	

c)	RMSE	MAE	MAPE
		ARIMA	
1-step	1568	1568	4
2-step	3104	3104	8
3-step	7057	6614	16
4-step	2735	2534	6
		ARMAX	
1-step	71	71	0
2-step	4043	4017	10
3-step	7510	7112	17
4-step	5286	4482	11

Source: Own calculations with EViews. b) Absolute change of permits. c) Forecast evaluation of permit levels for 2006-2009, 2007-2009, 2008-2009 and 2009-2009.

6 SUMMARY AND CONCLUSIONS

In this analysis a time-series model based on the Box-Jenkins approach was constructed with and without explanatory variables to explain and forecast Austrian building permit development between 1970 and 2009. The results indicate that for up to 2-step ahead forecasts, the ARMAX model with population and real income growth outperforms the simple AR(1) model with respect to model fit and forecast accuracy and is generally very suitable to perform accurate forecasts. Results suggest that on average, the forecasts are less than 10% away from realized values.

Because of its simplicity and low data requirements, such a model can easily be implemented by housing policy makers and practitioners to forecast future housing markets for a period of up to 2 years. Potentially, forecasts could be improved by taking expert knowledge into account (e.g. with respect to public housing investment plans) or by looking in more detail into forecast performance over the economic cycle. In the future, to make this forecast model even more useful to housing policy makers and economic forecasters, a complementation with respect to the lead structure to housing investment would be necessary. This would involve exploring the time lag between permit issuance and housing completion in Austria. Also, an analysis on the regional scale would be nice, since housing markets are often a local phenomenon.

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RISK MANAGEMENT OF TUNNEL WORKS

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Abstract

Policy decision-making regarding tunnels has to take into account a number of various factors, such as: risks, technical solutions, economic costs and benefits, alternatives of transport and routes etc. It also involves a range of national and local parties and implementation of different laws and regulations. The risk management will have to consider all these elements and factors that are integrated in the decision-making process. The reasonable practice is that risks should be reduced through all the phases of planning and through the construction time.

This paper gives an overview of the some important guidelines that should be taken into consideration when planning and designing tunnels, and emphasize the importance of risk management as a key part of overall project management.

Key words

Risk, management, construction, tunnel

1 INTRODUCTION

Tunnels are usually constructed near existing structures, in different types of soil and rocks. Their construction has many problems and risks, such as stability, safety and environmental influence during their excavation. Their design depends on many empirical methods and the risk factors cannot be exactly calculated. Many of those risk factors should be included during the design process and during construction and operation time of tunnels. Because of the high uncertainty of costs and financing, construction period, operation and maintenance period, safety and impact factors, complex requirements and conditions, risk management should be a regular component of every infrastructural project; therefore it should take part in every tunnel project. Hazard and risk identification and risk management should be taken into consideration in the design process, procurement and construction of tunnels.

Hazard is defined as an event that has possible influence on a project and has various consequences on: health and safety, environment, design, costs, technology of construction,

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organization of construction, construction time etc. The nature of the hazards and their resulting risks depend on the project phase. Hazards and risks should be identified and estimated through every project stage (planning, design, procurement and construction time and operation stage), in order to ensure their reduction as low as possible.

Risk is an unfavorable event having a probability of happening and an impact that will affect the realization of the project's objectives. There is a level of risk associated with each hazard. Risk has two primary components: a probability of occurrence and an impact of the occurred event. Future events that are favorable are called opportunities, and unfavorable events are called risks. The level of tolerable risk depends on the probability of an event occurring and the severity of the impact on the project and is obtained using a formal risk assessment. It is the most important tool that the client and designers have at their disposal. This is actually a formalization of a process that in the past was an approach to construction using decision and experience. The risk evaluation can either be quantitative or semi-quantitative and the level of risk will determine the extent to which measures are taken to mitigate the impact of a hazard on a project. Higher-level legal, economic and financial risks are generally the first to be considered, followed by construction and safety and risks.

Risk management is complex and methodical process of: identifying hazards and associated risks that impact on a project's outcome in terms of costs, quantifying risks, identifying appropriate actions that can eliminate, mitigate or reduce the risks and recognizing methods that can control the risks and allocating risks to the different parties of the contract. RISK management is the overall application of policies, processes and practices dealing with risk. It provides an approach for assessing, analyzing and managing risk during design and construction and ensures that the works are carried out safely and in accordance with the planned budget. Sometimes projects are unable to meet a construction plan, because a number of causes, some of which are not related to hazards in the conventional sense, e.g. a tunnel failure due to unforeseen local conditions, or because of inexperience on the part of a contractor. This emphasize that in procuring a major contract clients need to be aware that safety and preventing major collapses is only part of a much wider process that should be all embracing as far as the project is concerned. Risk management is not a separate project assigned to some risk management department or office, but it is one aspect of a proper project management. It should be closely tied with every key project process, such as project management, engineering, design, quality, schedule, cost, time etc.

The first step in risk management is a risk assessment. That is a systematic procedure that gives the basic guidance for documenting, identifying, evaluation and allocation of risks and gives strategies that are suitable for preventive and protective actions. Risk assessment is essential for every stage of a project and it should be summarized in proper registers that will evidently indicate the party responsible for the risk management of an identified risk, as well as possible measures available for the mitigation of the risk.

After the risk assessment, the next phase is to identify the potential risk issues by numerous different methods, according to life-cycle phases of the project. Any source of information that allows recognition of a potential problem can be used for risk identification. To identify risk issues and potential problems, evaluators should break down processes, elements and requirements to a level where they can perform a valid and suitable judgment.

A risk analysis is a detailed study of the risks that have been identified and approved by the decision-makers for further evaluation. The objective in this phase is to gather as much as possible information about the risks in order to give a possibility for judging the occurrence of the risk, impacts on the cost of the project, its schedule, performance of the project or the structure itself, possible consequences etc. The goal of risk analyses is to convert the results into risk levels and to specify the methodology that will allow risk rating.

Risk handling is the process that identifies, evaluates, selects and implements a strategy in order to set the risk to an acceptable level given by the designed or planned objectives and it includes risk assumption, avoidance, control and transfer of the risks.

Risk monitoring is used for tracking and evaluating of the performance of the applied risk mitigation actions. Monitoring results may also provide a basis for developing additional risk handling strategies and reanalyzing the already known risks, or they can help the identify new risks so that some aspects of the risk planning can be reviewed and changed.

2 GUIDELINES FOR TUNNELING RISK MANAGEMENT

Tunnels represent complex technical systems that can be exposed to hazard situations leading to severe consequences. Risk criteria for tunnels are therefore becoming a more and more important issue all over the world. The increased interest in tunnel safety is caused by many tragic events in the world which lead to an effort to take consequences of unfavorable events into consideration during design of new and assessment of existing tunnels.

As a result, risk management became an integral part of most underground construction projects. There is no single textbook answer on how to manage every possible risk because of too many different projects, influence factors and circumstances. The project manager must rely on his own judgment and on the appropriate tools and methods that deal with risks. From discussions on international forums and published papers, it became clear that risk management is performed in many different ways. Out of there came the idea of creating an international guidelines for tunneling risk management. Work on these guidelines began at the meeting of ITA Working group 2 ‘‘Research’’ in Oslo in June 1999 and they were finally completed in April 2003. These guidelines consider that risk management processes can be significantly improved by using systematic risk management techniques throughout the whole tunnel project stages. By the use of these techniques, possible problems can be clearly identified so that appropriate measures can be implemented in a timely manner, but it is not expected that these guidelines will cover every aspect of tunnel risk management. The goal is to provide the basic knowledge and indicate the most significant aspects of risk management. The guidelines show how risk management can be used throughout all of the phases of a project implementation: early design phase, tendering and contract negotiation phase and construction phase and they also contain some typical components of risk management and a short introduction to general risk management tools.

3 TUNNELING RISK MANAGEMENT

Tunnel works and underground construction works impose risks on all parties involved as well as on those not directly involved in the project. The nature of tunnel projects indicates that any potential tunnel owner will be facing significant risks when developing such a project. Due to the many uncertainties, including ground and groundwater conditions, there might be significant cost overrun and delay risks, as well as environmental risks. Also, as demonstrated by spectacular tunnel collapses and other disasters in the past, there is a potential for large scale accidents during tunnelling work. Furthermore, for tunnels in urban areas there is a risk of damage to a range of third party persons and property. Today, the state of the art of technology for tunnel construction is being pulled to the limits. For projects with a short duration time (less than one year) engineers can assume that the environment and site conditions are already known and stable. But, for projects with a longer duration time (few years), technology forecasting and possible risks must be considered.

Traditionally, risks have been managed indirectly through the engineering decisions taken during the project development. But that present risk management processes can be significantly improved by using systematic risk management techniques throughout the tunnel project development. By the use of modern techniques, potential problems can be clearly identified such that appropriate risk mitigation measures can be implemented in a timely manner. The use of risk management from the early stages of a project, where major decisions such as choice of alignment and selection of construction methods can be influenced, is essential. It is very important to emphasize that the risk management should be a process that will include a formal planning activity, analyses for estimation and prediction of the impacts caused by identified risks, a handling strategy for the risks and ability to monitor the progress in reducing the selected risks to the acceptable level.

Risk in tunneling construction projects can be classified in a different ways. They can be divided in three major groups, such as: socioeconomic factors, organization factors and technological factors. The socioeconomic factors take into account the environmental protection, public safety regulation, economy and exchange rate fluctuation etc. The organization factors include all the organization aspects of the design process and the process of tunnel construction, as well as the relation between contractors and participants. The technological factors consist of all the aspects of the technology of the tunnel project and tunnel construction, site conditions, construction methods etc. There are many different risks that should be analyzed in details, such as: risk to the health and safety of workers on the construction site, risk to the buildings and structures that are situated near the tunnel route, risk to the environment (together with the possible land, water and air pollution), risk related to the construction time extension, financial risks etc.

Risk management during project phase resolves the important and essential information that are needed for a successful tunnel project. History shows many tragically accidents, or sometimes disasters, related to road and rail tunnels that happened around the world. Apart from their specific causes and circumstances, these events showed a number of key facts regarding tunnel safety and gave the engineers the example of many risks that should have been analyzed during the process of designing and tunnel construction. Risks related to tunnels usually have low probability of happening, but they have significant scale of occurred consequences, impact and effects.

That is why the risk identification during the process of designing tunnels and their construction time is an essential, crucial and important task in every project. Each project should have a proper and clear construction risk policy that will point out and specify the scope of work, risk objectives and the risk management strategy. The construction risk policy and risk management should be included in every stage of the tunnel project and they should give the basic information about the possible hazards and give the general idea of the measures that will help to eliminate or mitigate the risks, in accordance to the existing state low regulations. The construction risk policy may also include some general statements for allocation and distribution of the risks between parties that take part in the same construction project, so that the risks will be allocated to the party that can control or mitigate it, with less consequence as possible.

The risk management strategy should be carried out during every stage of the tunnel project and it should provide the risk review in accordance with the available and existing information. The strategy includes the definition of the risk management responsibilities of the involved parties (contractors, consultants, organizations, experts etc.), an explanation of the activities that should be carried out by those parties, the rules and principles of monitoring procedures during the operation time etc. Risk management is the procedure by which project managers and owners make decisions that are based on the data generated in the risk assessment. For an effective tunneling project, it is very important that the risk analyses and risk management to start as early as possible, during the early planning stages of the project and during the feasibility studies. Another important thing is that every member of the team should be aware of the risk management policy and should be introduced with all the possible risks that might occur during tunnel construction or the operation time, and furthermore, with all the possible and applicable measures for risk mitigation. Also, every new member or consultant that joins the project at some later stage should be introduced with all what was said above. The first step of implementing a risk management is to prepare a risk policy together with the risk criteria that will be used for further risk assessment. Risk management is also dynamic process. When new information about risk events becomes available, managers should adjust accordingly. Project management and engineering are professions that require decisions to be made for the management of cost, time schedule, technical work and safety risks. In order to make decisions based on risk, a level of acceptable risk must be determined. For every type of the risks there should be quantitative risk criteria which will describe the risks and help with their estimation. For each risk a acceptable limit should be set in order to make a proper decision during the planning. If the risk is above that limit, than it must be reduced. If the risk is below that limit, than it is not required to consider a risk reduction. Success and benefits of implementing a risk management in the tunnel projects, depends on the quality of the analyzed and identified risks and measures for their mitigation, and on the experience and professional opinion of all the parties that take part in the project.

4 CONCLUSION

Modern practice of civil engineering projects, tunnels included, worldwide, shows the benefits and importance of using a risk management during each stage of the projects. Because of the many positive effects (keeping the level of safety, construction without delays and problems etc.), risk management should be a part of every tunnel project. Risk management in tunnel projects includes a clear definition of the responsibilities of each of the parties who participate in that project, preferably during the early stages of the project, before the beginning of the civil engineering work at the construction site. The project will be successfully delivered on time, with high level of safety and environment protection, only if the management is on higher level and properly introduced in the project.

Unfortunately the situation in Macedonia is different compared to foreign countries and their design policies. There is very little interest in implementing a risk management into civil engineering projects, even though almost every engineer is aware of its importance. Engineers and participants in the tunnel projects are planning and deciding based on their experience in previous similar projects. Tunnel design is relaying on traditional design methods and on the experience and professional judgment of the tunnel engineers. There are no detailed risk analyses, estimations or calculations, nor any plan for mitigating the possible risks that might happen in future. All tunnel projects involve risks: financial, organizational and technical. Engineer's job is to understand, analyze and estimate these risks and begin managing them early on. The disadvantages of not implementing a risk management as a official part of every tunnel project can be seen in a various situations when the traditional design methods and procedures are inadequate or they are beyond the experience of the engineers.

Many examples through the world showed that an applied risk management helped avoiding a number of serious damages or collapses of tunnels during their construction or operation time. There are no tunnel projects that will no benefit when a proper risk management is applied, talking about avoiding a safety, environmental, economic, construction or financial risks. Risk management can be justified on almost all tunnel projects, although the level of implementation may vary from project to project, depending on the size and type of the project and on the local environmental and site factors that influence on the project. That is why we do expect that public and engineers concern about risks during tunnelling projects and risk management will increase to a higher level. We certainly hope that in near future this practice of not using a risk management while designing a tunnel projects will change, because risk management is very important and essential for every construction project.

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A SURVEY OF CROATIAN COMPANIES FOR BUILDING MAINTENANCE MANAGEMENT

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Abstract

Building maintenance is not only important for the quality of life but also for the increase of a building's value. In Croatia building maintenance management companies exist and condominium owners are obliged, by law, to sign maintenance contracts with these companies. This paper presents the main research results of information about building maintenance management companies gathered from an Exploratory Survey, in which questions were styled to discover the basic data concerning the companies, such as number of employees, organisation structure, and also data on the number and kinds of repairs and general matters connected to relations with clients.

Key words

building maintenance, building maintenance management companies

1 INTRODUCTION

The condition and the quality of the buildings reflect public pride or indifference, the level of the prosperity in the area, social values and behaviour and all the many influences both past and present which combine to give a community its unique character [1].

After 1991 and the dissolution of Yugoslavia new social and economic relations were established in Croatia. Flats that had until then been state-owned were purchased by their occupiers and became private property. In the earlier system the housing stock was divided between flat owners and specially protected tenants who had the same rights as flat owners although the flat itself was owned by the state or by companies. The institution of the specially protected tenant was specific to the socialist system in Yugoslavia, and it greatly affected the condition and maintenance of multi-flat buildings. The users of these buildings were not bound to maintain the common parts of the building (roof, stairwell, façade etc.) because these were what was known as socially-owned property. The state had special funds from which it participated in building maintenance through regular maintenance, reconstruction and repairs, which included urgent unforeseen repairs. Building maintenance had been random and unsystematic in the former system, and there was a great difference

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between the maintenance of residential buildings and public buildings (theatres, schools, hospitals, courthouses, administrative buildings and the like) [2, 3].

To improve building maintenance an act was passed in Croatia in 1997 which compelled all condominium owners (co-owners) to sign a contract with a maintenance company and to pay a certain amount of money each month for the maintenance of the building, i.e. of the jointly-owned parts of the building. The minimum maintenance fee is 0.2 Euro/m2. The co-owners may pay more for the maintenance of the common parts, i.e. define a higher maintenance fee, if they wish. If the co-owners of the building do not sign a contract with a building maintenance management company of their choice, the State, under legal regulations, decides which company they must sign a contract with, and this is called "compulsory management". Considering the great age of the housing stock and the poor maintenance to date, these measures were indispensable to bring the excising housing into acceptable condition

2 EXPLORATORY RESEARCH

The aim of the research was to gather information about building maintenance management companies. The paper analyses a sample of eleven companies that were willing to take part in the research [4]. The Interview Method was used. A representative of each company was interviewed separately, using questionnaires with 28 questions. The questions were designed to get data about the company, number of employees, organisation structure, the number and kinds of repairs, and general matters connected to relations with clients. This type of research is exploratory research, which is used when there is not enough information to set up a hypothesis or to draw any preliminary conclusions about a particular issue. Since this is, to the best of the authors' knowledge, the first research of its kind in Croatia since the foundation of building maintenance management companies, this approach and method of getting information is satisfactory for initial research.

Below is a presentation of group results for eleven building maintenance management companies.

3 MAIN SURVEY FINDINGS

The results obtained from the questionnaire show that in legal form all the companies included in the survey are limited liability companies. According to the activities they are registered for, 100% of them are registered for building management and maintenance as their basic activity, and 46% also undertake additional activities.

In internal organisation all the companies, regardless of the size and number of employees, are divided into legal, financial and technical departments. Besides these departments, which exist in all the companies, 46% also have additional departments primarily connected with other activities that do not necessarily concern management and maintenance.

According to number of employees, the companies can be divided in 3 groups:

5 – 10 employees: five companies

10 – 30 employees: four companies

30 < employees: two companies

In this division it must be said that one of the companies by far exceeds all the others, with 300 employees (City Housing and Utilities Management Company - GSKG). This company existed even before Croatia gained independence and maintained buildings. Later, it was awarded most of the building under compulsory management.

Data about employee structure are given for 7 of the 11 companies, and these 7 companies have 99 employees. The employee structure by education is as follows:

Engineers (civil engineers, mechanical engineers etc.): 23

Economists: 12

Lawyers: 4

Technicians: 53

Other: 7

Table 1 shows the number of employees per company, and the number of buildings they manage. The two companies that manage many more buildings than the others have both residential and business buildings. One of them has a large number of employees (300), while the second biggest company with a large number of contract buildings has only 11 employees, but it reports that it occasionally employs up to 80 professional sub-contractors.

Tab. 1) Number of employees and contract buildings per company

Company	**Number of employees**	**Number of contract buildings**
Maksimus d.o.o	15	283
Monel d.o.o	9	146
Zapad-stan d.o.o	9	275
Upravitelj gradnja d.o.o	16	153
Lind-grad d.o.o	39	515
Rego-stan d.o.o	9	180
Stambeni ZG d.o.o	12	389
Upravitelj-stan d.o.o	6	217
Stambeni inžinjering d.o.o Pula	8	310
Hrvatski poslovni centar	11	6,000 (residential and business buildings)
GSKG d.o.o	300	149,874 (residential and business buildings)

All the companies make annual management contracts with the co-owners with an unlimited number of renewals on expiry of the contract. In the case of major work that requires a bank loan the contract is signed for the period until the loan expires. Furthermore, all the companies require an owners' agreement to be signed among the co-owners, in which they are chosen as managers and the maintenance fee is defined.

All the companies have annual maintenance plans for each separate building. Plans that will take several years are only made on the demand of the co-owners and for works that will last for a longer period of time.

In 46% cases the management company is paid 10% of the maintenance fee and in another 46% cases it is paid a fixed monthly sum that is defined on the grounds of the needs and requirements of a particular building. The remaining 8% management companies are paid a combined fee, a fixed monthly price (a price per unit of area or unit of space) plus a certain percentage of the maintenance fee collected.

72% companies report that 94% of the maintenance fee is regularly paid, in 18% companies the percentage is less than 90% and in 10% companies the percentage exceeds 95%.

All the companies work with sub-contractors whose exact number is impossible to establish as it changes with each job. However, it is known that 73% companies engage contractors for unforeseen repairs because they do not have their own repair teams. Besides the unforeseen maintenance teams, sub-contractors are usually also engaged for large-scale repairs. Only 27% companies have their own unforeseen repairs team, and all these companies have more than 15 employees.

The questionnaire provided incomplete data on the number of repairs made but the answers of 7 or 63% companies that provided data about the number of unforeseen repairs show that in 2009 there were 6,919 unforeseen repair jobs in 1,564 buildings. This is an average of 4.34 unforeseen repairs per building. Unforeseen repairs are those that appear unexpectedly and are unplanned, and therefore a lump sum is set aside from the common maintenance free to cover them (they serve only and exclusively for repairs to the common parts of the building).

All the companies organise inspection of buildings and have defined forms for building inspection, which is done once a year just before drawing up the annual maintenance plan. All the companies in the survey have some kind of information system and repairs register, which makes it easier for them to monitor all the activities that take place in each building.

The companies usually secure contracts on the basis of references and by posting flyers and advertisements in new buildings, only GSKG also secures contracts through compulsory management. All the companies interviewed have a web page on which, besides offering information about the company, they also provide information about the state of accounts and annual reports for their clients. This kind of company does not need special advertising and they all use oral reference as the best advertisement, in addition to which some companies, 46%, also use flyers as advertising material which are sent to interested groups of buildings.

In 82% companies employees are trained at seminars organised by the Manager Association and the Croatian Business Centre, and through subscription to various professional literature. Only one company, Monel d.o.o, also trains co-owners at the Monel Days event.

In practice the minimum maintenance fee has shown itself insufficient for quality maintenance of the building so the managing company proposed a higher maintenance fee, in accordance with the annual management plan and the wishes of the co-owners. In 18%

companies there are no data about the percentage of buildings that decided on an amount exceeding the minimum, and the data for the other 72% are given in Table 2. One of the companies, GSKG, has been left out of the table because it provided data per number of units (residential and business units) and not buildings, so this result cannot be compared with the others. This company contracted the maintenance of 149,874 units, 50 % of which decided on a maintenance fee in excess of the minimum so the average maintenance fee is 0.3 EUR/m².

Tab. 2) Percentage of buildings with a maintenance fee greater than minimum

Company	**Number of buildings**	**Number of buildings with maintenance fee greater than minimum**	**%**
Maksimus d.o.o	283	170	60%
Monel d.o.o	146	131	95%
Zapad-stan d.o.o	275	192	70%
Upravitelj gradnja d.o.o	153	137	90%
Rego-stan d.o.o	180	90	50%
Stambeni ZG d.o.o	389	311	80%
Upravitelj-stan d.o.o	217	173	80%
Stambeni inžinjering d.o.o Pula	310	155	50%
Total	1953	1359	72%

For the needs of financing major work 10 of the 11 companies provide credits and loans in cooperation with business banks, at an annual interest of 6-9.5%. Only one company gives their clients loans at somewhat more favourable interest than that of business banks.

All the management companies state that the most frequent impediment in work is that co-owners do not understand the problems of maintenance and their own responsibility for it. Also, they all agree that the lack of funds for quality maintenance is a great problem which should be solved by raising the minimum maintenance free, but this leads back to the first problem, the co-owners' lack of understanding

4 CONCLUSION

Because there was no systematic and quality building maintenance before the Act was passed and the provisions that compelled co-owners to maintain their buildings came into force, many multiple-unit dwellings are now in bad condition. The results of the questionnaire suggest that the co-owners have begun to understand that maintenance is not only of aesthetic importance for the building but pays back many times on the economic and social level. Proof is the increase of the minimum maintenance fee in 72% buildings. The statutory minimum maintenance fee is certainly not sufficient for regular maintenance. Changes are becoming apparent in the systematic investment in and current maintenance of the neglected housing stock.

For further research it is necessary to gather information about as many building maintenance management companies in the Republic of Croatia as possible, and questionnaire results would then help understand the real condition of the housing stock in Croatia. Statistical offices that keep data connected with maintenance do not have sufficient information, and the methodology of gaining information changes from year to year so that data are often impossible to compare. Much maintenance work is not even evidenced. In addition, the comparison of maintenance management companies and analysis of their services could improve the relationship with clients.

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SOCIAL BENEFIT OF BUILDING CONSTRUCTION

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Abstract

Paper is focused on the description of the application focused on the valuation of the social benefit in the substitution of materials in the preparation of the building object. The substitution is realized at selected building materials. Materials made from natural raw materials are substituted with materials made from recycled wastes. Social benefit expresses social gain of the material substitution as a measurable value expressed in CZK. It takes into account the social rate of the need to save natural resources regarding the degree of their renew ability and the negative impact on environment. Calculation of the social benefit is realized on case studies of buildings. It concerns about the phase of preparation of the building construction and the decision making about investment costs.

Key words

Social Benefit, Building Construction, Material Substitution, Software Application

1 INTRODUCTION

The paper deals with the problem of the expression of the social benefit connected with the utilization of materials made out from the secondary raw materials in the building industry. The utilization of materials made out from secondary raw materials can be from the economic and social aspect very beneficial, but it is quite difficult to express the final economic efficiency of this utilization. The paper introduces the application, developed by the project team from the Department of Structural Economics and Management in the frame of the research project, which is focused on the valuation of the economic efficiency of utilization of materials made out fro secondary raw material in the building industry.

2 APPLICATION FOR CALCULATION OF SOCIAL BENEFIT

Application is focused on the valuation of the social benefit in the substitution of materials in the phase of the preparation of the building object. The substitution is realized at selected building materials. Materials made from natural raw materials are substituted with materials made from recycled wastes.

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Social benefit expresses social gains of the material substitution as a measurable value expressed in CZK. It takes into account the social rate of the need to save natural resources regarding the degree of their renew ability and the negative impact on environment with the collecting of waste.

Calculation of the social benefit is realized on case studies of buildings. It concerns about the phase of preparation of the building construction and the decision making about investment costs.

On the selected object it is possible to set the rate of substitution at selected material and to do the calculation. It will be realized the calculation of the purchase price of the building part of the object with materials made from natural resources and the calculation of the building part of the object after the substitution with materials made from recycled wastes. The value of the social benefit is the difference between purchase and recounted price of the building part of the object.

Recounted price taking into account the social benefit is assigned using the coefficient K1, which comes from the valuation of the degree of the renew ability of the natural resource, and the coefficient K2, which expresses the rate of substitution in the functional part.

The database offers the set of case studies of selected buildings. The database is on the present price level. The administrator of the database continuously fills in the database particular case studies based on own selection. The administrator of the application will complete the database with case studies of users depending on their own requirements.

The social benefit is the index of valuation of savings, which can arise to the society with the utilization of materials made from recycled wastes for the construction. These savings are not necessary the direct saving of the investor, however from the general social aspect is the realization of these investments welcome.

3 INPUT DATA

For the possibility to use this application it is necessary to have appropriate information database. There are needed mainly data described in following part of the paper.

Existing Object

The user makes the selection of the building object for the comparable calculation. He selects suitable object, which presents minimal differences with relevant object. It concerns about the initial template, on which will be based the variant. In the case that the user has own object, he can ask the administrator to fill it in to the database. This step requires some data from the side of the user.

Mark of the Variant of Calculation

User selects individually the description of own variant of the calculation.

Selection of Functional Parts

The user selects functional parts, where he wants to realize the calculation of the social benefit with the substitution with the material made from recycled wastes.

Selection of the Material

User selects at particular functional parts the material, where he wants to realize the calculation of the social benefit with its substitution for the material made from wastes.

Coefficient K2 assignment

The user defines the rate of the substitution of the material from the recycled wastes in values from the interval (<0,1>).

4 CALCULATION OF VARIANT

The calculation is realized on the level of the initial variant and on the level of variant with defined parameters. Costs for functional parts, where it is not allowed the material substitution, are taken in the percentage expression from information about the object

Calculation of the social benefit of the selected variant is realized according to the following basic relation:

$$SB = \sum_{i=1}^{n} [JC - JC * (1 - K_1)] * K_2 * Q \qquad [1]$$

Where:

SB social benefit (CZK)

JC unit price of the material made from natural raw materials (CZK/m.u.)

K_1 coefficient of the social seriousness of the material from the natural raw materials from the interval (<0,1>)

K_2 coefficient of the rate of the substitution of the material made from recycled wastes from the interval (<0,1>)

Q quantity of the material item in measure units

i kind of the substituted material

n number of items of substituted materials in the variant

Coefficient K_1 is defined for each material in the database.

Coefficient K_2 is chosen by the user.

Calculated values of SB for particular variants are inserted in the comparative table.

5 EVALUATION OF RESULTS

Resulting value of the social benefit of the selected object is defined according to the particular functional parts and sub parts and totally for the object.

Example is in the following table 1.

Tab. 1) Resulting value of the social benefit assessment

Functional part (FP)	Rate from the price - original in CZK	Rate from the price - recounted in CZK	Social benefit in CZK	Coefficient K_2 description of material
Ord. n., code, description				
Totally FP				
Price totally object				x

In the next step there is realized the comparison of particular variants and evaluation of the optimal variant.

Example is in the following table 2.

Tab. 2) Comparison of particular variants

Number of variant	Description of variant	Price for object original in CZK	Price for object recounted in CZK	Social benefit in CZK

6 CONCLUSIONS

The paper is focused on the introduction of the one of the approaches for the determination of the economic efficiency of the utilization of materials made out from secondary raw materials in the building industry. There is introduced the basic principle of the methodology and the application for the economic efficiency assessment. It concerns about the simple approach, which is based on the calculation of the social benefit connected with the utilization of wastes. For the social benefit it is necessary to define two input magnitudes in the form of the social seriousness of the substituted material and the amount of renewable resources in the substituting material made out from secondary raw materials.

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SIMULATION OF THE PURCHASE PRICE RANGE OF CONSTRUCTION WORK

Leonora Marková[1], Milada Galatíková[2]

Abstract

The purchase price of construction work is one of the most important factors when making a decision on investments in construction work. Its calculation at the preparation stage is, however, limited by the documentation available. There is a risk that the planned investment efficiency will not be achieved for not keeping the purchase price. By simulating the purchase price range of construction work, its possible changes can be predicted, and thus also its impact on the investment efficiency. By modelling, the limit values of the construction work purchase price can be determined on a case study when defining the conditions.

Key words

Construction work purchase price, material substitution, software application

1 INTRODUCTION

The simulation of the purchase price range of construction work enables us to set the value of investment costs with a determination of their probability. In this paper, I follow partial values of costs of selected materials at their various purchase prices found on the market and subsequently their effect on the final value of the investment cost range. The calculation was performed using the Monte Carlo method in the Crystal Ball program on a case study of an apartment building.

2 CALCULATION PROCEDURE FOR PURCHASE PRICE RANGE

Step 1 – Selecting a building and drawing up a budget at the price level of 2010. For the purpose of simulation, a completed apartment building in Olomouc was chosen. The budget was converted from CZK to EUR. (Exchange rate 24.68 CZK/EUR as to 10.09.2010).

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Step 2 – Substitution materials were chosen. The main criterion of selection was the volume of costs in relation to the total costs of construction work related to the interval of the selling price variance. At least 15 prices were selected for each material.

Step 3 – The budget was entered into the Crystal Ball program, random values were set – substitution materials and the final simulation value – the total price of the apartment building in EUR.

Step 4 – Simulation, the total number of attempts 15,000.

Step 5 – Graphical and numerical evaluation of the simulation.

3 INPUT DATA

Object

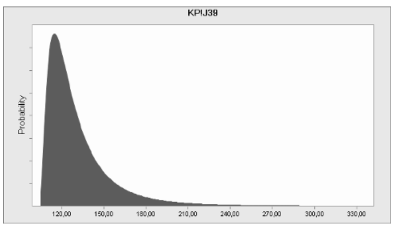
An apartment building was chosen for the purpose of simulation. The selected structure is a four-storey building with a residential attic and a basement under the entire ground plan. Structurally, it is designed as a masonry structure in the classical building technology of the POROTHERM system in combination with monolithic reinforced concrete pillars. The perimeter supporting wall is designed out of POROTHERM 44 P+D bricks, the staircase and internal supporting walls out of POROTHERM 30 AKU bricks, the partition walls out of POROTHERM partition elements in thickness 100, 125 and 150 mm. The ceilings are designed as monolithic in thickness 180 mm, seated on the supporting walls and monolithic concrete pillars connected by the system of supporting beams. The building roof is made up of a saddle truss with load-bearing elements out of steel rolled sections (purlins and posts). The roof cladding is insulated by ISOVER insulation made of mineral mats 160 mm thick. The roof covering is hard, out of KM BETA concrete tiles in brick-red colour, the covering of the vaulted roofs of dormers is made up of seam folded titan-zinc sheets, 0.65 mm in thickness. The external cladding is made of POROTHERM shaped bricks along with the BAUMIT plaster system.

Selection of the Material

Substitution was made for these materials:

- Porotherm P+D 44 – for the construction of perimeter supporting walls (5.65% of the total price), the input prices of the material are obtained from the web pricelists of suppliers. The input value character is shown in Graph 1 below.

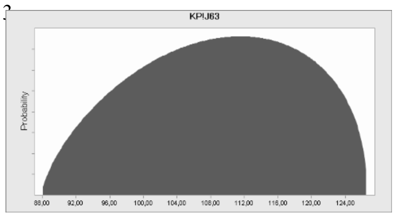
Graph 1



minimum	€107.94 per m^3
maximum	€182.46 per m^3
mean	€130.75 per m^3

- Concrete C25/30 for the reinforced concrete construction of the ceiling (2.88% of the total price), the input prices of the material are obtained from the web pricelists of suppliers; the input value character is shown in Graph 2 below.

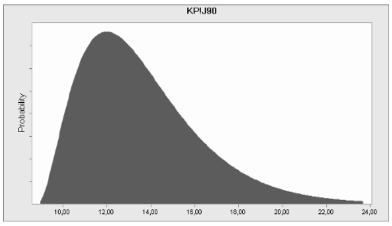
Graph 2



minimum	€92.46 per m^3
maximum	€124.47 per m^3
mean	€108.77 per m^3

- Baumit SilikatPutz – external colour plaster (1.05% of the total price), the input prices of the material are obtained from web pricelists. The input value character is shown in Graph 3 below.

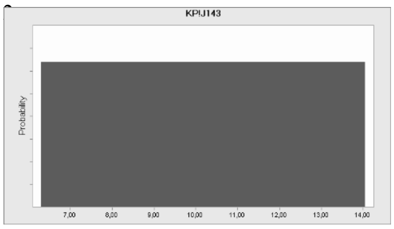
Graph 3



minimum	€9.65 per m^2
maximum	€18.44 per m^2
mean	€13.61 per m^2

- Isover Isophen – thermal insulation of the roof cladding (0.65% of the total price), the input prices of the material are obtained from web pricelists. The input value character is shown in Graph 4 below.

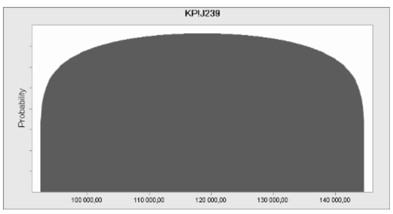
Graph 4



minimum	€9.79 per m^2
maximum	€13.74 per m^2
mean	€10.26 per m^2

- Plastic windows and doors – a complete supply of window and door units (3.93% of the total price). This item is provided as a set; the simulation is based on an assumption that the price difference in individual suppliers is not higher than ±20% . The input value character is shown in Graph 5 below.

Graph 5

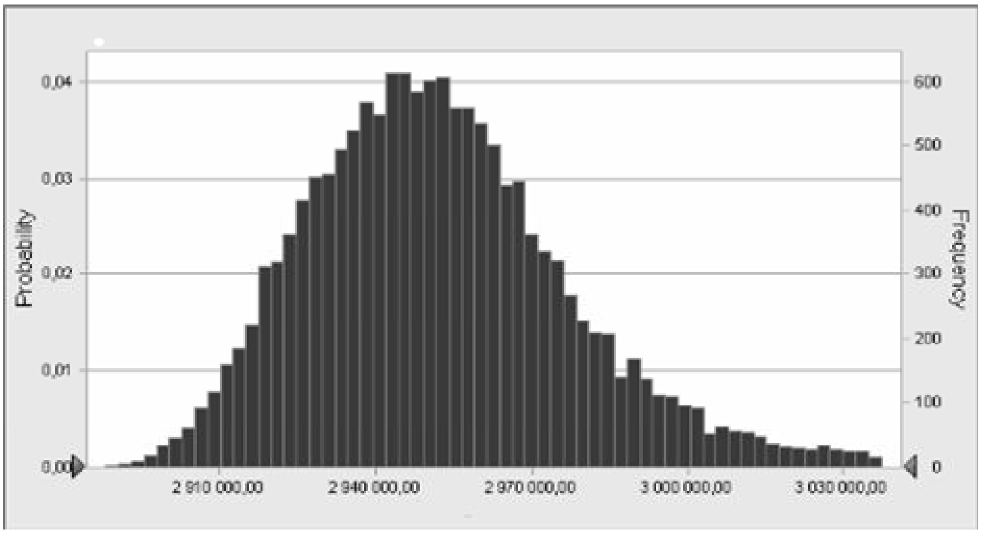


minimum	€94,822.63 per set
maximum	€142,233.94 per set
mean	€118,528.28 per set

Evaluation of the Results

Evaluation of the simulation result is shown in the graph below.

Graph 6



Statistics	Forecast values
Numbers of trials	15 000
Mean	€2,953,905
Median	€2,950,448
Standard Deviation	€29,787
Minimum	€2,888,013
Maximum	€3,338,340
Range Width	€450,327

The difference between the minimum and maximum values is €450,327 with a standard deviation of €29,787.

4 CONCLUSIONS

The aim of simulation was to find out the price range of an apartment building on condition that the prices of selected materials were not determined by a single value, but within a determined range and subsequently also the final price of the building is determined within the price range. These values are important information for the investor's decision-making. The price determined in this way should take into account all expected changes that may occur during the investment and will affect the final value. In this case, the simulation only takes into account the price effect of the inputs of selected materials. In the course of an investment, there is a large number of other economic factors that may affect the total price such as, in relation to materials, different distances of material suppliers from the construction site, quantity discounts, effect on the construction work quality.

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SIGNIFICANCE OF MAKING CONSTRUCTION MANAGEMENT PLAN – CROATIAN EXPERIENCES

Ivan Marović[1], Ivona Gudac[2], Diana Car-Pušić[3], Elvis Žic[4]

Abstract

In this paper the significance of construction management plan (CMP) within construction work preparation will be presented. Although making CMP in the Republic of Croatia does not present an obligation according to existing Spatial Planning and Construction Regulation, there are number of reasons why it is strongly recommended especially for demanding constructions. Due to system approach of CMP, all organizational, technological, economical and management elements whose early determination presents very effective response to possible risks during construction phase are defined. Reasons for making CMP will be shown in this paper through several case studies as well as CMP and its usual structure.

Key words

Construction management plan (CMP), methodology, system approach, case study

1 INTRODUCTION

Every construction project can be described as a non-routine, unrepeatable and unique venture that has distinct time, financial and technical objectives. It is a known fact in construction practice that effective preparation solves half of the production problems on a certain product. Some of the construction production specificities are [1]: static construction product, dynamic productivity factors, open space production (diverse weather conditions), single production, variety of production locations, large range and complexity of construction products, broadband of reproduction materials and number of people with different competences.

All the above represents proper reasons for the preparation of construction site to be conducted in best possible way. The more consistent and conscientious the preparation is the higher level of quality and lower time and cost levels will be needed for building construction. Construction management plan (CMP) gives us methodical overview of how to carry out the desired construction before its contracted deadline. It is supposed to manage building construction in a faster, better and more economical way.

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Building construction is a complex task which entails that the development of a quality CMP is even more so. The bigger construction is, the more complex development of CMP will be. Due to many elements and responses that the construction management plan has to offer, its own production should be carried out systematically. Certain parts of the project are subject to change in order to satisfy the set of project objectives (time, cost and quality).

In all construction projects risks and uncertainties occur. Regardless of their consequences, all risks can affect on project goals. For quality achievement of those goals it is of crucial importance that the CMP is made and verified before the start of construction. It is recommended that future construction site manager participates in development of the CMP.

In spite of the present Spatial Planning and Construction Regulation [2] which defines construction project management for assuring a quality, professional and responsible performance of those tasks and activities, the need for construction management plan is not legally specified. Reasons for making CMP will be shown in this paper through two case studies.

2 THE STRUCTURE OF CONSTRUCTION MANAGEMENT PLAN

Construction management plan conducts a set of activities with various information on different places in a particular time schedule what essentially represents construction management. It is very important to coordinate CMP with construction site and work environment specificities. Entire work, from the idea to the completion of a building, has to be well organized, planned and supervised. In order to develop the CMP it is necessary to have technical documentation, information of available operating funds, data about local and field conditions and the amount of work.

Well-developed CMP helps conducting the overall process of construction work with as less interferences and downtimes as possible. It gives an overview of the system functioning with the responses on how and what to build and with the management policies and draft decisions.

Construction management plan does not have its own unified structure, but it should give an answer to all technological processes, organizational structure and management, external and internal transport, preparatory and preliminary works, construction site schemes, material sources and suppliers, accommodation and food for workers, time and financial work planning, resource needs, work monitoring and control, cost planning and control, protection measures at work, calculation method and stimulations, production supervision method and necessary funds planning [1].

3 CONSTRUCTION MANAGEMENT PLAN APPROACH

Construction management plan can be developed in two phases: preliminary and executive CMP. Both plans are market oriented. Preliminary CMP determines fundamental elements that serve as a documentation base for tender whereas executive CMP is made after the job is obtained.

Development of construction management plan is an iterative process. Every step in the CMP production process should have a possibility of a feedback. If a previous problem solution is not appropriate in view of time schedule, chosen technology, resources and/or costs, or any other parameter, feedback enables an intervention with aim to achieve optimal solution.

Construction management plan must be made separately for each construction project. A scheme of CMP production process is shown in Figure 1. Nine shown steps/phases of the CMP production process should be carried out until the beginning of building construction.

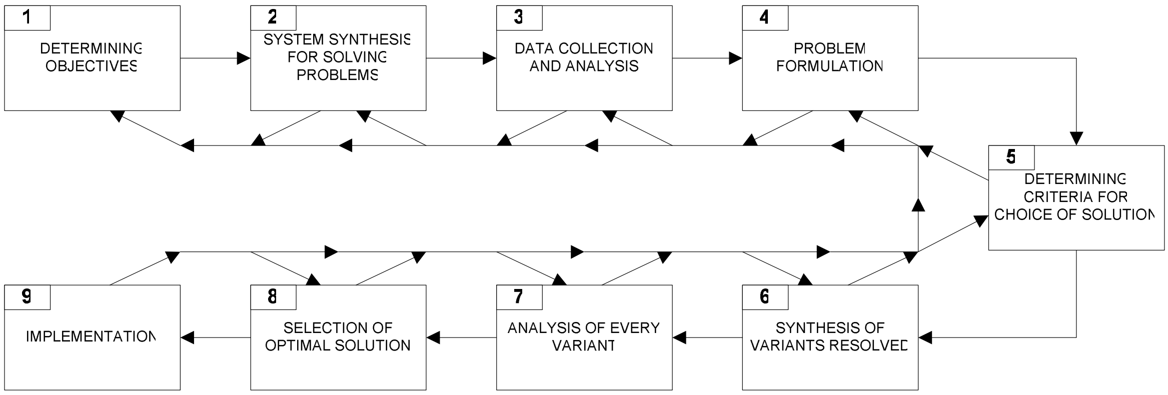

Fig. 1) A scheme of the construction management plan production process

4 CASE STUDIES

In this section the reasons for making CMP on two different case studies will be shown. Even though public facilities are presented in both case studies, first one represents a complex facility while second one represents a simple facility.

4.1 Kantrida Swimming Pools Complex in Rijeka

Kantrida Swimming Pools Complex in Rijeka (KSPsC) is a large sports-recreational swimming complex, one of the most sophisticated and most modern water sports centre in Europe. Whole complex spreads out on 20.000 square meters besides the sea with a total investments value of 33 million € [3].

Because of KSPsC's complexity project was divided in five construction phases [4, 5]: power plant as initial phase of complex, public garage, swimming pools complex with supporting facilities and fourth and fifth phase that include installation of sports electronics and all necessary equipment as well as construction of the PRESS centre, diving pool and a children's pool, installation of the equipment for cogeneration (simultaneous production of electricity and heat) and reconstruction of existing pool. Because of the specified size of the entire construction project, paper observes only the third construction phase, which has been divided in six operational units (Figure 2).

Third construction phase covered swimming pool complex as a central object that contains three pools – new indoor Olympic pool with maximum seating capacity of 1200 and two smaller pools for warming up and general swimming courses as well as supporting facilities of sports-recreational centre [4].

Council of Rijeka city decided to build KSPsC for city needs in addition to existing outdoor pool and club house of swimming club Kantrida. Intention was to have a stronghold for future application for the European and the Mediterranean water-sport competitions. First three phases were extremely complex with total facility net area of around 12.000 square meters and their completion was crucial to be done for the 12th European Short Course Swimming Championships held in Rijeka from 11 - 14 December 2008.

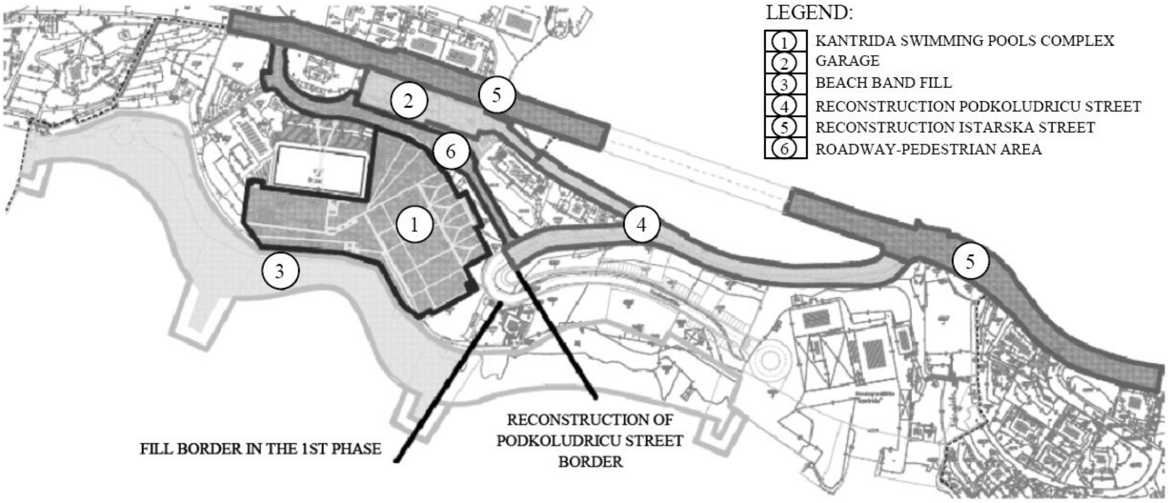

Fig. 2) Display of the 3rd construction phase of Kantrida Swimming Pools Complex

During data collection and analysis [4] several key problems were noticed: time, space and continuous sport activities.

Throughout KSPsC's construction work imperative was to remain the continuity of swimming activities on the existing outdoor pool. Initially temporary club house with locker rooms had to be constructed followed by demolition of the old club house. Construction of temporary club house began on the September 25th 2006 which indicated the beginning of Kantrida Swimming Pools Complex construction work. This precondition was hard to fulfil and there were few variants of it because of the lack of space (i.e. new complex had to be built on the position of the old club house, while temporary one had to have all the features as the former one). After the analysis of all variants optimal solution was selected and implemented.

Contractor had two years to complete first three phases in a very narrow urban area limited by the major city road (on the north) and by the sea (on the south). In spite of easy connection to the city water and power grid and close distance to material suppliers there were limitations of available site space so only the necessary quantity of materials and machines were permanently on site. That increased the level of communication, collaboration and coordination between main contractor and all subcontractors. Even though the construction of KSPsC was complex by itself, coordination of all subcontractors presented the biggest challenge. This task required great efforts during construction work.

Most delicate construction sequence was assembling and construction of steel roof structure with sliding skylight dome. Roof structure had to be made with precision tolerance of ±1,0 cm or dome sliding elements wouldn't have been able to slide under each other. According to the requirements of investors deadline was July 30th 2008 which was met.

Given construction time schedule of 22 months was extremely short considering the complexity and uniqueness of the project. Media pressure for upcoming European Short Course Swimming Championships added the difficulty to the organizational and time planning approach which culminated during construction work.

4.2 Sports hall at the Regional primary school Dubašnica on island Krk

Sports hall is a multifunctional facility for sport, social and cultural activities of the Dubašnica municipality on island Krk. Facility spreads on 2073 square meters with a total investment value of about 2 million € [6].

Facility is classic built combined with prefabricated structural elements [6]: monolithic concrete and reinforced concrete underlying system, bearing walls system of reinforced concrete and brick, reinforced concrete and steel pillars, standard-prefabricated laminated wood roof, reinforced concrete stands and staircases slabs and insulating covering of aluminium composite panels. It includes indoor sports area, sanitary area, locker rooms, thermo installation space as well as kitchen and dining room. Sport hall is connected with school through warm hallway.

The hall is relatively small with simple constructive elements and well-known construction process so it presents no problem during construction. For simpler constructions, such as this, a complete CMP is not usually made due to well known and frequently used construction phases. Only some basic elements, such as time and financial plan, lead by previous research of construction site location and surroundings.

Contractor had no deadline for completing this facility which is situated in very narrow urban area limited by the local roads (on the west and east) and by the school facility (on the north). In spite of easy connection to the city water and power grid and close distance to material suppliers there were limitations of available site space so only the necessary quantity of materials and machines were permanently on site. Construction site organization scheme of Sports hall at the Regional primary school Dubašnica is presented on Figure 3.

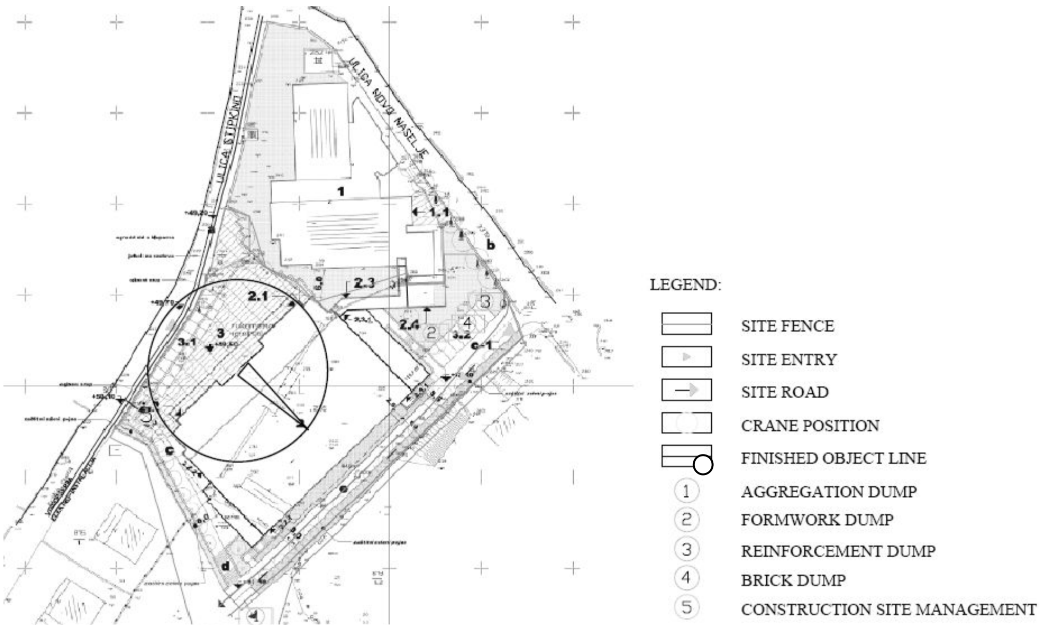

Fig. 3) Construction site organization scheme of Sports hall Dubašnica

Only limitation on this construction site, beside limitation of available space, was finances. Work on construction of the sports hall in Dubašnica depended on the cash flow which was very irregular. That was the main reason why construction time was long considering the size of facility and simplicity of construction. Total period of work lasted 24 months, form October 2006 until October 2008 [6].

5 CONCLUSION

The significance of construction management plan (CMP) within construction work preparation was presented with two case studies. Case studies were similar in one hand and completely opposite in the other. Although both facilities are public facilities, first one represents a complex facility while second one represents a simple facility. First case study shows importance of making CMP for complex facilities in order to meet the desired deadline while second case study shows that making CMP is not needed for simple facilities with well-known, routine, construction process in full size.

Every construction project can be described as a non-routine, unrepeatable and unique venture that has distinct time, financial and technical objectives. Construction management plan is an important element of construction production system and it is very important to acknowledge the specificities of the facility and the site locations with construction management plan. Acknowledgement of site specificities and coordination with the CMP will respond optimally on possible risks on site and achieve the prime objective – economical building in optimal time and cost schedule with requested quality of the building.

Although making CMP in the Republic of Croatia does not present an obligation according to existing legislation, theory and practice convincingly show the need of its development. Many contractors in Croatia have recognized the significance of CMP development and are regularly making it in the construction preparation phase.

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USABILITY OF RECYCLED MATERIALS FROM PETROLEUM DERIVATIVE IN SAVING ENERGY AND MATERIAL RESOURCES

Libor Matějka[1], Jan Pěnčík[2]

Abstract

Using of waste and waste material is a frequent and actual topic, which corresponds to current trends associated with the decreasing of power exigency and sustainable development. Current capacity of natural resources is limited. The tool to reduce usage of natural resources and decrease the produced waste consists in an efficient and possibly repeated use of resources - resource recycling. An important subgroup of waste is formed by materials from petroleum derivative - polymers (PP, PE etc.). During a decision process about recycling and usage of recycling materials for product production is necessary also consider an economic aspect. The whole process should certainly not be ineffective. Most of the recycled materials have targeted longer shelf life than traditional products.

Keywords

Waste, recycling, petroleum derivative, polymer, price

1 INTRODUCTION

Using of waste is an actual topic, which corresponds to current trends of decreasing of power exigency and sustainable development. Current capacity of natural resources is limited. The tool to reduce usage of natural resources consists in an efficient and possibly repeated use of resources - resource recycling. The advantage of recycling is the minimization of wastes as well as decrease of power consumption and CO_2 production.

The human population is the producer of communal wastes. The statistics show that it can be up to 15% of all the waste production [1]. Not only human population but each branch of the human activities is associated with production of waste of various volume and type. The biggest waste producer is the industry and power engineering. Also the area of civil engineering produces waste that represents an important share of company wastes. In the

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countries of the European Union, there is approximately 700 to 800 kg of civil waste falling on one citizen annually (without excavated earth).

An important subgroup of waste is formed by *petroleum derivatives* - *polymers*. According to the data of PlasticsEurope, BASF and K2004 approximately 221 mil. t of polymers and caoutchouc (of which 176 mil t. o materials) was manufactured in 2003 including 19 mil. t. of caoutchouc for technical rubber and tyres. In 15 years the production of plastic materials in global scale doubled. In 2006 it reached the value of 245 million tons and it grows every year approximately by 5 to 8%. This high production of polymers is associated also the increased production of waste plastic.

There exists a huge quantity of waste polymers - PP, PE, PET, PVC, PUR etc. (Fig. 1). These materials belong to the group of thermoplastic materials and they can be easily recycled due to their basic property - thermal plasticity. Another advantage of using recycled polymers is the possibility of improvement of their properties - mechanical and thermal.

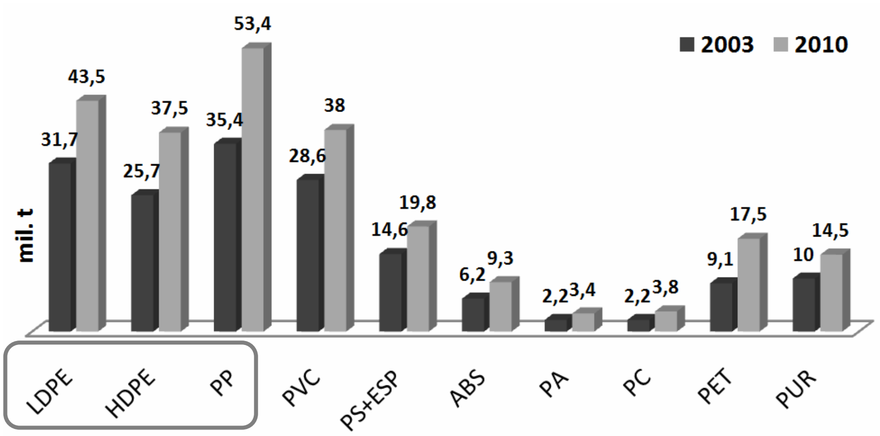


Fig. 1) World production of polymers in 2003 with forecasting to 2010 [2]

From the group of polymers (Fig. 1) have suitable properties for recycling and for repeat usage for product production available in the area of civil engineering waste polypropylene PP and waste polyethylene PE in low-density LDPE or high-density HDPE form [3]. From (Fig. 1) results that selected polymers represent more than 50% ratio of the total global production of polymers. This high production is associated with high production of wastes, which can be used as a source of material usable for other application.

2 USING OF RECYCLED MATERIALS IN CIVIL ENGINEERING

Current trends of energy savings in a branch of civil engineering is the design and construction of low-energy and passive houses. The difference between the low-energy and passive house is in the limit of heat consumption per year. In case of the low-energy house the top limit of heat consumption is 50 kWh/m^2 per year and in case of passive house the top limit is 15 kWh/m^2 per year.

This concept of construction of low-energy and passive houses is associated with the need to solve originated details, for example wall footing detail (Fig. 2). In this place thermal bridges originate due to decrease of thermal resistance of the structure. Solution and dispose of these thermal bridges contributes to heat savings and also to money savings.

There are two methods of solution of mentioned detail - direct and non-direct. Both of them interrupt thermal flow. In the non-direct solution is insert thermal insulation under adjusted terrain to the necessary depth (Fig. 2a) or the thermal isolation is depose on the terrain to the required distance from the wall (Fig. 2b). In the direct solution is thermal bridge get out using thermal insulation which is embedded between wall and foundation (Fig. 2c).

For solution of mentioned detail using direct method was designed new product an *insulation block* (Fig. 3). Product was designed and made of recycled polymers HDPE with modified mechanical and thermal properties. An insulation block is formed by boards of constant thicknesses which are laid on one another and the necessary thickness is achieved by increasing the number of these boards (Fig. 3). The boards are toothed and the individual tooting fit together and thus prevent mutual shift of the boards. The tooting in the contact with foundation and with masonry is deposited in glue matter and thus they co-act. Total thickness results from the requirements for thickness of the entire thermal insulation in the floor composition.

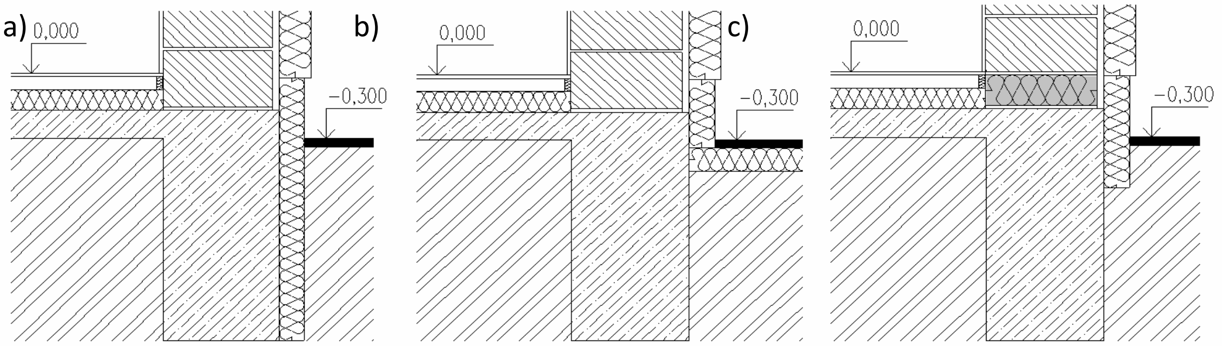


Fig. 2) Solution of a wall footing detail - non-direct (a), (b) and direct method (c)

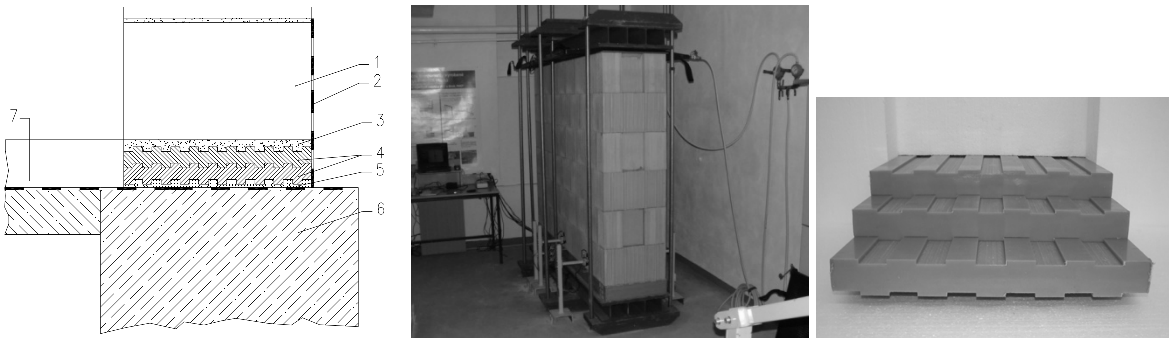


Fig. 3) Insulation block - section (a) and insulation block in the testing stand (b), detail of an insulation block composite by 3 boards (c)

alternative solution of thermal bridges using direct method - comparison of variants

Comparison of variants of alternative solution of thermal bridges using direct method is done by the help of FEA analysis. Using created analysis model was analysed 2-dimensional temperature field, where output is represented by value of calculated thermal transmissivity L and calculated thermal transmissivity through floor and soil L_g, both in unit W/mK. For each of 4 variants was calculated a linear factor of transmissivity ψ according equation (1)

$$\psi = L - U \cdot b - L_g \qquad (1)$$

where b is height of wall (1 m) and U is a coefficient of transmissivity for wall in W/mK. Alignment of analysed variants solution of thermal bridge (wall made from tile-brick Heluz THERMO STI 44):

- V1 - absence of thermal insulation solution method,
- V2 - usage of tile-brick Heluz with cavities filled with expanded perlite,
- V3 - solution of thermal bridge using insulation material – foam glass Perinsul,
- V4 - solution of thermal bridge using insulation block from recycled material - HDPE composite.

2.1 Results

Before comparison of variants V1 to V4 is in (Tab. 1) compared for each materials, or variant, thermal conductivity coefficients λ in unit W/mK. The variant using foam-glass shows best thermal insulation. This solution method is in the price comparison rather unfavourable.

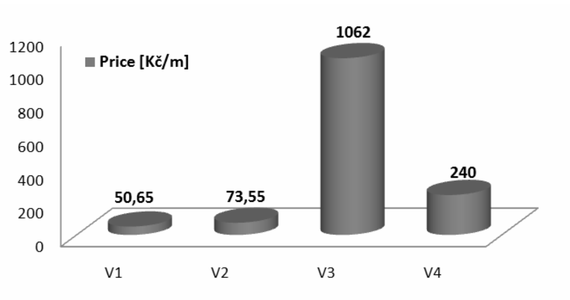
Tab. 1) Thermal conductivity coefficients

Material	Thermal conductivity coefficient λ [W/mK]	
	λ_x (horizontal)	λ_y (vertical)
(V1) tile-brick Heluz THERMO STI 44	0,102	0,674
(V2) cavities filled with expanded perlite	0,077	0,159
(V3) foam glass Perinsul	0,049	0,049
(V4) HDPE composite	0,090	0,090

A linear factor of transmissivity ψ, in unit W/mK, calculated according equation (1) is for variant V1 to V4 compared in (Tab. 1) and on (Fig. 4).

Tab. 2) Linear factor of transmissivity

Material	Linear factor of transmissivity ψ [W/mK]
(V1) tile-brick Heluz THERMO STI 44	0,146
(V2) cavities filled with expanded perlite	0,110
(V3) foam glass Perinsul	0,056
(V4) HDPE composite	0,080



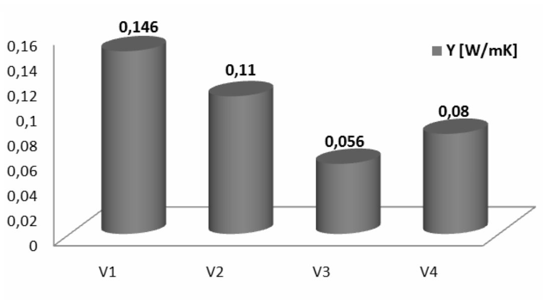


Fig. 4) Effectiveness of material solution and its price

3 CONCLUSION

The use of wastes and waste material is the most frequent and actual topic, which corresponds to sustainable development. The tool to reduce usage of natural resources consists in an efficient and possibly repeated use of resources - resource recycling.

From a group of waste can be selected a subgroup of waste formed by petroleum derivatives - polymers. These materials belong to the group of thermoplastic materials and they can be easily recycled. Suitable properties for recycling and for repeat usage for product production available in the area of civil engineering waste polypropylene PP and waste polyethylene PE in low-density LDPE or high-density HDPE form.

The recycled HDPE composite was used for solution of wall footing detail using a new product - an insulation block. It is clear from results that recycled HDPE composite meets requirements of comparable parameters of traditionally used materials. Qualitative properties and durability of the construction are not aggravated.

Application of recycled HDPE composite together to an insulation block is a good example of usage of recycled material in civil engineering with the purpose to save energy and protect environment at mutual economical valuation.

ACKNOWLEDGEMENT

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VALUE ASSESSMENT METHOD OF LAYING UTILITIES TO MULTIDUCTS

Petr Matějka[1]

Abstract

The contribution deals with value analysis of the engineering network multi-channel routes. It focuses on this technological solution methods compared to standard technological methods and differences in multi-channel lay methods with regard to current trends and technological possibilities in the field.

The main part of this contribution is based on research done by the student grant competition on Economy of technical solution utility tunnel. In the project, evaluation criteria for laying methods are formulated and evaluated by using Dephi method. These evaluation criteria are used for evaluating and assessing different engineering network storage systems afterwards. In conclusion, the theme of the topics future situation and evolution trends are partially developed.

Key words

value analysis, laying methods, multi-channel, multi-duct, SMST, collector, engineering network storage system, facilities, comparison, decision, decision-making process, criteria

1 INTRODUCTION

1.1 Overview

In these days, the topic of engineering network lying becomes more and more important issue. Old networks are becoming obsolete and they don't meet environmental, moral and technological requirements. After decades of these facilities lifespan, material possibilities and technologies made a big step forward. When in need of replacing old facility or building a new one, we have much more possible solutions we can choose from. This decision-making process often seems pretty clear, but when examined carefully, it becomes more and more complicated and complex. In this paper, some aspects of this decision-making process will be dealt with and some important issues will be pointed out.

It's not necessarily connected with building environment, but it's about whole human society: people want to live in highest possible comfort, where all their needs are satisfied. It doesn't

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matter, whether we refer to basic needs, or whether we are talking about life standards and luxury requirements. Trying to satisfy all these needs is nature of every person with no exception. But there are obstacles, of course. Sometimes, we don't know what we really want, because we are not familiar with assets and benefits of possibilities, we don't actually know possible solutions at all or we don't understand impacts and consequential and synergy effects of our decisions. Sometimes, there are conflicts between our different needs and sources, so we have to find the best possible solution with compromises, which often means, that our needs are not fulfilled completely. To make responsible decision, we don't need only to understand problem. We have to completely understand our needs as well and we need to understand connection between our needs, sources and problem we are solving. This article deals with the first part, trying to analyze actual view on the part of our needs – engineering network systems and their different technological storage methods.

1.2 Background

This paper is part of the longer term research (SGS 10/016/OHK5/1T/11 Economy of technical solution utility tunnel), where different types of engineering network storage systems are analyzed, evaluated and compared. The aim of this research is to formulate differences between different laying methods (mentioned later in this paper) and to examine modern technologies and their competitiveness against classical laying methods. Research deals with the lack of knowledge about multi-duct and collector networking, which negatively affects sustainable development and technology progress in facilities construction branch.

When referring to "future research" or "research", it is basically a reference to this work, which is in progress by the time of writing this article and cannot be fully used as a source. On the other hand, it can be understood as a suggestion to examine problem more carefully and from different angle as well, because this paper cannot cover all complex aspects of this topic and it concentrates on topics highly specific part.

1.3 Classification

In this article, four different network storage methods are examined:

- Classical laying method directly into the ground
- Multi-duct (multi-channel) solution
- Collector solution
- SMST (Modular system of mobile associated track) solution [1]

These methods represent ways, how engineering networks could be constructed and stored. For example, they do not cover other perspectives like technologically different methods how to put network on its place (classical vs. no-dig technologies etc.) or they do not specify type of network (electricity, water, gas etc.) or its dimensions. This is for the purpose to make decision-making process clean and understandable for analysis purposes. In case of real life decision-making process, all these other factors and perspectives have to be understood as well and should be put together. Making decision based just on the one factor would be terrible mistake. In case of analysis, breaking whole complex problem into shards is one of the first steps to fully understand complex problem.

Speaking about different laying methods mentioned above, SMST method stands beside other three, because it is incomparable with them in many scenarios. This is because of its different nature, being only one facility built above the ground, which could be, but is not necessarily true, for other three methods. Therefore SMST method is in the analysis just to make the list completed and to provide further comparison in case of need. The crucial part of this paper deals basically with the first three methods.

2 BASIC DECISION-MAKING PROBLEMS AND ASPECTS

When making decisions about what engineering network storage technology to use, we encounter many different problems. Only by eliminating or by understanding these problems, our decision can be precise. It's not necessary to solve problems connected with decision-making, but knowing possible problems allows us to fully analyze whole topic and adjust are decisions. In this chapter, some of the most important topics will be briefly discussed. Their impact on the decision-making process is absolutely crucial, but has different character, than what the main aim of this paper is - value analysis. Topics referred in this chapter have specific role. They have direct impact on whether chosen technology could be or could not be used. In other words, based on topics discussed in this chapter (which can limit us from some solutions or direct us to some solutions), we should be pretty sure about what technology is probably the best for us to use. On the other hand, many cases are not so clear and that's where value analysis should be considered to support our decision.

2.1 Qualification, awareness and legal obstacles

Qualification in the term of general knowledge (qualification of subjects participating in decision-making process) is one of the most important factors, because it limits us from making fully eligible decision. With lack of qualification, we may be limited to solutions we know or we can wrongly assess costs and benefits of compared solutions. Qualification of other subjects in the realization process can limit us as well. For example, our plans can be limited by state policy like area management etc. We should properly identify these threats and understand limitations we have to respect or overcome.

2.2 Resources

Resources can limit us from preferred solution realization and make these solution restricted to us. Resources can cover topics like finances, workforce qualification, technology level, machinery conditions etc. Based on resources, we may be forced to use specific solution with no regard to other aspects. Resources can highly influent other aspect of our decision-making process by making otherwise less important factor crucial.

2.3 Site and technological conditions

Site and technological conditions cover all aspects, which specify project we want to realize. Building in the city is different than building on "green meadow". Every kind of engineering network storage systems has its advantages and disadvantages. Where we need many connections, we will consider multi-ducts or even collectors. Where there is no need for jointed networks, we can prefer classical laying system. We have to consider space limitations, construction pollution limitations and all these aspects, which may be in some cases not only partly important, but absolutely crucial. Sometimes these factors will determine storage system we will use, because they restrict us from effectively using different ones.

3 VALUE ANALYSIS

As a part of the research (spoken about in chapter 1.2), value analysis of different engineering network storage systems have been made. Four different variants of storage systems (chapter 1.3) have been examined and 14 decision-making criteria have been formulated using Delphi method with the help of many respondents from different branches more or less connected with engineering network facilities. Based on Delphi method research, weights of criteria mentioned above were calculated. As a result, table with criteria have been made and this table was, with the help of respondents, used for four different engineering network storage systems comparison. Data gathered this way were used analyzed with some of the value analysis decision-making descriptive methods. This chapter deals with results of this value analysis.

It is important to have in mind that value analysis does not provide us with real data of actual situation in referred construction branch. Value analysis tells us, how respondents (professional public in this case) see situation in referred construction branch. And that's difference. Although results gathered from value analysis could be easily used for decision-making process, another part of the research (see chapter 1.2) is comparing value analysis of data gathered from respondents with real data. Unfortunately this is extremely complicated and often even impossible. When talking about Costs, there is no problem of comparing items. When talking about Moral lifespan, it is much more complicated and full assessment of compared technologies is uttermost complicated. Therefore it's important to have in mind that we should not refer to value analysis in this paper as to real world description. We should refer to it as to the way how the real world is understood. Confronting these two categories can then direct us to discrepancies and help us find mistakes of our decision-making process.

Another important fact is that value analysis could be completely different from different point of views, based on project cycle participants. These are: investor, designer, end user, contractor, network owner and state. Value analysis in this paper consists mostly from investors, designers, end users and contractors. In the future research (see chapter 1.2), this will be treated in more detailed way.

3.1 Criteria

Based on Delphi method survey, many different decision-making criteria have been gathered. These criteria have been analyzed, aggregated and combined into items. Although every each criteria is more or less important, some of items were put aside, because they have no (or insignificant) direct impact on variants differentiation – for example it were environment impact in the manner of noise and vibration during construction or regional site parameters, because these items are same or at least very similar for all variants.

In the end, 14 criteria were found. Some of items are connected and some of them are mingled, but they altogether reflect professional public opinion of what is important when making decision about which engineering network storage system we should use (with the exceptions mentioned above in chapter 2). These criteria are: 1) Variant riskiness (realization process, technological solution, "neatness"...), 2) Costs of purchase, 3) Possibility of reconstruction, renovation and innovation, 4) Operating costs, 5)-7) Lifespan: Operating reliability, Resilience (against external influences, geological conditions etc.), Moral lifespan, 8) Replacements and repair speed, 9)-10) Environmental impact: Liquidation difficultness (recycling ability), Operating environmental risks, 11) Network extending and modernizations possibilities, 12) Revisions and repairs possibilities, 13)-14) Surrounding and neighborhood impact during construction: Construction site size and surrounding limitation, Pollution (noise, vibration, exhalations, waste)

3.2 Weights

In the weight determination part of value analysis, each respondent were asked to arrange criteria set according to their importance order (equal importance was possible as well). Based on these data, average weights of criteria have been determined. Table 1) shows results with criteria ranking based on their importance.

Tab. 1) Weights and ranking

Rank	no.	Criteria	Weight
1.	2.	Costs of purchase	0,110
2.	4.	Operating costs	0,104
3.	5.	Lifespan - Operating reliability	0,102
4.	12.	Revisions and repairs possibilities	0,095
5.	11.	Network extending and modernizations possibilities	0,090
6.	8.	Replacements and repairs speed	0,088
7.	3.	Possibility of reconstruction, renovation and innovation	0,086
8.	1.	Variant riskiness (realization process, technological solution "neatness"...)	0,059
9.	6.	Lifespan - Resilience (against external influences, geological conditions etc.)	0,054
10.	10.	EI - Operating environmental risks	0,052
11.	14.	Surrounding and neighborhood impact during construction - Pollution	0,046
12.	13.	Surrounding and neighborhood impact during construction - Limitations	0,045
13.	7.	Lifespan - Moral lifespan	0,038
14.	9.	EI - Liquidation difficultness (recycling ability)	0,031

Here we can see total domination of costs criteria on the first two places, followed with lifespan reliability and revision, repairs, modernisation, extension, replacement, repair, renovation and innovation possibilities, which can be aggregated into lifespan quality and reliability. Slightly alarming could be lesser importance of environmental items, which does not reflect sustainable development and environmental friendly tendencies in later years.

3.3 Variants comparison

In another part of the survey, respondents were asked to compare four engineering network storage system variants in fields specified by formulated criteria. They compared variants on scale from 1 to 10, where 10 were better.

Tab. 2) Variants assessment

Rank	no.	Weight	1) Classic	2) Multi-duct	3) Collector	4) SMST
1.	2.	0,110	8,067	5,067	2,467	4,462
2.	4.	0,104	5,500	5,533	5,367	5,385
3.	5.	0,102	3,667	7,067	8,333	6,846
4.	12.	0,095	2,400	6,400	8,667	8,077
5.	11.	0,090	2,200	6,933	8,467	7,308
6.	8.	0,088	2,733	6,667	8,200	7,692
7.	3.	0,086	3,200	6,533	7,733	6,846
8.	1.	0,059	5,133	6,200	5,267	6,769
9.	6.	0,054	3,267	6,467	9,200	5,769
10.	10.	0,052	4,600	5,867	7,467	5,077
11.	14.	0,046	2,933	5,200	7,400	6,154
12.	13.	0,045	3,333	5,067	6,667	5,615
13.	7.	0,038	4,533	7,200	7,733	6,077
14.	9.	0,031	5,067	5,667	5,267	6,692

Data gathered this way were analyzed and combined into average values. These values were thereafter used to make value analysis. Four different methods were used: Index method, Hamming metric, Ivanovič deviation and Adjusted Ivanovič deviation. In following tables, results can be seen.

Tab. 3) Different methods results

<table>
<tr><th colspan="2"></th><th>1) Classic</th><th>2) Multi-duct</th><th>3) Collector</th><th>4) SMST</th></tr>
<tr><td rowspan="2">Index method</td><td>Utility</td><td>1,000</td><td>1,786</td><td>2,128</td><td>1,897</td></tr>
<tr><td>Rank</td><td>4.</td><td>3.</td><td>1.</td><td>2.</td></tr>
<tr><td rowspan="2">Hamming metric</td><td>Utility</td><td>0,632</td><td>2,692</td><td>3,465</td><td>2,909</td></tr>
<tr><td>Rank</td><td>4.</td><td>3.</td><td>1.</td><td>2.</td></tr>
<tr><td rowspan="2">Ivanovič deviation</td><td>Utility</td><td>3,341</td><td>2,073</td><td>0,039</td><td>1,192</td></tr>
<tr><td>Rank</td><td>1.</td><td>2.</td><td>4.</td><td>3.</td></tr>
<tr><td rowspan="2">Adv. Ivan. deviation</td><td>Utility</td><td>3,728</td><td>3,082</td><td>0,169</td><td>2,043</td></tr>
<tr><td>Rank</td><td>1.</td><td>2.</td><td>4.</td><td>3.</td></tr>
</table>

Although the first two linear methods show completely different results than the next two differential methods, outcomes are quite clear. When using simple methods, we do not count with differences in specific criteria weight distances. When we later use correlation coefficient or linear regression, it shows us importance of costs category criteria.

3.4 Results

As a result, we can state that although multi-ducts and collectors are basically desired engineering network storage systems, especially because of their quality, lifespan advantages and environmental related attributes, there is one important obstacle that these modern technologies have to overcome – the cost. As emerged from value analysis, high cost is in case of modern storage technologies understood like absolutely crucial in case of making decision. Even though modern technologies are considered better and more wanted in many ways, high costs are burden, which dive them to the similar level where classical storage systems are. The question is: Are modern technologies really that expensive, or is it just a myth? Answering this question should be another part of the future research (see chapter 1.2).

Lesser importance of modern technologies strengths is also noticeable. Although sustainable development and environmental friendly progress are sensitive and highly discussed topics nowadays, it seems that when put against money, they can hardly compete. Are these topics important only in case when decisions concerning money and functionality are already made? We should ask ourselves, if this is how we want it. In the end, it's about meeting end user needs and the question is: Is end user (and not only he) familiar with pros and cons connected with network storage systems and so he can responsibly make decisions.

4 CONCLUSION

This article tried increase awareness of modern storage systems and their usability how it is understood by professional public. It tried to bring up some questions about decision making process when choosing appropriate storage systems. These questions are based on value analysis that has been described and presented. Different variants have been compared with different results, which can be used for future research and deeper case study.

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CONCRETE GRADE INFLUENCE ON THE BEARING CAPACITY OF FLEXURAL MEMBERS

Dumitru Moldovan[1]

Abstract

High Strength Concrete has been in recent years the object of intensive study due to its numerous advantages over Normal Strength Concrete. Contrary to other Special Concretes such as Ultra High Performance Concrete or Reactive Powder Concrete, High Strength Concrete is becoming increasingly more available to contractors and thus more common to jobs all over the world.

This paper will provide a brief comparison on the flexural behaviour of members casted with High Strength Concrete, C60 and C80 grade respectively, against Normal Strength Concrete, C 30 grade, in view of a study for the author's PhD Thesis.

Key words

high strength concrete, comparison, flexural, behaviour, normal strength concrete

1 INTRODUCTION

Advantages for the use of High Strength Concrete may be generalised as being two:

- Immediate advantages, due to superior self-properties (i.e. the increase of the concrete grade will result in a reducement in the cross section, due to the increase in the compressive stress the concrete can bear)
- Collateral advantages, which reflect indirectly the above (i.e. less volume of concrete to be casted means less Portland cement to be produced, less transportation costs and even less wear for the road systems, etc.)

Therefore, due to such effects at the top of the system (i.e. the use of higher concrete grades) which can the identified all the way to the bottom (i.e. the Portland cement industry), it is safe to say that High Strength Concrete is a sustainable construction material.

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1.1 Research program

The results presented herein were possible due to the financial support from Grant A (1036/2004, *High Strength and...*) [6] and TD (280/2007, *Ductility of High Strength…*) [7]. The mix studied consists mainly in Portland Cement of CEM I 52,5 R type supplied by La Farge, silica fume supplied by Sika, and crushed aggregates of 0-4 [mm], 4-8 [mm] and 8-16 [mm] from a local quarry in Morlaca. The W/C ratio is of 0,266. A policarboxilate super plasticizer, commercially available as Ravenit, has been added at a dosage of 0,88 [%].

Tab. 1) Mix proportions

Name	Cement (52,5 R)	Aggregates (8-16)	Aggregates (4-8)	Sand (0-4)	Silica fume	Super-plasticizer (RAVENIT)	Water
I	480	706	530	530	48	13,5	152
BH	520	706	530	530	52	13,5	152
units	[kg/mc]	[kg/mc]	[kg/mc]	[kg/mc]	[kg/mc]	[l/mc]	[l/mc]

A number of 14 beams of $125 \cdot 250 \cdot 3200 - mm$ grouped in two series, have been casted in this research. The adopted reinforcement was the same for two by two beams.

The first series, named "I", consisted of a number of 8 beams, with the coefficient of longitudinal reinforcement, ρ, between 0,027 and 0,039. The type of steel used for the longitudinal bars is PC 52, a national mark with a yielding point of 350 MPa and a maximum strain of 50 [mm/m]. For this series, the concrete grade is C60.

The second series, named "BH", consisted of 6 beams, with the coefficient of longitudinal reinforcement between 0,013 and 0,027. The mark of steel used is Bst 500 S with a concrete grade of C80.

Concrete class has been established on a statistical basis, from 150 [mm] cubic specimens tested at the age of 28 days in uniaxial compression. Some specimens were tested at 90 days, the age of testing the beams in a four point setup that insures a constant moment zone in the middle third of the beam. Subsequently, failure has occurred in flexure, as intended.

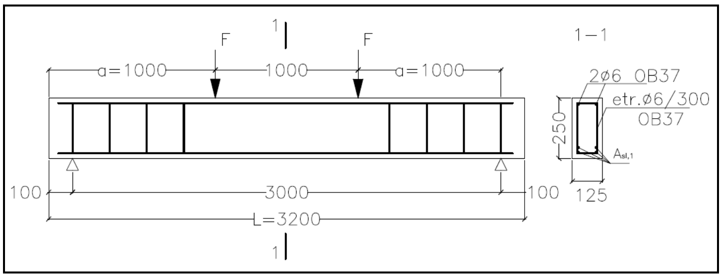

Fig. 1) Test setup, reinforcement and cross section dimensions

Up to the age of testing, the beams and the accompanying specimens were cured at $20^o C \pm 2^o C$ and at $RH\,60 \pm 5\%$. Loading was performed with a constant speed of $1\ N/mm^2$ at a first class precision compression/flexure machine with a maximum load of 3000 kN. Each loading step was 1/10 of the calculated bearing capacity in flexure. In addition, each step took about 10 to 15 minutes to complete, that is, to allow deformation stabilization and data recording.

2 BEARING CAPACITY

In order to present the desired comparison, the calculus of the bearing capacity according to Eurocode 2 and in particular to the national code implementing its provisions, SR EN 1992-1-1:2004 (Eurocod 2: *Proiectarea structurilor de beton*…, 2004) [3], will be presented further. All the results presented herein are determined based on these provisions.

2.1 Bearing capacity for High Strength Concrete

The stress block is defined by two parameters, one applied to the effective height of the compressed area of concrete, λ, and the second applied to the effective strength of the concrete, η. The equations to define those parameters are:

$$\lambda = \begin{cases} 0,8 & if\ f_{ck} \le 50\text{MPa} \\ 0,8 - \left(f_{ck} - 50\right)/400 & if\ f_{ck} > 50\text{MPa} \end{cases} \tag{1}$$

$$\eta = \begin{cases} 1,0 & if\ f_{ck} \le 50\text{MPa} \\ 1,0 - \left(f_{ck} - 50\right)/200 & if\ f_{ck} > 50\text{MPa} \end{cases} \tag{2}$$

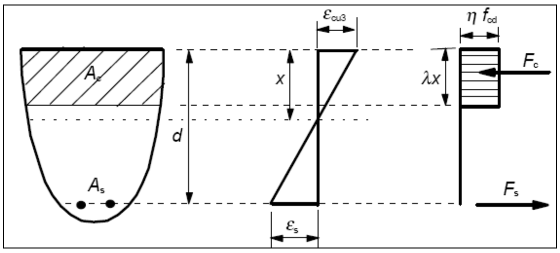

Fig. 2) Stress block parameters

The tensile resultant, based on the area of reinforcement in the cross section, A_s, and on the effective strength of the steel, f_{yd}, is:

$$F_s = A_s \cdot f_{yd} \tag{3}$$

The compression resultant, based on the stress block parameters, λ and η, and the width of the cross section, b, is:

$$F_c = \lambda \cdot x \cdot \eta \cdot f_{cd} \cdot b \tag{4}$$

The bending capacity of a particular cross section is therefore:

$$M_{Rd} = A_s \cdot f_{yd} \cdot z \tag{5}$$

Results of the above are given in Table 2. In addition to the results collected in the fore mentioned research program, several other studies are presented, such as ASHOUR (*Effect of compressive strength...*), [4], PAM et al. (*Flexural strength and ductility...*), [5], BERNARDO & LOPES (*Neutral Axis Depth...*), [6]. The presentation focuses only on the concrete grades closest to the ones obtained in the personal study.

Tab. 2) Bearing flexural moment for High Strength Concrete

Mechanical and geometrical characteristics						Calculated Values					
Name	Concrete Grade	Depth	Area of Reinforcement	Reinforcement coeficient	Mechanical Reinforcement Coefficient	Tensile Resultant	Compresive Resultant	Effective Height of Stress Block	Neutral Axis Position	Level Arm	Resistive flexural moment
	C	d	A_{sl}	ρ	ω	F_s	F_c	$\lambda \cdot x$	x	z	M_{Rd}
	[-]	[mm]	[mm^2]	[-]	[-]	[kN]	$\lambda \cdot x\ [kN]$	[mm]	[mm]	[mm]	[kNm]
I 1	C60	194.286	628.319	0.0259	0.2321	191.637	4.038	47.464	61.244	170.554	32.684
I 2		194.000	735.133	0.0303	0.2719	224.215		55.533	71.656	166.233	37.272
I 3		192.063	816.814	0.0340	0.3052	249.128		61.704	79.618	161.211	40.162
I 4		190.235	911.062	0.0264	0.3437	277.874		68.823	88.804	155.824	43.299
BH 1	C80	211.467	355.000	0.0134	0.1289	154.425	4.817	32.061	34.660	195.436	30.180
BH 2		194.500	452.389	0.0186	0.1785	196.789		40.856	44.169	174.072	34.256
BH 3		196.556	574.911	0.0234	0.2245	250.086		51.921	56.131	170.595	42.664
ASHOUR (2000) (Effect of compressive strength and tensile reinforcement ratio...), [2]											
B-M2	C70	215	509	0.0118	0.1169	234.583	8.400	27.927	37.235	201.037	47.160
B-M3		215	763	0.0177	0.1752	351.643	8.400	41.862	55.816	194.069	68.243
B-M4		215	1018	0.0237	0.2338	469.165	8.400	55.853	74.471	187.073	87.768
B-H2	C90	215	509	0.0118	0.0909	234.583	9.600	24.436	34.908	202.782	47.569
B-H3		215	763	0.0177	0.1363	351.643	9.600	36.630	52.328	196.685	69.163
B-H4		215	1018	0.0237	0.1818	469.165	9.600	48.871	69.816	190.564	89.406
PAM et al. (2001) (Flexural strength and ductility of reinforced normal- and...), [3]											
7	C55	260	1296	0.0249	0.3074	586.017	7.150	81.960	104.077	219.020	128.349
8		260	1473	0.0283	0.3493	666.052		93.154	118.291	213.423	142.151
9		256	1809	0.0353	0.4357	817.983		114.403	145.274	198.798	162.614
10 (11)		256	2099	0.0410	0.5046	947.288		132.488	168.238	189.756	179.754
12		256	2414	0.0471	0.5803	1089.449		152.370	193.486	179.815	195.899
13		256	2815	0.0550	0.6780	1272.870		178.024	226.062	166.988	212.554
14	C80	260	982	0.0189	0.1780	493.562	9.067	54.437	75.085	232.782	114.892
15 (16)		260	1473	0.0283	0.2670	740.343		81.655	112.628	219.172	162.263
17		256	1608	0.0314	0.2796	763.450		84.204	116.144	213.898	163.300
18 (19)		256	2414	0.0471	0.4412	1204.901		132.893	183.301	189.553	228.393
20		256	2815	0.0550	0.4957	1353.648		149.299	205.930	181.350	245.484
BERNARDO & LOPES (2004) (Neutral Axis Depth versus Flexural Ductility...), [4]											
A1	C55	238	452	0.0158	0.2004	209.885	4.290	48.924	62.126	213.538	44.818
A2 (A3)		237	628	0.0221	0.2933	305.809		71.284	90.519	201.358	61.577
A4 (A5)		234	804	0.0286	0.3904	402.000		93.706	118.992	187.147	75.233
C1 (C2)	C80	242	628	0.0216	0.2872	305.809	5.440	56.215	77.538	213.893	65.410
C3 (C4)		239	804	0.0280	0.3823	402.000		73.897	101.927	202.051	81.225
D1	C80	247	402	0.0136	0.1849	201.000	5.440	36.949	50.963	228.526	45.934
D2 (D3)		238	1030	0.0361	0.4901	513.209		94.340	130.124	190.830	97.936

2.2 Comparison between Normal Strength Concrete and High Strength Concrete

The comparison between Normal Strength Concrete and High Strength Concrete beams is based on the requirement to assure the same bearing capacity in bending while keeping constant the width of the cross section, b, and the reinforcement area, A_s. Thus, the only variation in dimensions is the height of the cross section. The results are given in Table 3.

Tab. 3) Height variation for Normal Strength Concrete sections

Mechanical and geometrical characteristics						Calculated Values		
Name	[illegible]	Resistive flexural moment	[illegible]	Depth	Reinforcement position	[illegible]	[illegible]	[illegible]
	[illegible]	M_{Rd}	$\lambda \cdot x$	[illegible]	d_1	[illegible]	[illegible]	Δh[illegible]
	[illegible]	[kNm]	[illegible]	[illegible]	[mm]	[illegible]	[illegible]	[illegible]
I 1	C60/C30	32.684	76.655	208.881	55.71	260	1.040	1.070
I 2	C60/C30	37.272	89.686	211.076	56.00	270	1.080	
I 3	C60/C30	40.162	99.651	211.036	57.94	270	1.080	
I 4	C60/C30	43.299	111.150	211.398	59.76	270	1.080	
BH 1	C80/C30	30.180	43.310	217.091	38.53	260	1.040	1.040
BH 2	C80/C30	34.256	55.191	201.668	55.50	260	1.040	
BH 3	C80/C30	42.664	70.139	205.665	53.44	260	1.040	
ASHOUR (2000) (Effect of compressive strength and tensile reinforcement ratio...), [2]								
B-M2	C70/C30	47.160	58.646	230.360	35.00	270	1.080	1.093
B-M3	C70/C30	68.243	87.911	238.024	35.00	270	1.080	
B-M4	C70/C30	87.768	117.291	245.719	35.00	280	1.120	
B-H2	C90/C30	47.569	58.646	232.105	35.00	270	1.080	1.107
B-H3	C90/C30	69.163	87.911	240.641	35.00	280	1.120	
B-H4	C90/C30	89.406	117.291	249.210	35.00	280	1.120	
PAM et al. (2001) (Flexural strength and ductility of reinforced normal- and...), [3]								
7	C55/C30	128.349	146.504	292.272	40.00	330	1.10	1.167
8	C55/C30	142.151	166.513	296.679	40.00	340	1.13	
9	C55/C30	162.614	204.496	301.046	44.00	350	1.17	
10 (11)	C55/C30	179.754	236.822	308.167	44.00	350	1.17	
12	C55/C30	195.899	272.362	315.996	44.00	360	1.20	
13	C55/C30	212.554	318.217	326.097	44.00	370	1.23	
14	C80/C30	114.892	123.390	294.477	40.00	330	1.10	1.200
15 (16)	C80/C30	162.263	185.086	311.715	40.00	350	1.17	
17	C80/C30	163.300	190.863	309.329	44.00	350	1.17	
18 (19)	C80/C30	228.393	301.225	340.166	44.00	380	1.27	
20	C80/C30	245.484	338.412	350.556	44.00	390	1.30	
BERNARDO & LOPES (2004) (Neutral Axis Depth versus Flexural Ductility...), [4]								
A1	C55/C30	44.818	52.471	239.774	32.00	270	1.00	1.000
A2 (A3)	C55/C30	61.577	76.452	239.584	33.00	270	1.00	
A4 (A5)	C55/C30	75.233	100.500	237.397	36.00	270	1.00	
C1 (C2)	C80/C30	65.410	76.452	252.119	28.00	280	1.04	1.037
C3 (C4)	C80/C30	81.225	100.500	252.301	31.00	280	1.04	
D1	C80/C30	45.934	50.250	253.651	23.00	280	1.04	1.056
D2 (D3)	C80/C30	97.936	128.302	254.981	32.00	290	1.07	

3 CONCLUSIONS

The first conclusion of our study is that the replacement of a C30 grade concrete with a C60 grade concrete while maintaining the same type or steel as a longitudinal reinforcement (i.e. PC 52) will lead to a reduction in the height of the section of about 7 [%/m].

The second conclusion is that a replacement of a given concrete grade (i.e. C30) with a higher concrete grade (i.e. C80) while also replacing the steel type (i.e. PC 52) with a higher mark (i.e. Bst 500S) will lead to a reduction in the height of the section of about 4 [%/m]. Paradoxally, this value is less than the one specified for a lower concrete grade (i.e. C60).

ASHOUR's data shows no clear trend, disregard of the concrete grade replacement, possibly due to the same mark of steel used for both concrete grades. PAM's data indicates a maximum increase of about 17 [%/m] in the case of C55 replacing C30 (similar to C60) and of about 20 [%/m] in the case of C80 replacing C30, for relatively similar steel marks to the ones used in our personal study. BERNARDO & LOPES's data show no difference between C55 replacing C30, while the case of C80 replacing C30 lead to the same result as the one obtained in our study, of about 4 [%/m].

The results obtained are therefore contradictory to the expected reduction in the height of the section as the concrete grade increases. This can only be explained by a faulty definition of the parameters λ and η in the case of High Strength Concrete. The difference in-between the experimental bending moment and the calculated one may also explain these results, which are of about 1.70 for C60 and of about 1.56 for C80. Values of 1.11 have been reported as means by ASHOUR and by BERNARDO & LOPES, while PAM reported a mean value of 1.02.

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RISK MANAGEMENT FOR SAFETY AT WORK IN CONSTRUCTION

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Abstract

Risk management for safety at work has always been a very complex process. In the Republic of Serbia during 2009, 70% of all work injuries happened on construction sites. According to a great number of participants, their complex interrelations and relations with materials, tools and construction mechanization as well as work operations, processes of risk identification and quantification are more complicated than in other industrial branches. [1] This paper will present a part of the analyses of causes of work injuries on construction sites according to types of construction works.

Key words

Safety at work, risk, injuries, body part, work operations

1 INTRODUCTION

The field of safety at work is known as the most delicate one within the building construction industry, having in mind that the largest number of incidents occurs in building construction. High rate of injuries at work presents a result which requires a systematic approach and record-keeping of all potential risks which can result from badly organized building processes and work technology. [2]

Considering the fact that the observed branch of industry is often marked by great losses, primarily of human lives, then working hours and financial resources, it is essential to create high quality data bases which would make the basis for managing the risk of safety at work in the field of building construction.

It is known that in the majority of countries employers are obliged to realize a range of activities related to workers and their safety at work, such as: risk assessment, introducing workers to the risks involved as well as safety measures, enabling workers to give first aid,

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regular medical check-ups, theoretical and practical preparation of workers for working safely, etc. By putting the mentioned activities into practice, some preconditions for proactive influence on work safety risks are met. They also contribute to creating of data bases which have grown into a standard in numerous building construction companies worldwide. However, data contained in those bases are not used sufficiently, leaving a considerable portion of this significant resource unused. This paper will present data gained through a research conducted in the Autonomous Province of Vojvodina, which are linked to work injuries that occurred on construction sites.

2 OVERVIEW AND ANALYSIS OF HISTORICAL DATA

In making this analysis, the data provided by the Institute for Health Protection of Workers Novi Sad were used. They are shown in table 1. and relate to rough construction works in the period from 20003 to 2007, as they appeared to involve the highest level of risk. [2] Within the period of five years, the total of various 565 injuries occurred when performing these works, ranging from minor to extremely severe ones, involving those which resulted in work disabilities, without taking into account the cases with fatal outcomes. It is necessary to note that table 1. only shows those injuries registered within the relevant medical department, without the injuries with fatal outcome as well as those that did not require any medical treatment.

With the aim of determining the cause of injuries, previously defined rough construction works are divided into 14 categories, 8 of which relate to the standard classification of works according to their types (Tab.1) as following:

- Carpentry works
- Masonry works
- Reinforcement works
- Concrete works
- Demolition works
- Earthworks
- Insulation works
- Preparation work

The remaining 6 categories (Tab. 1) are separated from the rest, since it was established that they should be regarded separately, considering the extensive number of injuries which occurred when performing these works, as well as due to their specific features. For instance, injuries which occurred during loading and unloading works can be associated with one or more of the 8 categories of basic groups of works mentioned previously. However, the number of injuries which happened during loading and unloading works implies the importance of these operations and points out that they deserve particular attention.

Classification of body parts shown in table 1. was established based on the most commonly used control lists. Identification of risks within those lists is done according to the type of works, work operations, planned tools, planned mechanization, etc. [2-4] The category of multiple injuries was separated, in order to avoid repetition of the same injuries for different body parts.

Coordinating the data basis with most commonly used control lists provides compatibility between risk identification and its quantification, which can be based on the data basis. This facilitates the use of the existing information, but also diminishes the subjective influence of the assessor, who is provided with accurate data on the frequency of injury occurrences. Since it is far easier to estimate the level of possible consequences (experience), and much harder to estimate the probability of risk occurrence, information on the frequency of injuries of certain body parts depending on types of works provide higher accuracy when estimating them.

The accuracy of assessment can be identified with its actuality, i.e. the measure which reflects the real state of conditions on the observed construction site. The more accurate (actual) an assessment, the better quality of the planned measures of protection.

Tab. 1) Overview of injuries according to work type and body parts

Work type (construction activities)	**Body part that was injured**								**Sum of injuries according to work type for 5 years**	**Mean of injuries according to work type for 1 years**	**[%] according to work type**	**Number of injuries for 100.000 workers for 1 year**
	Feet - legs	Hands	Body - torso	Multiple injuries	Head	Eyes	Face	Body - skin				
Material and tool transfer	45	29	13	11	8	1	2	0	109	21,8	19,75%	103,81
Carpentry works	41	38	10	13	4	3	0	0	109	21,8	19,75%	103,81
Moving on site	39	17	10	9	7	0	0	2	84	16,8	15,22%	80,00
Masonry works	11	9	4	8	6	13	0	0	51	10,2	9,24%	48,57
Reinforcement works	11	16	0	1	4	4	1	0	37	7,4	6,70%	35,24
Concrete works	9	13	4	1	3	4	0	0	34	6,8	6,16%	32,38
Unloading	10	11	6	3	4	0	0	0	34	6,8	6,16%	32,38
Loading	11	12	5	2	1	0	1	0	32	6,4	5,80%	30,48
Demolition works	2	8	0	0	1	3	0	2	16	3,2	2,90%	15,24
Earthworks	7	2	2	1	0	1	0	0	13	2,6	2,36%	12,38
Scaffold	1	5	1	3	2	0	1	0	13	2,6	2,36%	12,38
Site cleaning	4	2	0	0	1	0	0	0	7	1,4	1,27%	6,67
Insulation works	1	4	1	0	0	0	1	0	7	1,4	1,27%	6,67
Preparation work	2	3	0	0	1	0	0	0	6	1,2	1,09%	5,71
Sum of injuries according to body part	194	169	56	52	42	29	6	4	**552**	**110,4**	100,00%	525,71
[%] according to body part	35,14 %	30,62 %	10,14 %	9,42%	7,61%	5,25%	1,09%	0,72%				
Sum of injuries	**552**											

Based on table 1. and figure 1. it is possible to conclude that the majority of injuries, over 50%, occurred while moving materials and tools within the construction site, while performing carpentry works as well as while moving on site.

Moving of material and tools presents one of the basic work activities, as well as one of the most common ones on construction sites. Injuries occurring while performing these activities usually result from overloading of muscles, and dropping of tools and materials. Considering this, legs, hands and torso have most frequently been injured.

Moving on site is separated from the basic types of works since it presents an operation which cannot be avoided on construction sites, so the injury risk resulting from moving does not depend on the primary operation performed (moving), but on operations performed in the vicinity, as well as on the state of the construction site, regarding the way it is arranged and clear passages for moving.

Carpentry works usually resulted in injuries while realizing operations of assembly and disassembly of formwork, with injuries caused by falling of formwork and supporting elements being the most common ones. The combination of these factors and not using the personal protection equipment, led to extremely serious injuries. It is important to note that the injuries of the most sensitive body part, i.e. the head, belong to the group of the most frequent ones in the case of carpentry works.

It can be noticed that loading and unloading works together make 11.96% of the total number of injuries, which places them as the 4th in terms of number of injuries. The mentioned works normally belong to the group of less complex work operations, and the injuries usually occurred due to the lack of attention and not using the personal protection equipment, as well as an inadequate performance of work.

An interesting piece of information is the number of eye injuries in masonry works. These injuries present the most common ones in the mentioned group of works. The cause of the majority of eye injuries occurred while applying mortar.

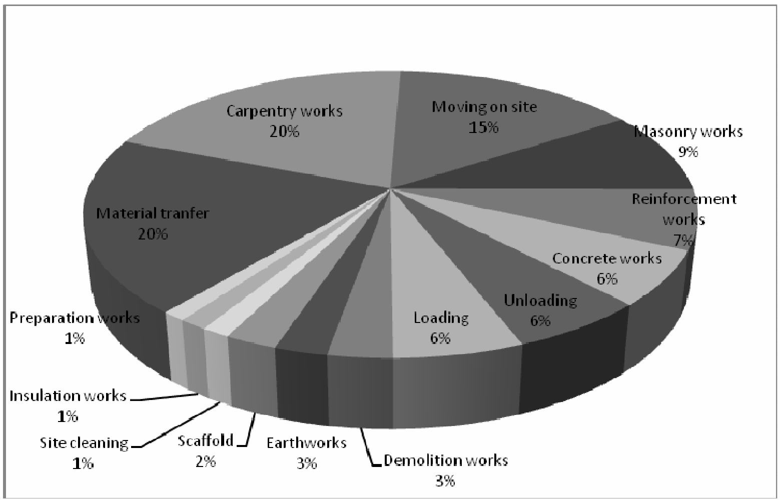

Fig. 1) Diagram of proportion of injuries according to work types

Body parts most often exposed to injuries are legs (feet), hands and torso. These results were expected, having in mind operations which are performed while building. What is worrying is the fact that legs and hand injuries can easily be avoided by using adequate personal protection equipment. On the other hand, the same result is encouraging as it leads to a conclusion that 66% of injuries (Fig. 2) can be eliminated by using adequate gloves and shoes.

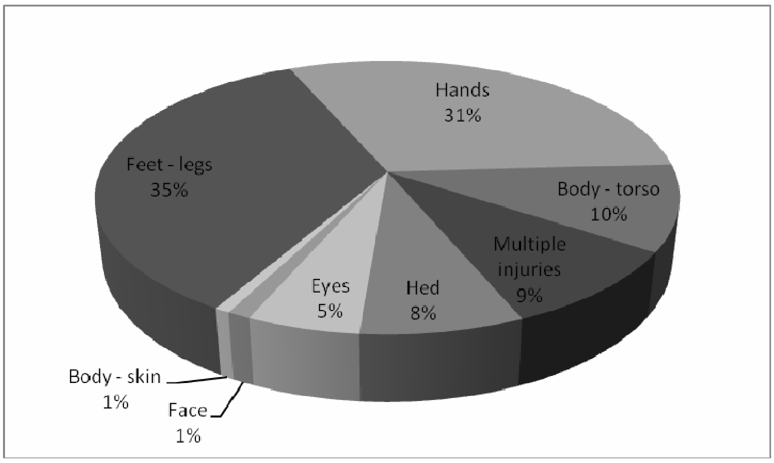

Fig. 2) Diagram of proportion of injuries according to body parts

Torso, as one of the most sensitive body parts, is most often injured while moving material (due to overloading of muscles), carpentry works (getting hit) as well as moving on site (badly cleaned passages for moving).

In the period after 2005, stricter control of construction sites in terms of work safety quality standards was initiated. The consequence of the mentioned activities was the more frequent use of protection helmet, as a compulsory and primary protection measure, which considerably reduced the number of head injuries. (Figure 3)

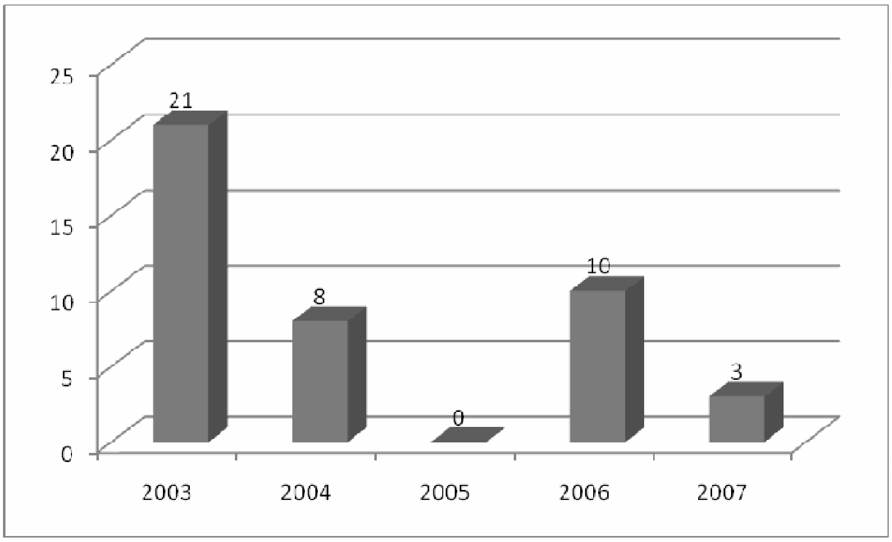

Fig. 3) Diagram of head injury proportion in the period from 2003 to 2007

Based on Figure 3, it is obvious that the number of head injuries dropped after 2004. In the first two years of the observed period, the total of 29 injuries was registered, whereas 13 head injuries occurred in the following three years.

Apart from the structure of injuries depending on the injured body part or types of works when they occurred, the average number of injuries for the observed period of 5 years was also shown, amounting to 110.4 per year. If a year consists of approximately 240 to 280 workdays, it is easy to conclude that an injury, minor or a serious one, occurs once in three days on the construction sites in Vojvodina. Considering the fact that the acquired unit of injury numbers in the world presents the number of injuries per 100 000 workers, these data were shown within table 1. When defining the mentioned number, it was assumed that there are about 21000 workers working on construction sites in building construction in Vojvodina, whereas it is estimated that another 30 – 40% of construction workers work illegally, which makes 6300 to 8400 workers.

3 CONCLUSION

Creating data bases of injuries at work according to types of work and body parts injured, provides an accurate method of risk assessment with specific information on the risk involved in certain activities within the building process. Apart from a more accurate risk assessment, it is also possible to generate better plans of risk management in work injuries in building construction.

On the other hand, it is necessary to improve the quality of data bases by providing information about the quality of construction site organization from the aspect of safety, workers' training as well as the quality of work safety procedures implemented by a construction company. By doing so, a more comprehensive analysis of the influence of individual segments of building process on the frequency and seriousness of injuries will be possible. Also, it will help satisfy the conditions for determining the importance and improvement of individual procedures, rules and activities, used when managing work safety risks.

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MANAGING THE CHANGES AS PART OF SUSTAINABLE PROJECT MANAGEMENT

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Abstract

Change is the only constant. If we are talking about the world of Project, this statement has to be expanded: Project Changes and Project Objectives are the only two constants. All other project characteristics are subjective to change, individually or collectively. The paper explains the position of project management of changes within other aspects of managing projects and gives the relationship between them. The basic requirements for adequate changes in managing the projects are briefly discussed and analyzed. Information flow on the projects with a good preset of basic principles and procedures in project management is critical for managing the proper changes in the projects. Procedures for properly managing the changes are listed, lined up in order of time occurrence and briefly described.

Key words

Managing the changes, project management, project management procedures

1 INTRODUCTION

All processes of monitoring and project control generate change requests. Those requests may require actions for repairing the error occurred, actions for returning to planned state or preventive actions to support project success. Change Management Team is responsible for reviewing and deciding on change acceptance. Roles and responsibilities in this matter are strictly defined and accepted by all key participants. All decisions of the Change Commission have to be recorded and updated. In case of change approval, project management system has to implement it into all concerned project activities and documents. When default initial plan is updated and changed, all supporting plans, together with formal contracting plan that is used in a formal change control process, has to be updated as well. Change of the basic plan should indicate the change from current state forward, which is approved; when something is

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already done, it can not be changed. Such an approach protects the integrity of the basic plan and historical information of already performed activities.

The question is: What is the key knowledge necessary for an objective and effective decision making on approving project changes? From the management aspect, it is crucial to know the interaction of managing the changes with other aspects of managing the project.

Figure 1 shows this interaction. What can be seen, is where all the input data required for managing changes comes from, and where the results of managing change process are going (the processes of updating project documentation, project management plan, administration, the procurement status update and change registry update).

Before the project execution, it is necessary to establish a change control system. Control system generally uses specific deliverables and contract documents. Change Control system, as part of it, is focused on the identification, documentation and control of changes in projects. Applied level of change control depends on the application, the complexity of the project, contracting requirements and the context and environment of running the project. It starts at the beginning of the project and runs until the end of it. Management Plan, statements about the scope of the project and other supplies are part of an effective and continuous managing of changes, ensuring that only approved changes are implemented in project.

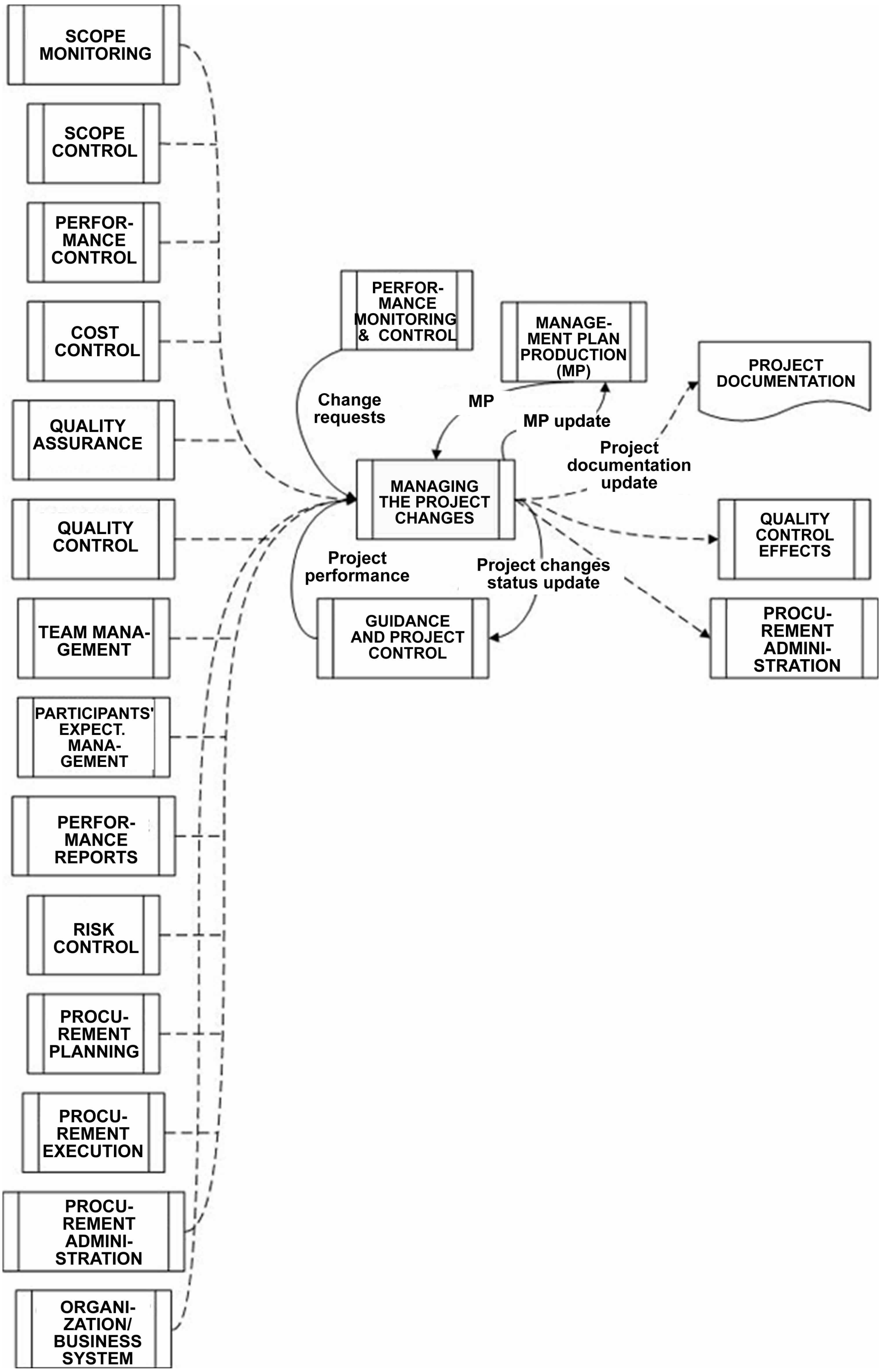

Figure 1 Change management in the context of other aspects of management [1]

2 PREREQUISITES FOR QUALITY MANAGEMENT PROJECTS

In order to effectively manage the requested changes in the peformance phase, it is necessary to implement proper preliminary procedures in the previous phases of the project lifecycle [2,3]. The set of preconditions, requirements and procedures needed for the effective managing of change, has to be established already in the contracting phase, for later use in the project. Some important parameters are coming from project planning phase.

It is well-known fact that the influence on project decreases in later phases. Similar to that, the uncertainty in the project shows declining trend during its development through phases.

There is a significant disparity between the required (possible project changes) and changes that may be granted, to keep projects identity (See Figure 2). Due to the nature of construction projects, change requests are modifying with respect to the interests and changing conditions in which the construction project is, but throughout the project lifecycle quantity of change requests are not reduced. Good governance before performance phase can contribute to better managing of changes. It is therefore necessary, in the planning phase, to prescribe the procedures which verify impact of changes to the initial project plan.

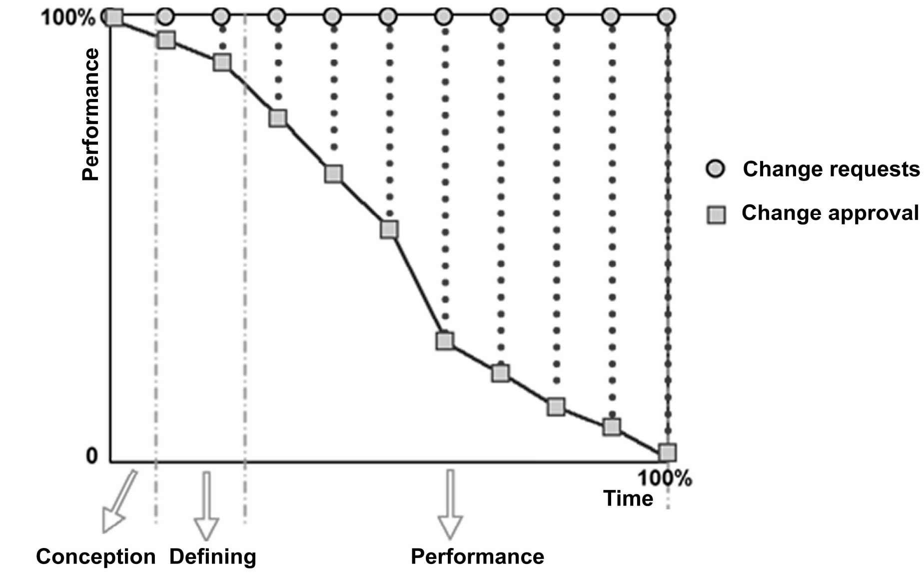

Figure 2 Quantitative amount of change requests and change approval through the project lifecycle [4]

Managing change in the project performance phase has certain documents from contractual obligations and the parameters of the project from the planning phase of the project. The key process in the initial phase and planning phase of the project, which contribute to later managing the changes, are given in Table 1 .

These processes and procedures are not only in the service of managing changes, but are the general procedures in the project management that are appled, among others, to managaging project changes.

A prerequisite for managing the change	The process of initial stages of projects which meet the prerequisite
• Determine what is and what is not part of the project • Display of which can not be waived in the project • Define all restrictions, their acceptability and feasibility threshold • Define all conditions and project environment	Planning and defining the scope of the project
• Define project structure	Creating a WBS
• Work and activities description required for project	Defining activities
• Detailed elaboration of the activities	Defining components of activities
• Determinating the activities	Estimate activity duration
• Determinating the necessary and available resources for activities	Planning and selecting the type and number of resources for activities on the project
• Knowing the cost impact of adding / subtracting activities and resources	The estimated cost of the activities and resources
• Knowing the possible sources of funding additional costs of the project (indluding changes)	Funding Analysis
• Determinating how the project is performed (technology etc.)	Project performance plan (time, location, tehnology)
• Minimum required quality of activities	Set the minimum quality of activities
• Communication routes, the intervals of meetings on the project	Communication Plan
• Expected changes Assessment on the project, given the existing experience and best practice	Risk assessment of changes in the level of activity / whole plan
• Legal limitations of project changes	Planning and selection of optimal contracting
• The positive impact of the planned dynamics • The negative impact of the planned dynamics • The positive impact of random dynamics • The negative impact of random dynamics	A preliminary impact analysis of the project dynamics

Table 1 Prerequisite processes for qualitive managing the changes on the projects

After implementation of these processes, the initiators of the project (usually the client or investor) have to analyse the flexibility of scope, cost and time on the project. Managing the changes must respect the priority of scope, time and cost flexibility on particular project. Therefore, it is necessary to fill out the following form (see Table 2):

	Flexible	Medium flexibile	Solid
Project scope			
Time			
Cost			

Table 2 Preliminary determination of flexibility in the initial project phase [1]

In each row, it is necessary to set in the appropriate column a single "X" designation in order to sort scope, time and cost by a certain degree of flexibility in the project.

All constraints must have their acceptability and affordability thresholds clearly defined. Acceptability threshold determines the boundaries between which constraint is beneficial for the project, while the feasibility threshold defines the limit that the project should not exceed, so it is the total tolerance of constraint in the overall project [4].

The main constraints that are always concidered in construction projects are: time, cost, hiring resources, scope of work and parameters that define project quality. Apart from these overall, there are specific constraints on the project caused by nature and environment of a specific project.

3 CONCLUSION

Early identification of changes and errors as well as their influence on project performance is crucial for managing errors and changes successfully in every phase of the project. This is impossible to achieve without proper completion of earlier initial and planning phases of the project. When we discuss managing the changes as part of sustainable project management, we should focus on earlier phases, when the managing change system is setting down. In the phase of project performance, where most problems with changes occur, only the predefined procedures may be applied. Their lack is critical for the project success.

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TIME UPDATE OF THE DATABASE FOR LIFE CYCLE COSTING OF BUILDINGS

Martin Nový[1], Jana Nováková[2], Miloš Waldhans[3]

Abstract

Application for calculating of life cycle cost of buildings uses a special database of weighting indicators of specific buildings. Detailed implementation budgets with particular items subdivided into material costs, other nonmaterial costs and profit are the data source of this database. The process of creating of weighting models of the budget is complicated and time-consuming. Due to uneven inflation in the different cost areas the weights in models change over time. The whole database must be kept up to date. This paper describes the methodology for recalculating of the weighting schemes using available price indices without necessity of the overvaluation of the baseline budgets and the repetition of the whole process.

Key words

Life cycle of buildings, costing, time update, price index, weighting scheme

1 ECONOMIC EVALUATION OF CONSTRUCTION

Economic evaluation is an integral part of each project. For construction projects, where construction work forms a part of the project, cost of implementation of the construction is the crucial item. Therefore, it is appropriate to propose and assess various variants of the construction differing in disposition, construction system or materials used. Constructions wear down during their usage and continuous maintenance is necessary to preserve their useful properties. With regard to long life of constructions, the cost of maintenance, repair and replacement of structures, if any, may achieve considerable amounts. Therefore, the whole life of construction must be taken into account when making the costing. The application called Náklady životního cyklu budovy [3] (Building Life Cycle Costs), available for free on the Internet, is an appropriate tool for such modelling. It is developed in terms of a research project dealing with production and use of construction materials produced with use of waste material [1]. Selected construction objects available in the application (mostly housing

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buildings nowadays) are subdivided to groups of structures ensuring the required functions of the construction. Implementation costs of such groups of structures - called functional parts (FPs) - are further subdivided to monitored materials and products, other materials, and other costs. Such structures costs form the database for further calculation and modelling of building life cycle costs.

2 MAINTAINING THE DATABASE

2.1 Method of time update

New constructions are continuously added to the model database. Cost of individual functional parts and their components are taken over from implementation budgets prepared by reliable budgeting software applications – for procedure see [2]. In the model, these costs are specified as absolute amounts in CZK and relative amounts in % of total cost of the object. Construction market develops continuously and prices of construction works are affected by many factors. Prices of building materials and products, building machines, energies, cost of manpower, overhead cost and profit are the items with decisive influence. Therefore, the price of construction work depends on the time when in was calculated, and it changes demonstrably in time. Changes occur not only in total price of the construction work, but also in individual FPs. Each FP has a different cost structure; thus, its price changes individually. It is the objective of authors of the Internet application to keep the database on such cost level that it captures the current status as faithfully as possible. One of the methods of keeping the whole system up to date is the use of "price indices". Price index is a coefficient expressing the price change in relevant area over specific time period. Prices of the construction object are then updated by multiplying the baseline price by appropriate price index. Price index may be used for the whole object or its individual parts. The more parts are included, the more detailed and precise the budget is. Appropriate structuring of the object and finding a trustworthy source of relevant price indices is the condition for accuracy and reality of such recalculation.

2.2 Model structuring

Cost model of each object is structured in a similar way. The building is divided according to basic functions of individual structures to FPs – see Table 1. FP is further subdivided to material, for which replacements are considered during the modelling process – see Table 2, and other material and other – nonmaterial cost. Cost of replaced material is specified in sufficient detail by means of accurate verbal description, unit of measure and quantity. Nonmaterial costs contain cost of employees (wages, social security and health insurance, cost of machine operation, overhead and profit). Costs of non-replaced material and nonmaterial costs are different for each FP as to their contents and volume and the model includes no detailed specifications for them. Only total price is assigned to them. Some FPs (those of no interest from the point of modelling) are not subdivided and only total price is specified.

Tab. 1) Part of functional part code list

code	description	code	description
1000	Substructure	6000	Panes for construction openings
1100	Foundations including excavations	6100	Doors
1200	Waterproofing for substructure	6110	Interior doors
2000	Vertical constructions	6120	Outer doors
2100	Vertical carrying and circumferential structures	6130	Joiner structures
2110	- bricked structures	6200	Windows, balcony doors
2120	- other than bricked structures	7000	Floors
2200	Partitions and dividing walls	7100	- heat, sound, vibration insulations
2210	- bricked	7200	- sublayers
2220	- other than bricked	7300	- stepping layers
2230	- plasterboards	7310	Pavement

Table 2) Material groups code list

code	material group
a	concrete
b	bricks
c	heat insulation
d	floor tiles
e	roof tiles
f	wall tiles
g	mortars
h	water insulation

2.3 Source of price indices

The source of price indices should be an independent organization, professionally competent, well-known to the public, with long history, which processes and publishes price indices on a regular basis in sufficient structure and provides details regarding generally known classifications. The entity meeting almost fully all the requirements is the Czech Statistical Office (ČSÚ). ČSÚ is an organizational section of the state funded from the state budget. It deals with statistics by operation of law and statistics, including the price statistics, is the basic scope of its activity. Procedures used in ČSÚ are in accordance with requirements of Eurostat – statistic authority of the European Union. In terms of price statistics, ČSÚ performs regular specialised price investigations with thousands of respondents in the area of production, services and, specifically, also building industry. It publishes the results of its investigation on monthly or quarterly basis. Publications are published on website for free. For classification, ČSÚ uses the statutory international classifications, which the Office manages as well. The only drawback of the price index system is the absence of similar classification in certain areas. One of unpleasant sides of statistics is the fact that it publishes its results with a certain delay, which is given by the scope and complexity of data collection and processing. Statistics always informs about what was and to which extent it was, rather than what, when and how something will happen.

Data from other professional companies, which deals with the issue of price development in building industry and publish the price indices, may be used as information source. However, the underlying materials for their calculations (methodology, quantity and quality of entry data) are usually not easy to access and verify. Some companies create forecasts for future periods as well. Thus there is a certain risk that the real development will diverge from the forecast.

2.4 Assignment of price indices

Amount of price for each FP is subdivided both in absolute terms (in CZK) and relative terms (in %) into replaced material, non-replaced material and other nonmaterial costs – see Table 3. Some FPs, which are calculated as a set or supply in the budget or which contain no replaced materials, are specified with a single value. Price indices must be assigned to A, B and C cost groups. Cost of group D is a total of costs of the previous groups.

Group A contains specific (verbally described) material, which is assigned to material group (a to h). Price index of the item, which fits best the contents of material group (e.g. Table 4 in publication [5]), can be found in selected source for each material group.

Group B contains all the remaining material occurring in FP object, but not included in group A. With a certain detached point of view, index of material inputs to building production for the relevant direction of construction (Table 5 of [5]) can be declared to be the price index of such group in each FP.

Tab. 3) Part of updated cost matrix for FP 2110

FP code	cost group	group description	baseline price, CZK	baseline weight from object, %	baseline weight from FP, %	price index	current price, CZK	current weight from object, %	current weight from FP, %
2110	A	Replaced material	3,039,213	5.65	71.3	1.1000	3,343,135	6.21	67.2
2110	B	Non-replaced material	495,393	0.92	11.6	1.1500	569,702	1.06	11.4
2110	C	Nonmaterial cost	728,625	1.35	17.1	1.4620	1,065,250	1.98	21.4
2110	D	Total cost	4,263,231	7.92	100.0	1.1677	4,978,087	9.25	100.0

Group C includes all nonmaterial costs (and profit), which are included in price of each FP and thus the whole object.

Price D in FP is a total of groups A to C and, where FP contains no detailed subdivision, it contains all the costs and profit. For the whole object, it represents the total of all prices of all FPs. For group D, price index of construction work for the corresponding classification item (Table 1 of [5]) can be used.

Price index for group C is iteratively calculated so that the index of the whole object equals the index for group D.

For materials included in group A, there is one more variant of solving the price update. There are normally a maximum of several tens of such materials in an object. If an updated baseline price source is available (e.g. appreciation database in current price level), it is possible to retrieve the price of each material and enter it into the cost table.

2.5 Recalculation of model weights

Weight model of each object is saved in a table. When necessary price indices are searched and entered into dedicated fields, the whole object is recalculated in terms of cost (in CZK) and weight (in %). It is always necessary to use a pair of the same indices with the same basis (e.g. average of 2005) for the period corresponding to the original and updated price level. Their proportion then determines the rate of shift of price level between the updated period and baseline period. In the Internet application [3] it is necessary to rewrite manually and save the updated weights of individual FP items and materials. Price indices for material recalculation are the same for all objects. Construction work classification items corresponding to classification of the updated object are used for group C and D.

3 PROJECT DEVELOPMENT

Once compiled cost matrices of objects can be updated to required price level using the method described above. This recalculation method is not simple, but it is less laborious if compared to recalculation of budget on new price level and its repeated conversion to FP structure. The target shape of the project is processing and time update of tens of budgets, which will enable the users to select an object approaching their project. Thereon, they can model the economic response of replacement of selected materials all over the life cycle of the construction.

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CIVIL ENGINEERING & MONEY OF DUBIOUS ORIGIN IN COUNTRIES OF EX - YUGOSLAVIA

Mihailo Ostojic [1]

Abstract

In this Research will be analyzed so-called "Washing of Dirty Money" over the Example of Civil Engineering in Countries of Former Yugoslavia, in Processes of: 1. Planning, Programming and Designing, 2. Obtaining of Locations for Building, 3. Trade of Building Materiále, 4. Sale of Buildings

Key words

Dirty Money, Civil Engineering

1 INTRODUCTION INTO RESEARCH

The Balkans has always been a restless area because of its geographical position. Wars are often destroyed the people and infrastructure … Only in the last 20 years were 5 wars of which was last driven against the 21 most developed countries of the world.

Bombs were destroyed everything in sight in Serbia and Montenegro. Almost whole infrastructure was erased. In addition to the sanctions unjust wars, Serbia and Montenegro, destroyed the economy and the lives of a proud people. Transition from communism to capitalism also did its job. In these hard times waste always comes to the surface and rich individuals to begin very quickly to the various dark ways. And when it comes time to ″play fair″, to find a way to illegal activities and resources legalize.

Fig. 1) *Consequences of the bombing in Serbia and Montenegro (insdustrial plants, orthodox monasteries, center of Belgrade)*

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2 RESEARCH ISSUES IN THE REGIONS OF FORMER YUGOSLAVIA

For ″washing money″, building is an inviolable machine. The safest and the quickest way for legalization of huge amounts of money is through the building. This assertion can be proven through numerous examples in the former Yugoslavia.

Montenegro

In Montenegro, ″money laundering″ through the building will become a little more legitimate economic activity.

Well known is the latest scandal regarding the *MAT Company*, whose owner is accused of smuggling several tons of cocaine from South America to Europe. The company headquarters is located at the north of Montenegro, where the company was the most active in its business, witch was acquisition of land on a suspicious manner, investing and building residential and industrial complexes. Behind north, company had business at the coast of Montenegro, in Serbia and Croatia. Owner is in hiding, and he is searched from more police in the region and beyond. Deprived of his property in Serbia, that is worth several billion euros.

But, the most of Montenegro's ″dirty money″ is not ″Made in Montenegro″. It is coming from ″outside″.

The biggest statesman of a modern times and the best Russian patriot since rule of Romanovs - Vladimir Putin raised fallen Russia firmly on her feet and returned to the place of world's force No1. In that New Russia rose on a foundations of the old empire, where law and order started to rule again, was no place for criminals who built their empires on the looting of their own people at the time of transition. Tons of ″dirty money″ needed to be ″washed″ somewhere outside.

Sun, sand, and sweet deals are luring more and more Russians to invest in Montenegro. The head of Montenegro's anti-money laundering bureau, Predrag Mitrovic, reminded real-estate agencies, automobile dealers, and lawyers of their duty to report any suspicious financial transactions to state authorities. Citing confidentiality restrictions, Mitrovic had prior to this refused to state whether foreign nationals and companies, especially from Russia, were investing ″dirty money″ in Montenegro, using it to purchase companies, hotels, houses, and land.

Reports of ever-greater Russian capital flowing into Montenegro come down to a few (rare) lines in local newspapers, indirect knowledge, and overheard conversations involving people who see Russians buying everything they can on the Montenegrin coast, thus forming the vanguard of the country's main industry-tourism.

There are many examples like this one: Some Russian is interested in buying a house in Budva. When he heard that owner was looking to sell for a certain price, the Russian asked, ″Do you happen to have any more houses?″ This kind of business is spreading in the Montenegrin tourism center.

The government of Montenegro concluded the first business with Russians as long ago as 1998, when they leased two hotels in Kotor. Since then Russian-based firms have bought six more state-owned coastal catering facilities. According to data provided by the state Industrial Restructuring and Foreign Investment Agency, the Moscow firm *Sibinegoresurs* purchased a hotel in Perazica Do for 2.5 million euros ($3 million); a firm called *Moskovskaya trastovaja* purchased a hotel and bar in Petrovac for 2.6 million euros, as well as business premises in the same small town; and the Splendid and Montenegro hotels in Becici were sold to a joint Montenegrin-Russian company, *Montenegro Stars*, for 2.4 million euros.

Hotel AS in Perazica Do, ″five stars″ Hotel SPLENDID in Becici , ″five stars″ Hotel BIANCA in Kolasin, ″ f ive stars″

Fig. 2) *Luxury Hotels in Montenegro - machines for money laundering*

In addition to hotels and houses, Russians are buying plots of land for new-built villas. The most attractive sites for this are Lustice, Sveti Stefan, and Zanjice, where several villas with a total living area of about 5,000 square meters have been erected on a hillside. Locals renamed the village of Blizikuce above Sveti Stefan "Russian Village" in honor of our brothers who have purchased most of the land there for new houses. One civil servant confided informally to journalists that the Russians have purchased some 30,000 houses in Montenegro, mostly at the coast.

The British company *Midland Resources Holding, Ltd.*, which according to company information is an industrial investment company with representative offices in 35 countries, a few months ago purchased *Nikshich Steel*. Unofficial assumptions, however, have it that its real owners are two Russians, while it is already common knowledge that *Nikshich Steel* is a co-owner of the Serbian meat processor *Carnex*, of *Danube Port* in Pancevo, of the *Stari Grad* catering company in Belgrade, and of the *Gumaplast gasket* factory.

According to Budva lawyer Milorad Bojovic, there is indisputably an enormous interest by Russian citizens in purchasing real estate in Montenegro. As he told NIN, ″Our law firm concentrates on representing Western companies, but during the last six months we have represented all the well-known Russian companies looking to invest in Montenegro. They are reputed civil engineering firms, with references leaving no room for doubt.

Unfortunately, Bojovic continues, such an assessment is not applicable to some Russian citizens who purchase property." He explains that in Montenegro, "a considerable number of Russian citizens are permitted by our laws to establish companies,

most commonly real-estate agencies. Once the agency is established, the next step is to advertise it and thus to attract their fellow nationals to come here and purchase real estate. It is no longer an issue whether Russians are buying, whether this is being done in a legal manner; the only remaining problems are ″wild agencies″ that negotiate deals″

A major legal dispute broke out over the controversial privatization of the Avala hotel and villas in Budva-this went as far as the Supreme Court-and a ski area in Kolasin. The sale of the Podgorica newspaper *Publika* also generated controversy. The Budva hotel and the ski area were purchased by the British firm *Bepler & Jacobson*, said to have ties to a Moscow-based Montenegrin, who in turn, according to press reports, is friendly with top Montenegrin officials and others in the embassy of Serbia and Montenegro in the Russian capital.

Serbia

A Belgrade lawyer involved in Russian-Montenegrin privatization contracts told

that although he was not authorized to comment on his dealings with Russian clients, the sources of their capital were impossible to establish, given that 175 millionaires and 20 or so billionaires are on the rolls of the Moscow Revenue Administration.

Director of the Anti-Money Laundering Aleksandar Vujicic said that in Serbia the money usually "wash" purchase and construction of real estate, investing in big commercial chains and casinos and through off-shore companies. Vujicic is a RTS said that all customers buying and selling real estate required performing over the banks and that it is prohibited property cash in amounts of 15,000 euros and higher, so that each customer must pay the seller through the account. He pointed out that the citizen in the system should feel completely safe, if you cooperate with the Agency for real estate and banks that are in the system to prevent money laundering.

It is estimated, it was said, that in Serbia a year "wash" between three and five percent of gross domestic product, or about 1.7 billion euros, a new Law on Prevention of Money Laundering, which is in use longer than two months, should strengthen the fight against this criminal activity.

Vujicic recalled that "money laundering" attempted legalization of illegally acquired property or property that was acquired by criminal acts, so that the "laundering" of money involved just the perpetrators of criminal acts.

According to him, money laundering is anywhere in the world and estimates that each year in the world "wash" between two and five percent of gross domestic product. Vujicic said that the legal form of the free zone of operations, to reduce, primarily, the cost and to make decisions for the company's vision for small business tax.

The problem is that many "money launderers" use this kind of business in order to hide illegally acquired income through multiple transactions attempt to conceal the true origin of money, "he said.

He added that in this respect makes international effort through the International Monetary Fund or the Egmont Group, an international organization of financial intelligence to prevent such occurrences.

He said that the Serbian in this area does not stand out from other countries in the region to implement all the international standards relating to the prevention of money laundering and financing of terrorism and that we must insist that all the authorities that the best way to cooperate.

"In a system for the prevention of money laundering are taxpayers, banks, insurance, leasing companies, real estate agency, that the Administration for the prevention of money laundering submit information on suspected or" cash transaction "of more than 15,000 euros," said Vujicic.

"It then analyzes all received data and if there is information that there is suspicion of" laundering "of money delivered by the competent authorities - police or prosecutors and courts," said Vujicic, reminding people that when leaving the country may to bring up to 10,000 euros "cash."

He pointed out that the Administration for the Prevention of Money Laundering member "Egmont Group, which now includes 116 countries and has recently signed a regional agreement in the area of all countries in the region.

Area in southern Serbia called Kosovo, which no longer under control of Serbian military and police is oasis for world's darkest crime-factory. These days Western press is full of articles in which boast an incredibly rapid construction of the local infrastructure…well, all that ″dirty money″ needs to be ″washed″, don't you think?!

Croatia

After all ″mighty effort″ Croatia is still not ready to enter the European Union, but in it flourishes ″money laundering″. One of the numerous scandals is the one with Hypo Alpe Adria Bank.

Former CEO of Corinthian Hypo Alpe Adria Bank Kulterer Wolfgang was detained in Klagenfurt, is suspected of embezzlement for allegedly facilitating provision of suspicious loans in millions.

Speaking of Hypo Bank, Damir Cain said that the bank created the nineties Croatian money, and that he intended to purchase weapons.

"Hypo Bank in Croatia reached the mid-90s, and that the bank recapitalization Slavonske from Osijek, and before that the Ministry of Foreign Affairs in the same bank took 20 million Deutsche Mark loan for the reconstruction of our embassies. In Istria Hypo Bank came at the end of 1990 and it's through investments in a hotel complex on the Red top Savudrija, "he explained Damir Cain.

He assumed, he said, that the rehabilitation of Hypo Bank and reason "spectacular" departure from power of former Prime Minister Ivo Sanader and that is why the Prime Minister Jadranka Kosor about strep Ciro. "My guess is that it has all the information from Austria and Germany when it comes to accounts in Hypo, and other banks," said Cain.

He said that according to his information Hypo Bank in Croatia, she worked not only with citizens, state and local governments, but also "elected generals, Tudjman's advisors, ministers, media authorities, a portion of their investment is achieved through the Lombard loan, backed by million, and they in turn receive millions of euros for construction projects in Croatia.

He conceded that he is certain that the Hypo Bank corrupted and people in Croatia, and possibly in Istra. "It should not only judge, but also seized their property. We should enlighten the way of money for the purchase of weapons and money laundering in the Philippines but to preserve the material substance of the bank.

Hotels throughout the Croatian coast built in the money of dubious origin

Savudriya - sight of successfully washed money

Fig. 3) *Croatian way of money laundering*

Although we Austrians are not so important, we must be important by our masters, who worked for two thousand euros a month, and received money for investments that are estimated to be tens of millions of euros, "he concluded Cain.

As our history and the present study, the Croats are strong only in words so far been. We will see how this affair is going to end.

Bosnia and Herzegovina and Macedonia

Bosnia and Herzegovina and Macedonia are two ex-Yugoslavian republics which have not yet solved its state status, and problems of corruption and money laundering will not, apparently never. So deep this type of crime came in all their pores that is impossible to even start to speak about it.

3 CONCLUSION

Finally set a moral issue: Are we building engineers have to fight against it?! **I don't think so!**

Our job is to build that remain standing in his later life, but about source of money went into account those who are paid for it - police. At the end, if one Switzerland could make it's empire on the foundations of the Nazi gold and secret bank accounts of numerous suspected businessmen from all around the world, and all planet is keeping it's eyes closed about that… why should we, civil engineers, put ourselves on a police officers' jobs?!

***Remark:** All data obtained through personal research, processing and analysis of texts in the public media and direct discussions with the responsible parties. The most of the files were getting from contacts in Security Agencies from ex Yugoslavian republics who wanted to stay secret.*

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COST METHOD ESTIMATION OF REAL ESTATE

Strahinja Pavlović[1]

Abstract

Estimation of the market value of real estate (land and buildings) can be made according to three methods for estimating the market value - a comparative, cost and income methods. In this document the general characteristics of the cost method are analyzed, with special reference to the method of replacing the real estate. The study includes the impairment of a new building on the basis of age, maintenance and temporality at the current Montenegrin regulation.

Key words

Real estate, market value, cost method, reduced values

1 INTRODUCTION

In the period after World War II until the beginning of nineties, not having the real estate market in the former Yugoslavia, exclusively cost and income methods of estimation of real estate were used. Today, the cost method is often used during the revision or sale of the company, in the estimation of fixed assets and accounting annual billing.

There are two ways of the structure estimation method by cost method such as expenditure process in building replacement and expenditure process in structure reproduction. Replacement procedure is used much more often. When evaluating the building by replacement procedure the factor of impaired structure is included as also the advantage effects of application of new building materials and technical solutions during the construction of new structure. Reproduction procedure is used when there is a case of surface enlargement on the existing structure, where the calculation is made at current rates that are applied in the market at the time of evaluation. In this document the replacement method will be analyzed.

The value of the real estate that is the subject of cost estimation method is determined based on comparison with the price of real estate substitute or real estate that can replace the property that is exposed for sale on the market provided that the substitution is not delayed. From this definition it is concluded that at the expenditure-based method of evaluation of real

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estate the time is very important, even decisive factor in getting the real market price. Cost estimation method involves the following steps:

- Estimation of the land value as if it is unconstructed, but in the state to achieve maximum profit by its use for construction purposes;
- Estimation of costs of construction a new property (construction costs) and cost estimation of continuous use of the property (development costs);
- Estimation of value reduction (depreciation) of the property on the basis of physical and functional rebate including rebate due to unforeseen circumstances (natural disasters, incidents, etc.)
- The value of a property is reduced by the amount of depreciation, maintenance costs and temporality of the facility;
- The value of new property minus depreciation and maintenance costs and the cost structure of temporality with added value of the land is the market value of the real property in the resulting cost method of valuation.

Based on these steps, we note that the values of the land and structure are determined independently of each other. The value of land is taken without impairment (depreciation) because the land is permanent and indestructible resource. Structures are subject to temporal, functional and other types of rebating (trivialization), so it is necessary to take depreciation into account.

2 EVALUATION OF THE LAND

Applying the cost method of evaluation of real estate the land is usually valued by method of comparison by comparing the price of land in similar locations and analyzing all the factors that influence on it. Land is compared to the cost price of one square meter of surface.

During the determination of the land value as part of the expenditure-based method of real estate evaluation, next to the physical value of land it is necessary to include compensation for the urban land. It has been said that the value of land is taken by the assumption that its activation achieves the greatest gain. To determine the way of land use which brings the highest profit it is necessary to analyze:

- the way of land use and potential facility on it;
- prospects of development of the location with the plot;
- expected changes in the real estate market at this location and
- current use of real estate.

Value of compensations for urban land is determined by the local self-government and published in the Official Gazette.

3 ESTIMATION OF CONSTRUCTION COSTS OF NEW REAL ESTATE

Value estimation of the facility by expenditure-based method of replacement starts with assumption that it is a completely new facility. With the help of following techniques determination of new building value can be done:

- The technique of quantifying the costs which includes the analysis and measurement of direct and indirect costs of replacing the existing facility with a new one. The direct replacement costs include: material, labor and installation of the facility, and indirect costs include: administrative costs, various fees and of course profit of the contractor.
- The technique of unit price that is based on the analysis and measurement of construction costs for new facility per unit of individual components (material, labor, installation, profit). Materials, labor, profit, part of the administrative costs should be given per unit (square meter building area), while other costs are reduced to unit costs per activity (heating, plumbing systems, etc.).
- The technique of calculating per square meter of structure surface is based on a comparison of cost for construction of an adequate facility which was recently built and comparable to the subject. This is the most commonly used technique for estimation of costs for reconstruction and replacement of facilities. For industrial facilities (industrial halls and warehouses) great cubic volume calculation is often done per cubic meter of space. The value of the subject structure is obtained by dividing the costs per measuring unit (m2 or m3) of recently constructed facility multiplied with the appropriate number of measuring units of the facility being evaluated.
- Technology of structure evaluation using the index of real estate price rates is simple and practical to implement. The present value of the structure is obtained by the investments which are invested in the structure that is the subject of evaluation is multiplied by the index of real estate price rates.

The value of new constructed structure shall include:

- costs of investment-technical documentation;
- audit costs of investment-technical documentation;
- costs of performing preparatory, construction, construction-craft, insulation and other works necessary to complete the structure in the functional sense;
- project management costs (supervision, technical overview, etc..) amounting about 5% (experienced data that depends on the type of facility, purpose, size, etc..) from the amount of the costs of previous items, including land with costs of compensation for its use;
- the costs of work insurance in amount of about 1.5% (experienced data that depends on the type of facility, purpose, size, etc..) to the amount of all the previous items, including land with the cost of compensation for its use;
- costs for contributions in the amount of about 7% (experienced data that depends on the type of facility, purpose, size, etc..) to the amount of all previous items including the land with the costs of compensation for its use;
- costs of terrain arrangement and planting.

4 EVALUATION OF THE IMPAIRMENT (REDUCTION) ACCORDING TO DEPRECIATION

When evaluating the property by cost method, especially by the procedure of structure replacement it is important to realistically determine the appearance and degree of impairment of that property. There are three types of impairment - physical, functional and location impairment of the property.

Physical impairment is the result of natural conditions affecting the facility and due to the use of the facility. The natural conditions include:

- effects of solar heat;
- climate changes;
- wind (wind has an influence to the structure by heating and cooling it through the external walls);
- water (the structure can have direct contact with water - from atmosphere, water flow, sea, lake);
- frost (freezing of water that has direct contact with the structure) and
- natural disasters (floods, high snow, drought, earthquakes).

The owner of the facility can directly control and influence the physical depreciation of facility by repairing, rehabilitation, reconstruction, restoration and permanent maintenance of the same. In this way, the owner extends the life of the facility and increases its physical depreciation. It is not profitable to invest funds for the maintenance, reconstruction and repair in the structures which are near the end of its useful life.

Due to poor design or inadequate architectural design of the facility functional depreciation of the structure appears. Examples of functional impairment are particularly noticeable in residential buildings. There are many architectural solutions of flats with poor layout and size of rooms in apartments of large areas. The owner, by his individual interventions, may affect the functional impairment often with minimal cash investment and thus prolonging the life of the facility.

Impairment of the site occurs under the influence of external factors on the facility. The external factors which affect the decline in value of the structure include: noise, traffic, air pollution and the like. Subsequent construction of structures which have negative impacts on the environment also increases the impairment of the site, and therefore the objects on it. The owner has limited ability to influence on these factors (the factors are mostly social responsibility).

All three forms of declining property values are not easy to estimate. Functional and site impairment becomes transparent by introducing buyers to the market.

Since 1992, when Agency for Economic Restructuring and Foreign Investments was formed in Montenegro, the Instructions for control of market value estimation of buildings and land, which is based on the Instructions on the contents of the report on valuation of companies with methodology assessment and transformation of enterprises (Official Gazette of the Republic of Montenegro, No. 16/92). Guideline for control of market value estimation of buildings and land is used in assessing the market value of the property using all three methods (comparative, cost and income), but it pays particular attention to the cost method.

The calculation of impairment of structure on the basis of age and frailty can be implemented in several ways. One of them is already listed as part of the contents of the Instructions on the contents of the report on valuation of companies with methodology assessment and transformation of enterprises (Official Gazette of the Republic of Montenegro No. 16/92).

In connection with the estimation of depreciation costs of in the Instructions for control of market value estimation of buildings and land, the following items are given directly related to the implementation of cost methods:

- For the calculation of structure depreciation it is necessary to accurately establish the year of construction and start of using the facility.
- Degree of facility depreciation is determined by the formula (1):

$$A = 0{,}70 \times n/N \times (n + N)/2 \times N\ [\%] \tag{1}$$

where:

A – Depreciation;

n – The age of facility;

N – Average lifespan of the facility.

- average lifespan of the structure depending on construction material is given in the following Table:

Structures of I category	100 years
Structures of II category	83 years
Structures of III category	71 years
Structures of IV category	50 years
For other structures	20 to 40 years

- The coefficient of the residual value of the structure is 0,70.
- Depreciation is not calculated on the total market value of structures, but on the part of that value which makes construction, craft and installation works with internal sewerage arrangement of the location (excluding primary infrastructure, land and properties at which it is).
- A significant lack of this method is that the after-life of 100 years the structures have a value, often not so small (the actual lifetime of structures is much longer).

It is noticeable that the depreciation of the structure is calculated on the basis of the average lifetime of the structure which is given by category. As the properties have a wide range of individual characteristics, it is clear that it is impossible to classify all structures in just five categories. This way of calculating the depreciation value can often give lump information.

The current structure value of the structure (the market value of the structure obtained by applying the cost method) is obtained by formula (2):

$$Sg = Ng - Ua - Uo - Up\ [€] \tag{2}$$

where:

S_g – The current construction value of the structure;

N_g – value of new built structure;

U_a – impairment of a new built structure based on the age and frailty of the structure;

U_o – impairment of a new built structure based on structure maintenance

U_p – impairment of a new built structure based on temporality of the structure.

If the object is thoroughly renovated, its duration is calculated from the date of renewal.

5 ESTIMATION OF THE IMPAIRMENT OF THE STRUCTURE BASED ON MAINTENANCE AND TEMPORALITY OF THE SAME

Impairment of the structure based on maintenance (U_o) needs to be assessed on the basis of detailed observation of the current state of the structure as a result of its maintenance and overall quality according to the following categories:

- Excellent maintenance (excluding depreciation,Uo = 0);
- Very good maintenance (Uo = 0,01 do 0,03 Ng);
- Good maintenance (Uo = 0,03 do 0,06 Ng);
- Insufficient maintenance (Uo = 0,06 do 0,18 Ng);
- Bad maintenance, structures that are partialy used due to bad maintenance (Uo = 0,18 do 0,35 Ng);
- Very poor state, the structures that are not used due to poor maintenance (Uo = 0,35 do 0,70 Ng).

Depreciation of the object based on temporality should be estimated taking into account age (n), structure category and the average lifespan (N), and the estimated period of use of the structure to its collapse within its average life. Impairment on the basis of temporality of the structure cannot be higher than 60%.

It should be noted that the total impairment of the facility based on age and frailty, maintenance and temporality cannot be higher than 80%, namely (3):

$$Ua + Uo + Up \leq 0{,}8 \times Ng \tag{3}$$

After calculating all the values of imperilment and the value of a new built structure, we get the present value of the structure received by the cost method.

6 CONCLUSION

Cost method of real estate evaluation in Montenegro today don't has such a significant application as before, primarily because there are significant information about the real estate market that therefore emphasizes the comparative method in estimation of residential and partly industrial facilities. The application of cost method can still be found in the accounting and partly in banking, as well as in estimation of cultural and historic structures, museums, religious buildings, libraries, etc., facilities which market is not developed, industrial facilities as the main assets of companies, public sports facilities and the like.

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INFORMATION SYSTEM FOR PLANNING AND CONTROL OF PROJECT REALIZATION

Nataša Praščević[1]

Abstract

Project realization includes a lot of participants and information. Collecting and storing a huge amount of information is not an easy process. Integrated system for project management can make the process of collecting and storing information easier. The result of this system is more efficient and effective process of project management. This kind of system permits access and usage of information by all of participants in project realization and includes many applications that can be used in various phases in project realization. In this paper information system for planning and control of project realization in construction industry is analyzed. The necessity for this system is emphasized. Process and data models are described. Information system is realized in Oracle Database management

Key words

Investment project, information technology, construction industry, information system, project planning, project control

1 INTRODUCTION

During a construction project realization, there are a large number of participants in the project who participate in various stages of its realization. For a team, which includes designers, engineers and managers, to function effectively it is necessary to provide the right information to the right users in the right format at the right time. They are to rely on large amounts of information, the sources of which are very different, the information itself contains different levels of detail and abstraction. Generally speaking, we can say that the potential of the existing software for monitoring realization of project is not sufficiently used. In part, this may be the result of uncompleted organizational changes that would increase the efficiency of utilization of the existing applications. To facilitate collection and storage of information during a project realization, and therefore increase the efficiency and effectiveness of the project management processes, it is necessary to develop an integrated project management system. Such a system would allow information sharing by all participants in the project during its realization, and it would contain a greater number of applications to be used at various stages of construction. Froese, Rankin and Yu [1] have

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introduced the concept of a total project system, which defines a computer system for construction project management. The main characteristics of this system are as follows:

- it is comprehensive: the system includes a number of applications that support all functions of construction project management,
- it is integrative: all applications contribute and share information on the project realization,
- it is flexible: the framework in which applications are used is open, flexible, divided into modules and distributed to various participants in the project realization.

The largest individual gain from access to the total project is extensive exchange of information between applications. Sharing information requires a unique data structure that allows information obtained in one application to be transferred and interpreted in another application. It is assumed that the system is general enough to accept a variety of applications, detailed enough to contain all the information necessary for the applications and robust enough to be widely accepted. Another key element of the total project system is the development of different modules that form the system.

2 THE CONCEPT OF A TOTAL PROJECT SYSTEM

Rankin and Froese [3] describe the current situation of using application for managing projects as a tool box containing all the available applications, which, each of them individually, are used to perform certain processes in the realization of a project (Figure 1). Each application uses certain information presented at different levels of detail. For example, to create a Gantt chart, it is essential to have the data on time, whereas to make a quote it is essential to have the information on costs. However, some data is shared by multiple applications, which leads to problems of system integration.

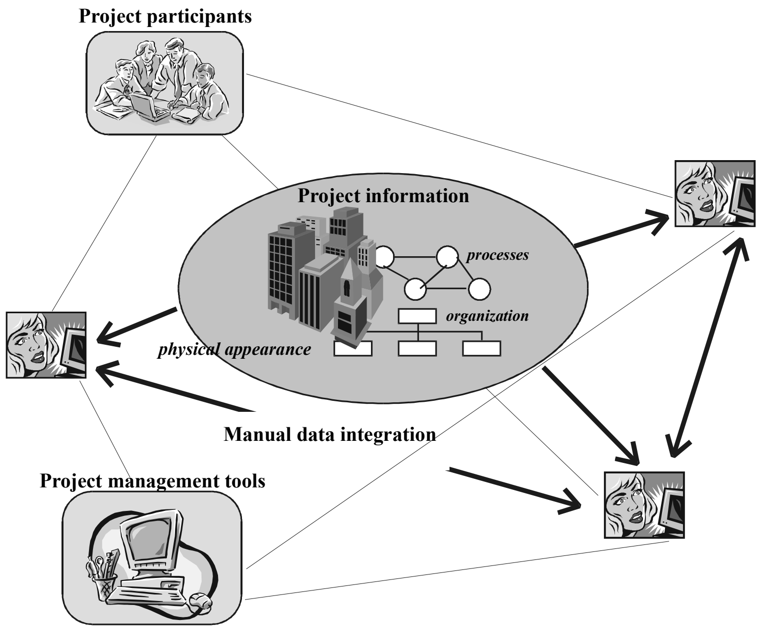

Fig. 1) Current integration of project management tools, Rankin [3]

This is why Froese [1] proposed the concept of a total project (an integrated project management system) in which the information is based on a common data model (Figure 2). This concept provides the same functionality as the "Tool box" concept but also provides greater consistency of information.

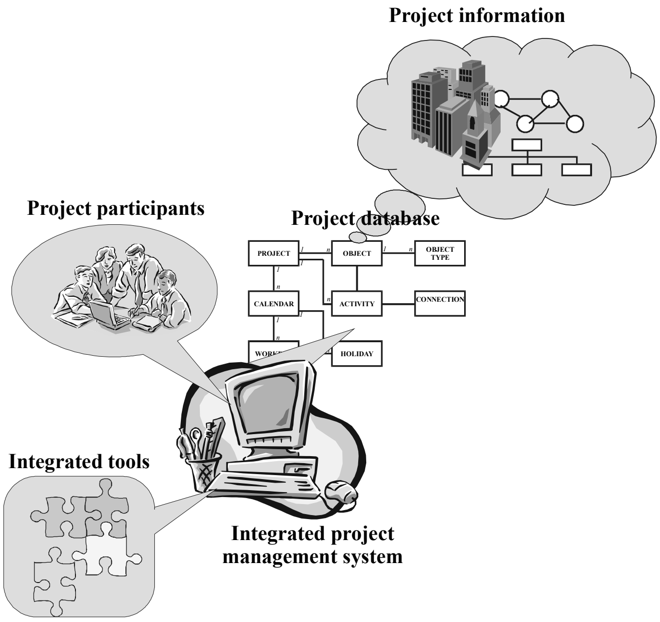

Fig. 2) The total project system, Froese [1]

As already noted, the total project concept is comprehensive, integrative and flexible. The above features are necessary for computer-based tools to become the primary means of a facility construction organization and not just specialized tools that are used only for the execution of a specific activity. The comprehensiveness of this system is reflected in the fact that the system supports a number of applications for project management in construction business. All applications use common information about the project that is located in one or more databases that represent the core of the information system. This makes it possible to get the same information and create different levels of abstraction. This use of information promotes data management system, i.e. it ensures that all applications use the most recent data. In addition to that, the applications can use a much larger range of information, which increases the capacity of tools to manage construction. Common information need not be stored in a single database, but can be distributed between the applications and the participants in the project via the Internet.

3 DATA MODEL

As previously stated, an integrated system for planning and monitoring project realization uses a common data model at the level of the entire project. In this paper, an original data model and the related software is developed. Based on the adopted model:

- the data for all applications that are used within the system is structured,
- the information data is exchanged between the applications within the system,
- the data from other applications, outside the system, is exchanged based on internationally adopted standards.

Data within the data model is grouped into the following subsystems:

- the subsystem for project planning,
- the subsystem for works standardization and quotation development,
- the subsystem for monitoring the project realization,
- the subsystem for human resources management,
- the subsystem for machinery management,
- the subsystem for monitoring the consumption of materials,
- the subsystem for contracting,
- the subsystem for recording business partners,
- the subsystem for document management,
- the subsystem for possibilistic and probabilistic planning and
- the subsystem for project optimization.

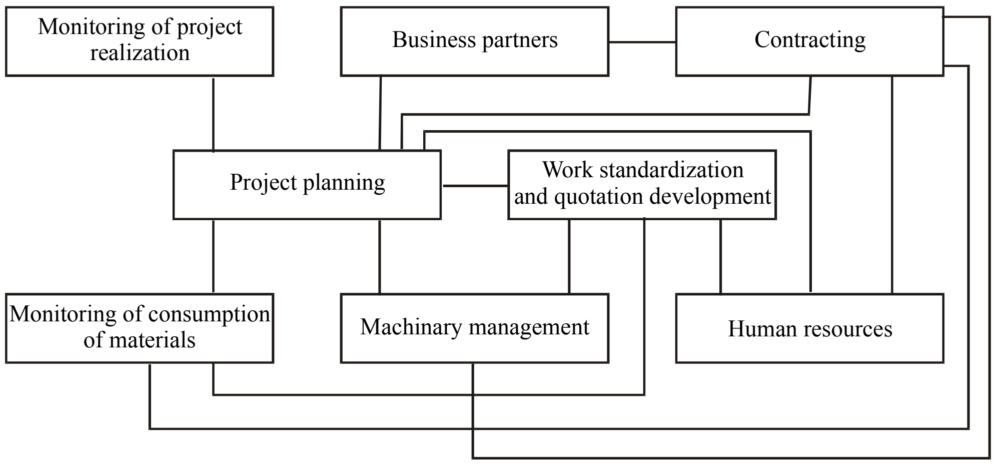

Fig. 3) Structure of the system for planning and monitoring a construction project realization, Praščević [2]

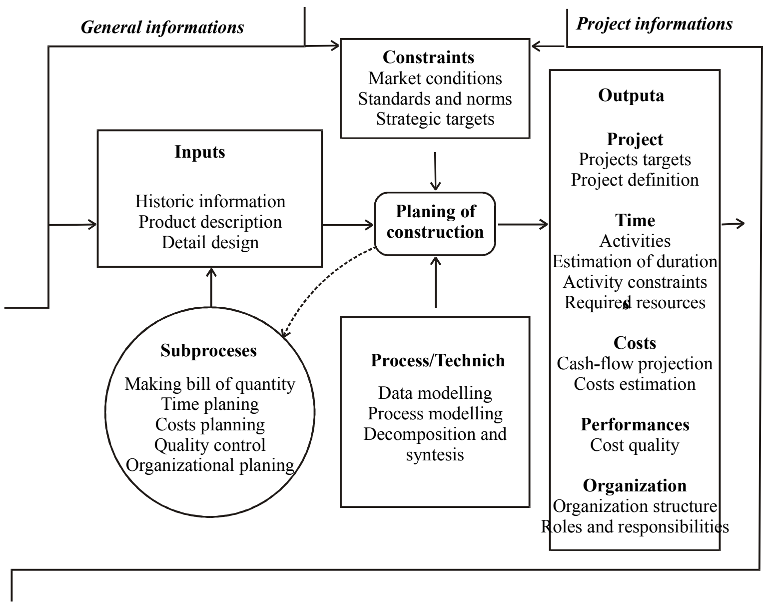

Fig. 4) Processes supported by the information system for planning and monitoring realization of a project

These subsystems operate in an integrated environment, meaning that the data from one subsystem can, without any additional processing, also be used in other subsystems. Furthermore, the data can be exported from the system and used in other commercial applications for planning and monitoring projects. The connective quality of the subsystem is shown in Figure 3. Figure 4 shows the input and output results of the application of a computer-supported planning for the realization of a facility. The system uses general information and the information related to the project (description of the facility and the project) as input data. It takes into account the following limitations: the state of the market (domestic and foreign), the applicable standards and construction standards and strategic objectives of the company. Within the system, data modeling techniques and processes, planning, analysis, decomposition and synthesis are used. The construction planning process that is enclosed in the system consists of the following sub processes: making bill of quantities, schedule planning, cost planning, monitoring project realization, monitoring the consumption of materials and involvement of other resources (machinery, equipment, labor), quality control and organizational planning, project optimization and probabilistic and possibilistic planning.

By using a computer-supported system for planning and monitoring a project we get the output results related to the project, time, cost, product performance and organization.

4 POSSIBLE APLICATIONS OF SYSTEM

The formed information system can be used to perform the following activities during the planning and monitoring process of a project realization:

- entering and storing basic data about the projects and facilities whose realization is in progress,
- to define a network plan in which a project is realized,
- to keep track of bids and concluded contracts on the project,
- to implement the existing and empirical construction norms,
- to determine the dynamics of realization works,
- to make a works quote (by activities and collectively)
- the allocation of machinery, materials and labor for activities
- to monitor the project dynamics,
- for keeping records of personnel within the construction company,
- for keeping records on the state of the material and its procurements,
- for possibilistic and probabilistic project planning,
- to optimize the project in relation to the total cost of the project.

For all these processes included in the proposed information system the relevant procedures are written and forms developed for data entry and updating, and a number of reports was formed. The information system is fully independent and does not rely on any of the existing software packages for planning and monitoring a project (Microsoft Project, Primavera, etc.). For the proposed information system to produce the expected results and to improve project monitoring and quality control of the executed works, the users need to enter the required data and to update them on regular basis. Since the system can accurately determine the allocation of resources (labor, machinery and materials) by activities, it is necessary that data on works executed is entered at regular intervals (it is suggested that this is done on daily, or possibly, on weekly basis). In this manner, the companies' management and the clients can know at any moment which works are completed and how that affects the dynamics of the works to follow. In addition, updating these data is also important for monitoring the consumption of materials and condition of materials on site. The proposed updates would be performed by the construction site foreman who would enter the data on the percentage of the works completed at the end of that work day. Since the input of these data is performed once a day, it is not necessary to have a replica of the information system on the construction site, but the data would be entered directly into the database located in the company's head office via the Internet. The proposed data transfer is supported by the Oracle platform so that it can use the existing procedures. Of course, it is assumed that the construction company has its own Web server. As already noted, an integral part of the system is the Human Resources Department, which provides the company's management with the possibility to know the schedule and availability of the personnel. If the data entry on the personnel is performed regularly (their schedule duties and position in the company) with relevant accurate data on work in progress, it is possible, with the proposed system, to know precisely which worker will do which jobs on a given day.

5 CONCLUSION

Based on the results achieved and conclusions drawn, the following directions for further development of information systems are suggested:

- By analyzing the processes and data flows that occur during the realization of construction projects it can be concluded that the number of transactions is relatively small (data updated once a day in the best case scenario, and in most cases it is done less frequently). Therefore, we do not recommend the use of a distributed database but it is better that the database is centralized and all data stored on the server located in the construction company's head office. Data entry from the construction site would be conducted via the Internet and by using any commercial Web browsers.
- The existing information systems should be linked to any of the commercial CAD applications, which would enable bill of quantities to be drawn automatically. This would link the process of designing the facility with the process of planning and monitoring its construction, and also increase the level of automation of the process of drawing the bill of quantities and the application of construction norms.
- In a developed information system, as already explained, the process of contracting and monitoring contract realization is fully supported. The system could also be expanded through the process of monitoring the payments collection for the work done, which would provide an improved insight into the financial flows on a construction project.
- The proposed information system, in addition to the above mentioned data, could also store the data on the existing situation of the facility, thus the system is expanded through the system required for facility management. This would

improve the quality control for the works executed, which is one of the crucial factors of successful realization of the project.

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APLICATION OF HETEROASSOCIATIVE MEMORY FOR MULTICRITERIA DECISION MAKING IN CONSTRUCTION INDUSTRY

Živojin Praščević[1], Miloš Knežević[2]

Abstract

A linear heteroassociative memory, as a special class of artificial neural networks, is used in this work for formulation of one prognostic mathematical model for decision making in the construction industry. This model is theoretically described firstly, and then used for the prediction of prices and other characteristic criteria for choice of apartments in the resort Budva, Montenegro. For the proposed model corresponding computer program is written out which is tested by the data collected from the local real estate agencies.

Key words:

neural networks, associative memory, construction industry, real estate

1 INTRODUCTION

In the construction industry, like in other branches of the industry, managers are often faced with problems of multi-criteria decision making. In the theory of decision making many methods are developed for solving these problems. Artificial neural networks (ANN) in the last decades are widely used as very useful models, not only for solving different problems, but for explanation of phenomena on the basis of collected data. It is especially useful when it is difficult or impossible to formulate exact mathematical relationships between existing input and output data concerning to the behaviour of a regarded system. ANN trained on the basis of realistic data may be successfully applied for the prediction of the system behaviour with known input data in a certain situations. In the literature there are large number of papers concerning to application of ANN in the civil engineering and construction industry. Authors of this work and their collaborators have used these techniques for solving several problems: ranking tenderers for a construction project realisation on tender procedure [3], formulation of the prognostic model for real estate evaluation, experimental data processing for some concrete and steel structures investigation [2] and so on.

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2 LINEAR HETEROASSOCIATIVE MEMORY

Associative memories belong to a class of ANN in which input patterns or vectors **x,** that belong to the real Euclidean space ($\mathbf{x} \in R^n$), are transformed into the output patterns or vectors **y** that belong to the real Euclidean space ($\mathbf{y} \in R^m$). The single-layer neural network, shown on Fig. 1, has *p* input vectors $\mathbf{x}_k$, which are called the *key input patterns*,

$$\mathbf{x}_k = [x_{1,k}, x_{2,k}, ..., x_{n,k}]^T, \ k = 1,2,..., p; \tag{1}$$

and *p* output patterns $\mathbf{y}_k$, which are called the *memorized patterns* or vectors

$$\mathbf{y}_k = [y_{1,k}, y_{2,k}, ..., y_{m,k}]^T, \ k = 1,2,..., p. \tag{2}$$

The mapping of input vectors $\mathbf{x}_k$ into output vectors $\mathbf{y}_k$ may be expressed as

$$\mathbf{y} = M(\mathbf{x}). \tag{3}$$

This mapping is called *retrieval*. The operator *M* denotes a general nonlinear matrix-type operator and represents the memory model which in dynamical cases involves the times variable *t*. The algorithm for computation of the operator *M* is called *recording* or *storage algorithm*.

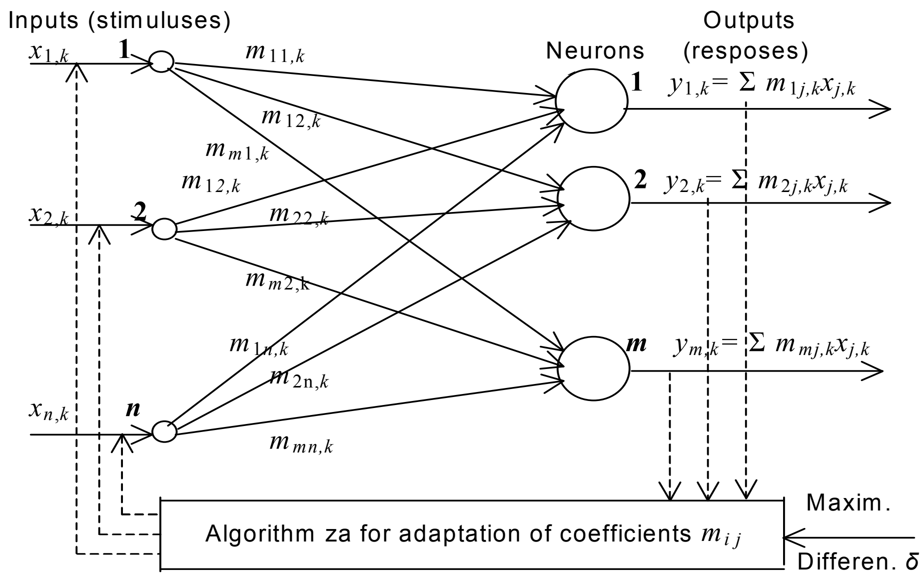

Fig. 1) Linear heteroassociative memory

Introducing in the memory any other vector $\mathbf{x}_c$ receives from (3) corresponding vector $\mathbf{y}_c$ and one of the memorized vectors $\mathbf{y}_k$ which is closest to the vector $\mathbf{y}_c$. It means, that to every retrieved vector $\mathbf{y}_c$ is associated one of the memorized vectors $\mathbf{y}_k$, and because of that these memories are called *associative memories*. Corresponding key input vector $\mathbf{x}_k$ to the associated memorized vector $\mathbf{y}_k$ is called *address* of the vector $\mathbf{y}_k$, and this memory is called *content-addressable*. This memory is *heteroassociative*, since input key patterns, denoted by

$\mathbf{x}_k$, are different from memorized patterns $\mathbf{y}_k$. If the input and output patterns are the same vectors $\mathbf{x}_k$, this memory is *autoassociative*. If operator M is the matrix $\mathbf{M}$ of type $[m\times n]$ this memory is named *linear associative* memory. In this case Eq. (4) becomes

$$\mathbf{y} = \mathbf{M}\mathbf{x} \tag{5}$$

In the literature exist several algorithms for calculation of elements of matrix $\mathbf{M}$ for known input and output vectors $\mathbf{x}_k$ and $\mathbf{y}_k$. (See Ref. [1] and [2]). These algorithms describe the training of ANN as the heteroassociative memory using corresponding learning rule. Here is applied algorithm based on pseudoinverse matrix that is explained in the author's previous work [3]. In many practical applications input key vectors $\mathbf{x}_k$ represent atributes or propoerties of the analised system for which decisions have to be done. Output memorized vectors $\mathbf{y}_k$ represent, in these cases, criteria that have to be satisfied on the best way, so that this problem becomes the problem of the multicriteria decision making. The atributes and criteria in many situations have not the same importance for the decision maker or the user of the system, and because of that are introduced weight vectors $\mathbf{w}_x$ for the atributes and $\mathbf{w}_y$ for the criteria, writen in the transposed form

$$\mathbf{w}_x = [w_{x1}, w_{x2}, ..., w_{xn}]^T \text{ and } \mathbf{w}_y = [w_{y1}, w_{y2}, ..., w_{ym}]^T . \tag{6}$$

$$\sum_{i=1}^{n} w_{x,i} = 1 \text{ and } \sum_{i=1}^{n} w_{y,i} = 1. \tag{7}$$

The recording algorithm for computation matrix $\mathbf{M}$ performs in several steps.

1. *Normalization of input* $\mathbf{x}_k$ *and output* $\mathbf{y}_k$ *vectors*. Components of these vectors usualy have absolute values grater then one, and therefore shouldd be normalized by the next formula

$$\bar{x}_{i,k} = w_{xi} x_{i,k} / N_x \le 1;\ \bar{y}_{i,k} = w_{yi} y_i / N_y \le 1;\ \ i = 1,2,...,n; k = 1,2,...p. \tag{8}$$

N_x and N_y are maximal values of Euclidean norms of vectors $\mathbf{x}_k$ and $\mathbf{y}_k$

$$N_x = \max\left\{ \|\mathbf{x}_1\|_2, \|\mathbf{x}_2\|_2, ..., \|\mathbf{x}_p\|_2 \right\},\ \ N_y = \max\left\{ \|\mathbf{y}_1\|_2, \|\mathbf{y}_2\|_2, ..., \|\mathbf{y}_p\|_2 \right\}. \tag{9}$$

2. *Formulation of correlation matrix memory*. Initial form of the matrix $\bar{\mathbf{M}}$, which is called *corelation matrix memory*, calculates by next formula [1]

$$\bar{\mathbf{M}} = \sum_{k=1}^{p} \bar{\mathbf{y}}_k \bar{\mathbf{x}}_k^T \quad \text{or} \quad \bar{\mathbf{M}} = \bar{\mathbf{Y}} \bar{\mathbf{X}}^T, \tag{10}$$

where matrices $\bar{\mathbf{X}}$ and $\bar{\mathbf{Y}}$ are composed from columns vectors $\bar{\mathbf{x}}_k$ and $\bar{\mathbf{y}}_k$ respectively.

3. *Learning of the ANN*. If this matrix is multiplied by the key input vector $\mathbf{x}_k$ should receive appropriate memorized vector $\mathbf{y}_k$, which is in that case perfectly reproduced. But it will happen when key input vectors are orthogonal only. Therefore, it is necessary to reconstract matrix memory $\bar{\mathbf{M}}$ and receive new matrix memory, denoted as $\mathbf{M}^*$, for which is valid

$$\overline{\mathbf{y}}_k = \mathbf{M}^*\overline{\mathbf{x}}_k \text{ or } \overline{\mathbf{y}}_k = \mathbf{M}^*\overline{\mathbf{x}}_i + \mathbf{e}_k,\ k = 1,2,...,p. \tag{11}$$

In the second case memorised vector $\overline{\mathbf{y}}_k$ is reproduced with an admissible error vector $\mathbf{e}_i$. Determination of elements of the memory matrix m_{ij}^* $(i = 1,2,...,n; j = 1,2,...,m)$, which is known as the *learning of neural network*, is based on least square values of the error vectors. This procedure which is described in the literature (See ref. [1], [3], [4]) performs iteratively while maximal absolute values of components of the error vectors are $\max|e_{i,k}| \geq \delta$, where δ is a maximal previously prescribed error. Here is shown something different procedure. When equation $\mathbf{M}^*\overline{\mathbf{X}} = \overline{\mathbf{Y}}$ is multiplied by the transposed matrix $\overline{\mathbf{X}}^T$ it obtains, taking into account Eq. (10)

$$\mathbf{M}^*\overline{\mathbf{S}} = \overline{\mathbf{M}}. \tag{11}$$

The matrix $\overline{\mathbf{S}} = \overline{\mathbf{X}\mathbf{X}}^T$ is symetric square matrix of the type ($n\times n$), and if its determinant $det\,\overline{\mathbf{S}} \neq 0$, this system of linear equations is easy solvable. But in many cases matrix $\overline{\mathbf{S}}$ is singualr one ($det\,\overline{\mathbf{S}}$=0) or nierly singular. In this case may be applied Moor-Pernose psedoinverse matrix, which is denoted as $\overline{\mathbf{S}}^+$, so that obtains

$$\mathbf{M}^* = \overline{\mathbf{M}}\overline{\mathbf{S}}^+. \tag{12}$$

In this way. the learning of the ANN is performed and elements of heteroassocitive memory $\mathbf{M}^*$ are obtained, which may be used for any input vector $\mathbf{x}_c$, which is not key input vector, to determine corresponding output vector $\mathbf{y}_c$ and memorized vector $\mathbf{y}_k$.

4. *Determination of the corresponding memorized vector for some nonkey input vector* $\mathbf{x}_c$. This vector is normalised firstly to receive vector $\overline{\mathbf{x}}_c$, and then from the first of Eqs (11) corresponding normalized output vector $\overline{\mathbf{y}}_c = \mathbf{M}^*\overline{\mathbf{x}}_c$ is determined. To find corresponding memorized vector $\overline{\mathbf{y}}_k$ that is closest to the vector $\overline{\mathbf{y}}_c$, Hammings‘ distances from all memorized vectors $\overline{\mathbf{y}}_k$ to the vector $\overline{\mathbf{y}}_c$ are calculated by the formula

$$HD_{ck} = 0.5\sum_{i=1}^{p}|\,\overline{y}_{i,c} - \overline{y}_{i,k}\,|,\ k = 1,2,...,m. \tag{13}$$

The vector $\overline{\mathbf{y}}_l$ with minimal value of Hamming distance

$$HD_{cl} = \min_k \left(HD_{ck}\right) \tag{14}$$

is taken as the coresponding memorized vector.

The real (nonnormalized) components of the output vector $\mathbf{y}_c$ are calculated by the formula

$$y_{i,c} = N_y\overline{y}_{i,c} / w_{i,y} \tag{15}$$

According to this procedure corresponding computer program is written out in the MATLAB computing system.

3 EXAMPLE

This model is applied for prediction of the of the prices and other main criteria of apartments in Budva, the resort at Adriatic Coast in Montenegro. This problem is solved on some different way by M. Knežević [2]. He performed training on the nonrecurent neural network, while learning of the neural network is executed using backpropagation algoritm with the sigmoidal function.

The real estate market is very active at montenegrian part of Adriatic coast, especially in Budva. The market values of real estates are dependet of tme and are determined for the given date, and because of that this model is time dependent in the reality. In this case is taken into account tat this value and other criteria are dependent of the real estate location and other relevant external factors. This value is determined, starting from most possible usage of te real estate, in accordance with the economical opportunity, phisical possibility and rules of legislation. In this analysis are used six atributes of apartments:

1. Area of the apartment,
2. Floor where the apartment is located (ground, first, second, third, fort and attics)
3. Zone of the city where is te apartment located (the best - A, good – B, acceptable - C),
4. Number of rooms (one, two and three),
5. Quality of production of the apartment (good, very good, excellent),
6. View on the Adriatic see (good, partly good and without view on the see).

Three main criteria are considered for the prediction and evaluation of te appartments:

1. Price of the apartment,
2. Mean deily cost of the apartment for rent to turists,
3. Mean annual number of days for rent to turists.

Components of input vectors $\mathbf{x}_k$ are related to the atributes of apartments, while compomnents of output vectors $\mathbf{y}_k$ are related to the criteria for selection of the apartments. In this case vectors $\mathbf{x}_k$ have n = 6 components and vectors $\mathbf{y}_k$ have m = 3 components, so that matrix of the heteroassociative memory $\mathbf{M}^*$ has three rows and six columns. Since the atributes and criteria are given in different dimensions and values, for successful data processing they are expressed by the real numbers from 1 to 10.

The area of the apartments is expresed in 10×m^2, the floor where they are located is assesed by numbers 1 to 5, the zone of the city, the quality of the apartment and the view on the see are assesed by numbers 5, 4 and 3. The price of the apartment are expresed in 1000 ×€/m^2, the mean daily rent in 10×€/day and annual mean number of days for rent in 10×days. For example for the apartment which is located on the third floor, with area 47 m^2, located at zone B, possesses very good quality, exelent view on the see, with the prices 2 323 €/m^2 , the mean deily rent 55 €/day and 92 days for the rent annually, corresponding input and output vectors are

$$\mathbf{x}_k = [5 \quad 4.7 \quad 1 \quad 4 \quad 5 \quad 5] \text{ and } \mathbf{y}_k = [2.323 \quad 5.50 \quad 9.2].$$

In this investigation were colected data for 78 apartments with different atributes and prices. For formulation of the heteroassociative memory are used data for 45 apartments (15 with one room, 15 with two rooms and 15 with three rooms). Data for other apartments are used for validation of the heteroassocitive memory. Due to limited space of this paper is not possible to present here all these data, which are processed by the mentioned computer program..

The vectors of weights for atributes $\mathbf{w}_x$ and criteria $\mathbf{w}_y$ are

$$\mathbf{w}_x = [1/6 \quad 1/6 \quad 0.5/6 \quad 1/6 \quad 1.5/6 \quad 1/6] \text{ and } \mathbf{w}_y = [0.4 \quad 0.3 \quad 0.3]$$

The matrix of the heteroassocitave memory is

$$\mathbf{M}^* = \begin{bmatrix} 0.0266 & 0.0102 & -0.0340 & 0.3677 & 0.2235 & 0.2733 \\ 0.0526 & 1.8598 & 0.2450 & 0.0958 & 0.0062 & -0.1434 \\ 0.2232 & 0.1431 & -0.4290 & 1.0759 & 0.5955 & 0.8255 \end{bmatrix}.$$

For example, if some customer is interested for the one-room apartment on the second or third floor, with area cca 45 m^2 , located at zone B, with excellent quality of production and partly good view on the see, then the input vector $\mathbf{x}_c$ and normalised vector $\overline{\mathbf{x}}_c$, acording to expressions (8) and (9), are

$$\mathbf{x}_c = [5 \quad 4.5 \quad 1 \quad 4 \quad 5 \quad 4], \quad \overline{\mathbf{x}}_c = [0.0572 \quad 0.0515 \quad 0.0057 \quad 0.0859 \quad 0.0458].$$

Using Eq. (11) obtains normalized output vector $\overline{\mathbf{y}}_c$ and then according to Eq. (15) real output vector $\mathbf{y}_c$

$$\overline{\mathbf{y}}_c = [0.0504 \quad 0.0986 \quad 0.1559], \quad \mathbf{y}_c = [2.0254 \quad 5.2819 \quad 8.3570].$$

According to these results, the predicted price of the apartment is 2 025,4 €/m^2 with the rent 53 €/day and 84 days for the rent annually. Using Eqs. (13) and (14) for calculation of Hamming distance, is found that vector $\mathbf{y}_c$ is the closest to the key output vector $\mathbf{y}_1$. Therefore, can be concluded that inputing vector $\mathbf{x}_c$ in the heteroassocitive memory $\mathbf{M}^*$ will be drown from this memory output vector $\mathbf{y}_1$ which has corresponding vector $\mathbf{x}_1$ with components

$$\mathbf{x}_1 = [5 \quad 4.3 \quad 1 \quad 4 \quad 5 \quad 4] \text{ and } \mathbf{y}_1 = [2\,100{,}0 \quad 5.100 \quad 8.300].$$

For the training set of data, which is the same as the set of key input vectors $\mathbf{x}_k$, maximal error was found 8% and for the validation set 14%. M. Knežević [2] obtained similar results using ANN with backpropagation algorithm.

4 CONCLUSIONS

Proposed prognostic model which is formulated as linear heteroassocitive memory (LHM) is very useful and may be applied for solving different problems in civil engineering investigations andin the construction industry. In our opinion this is main merit of tis work. Formulation of LHM using pseudoinverse matrix on the basis of known input and output data is very simple and gives relatively small error for applied input data. This error is usually the result of inconsistencies and irregularities of entered input data. This is the consequence of some socio-technical and economical circumstances which are characteristic for the real estate market in that region. Authors are thankful to the unknown reviewer for useful remarks.

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HEALTH AND SAFETY MEASURES ON CONSTRUCTION WORKS

Marina Rakočević[1]

Abstract

Work in construction is very complex because workers are performing their work in an open space where generally they have unfavourable conditions, such as extremely low or high temperature, noise, vibration, dust, work at height and depth and constant danger of falling objects from above.

At construction site worker is exposed to these unfavourable conditions for long period of time. During the construction work it is necessary to implement health and safety measures to ensure safety of workers and other participants involved in construction process.

The paper presents application of health and safety measures on building construction works.

Key words

Health and safety measures, safety of workers

1 INTRODUCTION

Regarding safety measures, construction works are arranged with a series of laws and regulations. Valid legal regulations in Republic of Montenegro which specify the area of health and safety measures in construction are: Montenegrin Law on Safety at Work (‘Official Gazette of Republic of Montenegro’No.79/04), Regulations on safety in construction (‘Official Gazette of SFRY’,No. 45/68), Regulations on the Elaborate content on organization of site (‘Official Gazette of RM’, No. 4 / 99), and others.

Organization of the work on site must be such as to largely exclude the possibility of workers' injury. The organizational documents should provide all required and in practice perceived safety at work measures which are necessary to be implemented for conduction of the work of employees in a safe way. With the contract between the investors and contractors all necessary safety measures have been regulating in terms of their organization and implementation, as well as the mutual rights, obligations and responsibilities [1].

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2 SAFETY AT WORK REQUESTS

Basic safety at work requests on the site are:

- Working environment is designed, built and maintained with the application of measures of protection against risks to life and health of workers,
- Working conditions are adapting to physical and mental abilities of workers,
- Technology and organization of work is defined so that the worker works in an optimal position,
- Electrical and other installations need to be performed and maintained in accordance with technical regulations,
- In the working and auxiliary spaces and premises, namely in working places, chemical, physical and biological harms should not be above the allowable limits,
- Machinery, tools, equipment and other technical means of work should be designed, installed and used in such a way not to endanger the safety of workers,
- Personal safety equipment should be used as it is provided, as an additional protection to application of other appropriate safety measures [2].

Of the total number of workers injuries at work about 80% are the injuries in the construction industry. Injuries in construction usually occur as a result of taking preventive measures of safety at work by the contractor, as well as non-compliance with them by the workers.

In addition to the human factor as the main cause of occupational injuries in construction, small number are caused by unregulated and unpredictable factors and the inability of fully provision for workers to work in a safe way.

3 ELABORATE ON SITE ARRANGEMENT

Safety measures at the construction site must be closely regulated (with sketches, descriptions, profiles, etc.) by developing Elaborate on the site arrangement as the most important document for work in a safe way. The Elaborate on the site arrangement is required to be prepared by a contractor, if he is working by himself, ie, the main contractor, if there are more contractors [3]. For the sites in inhabited places, the Elaborate must be submitted to the competent inspection with the application of the beginning of works, at least 8 days before the start of works.

Elaborate includes general and special part. The general part includes the survey of the site and a text part and it is more focused on securing of so-called preparatory works, accommodation and meals for employees, healthy drinking water and heating, all temporary installations and access roads, location of temporary facilities, displays of various storages-landfills, site boundaries, the organization of first aid and others. Special part of the Elaborate is made for work and work operations for which performance it is necessary that worker has a special health and psycho-physical skills, as well as to those jobs for which there is an increased risk of injuries and the occurrence of hazards to workers health, and which cannot be removed by application of individual safety measures such as technical protection of the tools and personal protective equipment. These works include works on slopes, wide excavations, underground work, work at heights, prefabricated construction, works with a reduced or increased air pressure, works in the trenches and pits more than one meter deep and works where there is a danger of falling objects at workers. A special part of the Elaborate consists of separate designs for each technological unit in the working process.

If there are more contractors on the, each of them has an obligation to implement all safety measures provided in the Elaborate for which bears full responsibility on his part of the site and for his workers. The main contractor is responsible for protection and implementation of safety at work for the entire site [7].

3.1 APPLICATION OF SAFETY MEASURES ON EXAMPLE PERFORMANCE OF THE STRUCTURE ACC CONSTRUCTION IN PODGORICA

3.2 Organization of the building site ACC

Residential-office building Atlas Capital Center, abbreviated ACC (Picture 1) is located in Podgorica. The building is basically an area of about 10,120 m2 (Picture 2), there are four underground floors and 6, 9 and 11 above ground floors (without technical floors). The total area is about 90.000m2.

Fig. 1) Construction of residential – office building ACC

On the construction of reinforced concrete structure, according to the Elaborate on the site arrangement, four reinforcement plants were organized on the site, 5 cranes-elevators of different lifting height and load carrying capacity, the chambers for examination and first aid, facilities for the accommodation of personal protective means and equipment (for each subcontractor separately), office space (metal containers) for the technical staff of the supervisory body, the main contractor and subcontractors, facilities for the rest and nutrition of workers, facilities for spare parts, carpentry workshops and others.

Construction site is fenced with a fence of tin, 2 m high, with two fixed entrances - exits. During the construction temporary passes for transport of materials and certain equipment were opened. The construction site is secured by the service of physical - technical support with 3 employees in one shift. For the operation of the service on the whole site video surveillance is installed and instruction prepared with specially defined measures for control of the entrance - leaving of workers on the site, but also of visitors who do not work on the site. During the performance particular duties of this service are defined and the way of work in working and non-working time. A system of electronic access control is introduced at the construction site.

Organization of work on the site was carried out in a way to largely exclude the possibility of workers' injury. The organizational documents provide and prescribe in practice observed necessity for safety measures that were implemented, so the work of the workers was carried out in satisfactorily safe manner.

On the construction of reinforced concrete structure, beside the main contractor, 5 subcontractors were engaged on the site, specialized for performing of rough construction works. The total number of employees at the structure at one time was about 400. Each subcontractor has constantly working engaged engineer responsible for monitoring the quality and quantity of works and implementation of safety measures. In order to complete the works in due time the work was performed in several shifts.

The Investor has determined the supervising authority that is composed of experts of different profiles: civil engineers, mechanical engineers, electrical engineers for the strong and weak electricity, architect and engineer of safety at work. In accordance with the law on planning and construction of facilities, the main Contractor has appointed the chief engineer on building site. In addition, for certain types of work and some parts of the building by internal decision other organizers were appointed to monitor the quality of works and organize the implementation of safety measures on the proposal of a Specialist in health and safety of contractors at work.

The main contractor and all subcontractors (the builders) have owned the Regulation on Safety at Work and Act on risk assessment. All employees had to be charged with the appropriate personal safety means and equipment in accordance with the Regulation. Jobs with special conditions were defined. Each employee has been trained for safe work, and employees assigned to the jobs with specific work conditions were examined by a doctor specialist of occupational medicine.

For the worker on crane, cargo tier and signalman a special instruction with precise individual duties and responsibilities in the way of transferring material is made. Having in mind the large number of employees, the condition for avoiding the presence of employees in manipulation and manoeuvring space could not be satisfied. This problem is solved by providing of wireless devices for worker on crane, signalmen and cargo tier and, also in the transfer of cargos, workers on crane have an obligation to warn workers of the danger of falling of cargo by using audio signals.

A large number of working means of different drive, use, maintenance and prescribed review and research deadlines have been used on the building site. Manufacturer of working means is obliged, during the designing, construction and production of the means, to apply the required technical measures, standards and safety measures. Manufacturer that produces the mechanical working means is obliged to provide with each produced means an instruction for use and safe operation, maintenance instructions with prescribed time review, prescribed public documents and report on results of testing the working means in the customer language to prove that safety measures are implemented and that means are safe for use.

Supervision of the Investor and authorized worker of the main contractor are controlling the building site every day. Weekly tours of the site are carried out jointly as also the control of the implementation of safety measures. After each site visit the minutes are made in which individual obligations and responsibilities of all participants in construction are defined.

3.3 Examples of non-compliance with prescribed safety measures

During the performance of the building ACC in some cases the prescribed safety measures have not followed. Picture 2 shows the case when improperly prepared scaffolding for work has been used. Frame scaffolding with wheels that didn't have proper mechanism for braking was often used during the work performance. Also, makeshift of scaffolding was often carried out.

For work at height the use of wooden ladders, which are improperly made, could be observed. In many cases, there was no compliance with the obligations for setting of protective fences on openings in the floor and in mezzanine structures. During the temporary work at height, where there is no conditions for posting of scaffolding, it was noted that protective belts with rope reception are not used. In some cases, lifting, lowering and handling the cargo is done without prior warning. The carried cargo was of greater weight than the nominal capacity of the crane and the workers performed its manual routing. The noted things were a constant threat to the health of workers due to their stay in manipulated space of the crane. Also, the hanging rope for cargo was damaged on several occasions. In some cases it is observed that the cargo which was transferring was not protected from waste (cement pallets, bricks and full blocks, all kinds of joints, pipes, small reinforcement elements, etc..).

Fig. 2) Improperly made scaffoldings

During the performance of works the damage occurred or improper installation of electrical cable connectors. Rotating and moving parts of the working means in many cases were not properly protected, Picture 3.

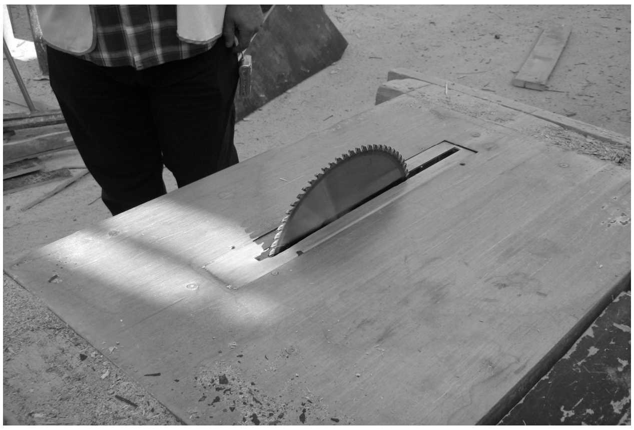

Fig. 3) Unsecured working means

Personal safety means are not always used or are not used applicable, especially working in the summer months when there are high temperatures.

3.4 Examples of compliance with the prescribed safety measures

With adequate response of the experts for investor's safety at work and main contractor as well as the responsible workers of the main contractor, shortcomings were quickly removed and didn't cause serious consequences, Picture 4.

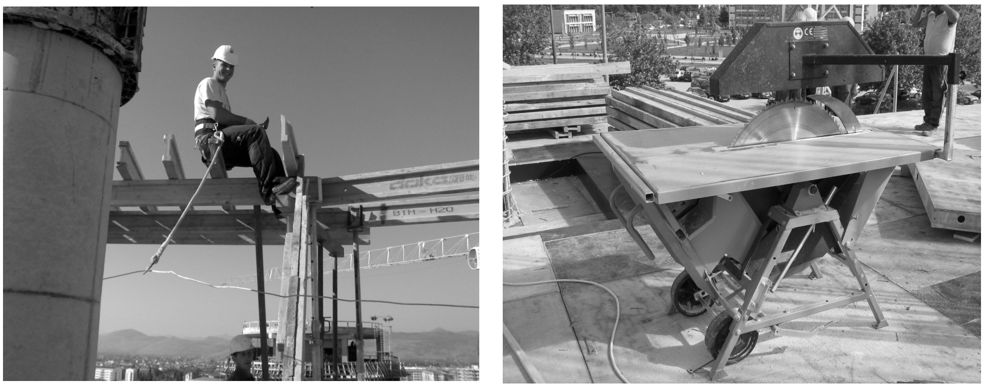

Fig. 4) Implementation of safety measures

4 CONCLUSION

To reduce the risk of workers' injury it is necessary to prescribe, in accordance with normative acts and practices, safety measures and insist on the implementation of all safety measures in practice. Necessary safety measures in the construction are the part of the Elaborate on the arrangement of construction site. Since the injury in the jobs are most often a consequence of not taking preventive safety measures by the contractor, as well as because of non-compliance with them by the workers during construction works, it is necessary to constantly insist on the implementation of the prescribed safety measures..

During the performance of the construction of Atlas Capital Center, located in Podgorica, as a result of non-compliance with the prescribed safety measures, there were a very small number of minor injuries of workers who participated in the construction. There was no serious body injury of workers and life-threatening injuries either. Specialists of safety at work and other employees in the construction of the building had a very important role in the application of prescribed safety measures and thus contributed to the reduction of injuries and their severity, and protected the health of employees at the displayed structure.

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INTRODUCTION TO MANAGEMENT OF SUSTAINABLE BUILDINGS

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Abstract

Green buildings are designed for the purpose of reducing operating costs and to achieve an appropriate level of indoor environment. The main reason is the ever-growing financial costs of managing objects. That is why the professional facility management that can deliver these cost savings but also better quality, convenience services, or longer life technology equipment and building structures. New technologies that automate and integrate facility life-cycle processes can help building owners, facility managers and planners answer these questions. An integrated system for facilities management would help facility managers, planners and others better manage facility life cycles. The aim of paper is to present the state-of-art of management application in sustainable buildings.

Key words

Sustainability, sustainable development, green building, facility management, life cycle

1 INTRODUCTION

The built environment presents us with a major challenge. Achieving sustainability requires us to live within the limits of the earth's capacity to provide the materials for our activities and to absorb the waste and pollution that our activities generate. The construction, operation and ultimate demolition of buildings is a huge factor in human impact on the environment both directly (through material and energy consumption and the consequent pollution and waste) and indirectly (through the pressures on often inefficient infrastructure). The built environment also has a crucial impact on the physical and economic health and well-being of individuals, communities and organizations. A good building is a delight and will enhance a community or organization, enhance our ability to learn or increase our productivity. A poor building will do the opposite. Where buildings and built environments contribute to ill-health and alienation, undermine community and create excessive financial liability, they are undesirable and unsustainable. Facility management is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place,

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process and technology. The main reason is the ever-growing financial costs of managing objects. That is why the professional facility management in the hands of specialist companies that can deliver these cost savings but also better quality, convenience services, or longer life technology equipment and building structures. New technologies that automate and integrate facility life-cycle business processes can help building owners, facility managers and planners answer these questions. An integrated system for facilities management would help facility managers, planners and others better manage facility life cycles.

In fact, globally and nationally commercial buildings contribute significantly to resource consumption, as well as to other environmental impacts, such as air emissions and solid waste generation. These and other global environmental and human - health related concerns have motivated an increasing number of designers, developers and building users to pursue more environmentally sustainable design and construction strategies. However, compared to other "products" buildings are more difficult to evaluate for the following reasons. They are large in scale, complex in materials and function and temporally dynamic due to limited service life of building components and changing user requirements. Their production processes are much less standardized than most manufactured goods because of the unique character of each building. There is limited quantitative information about the environmental impacts of the production and manufacturing of construction materials, or the actual process of construction and demolition. All of these factors make environmental assessments of the building industry challenging. [1]

2 SUSTAINABLE DEVELOPMENT

The definition of sustainable development given was: Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs. A more correct and rigorous definition can be found in most chemistry, biology and even economics textbooks: A sustainable society, process or product is one that can be sustained or continue to be produced over the long term, without adversely affecting the conditions necessary to support those same activities in the future. [2]

The concept of sustainable construction we can characterize as construction that includes environmental criteria in the project concept, in the way of building, maintaining and, when the time comes, of demolishing the works. Sustainable construction may allow the construction industry to become a sustainable development. [3]

Clearly, we are very far from producing even a single truly sustainable building in the industrialized world. A sustainable approach to the built environment involves a holistic approach to the design of buildings. All the resources that go into a building are the materials, fuels or the contribution of the users need to be considered if a sustainable architecture is to be produced. Producing green buildings involves resolving many conflicting issues and requirements. Each design decision has environmental implications. Measures for sustainable buildings can be divided into four areas:

- Reducing energy in use
- Minimizing external pollution and environmental damage
- Reducing embodied energy and resource depletion
- Minimizing internal pollution and damage to health

To meet the challenge we have to enhance quality of life for all by designing healthy buildings and environments fit for individuals and communities both now and in the future. We need to minimize resource throughputs, waste and pollution, and to fulfill our responsibility to protect other species and environments. Given how far we are from producing truly sustainable buildings, a working definition of a green building is one that is more sustainable than current practise. The operative goals of a green building can be stated as: A green building is one that uses energy and material more effectively both in production and operation while polluting and damaging natural systems as little as possible. [2], [4]

2.1 Dimensions of sustainability

Addressing sustainability in building construction includes consideration of the three primary dimensions of sustainability - economic, environmental, and social.

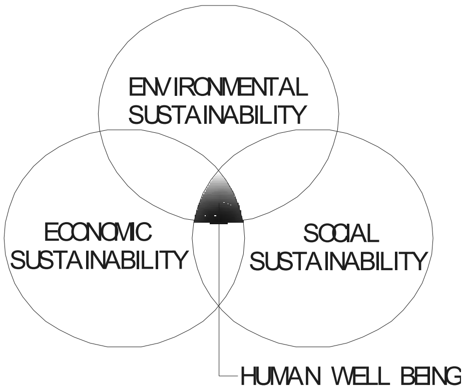

Fig. 1) Primary dimensions of sustainability

Economic dimensions: These relate to costs and benefits that measure the impact to the economy, wholly or partially resulting from activities, products or services used in the construction work or in the use of the construction works.

Environmental dimensions: These relate to current use of the earth's resources; consider impacts on the quality and the quantity of resources as well as local, regional and global eco-systems; and incorporate life cycle assessment to evaluate the impact to the environment, wholly or partially resulting from activities, products or services used in the construction work or in the use of the construction works.

Social dimensions: These relate to intergenerational ethics and recognize the inherent value of ecosystems, traditions and cultures. Impacts to society or quality of life, wholly or partially resulting from activities, products or services used in the construction work or in the use of the construction works involves impacts on local culture and the provision for basic human rights and human needs, and should include any legacy left by the construction works beyond its useful life.

These dimensions are inextricably linked to each other and are interdependent, and normally a dynamic balance exists between them, which may be fragile or enduring. [5]

2.2 Principles of sustainable architecture

To meet the satisfaction of people we have to enhance quality of life for all by designing healthy buildings and environments fit for individuals and communities both now and in the future. We need to minimise resource throughputs, waste and pollution, and to fulfill our responsibility to protect other species and environments. Buildings and the built environment will therefore increasingly be required to satisfy a number of criteria, including that they should:

- Enhance biodiversity - not use materials from threatened species or environments and improve natural habitats where possible through appropriate planting and water use.
- Support communities - identify and meet the real needs, requirements and aspirations of communities and stakeholders and involve them in key decisions.
- Use resources effectively - not consume a disproportionate amount of resources, including money and land during material sourcing, construction, use or disposal; not cause unnecessary waste of energy, water or materials due to short life, poor design, inefficiency, or less than ideal construction and manufacturing procedures.
- Minimize pollution - create minimum dependence on polluting products and materials, management practices, energy, power and forms of transport.
- Create healthy environments - enhance living, leisure and work environments; and not endanger the health of the occupants, through exposure to pollutants, the use of toxic materials or providing host environments to harmful organisms.
- Manage the process - stewardship of projects is a vital and overarching aspect in delivering sustainable projects, both in the first instance and also in ensuring their performance over time.
- Good designing - all possible measures are to be taken to achieve an efficient, long lasting and elegant relationship of use areas, circulation, building form, mechanical systems and construction technology. Symbolic relationships with appropriate history, the Earth and spiritual principles are to be searched for and expressed. Finished buildings shall be well built, easy to use and beautiful.

There is amount of information available to all professions on how to design buildings that are attentive to the needs of sustainable construction, but practice falls far short of applying the easily applicable principles in projects. The result is that buildings and the industries that supply building designers with products, materials and services are less efficient, less economical and polluting than they might otherwise be. The positive impact on the environment and on quality of life from addressing these issues could be immense. [4], [6]

2.3 How achieve sustainable development

Sustainability challenges us to ensure that we do not cause harm whilst maintaining a non-declining stock of capital assets, including environmental assets, to meet the needs of society in the future. Success relies on action at different levels. Four tenets of sustainable development:

- Social progress which recognises the needs of everyone. Everyone should share in the benefits of increased prosperity and a clean and safe environment. We have to improve access to services, tackle social exclusion, and reduce the harm to health caused by poverty, poor housing, unemployment and pollution. Our needs must not be met by treating others, including future generations and people elsewhere in the world.

- Effective protection of the environment. We must act to limit global environmental threats, such as climate change; to protect human health and safety from hazards, such as poor air quality and toxic chemicals; and to protect things which people need or value, such as wildlife, landscapes and historic buildings.
- Prudent use of natural resources. This does not mean denying ourselves the use of non-renewable resources like oil and gas, but we do need to make sure that we use them efficiently and that alternatives are developed to replace them in due course. Renewable resources, such as water, should be used in ways that do not endanger the resource or cause serious damage or pollution.
- Maintenance of high and stable levels of economic growth and employment. Everyone can then share in high living standards and greater job opportunities. For each country to prosper, the businesses must produce the high-quality goods and services that consumers throughout the world want, at prices they are prepared to pay. To achieve that, we need a workforce that is equipped with the education and skills for the twenty-first century. We need businesses ready to invest and an infrastructure to support them.

The built environment offers plenty of evidence that there are links between economy, environment and society, and plenty of opportunity to reinforce the positive links that generate net benefit. And the construction sector has a significant role to play. [6]

3 FACILITY MANAGEMENT

The environmental and facility management are one of the fastest growing professions in the many countries. In general, all organizations, whether public or private, use buildings, assets and services – facility service, to support their primary activities. By coordinating these assets and services, by using management skills and by handling many changes in the organizations environment, facility management influences its ability to act proactively and meets all its requirements. This is done also to optimal the cost and performance of assets and services. Facility management can be generally defined as a method of harmonizing the mutual employees, work activities and working environment, which encompasses the principles of business administration, architecture, humanities and technical sciences. It is internationally respected term, which is in the form defined in STN EN 15221-1:2007 Facility Management, valid in Slovakia since 1st September 2007. [7], [8], [9]

The European standard STN EN 15221 - 1: 2007 the Facility Management defines as the integration of processes within an organization to maintain and develop the agreed services witch support and improve the effectiveness of its primary activities. Integrated facility services are the set of facility services that interact with each other. The basic concept of facility management is to provide integrated management on strategic and tactical level to coordinate the provision of the agreed support services facility management. This requires specific competencies and distinguishes facility management from the isolated provision of one or more services. [9]

3.1 Facility management of sustainable buildings

The concept of sustainable facility management has developed and evolved recently in parallel with the overarching concept of sustainable development and the growing appreciation of the scale of predicted climate change. The case for change has been successfully made and the need to balance the three strands of sustainable development - social, economical and environmental - is apparent. It is both fortuitous and timely that the facility management profession has embraced the agenda for change and is developing practical sustainability goals within this rapidly evolving profession. [10]

Many research and studies show that green or sustainable buildings can save a lot of money each year to the bottom line. They are more efficient in lowering operating costs; protecting occupant health; improving employee productivity; utilizing energy, water and other resources; and reducing the overall impact to the environment. In an effort to reduce their ecological footprints, facility managers offer a strong business case when speaking about the importance of incorporating energy efficient and sustainable design to their buildings. As every day passes, one comes to realize that going green is smart business and is easy if you have the right tools at your disposal. Green buildings require designers and builders to understand the problem, modify their processes, and measure the outcomes against some standard. Only in this way we can improve our current buildings and built of new green buildings to a sustainable future.

4 CONCLUSION

The quality and reliability of building construction, while not endanger the environment in and around the workplace, to ensure the health and safety of employees, would now be to the basic standards of all designer works. Green buildings are designed in order to fulfil the purpose of reducing operating costs and to achieve an appropriate level of the internal environment of buildings. This aspect contributes significantly to facility management. The green building should be seen not only in terms of environmental and architectural aspects, but also in terms of technical equipment of buildings, using the latest technology and materials solutions, and overall management of the building. The development of these aspects, there should be alternatives, green buildings, which will be targeted to improve environmental safety and security of buildings.

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STUDIES ABOUT FIRE BEHAVIOUR OF POLYSTYRENE AND MINERAL WOOL USED FOR THERMOINSULATING SYSTEMS OF BUILDINGS

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Abstract

In this article are outlined some aspects about the actual state of fire regulations in Romania, in transition to Eurocodes. Forwards, are presented the fire test results for different insulating systems for buildings and finally, observations and conclusions about the fire behaviour of polystyene and mineral wool. The subject is topical because many buildings were rehabilitated with polystyrene through a national program, without taking account of fire hazard of this material.

Key words

thermal rehabilitation, fire safety, expanded polystyrene, mineral wool

1 INTRODUCTION

European Directives must be strictly held by each member of European Union, which involves not only the existence of uniform national laws between member countries, but also of the same technical regulations and institutions that work acoording to harmonized procedures. Thus, in Romania, the Government issue no. 622/2004 transpose the European Directive 89/106/EEC referring to construction products: essential requirements, reference technical specifications, conformity assessment systems, institutional organization required. In 2002 was enacted by Government Emergency Ordinance no. 174, a national program for rehabilitation of multistoried residence buildings, in order to prevent the huge loss of energy in this construction sector. Due to the low price and easy labor, the thermal systems with expanded polystyrene (EPS) were wide used, currently being the most common thermal system for rehabilitation of multistoried dwellings in Romania. In Europe, however, expanded polystyrene is not in big request anymore. In England, Norway, Sweden, Germany, mineral wool is uppermost in use for thermal insulation of buildings because of its serviceability and fire performance. Compliance with the essential requirements of directives does not

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necessarily mean that a product has excellent technical performance, but only that are no risks in terms of the directive. [1]

1.1 POLYSTYRENE – generalities and fire behaviour

Polystyrene is a thermoplastic polymer, commonly produced in three forms: expanded polystyrene foam (EPS), extruded polystyrene (XPS) and extruded polystyrene foam. There were also produced copolymers, which contain one or more other monomers in addition with styrene. Expanded polystyrene foam (EPS), was developed and produced in 1959 by Koppers Company in Pittsburg, Pennsylvania. Polystyrene foams are produced using blowing agents, that form bubbles and expand the foam. Expanded polystyrene can have a flammability hazard due to its content in hydrocarbons such as pentane. It melts around 74…105 C° and its density varies between 10 and 30 kg/m^3. When it is exposed to fire, it shrinks and burns easily with jets and persistent yellow flame. Polystyrene can be dissolved by substances that contain acetone, like aerosol paint sprays, and cyanoacrylate glues, that is why the finishing materials compatible with polystyrene are water-based paint, mortar or acrylic cement render or silicate plaster. The tests performed of EPS products [2], determined that thermal conductivity coefficient changes reversely with density, therefore decrease of thermal conductivity coefficient is provided by increase in number of EPS grains in unit volume results in less void volume between grains and also result increase in number of pores in the EPS grains. Polymer combustion is a complex proces which consists of a sequence of events like thermal degradation, char formation, transport of degradation, ignition, fail of burning dropletts etc. To improve the fire behaviour of polystyrene, is important the understanding of factors that influence each event of its burning process.

1.2 MINERAL WOOL – generalities and fire behaviour

Mineral wool is made from molten glass, stone or slag that is spun into a fiber-like structure and held together with a phenolic resin. In order to give cohesion and mechanical properties to the mineralwool mat , small quantities of binding agents are added to the fibers and to prevent dust is used an oil emulsion. Mineral wool is produced in three categories: glass wool, stone wool and ceramic fibre wool, different by the content of glass or volcanic rock and by the furnace temperature while manufacturing. Stone wool is more expensive because it requires a furnace temperature around 2000° C, while glass wool is produced at approximately 1400° C. Therefore, the thermal properties of all kind of mineral wool are different. Ceramic fiber wools have a maximum temperature endurance of 1200° C, stone wool withstands temperatures of more than 1000° C and glass wool has a good behaviour at fire exposure under 230° C…250° C. The thermal conductivity coefficient for mineral wool is ranging between 0.03 W/mK and 0.045 W/mK, comprised between 0,032 to 0,040 W/mK for glass mineral wool and between 0,033 and 0,035 W/mK for stone mineral wool. The density of mineral wool can be from 40 kg/m^3 till 200 kg/m^3. According with Euroclass Classification, mineral wool is a non combustible material having class A1 or A2 of fire reaction.

2 EXPERIMENTAL WORK

Flammability describes the ability of a material to burn. Flammability characteristics are those properties that define, describe, or measure the behaviour of a material when is exposed to heat or fire. The flammability characteristics that are most important in measuring the material burning process are ignitability, flame spread, rate of heat release, smoke emission rate and fire-gas production.

The were performed two fire tests: Single Burning Item (in accord with SR EN 13823) [3] and Ignitability (according to SR ISO EN 11925-2) [4] on three thermal systems with polystyrene, adnoted below with M1, M2, respectively M4 and one thermal system with stone wool, adnoted M3, in Laboratory of Fire Tests at National Center for Fire Safety and Civil Protection in Bucharest (Bucharest CNSIPP). Each of the four systems had a thickness of the insulating layer, polystyrene or mineral stone wool, of 10 cm. The density of polystyrene was around 14,9 kg/m^3, respective 87,7 kg/m^3 for mineral wool. Two of the thermal systems had acrylic finishing and two had silicate plaster and for M1 was used polyurethane adhesive instead of adhesive mortar for conectind the insulation boards with the substrate.

Tab. 1) Fire test results for M1-polystyrene with polyurethane adhesive and acrylic plaster

Test methode	Parameter	Nr. of tests	Results	
			M1	
			The average of continous parameter [m]	Parameter of compliance
SR EN ISO 11925	Fs ≤150mm	6	(-)	Yes
	Inflame filter paper		(-)	No
SR EN 13823 /2004 Single Burning Item (SBI)	$FIGRA_{0,2\ MJ}$ [W/s]	3	50.3	(-)
	$FIGRA_{0,4\ MJ}$ [W/s]		48.5	(-)
	LFS ‹ sample's border		(-)	Yes
	$THR_{600\ s}$ [MJ]		1.2	(-)
	SMOGRA [m^2/s^2]		10.6	(-)
	$TSP_{600\ s}$ [m^2]		41.9	(-)
	Burning droplets		(-)	No

Tab. 2) Fire test results for M2- polystyrene with adhesive mortar and acrylic plaster

Test methode	Parameter	Nr. of tests	Results	
			M2	
			The average of continous parameter [m]	Parameter of compliance
SR EN ISO 11925 Ignitability	Fs ≤150mm	6	(-)	Yes
	Inflame filter paper		(-)	No

SR EN 13823 /2004 Single Burning Item (SBI)	$FIGRA_{0,2\ MJ}$ [W/s]	3	27.1	(-)
	$FIGRA_{0,4\ MJ}$ [W/s]		26.5	(-)
	LFS ‹ sample's border		(-)	Yes
	$THR_{600\ s}$ [MJ]		1.6	(-)
	SMOGRA [m^2/s^2]		3.6	(-)
	$TSP_{600\ s}$ [m^2]		47.3	(-)
	Burning droplets		(-)	No

Tab. 3) Fire test results for M3- stone wool with adhesive mortar and silicate plaster

Test methode	Parameter	Nr. of tests	Results	
			M3	
			The average of continous parameter [m]	Parameter of compliance
SR EN ISO 11925 Ignitability	Fs ≤150mm	6	(-)	Yes
	Inflame filter paper		(-)	No
SR EN 13823 /2004 Single Burning Item (SBI)	$FIGRA_{0,2\ MJ}$ [W/s]	3	9.2	(-)
	$FIGRA_{0,4\ MJ}$ [W/s]		8.1	(-)
	LFS ‹ sample's border		(-)	Yes
	$THR_{600\ s}$ [MJ]		1.0	(-)
	SMOGRA [m^2/s^2]		1.0	(-)
	$TSP_{600\ s}$ [m^2]		39.4	(-)
	Burning droplets		(-)	No

Tab. 4) Fire test results for M4- polystyrene with adhesive mortar and silicate plaster

Test methode	Parameter	Nr. of tests	Results	
			M4	
			The average of continous parameter [m]	Parameter of compliance
SR EN ISO 11925 Ignitability	Fs ≤150mm	6	(-)	Yes
	Inflame filter paper		(-)	No

SR EN 13823 /2004 Single Burning Item (SBI)	$FIGRA_{0,2\ MJ}$ [W/s]	3	36.6	(-)
	$FIGRA_{0,4\ MJ}$ [W/s]		34.1	(-)
	LFS ‹ sample's border		(-)	Yes
	$THR_{600\ s}$ [MJ]		1.6	(-)
	SMOGRA [m^2/s^2]		5.9	(-)
	$TSP_{600\ s}$ [m^2]		60.0	(-)
	Burning droplets		(-)	No

The classification parameters of the SBI test are fire growth rate index (*FIGRA*), lateral flame spread (*LFS*), and total heat release (THR_{600s}). Additional classification parameters are defined for smoke production as smoke growth rate index (*SMOGRA*) and total smoke production (TSP_{600s}), and for flaming droplets and particles according to their occurrence during the first 600 seconds of the test. All four thermal systems were classified by the test report having class B of fire reaction, s1- smoke emission and d0 - flaming droplets and particles. To be classified in A1 or A2 fire reaction class, the systems with mineral wool need to perform the Calorific Potential test - SR EN ISO 1716. Nevertheless, examining the above tables, can be noticed that the thermal system M3, containing mineral wool, had a better fire behaviour: the less total heat release and total smoke production. After FBI test could also being observed that polystyrene was completely burned in the corner where was the flame, but mineral wool has not suffered any damage throughout the fire exposure. It was noticed that the silicate plaster produces more smoke than the acrylic. During Ignitability test, for 30 seconds it did not occur any flaming or glowing, nor the falling of flaming debris on the filter paper placed beneath the specimen holder.

3 CONCLUSION

The performed fire test shown that polystyrene burns very fast once the protecting plaster is destroyed, while mineral wool resists well at fire exposure working as a fire barrier.

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IS ONE INSPECTION ENOUGH TO ESTIMATE DURABILITY IN BUILDINGS? A SIMULATION STUDY.

Carles Serrat[1]

Abstract

Decisions about intervention in existing buildings are generally based on information gathered from inspections, as a systematic tool for the identification of some injury in buildings. In this sense, in order to carry out an efficient preventive task and maintenance, knowledge of the evolution of injuries and their distribution are essential. However, this information, unfortunately, does not exist and there are few studies that describe the lifecycle of constructive elements in play; so we must use durability estimators based on inspections. The main problem of this methodology is the high variability of the resulting estimator. The goal of this research is to present a simulation study that aims to analyze this accuracy and allows the design of an efficient inspection plan.

Key words

Censored data, Durability, Maintenance, Nonparametric estimator, Simulation, Survival analysis.

1 INTRODUCTION TO THE METHODOLOGY AND MOTIVATION RESEARCH

Buergel-Goodwin *et al.* (2005) [2] proposed the interest of the use of survival distributions for monitoring and maintenance of buildings. Recently, Serrat *et al.* (2009) [8] presented a methodology for inspection and analysis for the study of the time to injury on the façade. Concerning the methodology of inspection, Serrat *et al.* (2009) [8] proposed a systematic inspection of façade elements aimed at the detection of risk factors based on the characterization of the buildings, the building parts and elements that compose the façades and its materials, the most recurrent injuries that may affect the façades, the severity of these injuries, and finally, its magnitude. Data coming from one inspection are known as current status data and are characterized by the effect of the censorship (Gómez and Canela, 1994 [3]; Meeker and Escobar, 1998 [7]; Kleinbaum and Klein, 2010 [5]) due to the fact that it is not possible to observe the exact (failure or injury) times of interest. As regards the methodology of analysis, durability was estimated with a nonparametric estimator (Turnbull, 1976 [9]) that takes into account the censorship mechanism in the data, takes advantage of all the available information, and extends the estimator Kaplan-Meier (1958) [4].

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A high proportion of censorship in the data generates a high variability in the resulting estimators and the investigator may wonder, for a given time, how far the proposed estimator is from the true value of durability. It is obvious that a schedule of successive inspections improves the quality of data (although still being 100% censored) and reduces the negative impact of censorship in the precision of the estimators. And the question is: how often should we inspect the building for an efficient estimation of durability? In this regard, the objective of this research is the study via simulation of what should be an efficient inspections schedule that minimizes the effect of censorship.

2 DESIGN OF THE SIMULATION

Different scenarios for the simulation are design taking into account: a) the true failure distribution (family of probability distributions, shape, and scale), b) the number of buildings subject to inspection and c) the inspection mechanism (number of inspections performed on the same building and its distribution across time). This configuration gives rise to more than 4500 scenarios that allows us to study models under assumptions that include a great variability of distributions of risk and inspection strategies. Estimated durability function is calculated for each scenario and its goodness of fit is measured and this allows the study of the efficiency of the resulting estimators.

2.1 Family of probability distribution

As regards the functions of density to be considered, it is important to take into account different behavior patterns for the risk function, and consequently for the durability function. In this sense we have considered Weibull distributions for modeling monotonous risk (increasing, constant or decreasing over time), Lognormal distributions in the case of a cushioned risk function or distributions to enable bathtube shaped risk functions like a Weibull-Exponential-Weibull combination, the Gamma-Weibull family (also known as Generalized Gamma) and the Weibull with resilience family. Details about these density functions can be found in Marshall and Olkin (2007) [6].

Table 1 shows the selected configuration parameters for each distribution and the resulting 78 distributional scenarios. This setting models different patterns of durability in the 150 years observation window that we are considering. Figures 1 to 4 illustrate the durability function and the risk function that we are modeling. Results for the Weibull with resilience family are similar to the obtained for the Gamma-Weibull family.

2.2 Sample size

Sample size, n, has been setup at the values n = 100, n = 400, n = 1600 and n = 6400, in order to check which sample size is large enough to correct the negative effect of censorship in the data on the resulting estimator data.

2.3 Inspections scheduling

Concerning the scheduling of the inspections for each distribution and sample size two strategies of inspection has been considered, depending on the number of inspections and the interval between them, namely:

1) from 1 to 5 inspections with an interval equal to the fifth part of the interquartile range

2) from 1 to 10 inspections with an interval equal to one tenth of the interquartile range.

Tab. 1) Distributional scenarios for the simulation

Family	Parameters	Values	# scenarios
Weibull	α $(shape)$ β $(scale)$	$\alpha = 0.5, 1, 1.5, 2, 3, 4$ $\beta = 50$	**6**
Lognormal	μ $(location)$ σ $(scale)$	$\mu = 1, 2, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5$ $\sigma = 0.5, 1, 2$	**30**
Bathtube			
Weibull-Exponential-Weibull.	α_1 $(shape\,Weibull_1)$ a $(origin)$ b (end) β $(scale)$ α_2 $(shape\,Weibull_2)$	$\alpha_1 = 0, 5$ $a = 5$ $b = 10, 25$ $\beta = 10, 25, 50, 100$ $\alpha_2 = 1.5, 2, 3$	**24**
Generalized Gamma	α $(shape\,Weibull)$ β $(scale)$ ν $(shape\,Gamma)$	$\alpha = 1.5, 2, 3$ $\beta = 125$ $\nu = 0.1, 0.2, 0.3$	**9**
Weibull with resilience	α $(shape\,Weibull)$ β $(scale)$ η $(resilience)$	$\alpha = 1.5, 2, 3$ $\beta = 125$ $\eta = 0.1, 0.2, 0.3$	**9**
		Total	**78**

In all cases the time of initial inspection is generated with an uniform distribution between 0 and the true distribution 99.9 percentile. This approach generates 15 different inspection mechanisms for each simulated dataset.

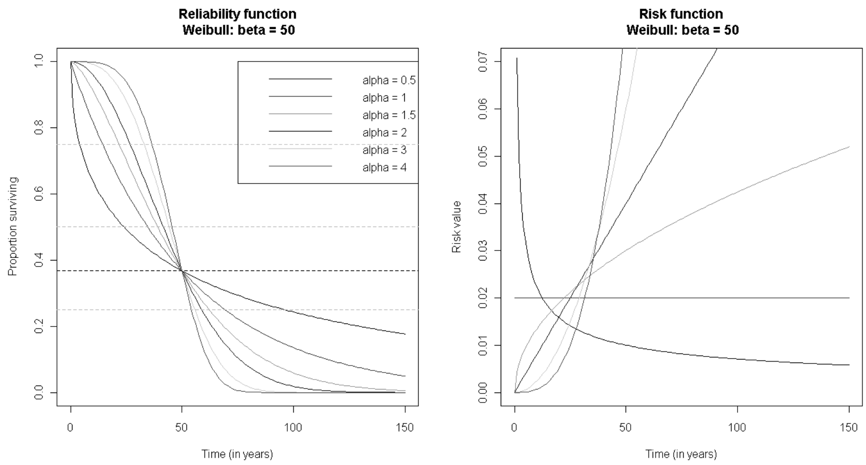

Fig. 1) Durability function and risk function for selected parameters of the Weibull distribution

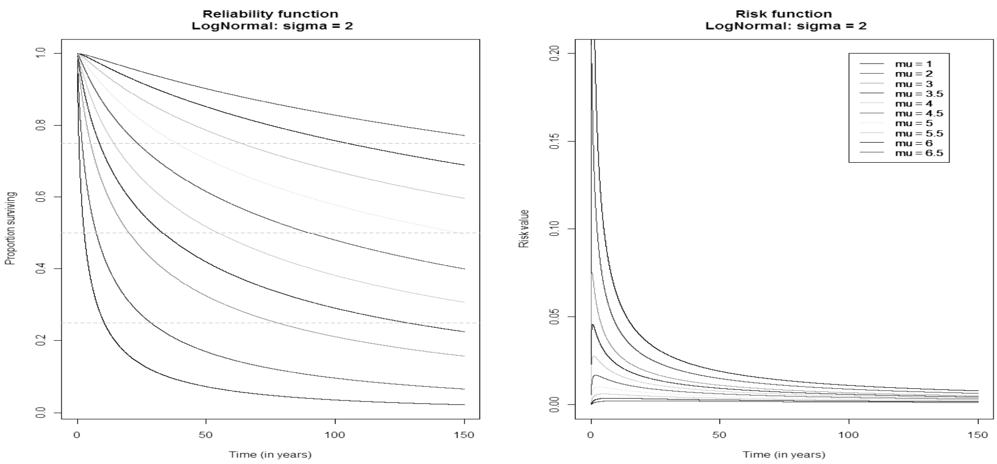

Fig. 2) Durability function and risk function for selected parameters of the Lognormal distribution

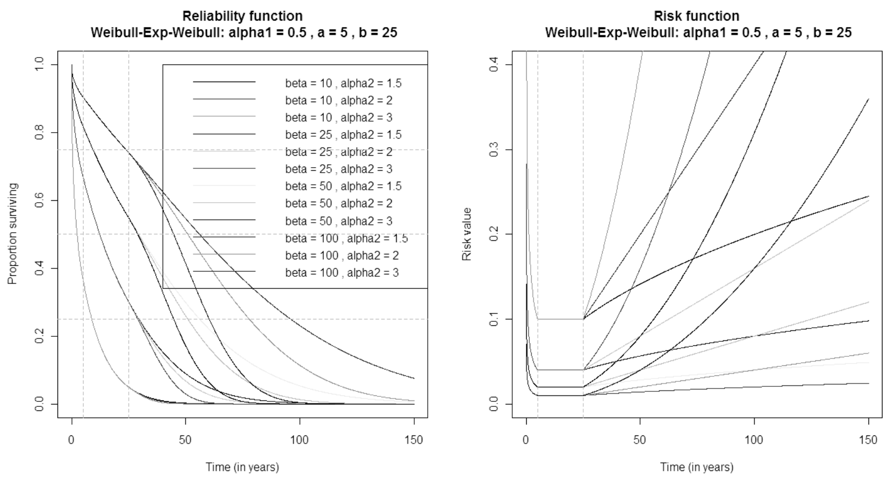

Fig. 3) Durability function and risk function for selected parameters of the Weibull-Exponential-Weibull distribution

2.4 Resulting scenarios

With the above-mentioned settings in the previous sections the number of scenarios to simulate is 78·4·15 = 4680.

2.5 Number of replicas of simulation and goodness of fit measurement

For each of 4680 simulation scenarios 1000 replicas of simulation are run and evaluated. Evaluation of the goodness of fit of each of the replicas is measured in a timely manner in the 10th, 25th, 50th and 75th true percentiles (a priori known after choosing the true distribution) and, in a overall way, by the resulting percentage of left, right and interval censorship, by the supremum of the residuals in the observation window. More specifically, in each quantile we measure: bias, 95% confidence interval, coverage and half-amplitude. The summary statistics of the replicas of each scenario are:

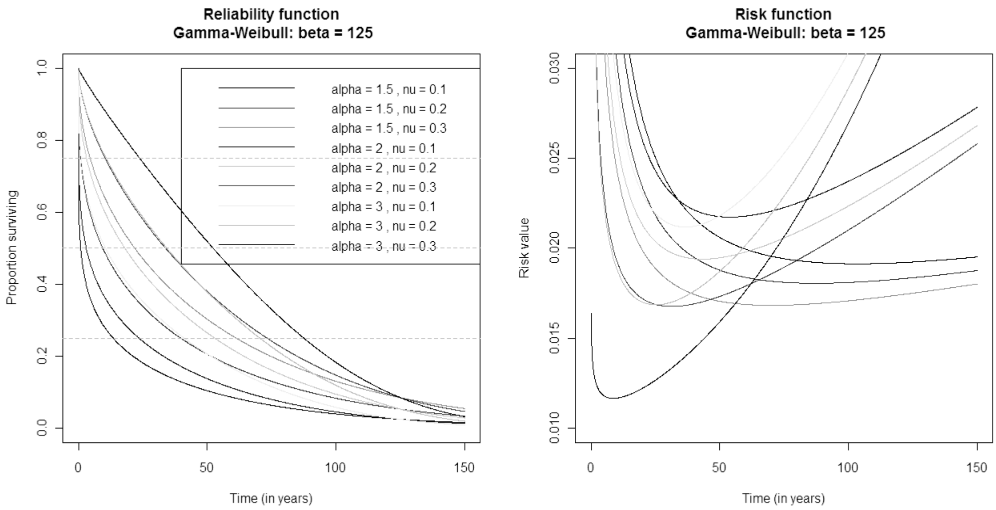

Fig. 4) Durability function and risk function for selected parameters of the Generalized Gamma (Gamma-Weibull) distribution

1) In each quantile: the mean bias, the mean square error (MSE=variance + bias^2), mean coverage and the mean half-amplitude.
2) Globally, mean of censorship, maximum of the suprema and the mean and the standard deviation of the distribution of the points where supreme is reached.

2.6 Simulation scheme

Figure 5 illustrates the flow diagram of the generation of the replicas, and the data and the results that we obtain.

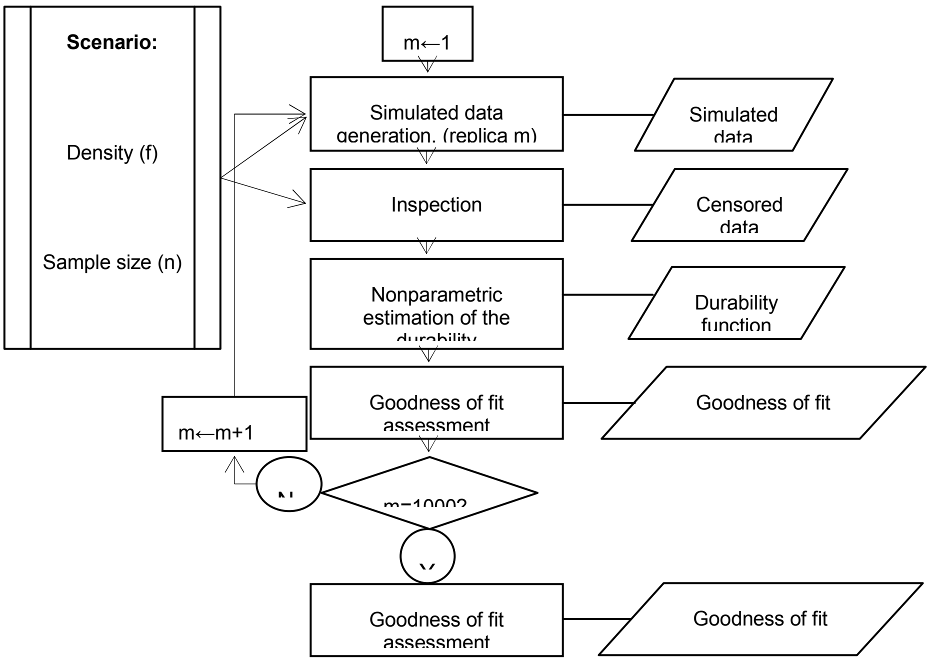

Fig. 5) Flow diagram of the simulation

2.7 Implementation and analysis of the results

All procedures for the simulation have been developed in S-PLUS ® Insightful ® (Braun and Murdoch, 2008 [1]).

The interpretation of the results is derived from the comparison of the summary statistics obtained at the end of each scenario. At each quantile, mean bias reduction, mean square error reduction, mean coverage close to (or higher than) the nominal value (95%) and half-amplitude reduction of the confidence interval will be recommended. Globally, maximum of the suprema (and its distribution) represents an upper bound for permissible errors and allows the investigator to globally assess the goodness of fit. On the other hand, efficient estimators can be chosen by evaluating the ratio of the respective MSE.

3 CONCLUSION AND FUTURE RESEARCH

One useful tool for the design of inspection programmes in heritage built has been proposed, in order to get efficient estimators for the durability function. The major advantage of this methodology is its independence from the type of injury or event of interest we are considering, although it clearly depends on the underlying distribution of the data.

In order to help the decision-making system, a potential extension of this methodology could incorporate the associated cost of the inspection strategy. This would allow to assess the price of the improvement in the quality of information obtained from successive inspections.

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INTERNATIONAL SCIENTIFIC CONFERENCE
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PROCEDURAL MANAGEMENT IN BUILDINGS

Marie Šefelínová[1]

Abstract

Building management would had proceed what most effective. This effectiveness is possible ensure whit procedurar management. Procedurar managent is identification suits in building industrie. It is general instrument which we can use in building structure or management construction company. Procedurar management is identified suits, his entry and exits. This way we ge to decomposition duplicate working and we achieve effective management.

Key words:

management, procedural management,

1 INTRODUCTION

As already mentioned in the abstract, process management is an effective management tool, which can be used both in the management of construction enterprises, as well as in construction. Assumes that all construction work and every business, whether building or another, is made up of a set of activities. These activities can be built into the process according to chronology. For each activity we can identify its inputs and outputs of the role (part) that it will perform. In this way you can model the processes during construction activities and in construction companies, thus allowing the transparency of the activities performed and eliminating duplicate or inefficient.

2 PROCEDURAL MANAGEMENT IN BUILDINGS

Process management is generally based on the decomposition of an enterprise or other implementing actions such as the construction process. Each process is further decomposed to activities, their inputs, outputs and roles (parts) that carry out activities in the process. From its universality that it can be used both during construction actions and management of construction enterprises.

2.1 Creation of process management in building industrie

Regarding the implementation of construction activities, it is sufficient for its transparency and streamline its process to model the initiation of action, through work towards the

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objectives of the action, their inputs and outputs of the roles (parsts) they carry out activities, to target the actions which we want to achieve. Sample process model is shown in Figure 1.

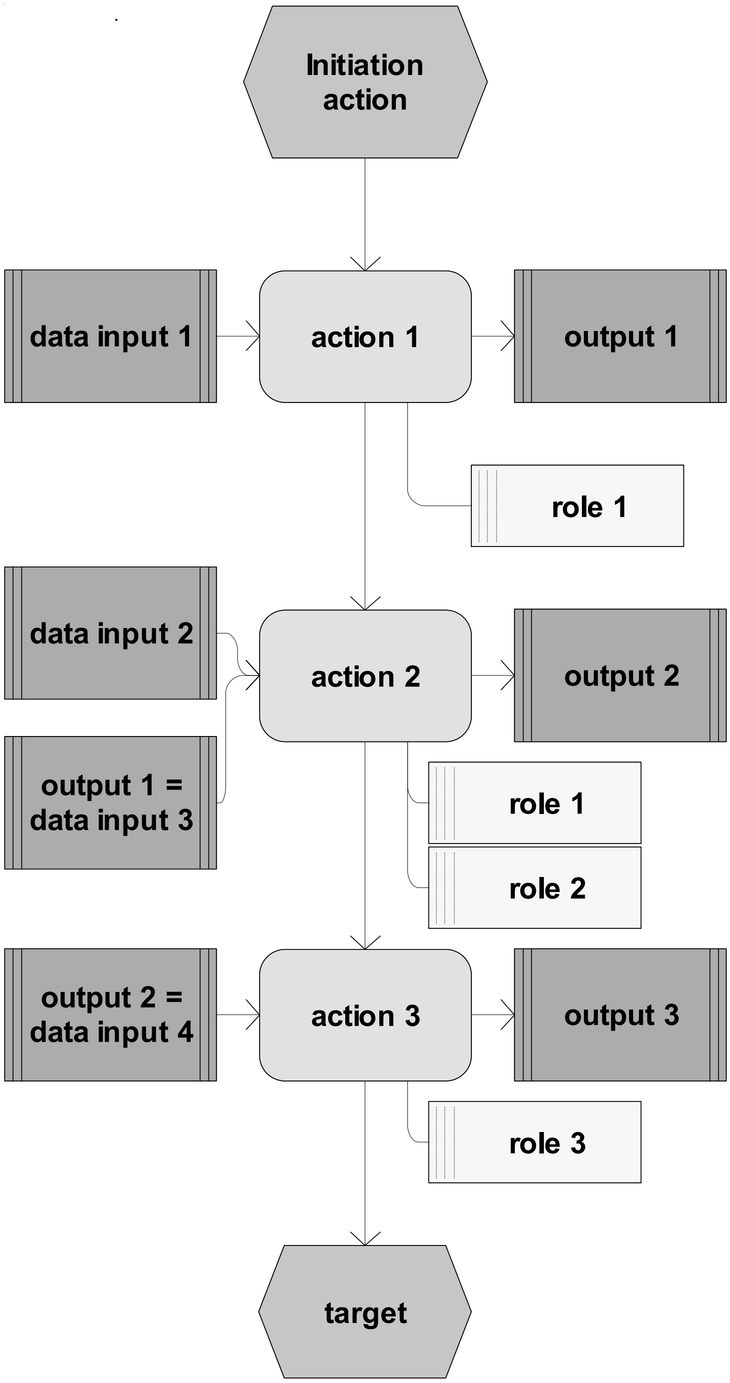

Fig. 1) Method of making process

The picture we see that activity 1 is input 1 and output 1, which is currently entering into activities 2 activity 2 is but one more input, output, activity 2 is out two, which is currently entering the third activity The output of Activity 3 will achieve the objectives of the action. Such identification of activities needed to achieve the objectives of the action will remove duplication of efforts, not of actions to achieve any value. Modeled the process of action is how we ensure that actions to achieve the objective is to effectively and simultaneously reduce costs for its implementation.

2.2 Procedural management in company

In business, unlike the strike action is necessary not only to identify the processes, their activities, inputs and outputs of the role, but need to connect processes with departmental organizational structure. This is possible only through the activities and roles in business processes, the process control implemented. Through the activities and roles in the process management process management is linked to departmental organizational structure. Conversely departmental organizational structure are linked to process management through functional positions and activities in the departments. Interconnection process management and departmental organizational structure is analytically so that they are the same or similar activities in the process management units identified in the departmental organizational structure and the time they are assigned. After you assign the same or similar Activities of process management to the same or similar activities of staff departmental organizational structure, and will assign roles to activities performed in the process control for functional sites, which the same or similar activities are performed by the departments organizční departmental structure. Method of making process-oriented organizational structure are schematically shown in Figure 2.

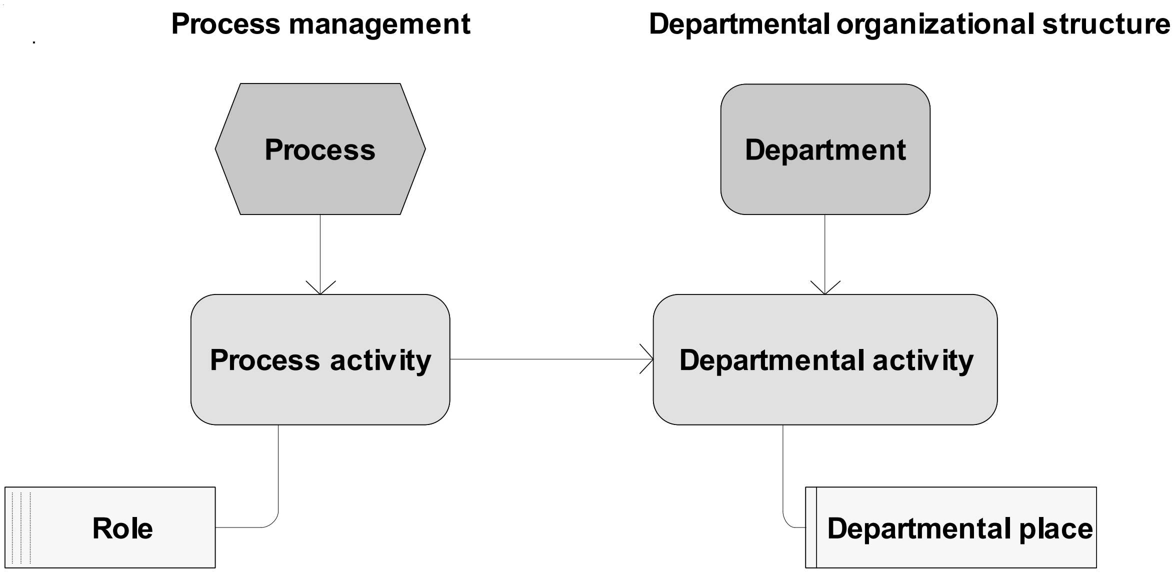

Fig. 2) Method of making process-oriented organizational structure

Systematic method of creating a process-oriented organizational structure of the activities in the process of the activities of departments and departmental structure of the roles that perform activities in the processes of functional sites, which carry out activities in the departments, ensuring the effectiveness of process-oriented organizational structure, transparency for cost management and reduces costs the poor quality. Method of making process-oriented organizational structure ensures that the organizational structure there departmental departments that perform inefficient, it is the activities that are not included in the process and that further proceedings in departmental organizational structure there is a functional space that do not add business value, is a functional space, which carried out activities that are not included in the process of process management. Systematic approach in developing process-oriented organizational structure is a guarantee of quality management.

3 CONCLUSION

Using process control during construction activities or construction companies ensures that events and businesses operate efficiently. It is guaranteed that the use of process management identifies inefficient business that do not add value to the business or building event. Identified actions may be ineffective odstaněny, thus they are not spent their resources, which enables enterprises to reduce costs and construction events. In this way are removed from the cost of poor quality.

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LOGISTICS OF MATERIAL RESOURCES AT URBAN CONSTRUCTION SITES

Martina Španić[1], Zlata Dolaček-Alduk[2], Josip Špoljarić[3]

Abstract

A great demand for apartments in the last ten years has led to the expansion of housing in Croatia. Since there is no enough space in towns for the construction of residential areas, apartment blocks had to be constructed on the plots of existing, deteriorate family houses. The lack of space on such plots, however, brought into question the basic elements of site organization, as well as management of material resources.

Massive construction materials, their quantity, weight, handling and susceptibility to damage, and building on narrow and small parcels require more careful work organization. This paper proposes the logistics of material resources as a model for the solution of the mentioned problems and for the successful establishment of a "just in time" concept.

Key words

Material resources, logistics, just in time concept.

1 INTRODUCTION

In the last ten years, a great demand for apartments in the last ten years has led to the expansion of housing in Croatia. In terms of housing construction, lack of space caused the construction of apartment buildings on smaller parcels of the old and worn family houses. Such plots are usually located between two or more existing family homes.

Because of shunting, lack of space brought the basic elements of site organization into question.

Building material itself is massive in the sphere of quantity, weight, handling and susceptibility to damage. Traditional construction is based on a system of supply of needed material at a time when it runs out, just before the installation and procurement of the cheapest materials in large quantities to receive additional savings.

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Logistics in construction is a modern dimension of business and in this paper is proposed as a model for successfully resolving issues related to the massiveness of construction materials.

There is no universal logistics system which is applicable to all companies, the companies themselves according to their needs create by their logistic chains or reconstruct the existing. Smaller inventories, lower inventory costs, lower overall costs, lower product prices, shorter storage time, higher quality and faster introduction of new technologies and products, increase distribution efficiency, faster delivery are the benefits of logistics.

The rationalization of the logistics process leads to an adequate supply of material quality and the required amount of space requested in the required time. [1]

2 SPECIFICS OF CONSTRUCTION INDUSTRY RELATED TO LOGISTICS

Construction output in relation to the industry has its own particularities:

- long-term construction
- no mass production
- great needs in terms of material (quantity, type, quality)
- the need for storage and transport
- uniqueness of the facility

Construction materials are the biggest factor in logistics. Also logistics take into account the human resources, control plans, infrastructure and equipment on site, material flow at the site directly related to building and information flow.

Logistics of construction companies can be divided into two parts:

- supply logistics - the external relations, the relations of the firm with external suppliers in terms of materials, manpower, services and equipment, etc.
- construction site logistics - is an internal relationship between all levels within the company (administration, warehouse, manufacturing facilities, the correlation with parallel projects, etc.) and construction site.[2]

Figure 1 show these two parts and material flow of raw materials through semi-finished or finished products to the installation at the site, and the flow of information of requirements moving from site to the suppliers. The same logic can be shown and other logistical elements of the construction industry.

Large quantities of materials used in construction activities from the view of logistics deserve the greatest attention. The current practice is based on the fact that the procurement and supply of necessary materials for the construction is done at a time when it is running out, or just before it is needed and also the practice of purchasing the cheapest materials.

Problems created by such a practice are:

- delays
- the problem of storage

- losses and material damage
- insufficient quality
- elements of theft

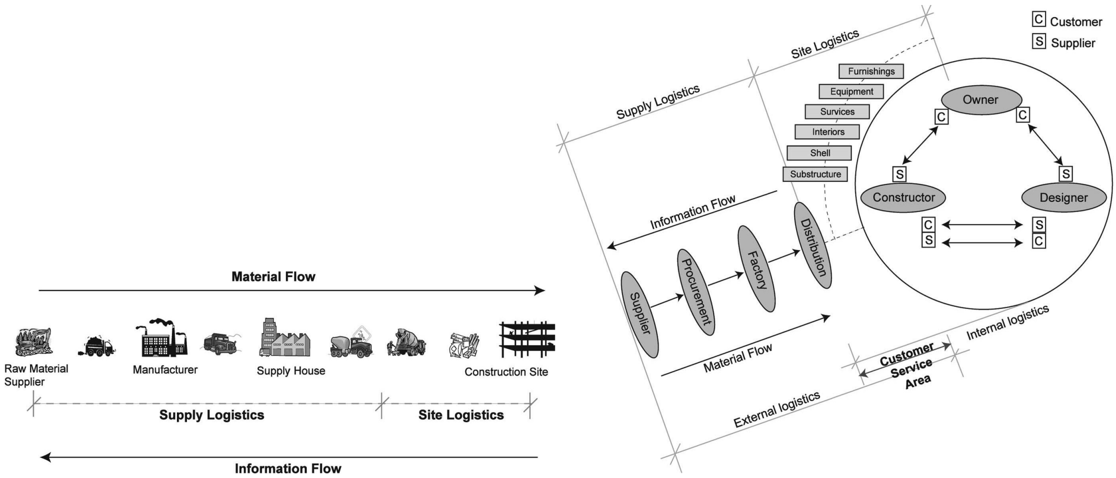

Fig. 1) The process of logistics in the construction.[2]

Often, delay in delivery of material on site may cause the delay of construction, also urgent delivery of requested materials is an additional cost.

Building materials are very massive in terms of quantity and weight, and assessable to damage, the weather opportunities, but also from the effects of machines and people. Purchase larger quantities of materials produce savings in terms of cost of material and transport thereof. However, most of the sites do not have sufficient space or adequate storage facilities for the supply of large quantities of material. It’s inappropriate storage, transfer and use cause losses and damage. Figure 2 shows the current method of storage material.

Emergency supply sometimes leads to unsatisfactory material delivery, such supplies are returning vendor, thus causing delay and / or installing them decreasing the quality of the finished object.

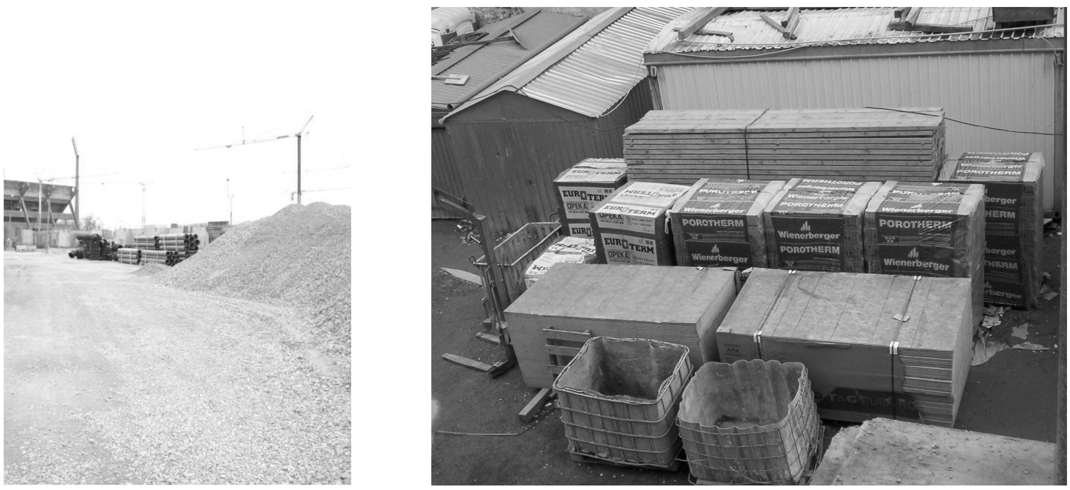

Fig. 2) Material storage at the construction site (sports hall construction in Osijek City Garden).

Swedish researches Söderman and (1985) Andersson, (1983) show that the cost of transportation of certain materials is almost a third of their total costs, and that in relation to the overall cost of building construction material cost is 50% and cost of transport in some cases over 10%.[3] Such devastating data and low productivity are the result of a lack of planning and logistics in the management of material resources. Involvement of the contractor, subcontractor work and material suppliers in the design stage can significantly increase the positive effects of logistics. Implementation of building "capacity" factors enables facilitate planning, production, transport and losses on the construction sites in the design phase.

3 JUST-IN-TIME CONCEPT

Though it was not the first in the implementation of JIT concept, Toyota is a world-renowned as a company that has this concept developed and promoted. What has prompted Toyota to develop such a concept paper was primarily a lack of storage space, and also the requirements for quality and development of the company.

JIT concept is exactly the supply of certain resources for production, in the particular, exact required quantity to produce, at the exact moment when needed. This production is without stock.

The implementation of JIT concept to planning and realisation of construction sites has the following principles.[3]

- Elimination of losses (material, time, labor) - eliminating unnecessary inventory on the site it becomes neater and browsing, working environment this is less chaotic, and creates more work space and outdoor space for machinery.
- "Kanban" system or system of "withdrawal" - supply of material on site in small quantities from a supplier who "train" piece by piece and shipped at the moment just before you use it. These small parts of total required quantity of material, called "Kanban".
- Uninterrupted workflow - obtained by reducing the transmission of material, its handling and use of prefabricated building products whenever possible.
- Quality control - aims to do the job well the first time, and if a problem occurs immediately addressed to avoid losses on subsequent repairs.
- Inclusion of employees - including all site employees, from managers to workers, so that conscientious attitude towards work and a sense of responsibility effect on minimizing losses and damages of any kind.
- Relationships with suppliers - suppliers should be involved in the planning phase of construction also in contracting phase and after contracting business. They have to have your material and a copy of the master plan construction and material needs, the type and quantity, and a specific time as needed on the site.
- Continuous improvement.

4 THE DANISH EXPERIENCE

Danish Ministry of Housing and Construction was financed by the early nineties, the construction of 100 duplex housing units including municipal infrastructure.

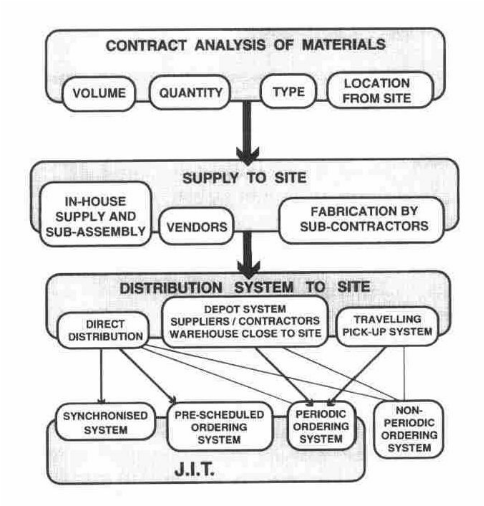

Fig. 5) Application of JIT systems to building materials.[4]

Seeing the potential savings in logistics and JIT concept Danish Civil Engineering Research Institute (SIB) conducted the survey. The goal was to minimize costs by eliminating the losses of all kinds, special emphasis is on materials and their costs involving all costs the same, and not only the costs of his transportation.

A vital part of the logistics concept is to implement any elements of the performance in the design phase. To this end, the contractor and suppliers of materials and equipment were involved in the design phase so that the possible losses are reduced to a minimum.

Comparing the traditional design and construction, logistics concept has brought considerable savings despite its additional cost. The total savings was 5% of construction costs.[5]

Tab. 1) Showing the effects of logistics planning at the total cost of construction.[5]

	Cost Savings (%)	Incurred additional costs (%)
Reducing loss and fractures	3	
Reduction of working days	5	
Material Coordinator		1
Telescopic handler		1.5
Additional administration		0.5
Amount (%)	8	3
Total savings (%)	5	

5 CONCLUSION

Material resources logistics is the new strategic step in non-traditional works. It includes detailed planning and communication between contractors, subcontractors and suppliers so that necessary materials were supplied in the required amount in the required time. Because of lack of adequate storage conditions, both capacity and quality in most cases, logistics eliminates the stock of material on the site. Also, this approach significantly reduces losses of material damage, its moving, its late delivery and non-quality.

Inclusion of all parties involved in construction related to material resources, their coordination and communication during the design phase, contracting and construction results the significant savings compared to the traditional way. Danish example clearly shows how are these savings and how much detailed planning, specification of materials and mutual coordination of all participants in construction are important for proper and effective implementation of the logistics concept in construction practice.

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STYLE OF ENVIRONMENTAL THINKING IN CONSTRUCTION COMPANY

Zdeněk Tichý[1], Alena Tichá[2]

Abstract

Currently, we have often seen the construction company seeking an environmental certificate purely because of the possibility to obtain public contracts but without striving for reducing their negative impact on the environment. Article intends to outline (show) such style of thinking, which should lead builders to effective implementation of environmental thinking with respect for the principles of environmental management according to international standards.

Key words

environment thinking management certificate ISO 9001 14001

1 ÚVOD

The article is focused on such "style of thinking", which should lead the construction companies to real application of environmental thinking with respect to the rules of environmental management according to international standards.

We decided to present this theme as certain parallel of both systems – the quality management system and the system of environmental management.

QUALITY MANAGEMENT SYSTEM

Practically all Czech construction companies have certified their quality management system (next only „QMS") according to standard ČSN EN ISO 9001, so that the principle of „continuous improvement" should be familiar to all the manager involved in using this system. Scheme of the model of „process oriented" quality management system is shown directly in this standard, and simplified version of it is shown in the picture Fig. 1).

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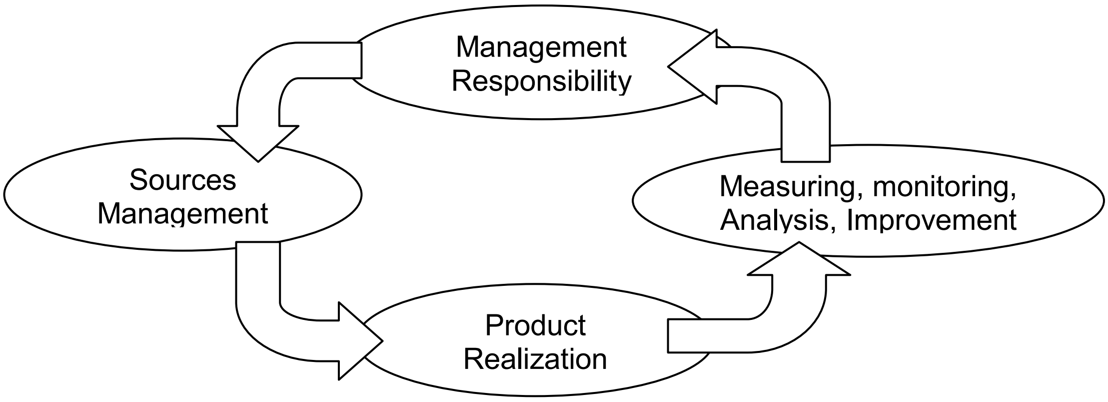


Fig. 1) Model of quality management system

This scheme is of course very abstract one, because it must be general for universal usage of the standard. More practical variant, using already entirely concrete terms from the standard ISO 9001, is shown below in Fig. 2) .

So we venture optimistic (we defend against the term “naive”) statement, that Czech manager have already accepted the idea (or principle) of “continuous improvement of quality, and some of them even use it in the spirit of the password „If I have to do something (maybe only because of the marketing purposes), so why not to use it also for my benefit”.

It means for continuous improvement of:

- CUSTOMER SATISFACTION (including Quality of Products, Time, Costs),
- QUALITY OF PRODUKT (in itself),
- QUALITY OF INTERNAL PROCESSES (including Time, Costs, Responsibilities, ...) .

This functioning quality management system is becoming for the manager also the tool for continuous improvement of efectiveness of main processes, and thus also of company profit.

2 SYSTEM OF ENVIRONMENTAL MANAGEMENT (EMS)

And how can this „principle of continuous improvement“ work in the environmental management system?

The scheme mentioned before for QMS can be adapted for system of environmental management. Resulting scheme is shown in Fig. 3).

Main diferencies of both these systems are:

1. **Customer Requirements** are replaced in EMS by **legal and other requirements**. (Of course it doesn’t eliminate, that also the customer can have some environmental requirements, both for the purchased product and additionally for the impact of our activities on the environment.
2. Standard ČSN EN ISO 14001 requires for the company to identify its **environmental aspects** and evaluate that aspects, which have or which can have significant impact to environment (as „important environmental „aspects“). These aspects, characterizing

the „environmental level“ of company, thus create the certain parallel to the „quality characteristics“ which are significantly defining the quality of product.

3. Specific requirement is the **emergency preparedness and response**. On the other hand it is nothing new for our managers – they are already used to create different emergency, fire protection and other regulations for a long time.

4. One of the assessing activities is the **evaluation of compliance**. Practically it means that the company, respectivelly its activities and products, has to be in the compliance with applicable legal and other requirements, and company has to to evaluate this non/compliance.

From the parallel with QMS we can answer in the spirit of the name of this article the question, „what should be the environmental style of thinking of manager in construction company (or in any other company)“?

System of environmental management should lead construction firms to the real application of environmental thinking, which should lead to continouous improvement of

- SATISFACTION of „ENVIRONMENTAL“ CUSTOMERS (usually state offices in environmental area), it meants it should lead to preventing the penalties for not keeping the environmental legislature etc.).
- „ENVIRONMENTAL“ QUALITY of PRODUCT - to the design of the product with minimized impact to environment.
- QUALITY of INTERNAL „ENVI“ PROCESSES. It means to use such processes with minimized impact to the environment. ogether with that the optimum would be, if such „environment friendly“ processes were also economically beneficial. Example: As less of waste the company will produce then leass money it will pay r its liquidation. (Variantt with unlegal liquidation or „no lquidation“, is of course unallowable in finctioning EMS, also due to the fact it should lead to „dissatisfaction of environmental customers“.

3 CONCLUSION

Functioning systemof environmental management should lead at first to the reducing of environmental impacts of company activities. As well this system can become the tool for continuous increase of effectiveness of main processes, and thus also the company profit (in the same way as functioning quality management system).

Finally the thing is to learn the managers this „environmental style of thinking“, and not to accept the environmental system as a „necessary evil“.

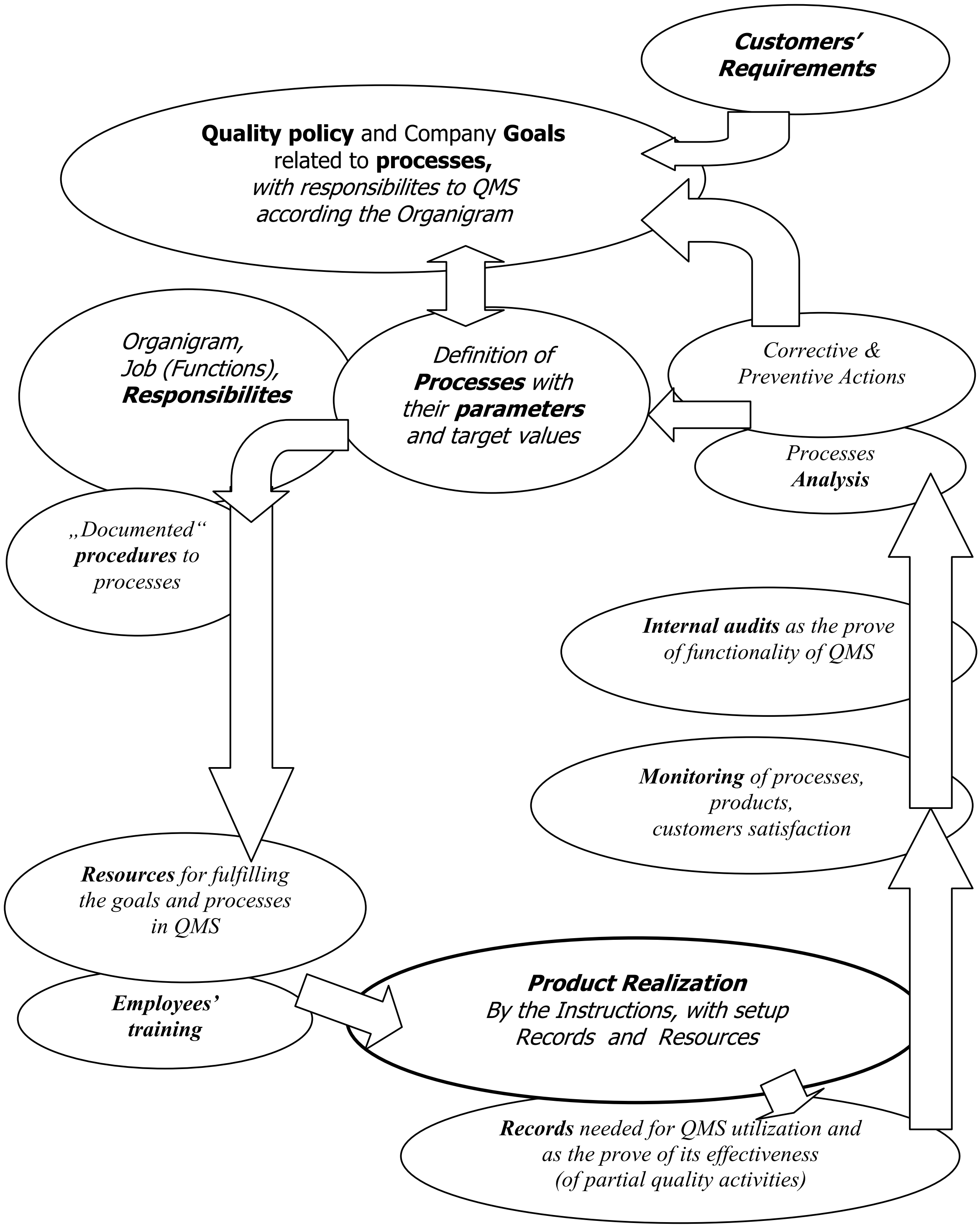
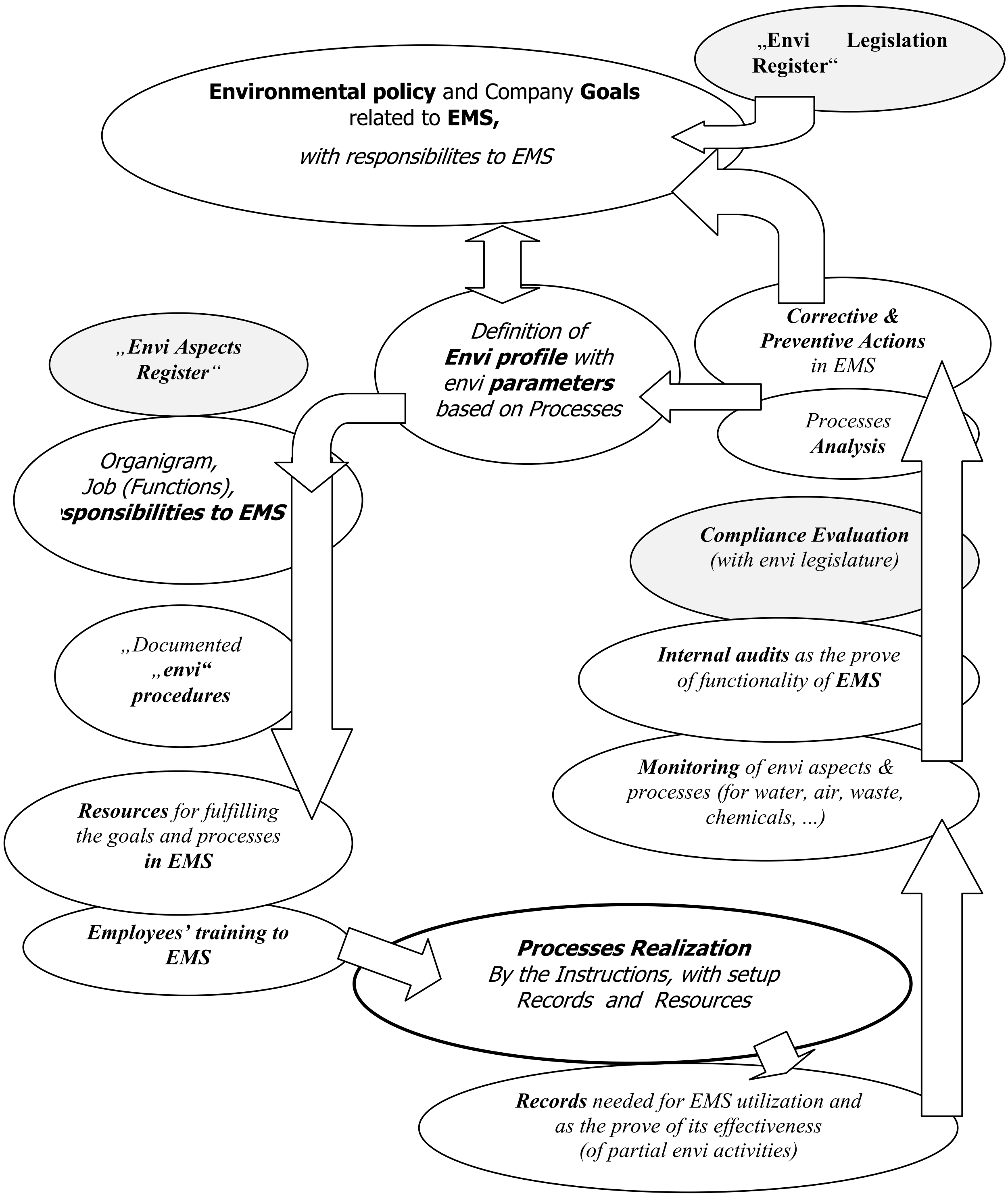


Fig. 2) Scheme of continuous improvement in quality management system



Note: activities in grey colour - biggest differencies from QMS

Fig. 3) Scheme of continuous improvement in quality management system

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RELEASING RESTRAINTS ON NETWORK SCHEDULING TECHNIQUES

Zoltán A. Vattai[1]

Abstract

In 1989 engineers of Hungarian Railway Company (MÁV) asked experts of Department of Construction Technology and Management (DCT&M) of Budapest University of Technology and Economics (BUTE) to develop a Computer Aided Decision Supporting system to assist scheduling periodic and by-need reconstructional and maintenance works along the whole railway system. Challenge of modelling the problem was the Permanent Scheduling Job of works on a 3-years long rolling basis, including thousands of jobs within accuracy of minutes (due to ongoing operation). Answering key questions of elaboration enforced researchers to revise capabilities of well-known network-typed scheduling techniques (CPM, PERT, MPM, PDM) trying to release restarints on their application. Results have been referred and taught since then as General Time Model (GTM) based on a version of Floyd–Warshall algorithm. The paper introduces key ideas of new considerations.

Key words

operations research, graphs, network techniques, computer applications

1 INTRODUCTION

In early applications (CPM [4], PERT [5]) graph structures for scheduling had been restricted to a very strictly restricted topology addressed as network. Namely: a directed weighted connected graph with one starting node (origin), with one ending node (terminal node), with no loops and with no negative weights on the edges. Necessity of these restrictions on graph structure can be ascribed mainly to early solution algorithms, such as labelling techniques, and to capabilities of early computers the applications had been run on.

It can be shown that without the rest of before mentioned restrictions, on general directed weighted graphs, valid and calculable time models can be interpreted for use of any level of project and/or production management. Moreover, in widely known MPM [7,8] and PDM [5,13] techniques loops and negative weights have been implicitly integrated in the models resulting in no any unexpected, contrary and/or unsolvable conditions. Furthermore the practice of originating all initial steps/tasks from one single starting node in the model, and/or directing all finishing procedures/tasks into one single ending node may integrate unintended

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and misguiding information, when modelling and analyzing a complex project under examination.

2 THE NEED

The need for revising restrictions of „traditional“ network techniques emerged at a research project while elaborating a Computer Aided Supporting System assisting managerial decisions at planning and controlling under-operation reconstructional and maintenance works of hungarian railways’ system [9].

Challenge of management problem was the „Permanent Scheduling” of works on a 3-years slipping time-span looking over thousands of jobs with accuracy of minutes. No expressed start, no expressed end, widely diversed responsibilities, dispersed locations across the country, but one complex „must-be-operating” (under traffic) railway system and a restricted common pool of some significant specialized resource series.

Traditional Scheduling techniques (including traditional Network Techniques) proved to be insufficient. „The project to be scheduled was not a project.” Conclusions of revisional studies on network-techniques have been discussed as „General Time Model“ (GTM) in curricula of elective subjects of Department of Construction Technology and Management of Budapest University of Technology and Management since nineties of last Century.

3 MATHEMATICS BEHIND

The scheduling problem, itself, with pre-set durations of tasks (weights) and with pre-set precedence relations amongst them (edges) can be derived from a primal-dual problem-couple widely known in operations research, namely: the longest path problem on a weighted graph (Kelly-Walker, CPM), and the minimum potential’s problem with lower bounds on differences of pairs of potentials (Roy, MPM).

Exposed or not, usual algorithms (manual or automated) developed for to solve the scheduling problem are focusing on the minimum potential’s problem meanwhile executing a kind of implicit labelling technique [1,3,6,13]. (Calculations are started at the origin and are rolling towards the terminal node, then back – “forward pass” and “backward pass”).

Setting The Longest Path Problem in the focus of examinations necessity of preset restrictions can be reduced radically. Length of any path – though the term itself is directed, you have to state where from where to – on a weighted graph is interpreted as pure sum of weights of edges constituting the given path. And, it is irrelevant, from the point of view of the result, in what a sequence the members (weights of edges) are added together. Thus, no need for pre-set origin, pre-set terminal node, neither numbers of them are important during the calculations, length and edges of longest paths can be identified, and knowing the longest paths time potentials (early and late times) can be assigned along them to the events and to activities represented by nodes and/or edges of the graph model.

In case of a CPM/PERT time model considering the logic of calculation and the linkage between the Longest Path Problem and The Minimum Potentials’ Problem calculations can be summarized as:

$\Pi_i \geq 0$; $\forall i$ $i \in N$ (*non-negative potentials should be assigned to all nodes of the graph*)

$\Pi_j - \Pi_i \geq \tau_{ij}$ $\forall ij$ $ij \in E$ (*differences of pairs of potentials are limited by lower bounds, testified by directed weighted edges of the graph, where lower bound values are the weights of the edges*)

$\Pi_{max} \rightarrow \min$ (*the largest value in the established potential system would be at minimum, which equals to the length of the longest path from the origin to the terminal node*)

(Where N is set of nodes (i), E is set of edges (ij), τ_{ij} is the lower bound value that is the weight at edge ij, Π_i is the time potential to be assigned to the node i)

In case of a MPM/PDM time model tasks (activities/processes) having pre-set fixed durations are represented by nodes of the graph, hiding significant characteristics, that on any path, including the longest one, a node has a significant extent (its duration).

Due to elementary rules of algebra, multiplying inequality representing bound on difference of a pair of potentials by minus one, any upper bound can be equally substituted by a lower bound (reversing the direction of subtraction, that is direction of edge, and changing the sign of the limit value) Thus, a mixed bounding system can be transformed to a homogeneous one (having “lower” bounds only).

$\Pi_j - \Pi_i \leq \tau_{ij}$ $/ \cdot(-1)$ (*upper bound*) (1)

$\Pi_i - \Pi_j \geq -\tau_{ij}$ (*upper bound turned to lower bound*) (2)

Analogically, any fixed duration of a task can be set by a pair of lower and of upper bounds having the same limit values (τ_{SF}, that is its duration) between its start (S) and its finish (F).

$$(\Pi_F - \Pi_S = \tau_{SF}) \quad \equiv \quad (\Pi_F - \Pi_S \geq \tau_{SF}) \ \cup \ (\Pi_S - \Pi_F \geq -\tau_{SF}) \qquad (3)$$

As a consequence of above, loop of directed edges is given (between the starting and finishing "nodes" of the task), negative weight is given (upper bounding for fixed duration), while analogy of the Longest Path Problem is not damaged and the model is also calculable.

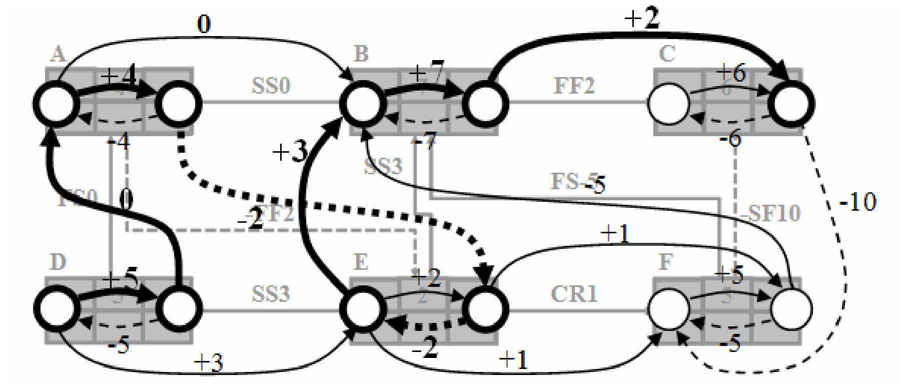

Fig. 1) A "radiographic view" (standard DiGraph representation) of a typical MPM/PDM network with fixed durations (boxes and arrows in gray in the background), with loops, positive (lower bounds - solid arrows) and negative (upper bounds - broken arrows) weights. (From Syllabi of BUTE-DCT&M; www.ekt.bme.hu)

The only problem may emerge if contradictious conditions (any loop with positive length, that is where sum of weights of edges forming the loop is greater than zero) is set in the model. Though it should be mentioned that researches are going on to study the behaviour of positive loops in time models, generating "endless", periodically repeated jobs in production models.

An interesting, not widely known phenomenon as a consequence of negative weights inserted is the so called paradox situation, when decreasing the duration (bounds, in absolute value) of a task results in an increment in the length of the longest path (increases the overall time of the project). Such a situation may occur when edges with negative weights are included in the longest path. (Consider MPM task "E" in Fig.1.)

To calculate network models with negative weights and with loops, traditional rolling typed calculations (such as labelling techniques) may prove inefficient, and may necessitate some kind of iterative approach and/or overwhelming analysis of all possible solutions. The earlier can be based on recognition that by each iteration at least one potential (Π_i) gains its final value, while for the later either a modified Floyd-Warshall algorithm can be applied [2,11].

4 RESTRAINTS TO RELEASE

Seeing no mathematical difficulties or contradictions when releasing early restrictions (no loops, no negative weights, etc.) on a network time model let's review restraints pressed on the user of traditional network techniques from the point of view of construction practice.

4.1 With no loops and with no negative weights

Negative weights (upper bounds) in a dynamic time model are of much use when modelling technological processes. One should think of the so called sensitive conditions (supporting the earth-wall of the trench after excavation; blinding after refinery excavation for to preserve soil conditions; demolishing upper segment of a soil-mech pile for interworking its reinforcement with that of pile-cap; etc.) and of resource management aspects (bounding and/or excluding idle times).

Even more – as it is in reality – durations of tasks (activities) are usually bounded both from up (economic aspects) and from down (technical aspects), and the applicable or "optimal" duration can be resulted from time analysis of the model itself (exact values of durations of tasks can be output of network calculations, while real input is the bounding system only).

There is no mathematical need for to set exact task (activity) durations in advance.

Double limitation (lower bound and upper bound together) ab ovo vindicate arrow loops when representing them graphically as introduced above (See Fig.1.).

4.2 Connected graph, with one starting node and with one ending node

In case of complex and/or regional development project contractors of various industries are co-operating for to achieve the aim set for the project. A project can (even more must) have a well defined initiation (launch), and a well defined target (delivery, state, etc.). But nearly all the contributors do have their own interests and their management preferences out of the common project too. For them the project is not a project – in classical sense of a project – but one (bigger or smaller) item in their business (production) management.

Do consider a hydro-electric power station. Massive works of landscaping (dams, access roads, reservoir, etc.), sub- and superstructure construction (turbine shafts, generator house, operator centre, etc.) and manufacturing and installing electro-technical equipments (turbines, generators, transmission lines, switch stations, etc.) are to be executed. It is hard to believe that a float (slack) indicated by a closed network (one origin, one terminal node) due to time-consuming preliminary earthworks can be utilized during manufacturing electro-technical equipments. (The manufacturer is unwilling to assign its resources to the project immediately from the launch of the project, if it is not necessary. It would produce for other consumers instead, and would have its "own" starting point for contributing the project in proper time.)

Anyway, as pointed above, for algorithms focusing on the Longest Path Problem there is no need to have one single origin and one single terminal node. Besides, any float (slack) is manageable if necessary resources are dedicated to the project exclusively.

As a consequence, it is not needed that the model (graph) be connected. Independent, parallel projects can be studied simultaneously, and can be analysed from view point of other – say environmental and/or sustainability – consequences. (See: "multi-project management").

4.3 Directed graph

Probably the most staggering recognition: sometimes, the graph developed for modelling relationships in time do not need to be directed! One should think of finishing jobs of building a dwelling house, when succeeding crafts are sharing the same limited location (room, surface, etc.), but they have no specific technological relations to each other (say: installing electric fittings in the walls and on the ceiling, and laying tiles on the floor), so their sequence is occasional or is set according to other (non technological) aspects.

An interesting modelling challenge can be scheduling of construction of a large waterproof foundation slab (or basin) to be concreted in special pattern of blocks, letting shrinkage of concrete happen before neighbouring units get be casted. Restrictions are on minimum ages of blocks, but not on sequence of them. (Undirected graph edges can indicate adjacencies of neighbouring blocks, while weights can represent expected differences of ages.)

Ruefully, for to calculate a model of this kind, Combinatorics is holding a great barrier, and usually some kind of Branch & Bound technique or Heuristics would be applied, running ("solution") time of which is depending mainly on the data themselves. [1,3,6,10]

5 CONCLUSION

Applied Mathematics (Operations Research, Management Science) had developed much since the boom of fifties and sixties of the last century. Modern computer technology is besieging frontiers of material world. Though modern and high-capacity tools for aiding solutions of practical problems are available, Construction Management seems to be contented with some smart old modelling techniques had been developed in early years of Management Science.

Pointing out unnecessary and obsolete (mathematically undue) restraints set on network time models, the same time feeling would-be utility (and lack) of releasing restraints mentioned above, "exclusive" use (and education) of traditional network techniques is going to be less acceptable. The contradiction is even more evident when considering Construction in its production (Production Management) environment.

While respecting and paying honour to developers of well known and approved "traditional" network techniques (CPM, PERT, MPM, PDM) we have to face the fact that their terms, interpretations, restrictions, solution algorithms even their inputs and outputs got be worth rethinking. Traditional terms as "start", "termination", "critical path", "loop" (see Fig.1.) are worth rejudging. Characteristics earlier reckoned as obstacles and caused difficulties at handling time-modelling techniques can be rehabilitated and can be of much more use then some would think it.

A general time model (GTM), initiated by a serious practical problem, had been elaborated at BUTE-DCT&M, without above mentioned restrictions, and also without harming analogies of problem-couple of The Longest Path Problem and The Minimum Potentials Problem. Essence and key ideas of it have been integrated in curricula of students of Civil Engineering studies.

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NEW APPROACH TO INTEGRATED ASSESSMENT OF BUILDINGS

Silvia Vilčeková[1], Eva Krídlová Burdová[2]

Abstract

In the previous time the requirements on environmental safety, suitability and responsibility of buildings have been increased. The criteria of sustainability are included in building environmental assessment systems and tools used in different countries for evaluating the sustainable and environmental performance. The purpose of this paper is introduced the building environmental assessment system developed in Slovakia. The existing systems and methods used in many countries were the base of new system development. The main fields are building site and project planning; building constructions; indoor environment; energy performance; water management and waste management.

Key words

Building environmental assessment, sustainable buildings, system, method

1 INTRODUCTION

An environmental building assessment method reflects the significance of the concept of sustainability in the context of a building's design and subsequent construction work on the site. The primary role of the environmental building assessment method is to provide a comprehensive assessment of the environmental characteristics of a building using a common and verifiable set of criteria and targets for building owners and designers to achieve higher environmental standards. It also enhances the environmental awareness of building practices and lays down the fundamental direction for the building industry to move towards environmental protection and achieving the goal of sustainability [1, 2]. Different building assessment systems approach this task from somewhat different perspectives, but they have certain elements in common. Most, if not all, deal in one way or another with site selection criteria, the efficient use of energy and water resources during building operations, waste management during construction and operation, indoor environmental quality, demands for transportation services, and the selection of environmentally preferable materials [3]. The assessment of building environmental performance covers a wide range of issues and may

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involve not only a number of environmental, but also economical, social and cultural factors. These comprehensive assessments of buildings require a multidisciplinary and multi-criteria approach which demands cooperation among civil engineers, architects, environmentalists and other experts from different areas of building environmental assessment. The assessment systems are based on the building's life cycle: pre-design, new buildings, existing buildings, and renovation.

2 BUILDING ENVIRONMENTAL ASSESSMENT IN SLOVAKIA

In the recent years the evaluation of building performance in term of environmental, social and cultural aspects is also discussed theme in Slovak republic. The new building environmental assessment system (BEAS) has been developed at Institute of Building and Environmental Engineering, Technical University of Kosice. The systems and tools used in many countries were the base of new system development for application in Slovak conditions. The main fields and relevant indicators of building environmental assessment were proposed on the bases of available information analysis from particular fields of building performance and also on the base of our experimental experiences. The base of system development was mainly SBTool. BEAS as a multi-criteria system includes environmental, social and cultural aspects. The proposed fields and indicators respect Slovak standards, rules, studies and experiments. In this study presented system is developed for the preliminary stages of life cycle, i.e. pre-design and design. The developed assessment system for Slovakia contains 6 main fields and 52 indicators. For the purpose of system weighting was used the Analytical hierarchy process (AHP) [4]. The general structure of BEAS is consist from A – Site Selection and Project Planning, B – Building Construction, C – Indoor Environment, D – Energy Performance, E – Water Management, F – Waste Management (Table 1). Figure 1 summarizes the proposed fields and sub-fields of BEAS with their weights determined by Saaty's method [5]. In the Figure 1 is shown percentage weighting of main assessment fields in Slovak building environmental assessment system.

Tab. 1) Hierarchy structure of BEAS

BEAS									
A		**B**		**C**	**D**			**E**	**F**
A1	A2	B1	B2	C1	D1	D2	D3	E1	F1
A1.1	A2.1	B2.1	B2.1	C2	D1.1	D2.1	D3.1	E2	F2
A1.2	A2.2	B2.2	B2.2	C3	D1.2	D2.2	D3.2	E3	F3
A1.3	A2.3	B2.3	B2.3	C4	D1.3	D2.3		E4	
A1.4	A2.4	B2.4		C5	D1.4				
A1.5	A2.5	B2.5		C6	D1.5				
A1.6	A2.6			C7					
A1.7	A2.7			C8					
A1.8				C9					
A1.9				C10					
A1.10									

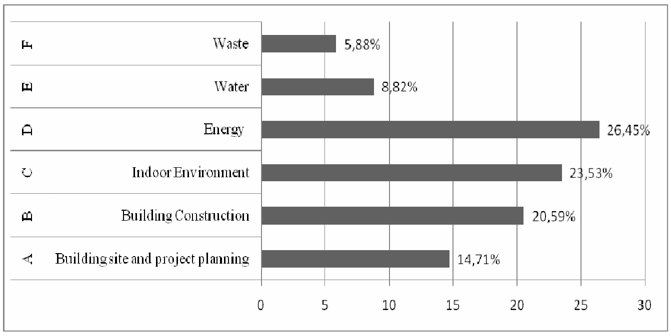

Fig. 1) Building environmental assessment system in Slovakia

2.1 Building site and project planning

In the context of sustainable city planning, it can be observed in recent years an increasing policy interest in urban environmental quality management in relation to land use. The potential for sustainable land use solutions in urban areas is often severely hampered by the existence of unacceptably high levels of soil pollution [6]. First assessment field is Building site and project planning. Site selection issues include transportation and travel distances for building occupants, impacts on wildlife corridors and hydrology, energy supply and distribution limitations. In the Figure 2 is shown main field A – Building site and project planning with weights determined by Saaty's method. This field has two subfields: A1 – Site Selection and A2 – Site Development. These subfields have several indicators of assessment shown in figure.

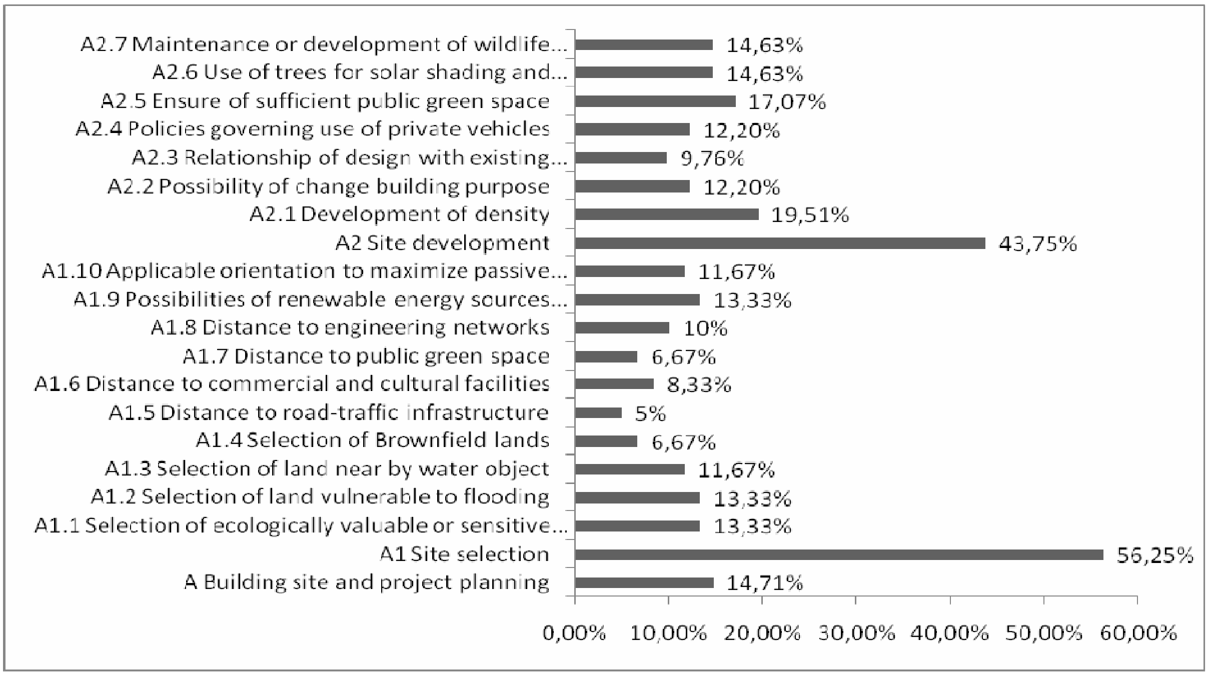

Fig. 2) Building site and project planning

2.2 Building constructions

Along with technical criteria, economic and environmental criteria have become increasingly important factors when choosing and developing building materials. Materials with the smallest possible environmental impact (such as low levels of toxic emissions or required primary energy) are considered sustainable and suitable for use in the future [7]. Environmentally friendly building materials and constructions are aimed to reduce energy and material flows during the entire building life cycle. The evaluation is focused on the assessment of consumption and depletion of material resources, especially non-renewable resources, to minimize the life-cycle impact of materials on the environment and enhance the indoor environmental quality by concentrating on the evaluation of energy flows through the building constructions. The proposed subfields and indicators of building construction fields with their weights determined by Saaty's method are presented in the Figure 3.

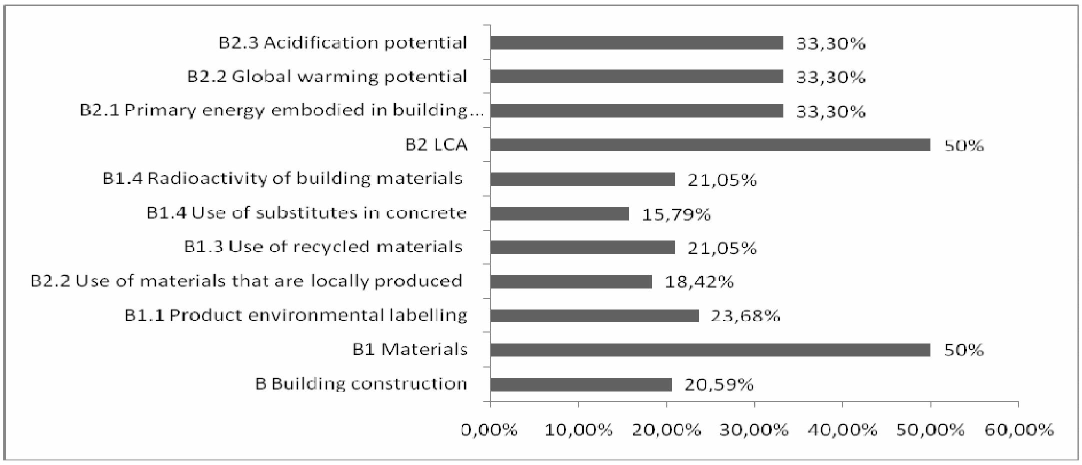

Fig. 3) Building Construction

2.3 Indoor environment

Indoor environmental quality involve to all environmental factors that affect the health and wellbeing of building occupants. Indoor environmental quality focuses largely on indoor air quality, with comfort, humidity, air exchange, acoustics, and lighting quality being contributory factors. In Figure 4 is shown the proposed indicators of indoor environment.

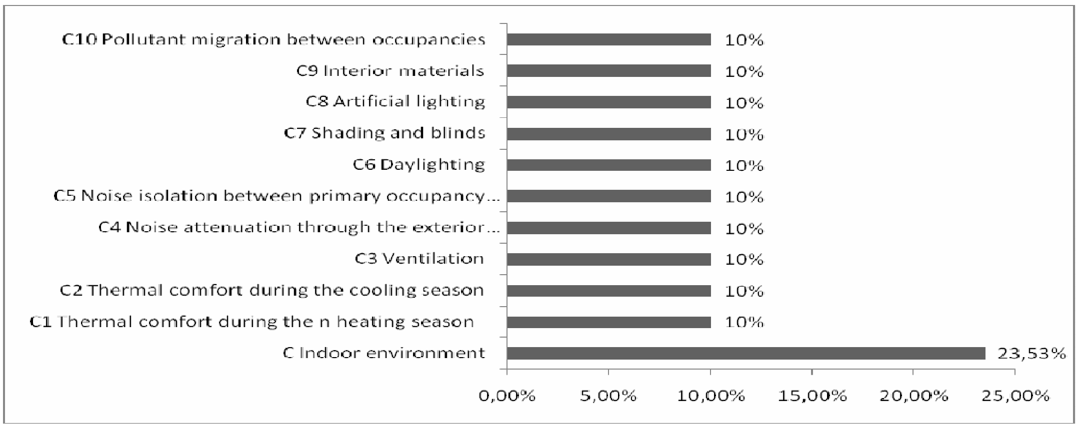

Fig. 4) Indoor Environment

2.4 Energy performance

The choice of indoor design conditions, including the dry bulb temperature set-point, the ventilation rate, the occupancy density and the lighting and equipment power intensities can influence substantially the air-conditioning energy use in a building [8]. Accordingly, whether or not they are used in determining the energy budget will have significant impact on the energy performance assessment result. If design values are selected for the calculations, the validity of the assessment result is dependent on whether the design conditions will match well with the in-use conditions [9]. In the last few years, considerable attention has been devoted to the energy performance of buildings in Slovakia. Energy performance of buildings is related mainly to the energy consumption for heating, cooling, domestic hot water, ventilation and lighting. The proposed subfields and indicators related to energy performance of buildings with weights determined by Saaty's method are presented in the Figure 5 [10].

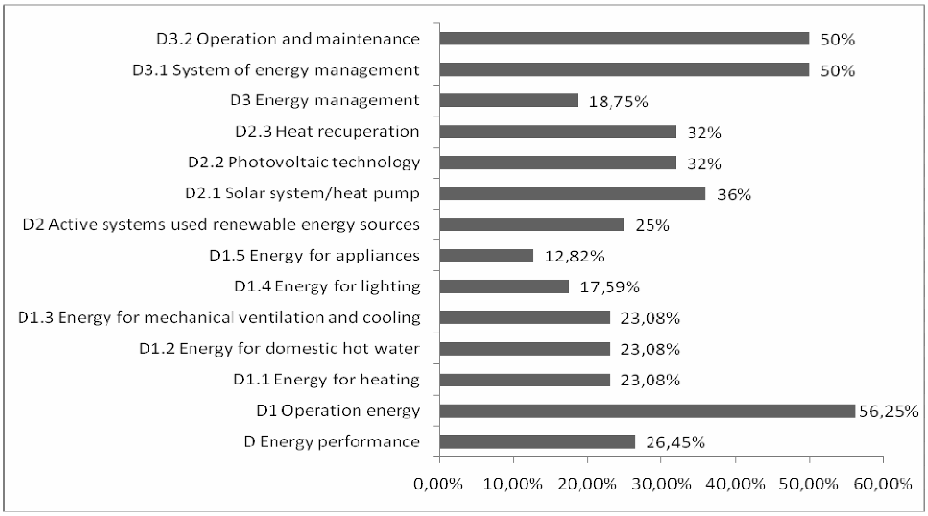

Fig. 5) Energy performance

2.5 Water management

The goal of water management is to preserve the site watersheds and groundwater aquifers, conserve and reuse storm water, maintain an appropriate level of water quality on the site and in the building, reduce drinking water consumption and to reduce off-site treatment of wastewater. Figure 6 summarizes the proposed indicators of water management fields.

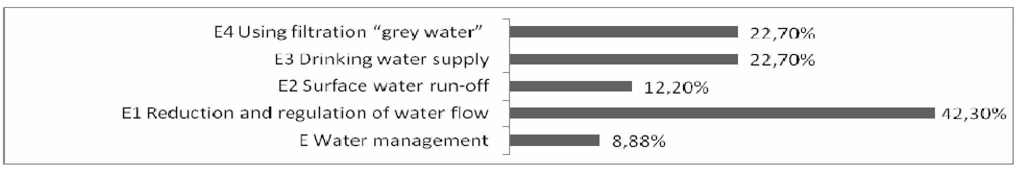

Fig. 6) Water management

2.6 Waste management

The goals of waste management is to minimize the waste generated from construction, renovation, and demolition of buildings, and minimize waste generated during the building occupancy and to encourage better management of waste. Figure 7 summarizes the proposed indicators of waste management fields.

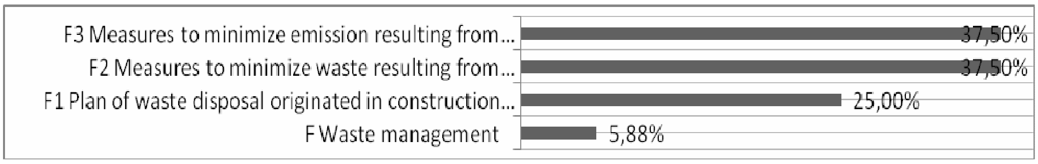

Fig. 7) Waste management

DISCUSION

The building environmental assessment systems and tools have been developed for various types of buildings and for each phase of the life cycle. The more significant methods and systems developed in various countries are presented in this paper. The comparison of methods used and tools is difficult making it possible to suggest that the approaches of these methods are principally not very different. Several differences are found in terminological expression, and in some of them the different indicators are assessed under the same areas. Again the methods of impact rate classification are also different and mostly respect their national conditions and requirements. They cover the building's life cycle differently. The method sensitivity can also vary and the indicators independence are not always secured. The building environmental assessment requires a multidisciplinary and multi-criterion approach.

CONCLUSION

In this paper is introduced the proposal of building environmental assessment system. The proposed environmental assessment system of buildings applicable in Slovak conditions consists of 6 main fields and 52 relevant indicators. The main fields are building site and project management, building constructions, indoor environment, energy performance, water management and waste management. The theoretical level of present knowledge of building environmental assessment is completely. It is necessary to implement this knowledge to construction practice. The following research work will be aimed at determination of significance weights of indicators. For the purpose of assessment system verification, it is needed to evaluate a statistically significant set of buildings. The results from further system verification will allow modify the significant weights of indicators.

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DETERMINATION OF COST OF THERMAL INSULATION STRUCTURES ACCORDING TO THE BULIDING ENVELOPE

Miloslav Výskala[1], Jana Korytárová[2]

Abstract

The paper is focused on defining the costs of improving the thermal-technical properties of buildings, broken down by parts of the building envelope. This paper aims to provide general indicators of the costs of different construction to improve thermal and technical properties of the objects because the proportion of the total potential heat savings.

Key words

Thermal characteristic of building, total thermal transmittance, U-value, thermal resistance, specific heat use for heating

1 INTRODUC;TION

One of the evaluation criteria for investment options for improving the thermal-technical properties of buildings is to determine the cost in proportion o the value of building energy-efficiency. In determining this ratio can be in several successive steps to split calculations. Determine the heat loss of the building. Divide it's by the building envelope. In addition to establish baseline performance of a building energy efficiency by the time period. Based on the assessed value of the building energy efficiency to include one of the energy classes according to Decree No. 148/2007 Coll.: on the energy performance of buildings..

Thus the initial situation described can be assigned to model investment options and new thermal-technical properties and the related investment costs.

2 BUILDING HEAT LOSS

Total heat loss coefficient can be divided into transmission heat loss H_T [W/K] and the loss of air exchange H_V [W/K]. Heat transmission structures is directly, if they are in contact with the outside air, or indirectly, when unheated space is between the exterior and the heated space.

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Heat losses of heat transmission are generated around the system boundaries heated and unheated space, the building envelope.

2.1 Heat losses of heat transmission

Heat losses of heat transmission depend on the heat transmission between the heated and ambient environment. Transmission heat loss coefficient H_T [W/K] is calculated as the sum of the thermal envelope permeability (L_D), constant heat transmission through the ground (H_S) and specific heat loss by transmission through unheated spaces (H_U) [3].

$$H_T = L_D + H_S + H_U \tag{1}$$

The most noticeable losses of heat are caused by direct transmission of heat to the external environment L_D [W/K]. They are directly dependent on the area (A) of envelope and their thermal-technical properties (U). Heat losses of heat transmission are also negatively affected by the action of linear ($\sum_k$) and point ($\sum_j$) thermal bridges according to the formula (2).

$$L_D = \sum_i A_i U_i + \sum_k l_k \psi_k + \sum_j \chi_j \tag{2}$$

Schematic expression of heat loss of the building is shown in Figure No. 1 (The system boundaries of the heated area are highlighted by dashed line).

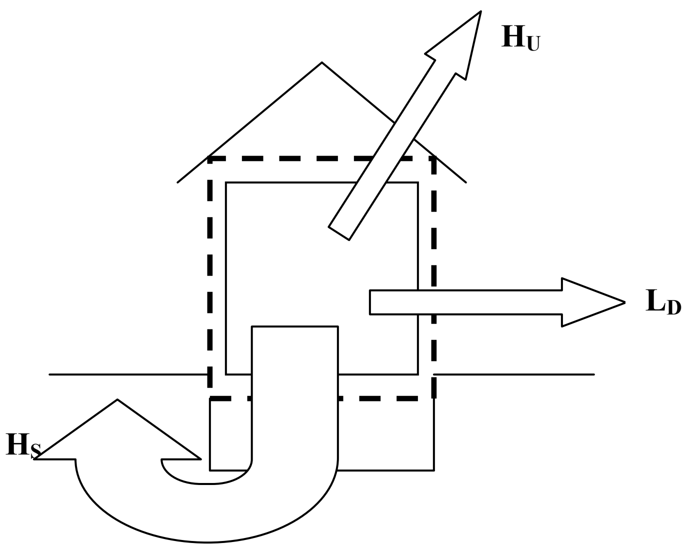

Fig. 1) Schematic overview of the building heat loss [1], [2]

2.2 Heat loss in the time period

To determine the total energy demand for heating Q_l [Wh/the period], it is necessary according to the formula (3) to determine the total specific heat loss H [W/K] by periods, furthermore, the required internal temperature and ambient air temperature for the period.

$$Q_l = (H_T + H_V)(\theta_i - \theta_e)\, t \tag{3}$$

Based on the total calculated heat loss of building Q_l can be clearly assessed the building included in the energy class, according to Decree No. 148/2007 Coll.: On the energy performance of buildings (Table 1). Specific energy use for buildings heating is the total energy needs to set its transfer to the building floor area under consideration.

According to Decree No. 148/2007 Coll., are building energy requirements (by law 406/2000 Coll.: on Energy) satisfied in the case, where the energy performance of buildings is less than the energy performance of the reference buildings. The reference building is such a building, where energy intensity corresponds with the interval values shown in column C of Table 1. The energy performance of buildings is estimated using specific energy consumption EPA [kWh/m^2a] as [4]:

$$EPA = 277{,}8 \times EP/Ac \tag{4}$$

In terms of thermal protection of the buildings defining the energy performance of existing buildings and new construction projects or changes as the amount of energy actually consumed, respectively, calculated as the amount of energy to meet the standardized use of the building, particularly for heating and hot water.

Tab. 1) Energy class different types of buildings [4]

Building type	A class of energy efficiency in buildings kWh/m^2a						
	A	B	**C**	D	E	F	G
Houses	< 51	51 - 97	**98 – 142**	143 - 191	192 – 240	241 - 286	> 286
Residential houses	< 43	43 - 82	**83 – 120**	121 - 162	163 – 205	206 - 245	> 245
Hotels and restaurants	< 102	102 - 200	**201 – 294**	295 - 389	390 – 488	489 - 590	> 288
Office buildings	< 62	62 - 123	**124 – 179**	180 - 236	237 – 293	294 - 345	> 289
Hospitals	< 109	109 - 210	**211 – 310**	311 - 415	416 – 520	521 - 625	> 290
Educational establishments	< 47	47 - 89	**90 – 130**	131 - 174	175 – 220	221 - 265	> 291
Sports equipment	< 53	53 - 102	**103 – 145**	146 - 194	195 – 245	246 - 297	> 292
Commercial buildings	< 67	67 - 121	**122 – 183**	184 - 241	242 – 300	301 - 362	> 293

3 ASSESSMENT OF THE CURRENT SITUATION AND DRAFT ACTION

The current state of the object is clearly defined by the values listed in table 1. The proposed measure must meet the requirements of energy performance of buildings for at least the value listed for each property in column C of table 1.

Need for further design of structures affecting and improving thermal and technical characteristics of the building is necessary to recalculate the total recoverable energy demand for heating Q_i for different functional parts of the building envelope. After this recalculation is necessary to clearly define the status of the calculated thermal transmittance (U) and particular heat loss (Q), calculated at intervals of a partial energy requirement for heating. The current situation can be illustratively graphically expressed by the Fig. 2

For each part of the building envelope is then necessary to select and propose a specific construction to improve thermal and technical properties of the object. The found solution is possible to assign the appropriate technology and used insulating material, according to which one can determine not only total costs but also the thermal and technical characteristics of new construction represented by the values of the coefficient of thermal transmittance U.

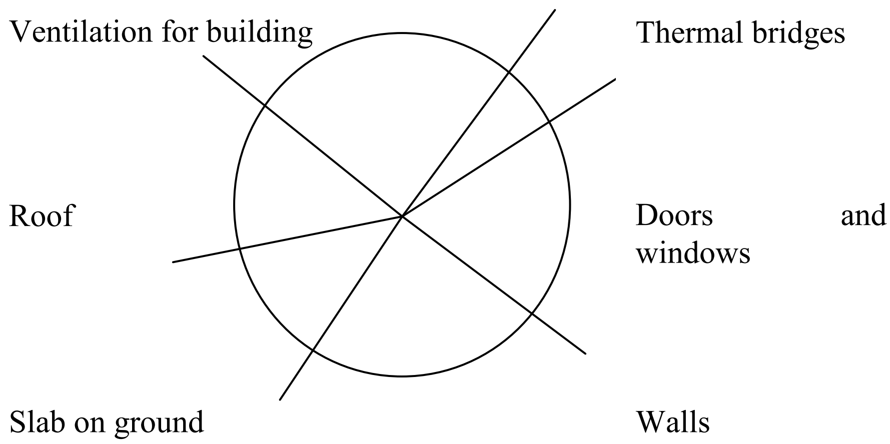

Fig. 2) The breakdown of energy use under the building envelope [kWh/m^2a] and their ratio

4 DETERMINATION OF COST OF INSULATING STRUCTURES

The cost of heat-insulating structures classified by the building envelope are the sum of the cost of using technology (installation), insulating material used (their thickness) and other costs associated with structures. The individual measures can be completed thermal-technical properties and repeat the calculation of heat losses and it needs to derive energy for heating.

The cost of thermal insulation structure can be expressed within the modeling options for different kinds of technologies and materials used (and thickness). Individual options can be compared with the zero option by splitting the energy needs shown of the Figure 2.

One of the options for the subsequent evaluation of investment options is the conversion efficiency of its resources by determining the reduction of energy consumption monitoring of buildings, ie: how much money should be spent on reducing energy intensity by one kWh/m^2? (See in table 2).

The necessary calculations for the different parts of the building envelope designed to carry out in Table 2. The table below shows the total costs primarily for thermal insulation in walls to polystyrene plates with variable thickness. In the first half of the table are defined technical and heat-insulating properties of the price structure. In the second half of the table is the power demand recorded before and after the proposed change, the calculated energy savings and cost savings described above.

Tab. 2) Determination of the cost of heat-insulating structures per unit of measurement

	Determination of the cost of heat-insulating structures per unit of measurement							
	Facade polystyrene plates PS EPS 70F $U = 0{,}039\ W/m^2K$				The energy need original / after changes			
Isolation thickness	R	Price of con.	MJ	Total price	Original energy need	After chan. energy need	Distinction energy need	Costs of savings
mm	m^2K/W	CZK/m^2	m^2	CZK	kWh/m^2a	kWh/m^2a	kWh/m^2a	CZK
10	0,26	978,30		15652,80		127,12	0,88	17787,27
20	0,51	998,50		15976,00		126,24	1,76	9077,27
30	0,77	1018,70		16299,00		125,33	2,67	6232,21
40	1,03	1 040,00		16640,00		124,40	3,57	4661,06
50	**1,28**	**1 079,20**		**17267,20**		**123,40**	**4,60**	**3753,74**
60	1,54	1 101,00		17616,00		122,52	5,48	3214,59
70	1,79	1 122,00		17952,00		121,64	6,36	2822,64
80	2,05	1 143,00	16,00	18288,00	128,00	120,24	7,76	2356,7
90	2,31	1 166,00		18656,00		119,95	8,05	2317,52
100	**2,56**	**1 206,00**		**19296,00**		**119,11**	**8,89**	**2170,52**
110	3,08	1 249,00		19984,00		118,20	9,80	2039,18
120	3,33	X		X		X	X	X
130	3,59	1 292,00		20672,00		115,97	12,03	1718,37
140	3,95	X		X		**X**	X	X
150	**4,1**	**X**		**X**		**X**	**X**	**X**

5 CONCLUSION

A key aspect in modeling the thermal variations of improving the technical properties of the object is a technical and economic balance of all proposed structures. The procedure generally provides cost indicators for individual construction to improve thermal and technical properties of objects with regard to the proportion of the total potential heat savings.

The procedure (after defining the initial state) to solve the technical improvement of the thermal and technical characteristics of the different parts of the building envelope in parallel, which is guaranteed to find an effective solution to the problem.

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INNOVATION AND SUSTAINIBILITY IN CONSTRUCTION – THE ROLE OF THE MATERIAL GOODS INDUSTRY

Michael Weingärtler[1]

Abstract

Innovation is amongst others needed to fulfil the national Kyoto climate targets. This also affects the construction and real estate business as a major producer of greenhouse gases. The aim of this paper is to show the Austrian research and development activities in construction by input and output indicators which are a key driver of sustainable construction. The contribution of the construction material sector in this matter will be derived for selected European countries. One of the conclusions is that patent registrations on the European level gained more and more importance in the Austrian construction industry. The material goods sector is a significant provider of innovations. Analysis showed that every tenth patent which was registered in this sector was used in the construction industry.

Key words

Construction, Sustainability, Innovation, Patents

1 INTRODUCTION

The Republic of Austria committed to an ambitious target: to reduce the greenhouse gas by -13% until 2012 against 1990. Therefore thermal and energy efficient buildings make an important contribution to achieve this target, because within the building sector 14% of Austria's CO_2 emissions [6] are produced. Beside the issue of greenhouse gases the construction sector is - to a large extent - responsible for waste accumulation. In 2007 around 8 mill. tons of waste were created in construction and additional 24 mill. tons of excavation material which takes a share of 43% of the total volume of waste [5]. Therefore sustainable innovative construction is a key factor from the economic, social and ecological point of view.

Section 2 takes a look at the Austrian research and development (R&D) framework with a main focus on the construction industry. On the one hand input factors of innovation such as R&D expenditures, research units and employees will be discussed. On the other hand a picture about the innovation output will be derived by analysing patent information. Additionally, basic facts about the role of sustainability in construction innovation, which are based on a survey of the Austrian Institute of Economic Research, will be given.

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In Section 3 different perspectives of patent registrations on the European level will be presented. The development of patent registration from the construction companies at the European Patent Office will be shown and the relevance of the innovation activities of the material goods sector for the construction industry is derived by analysing its patent registration on the European level.

2 RESEARCH AND DEVELOPMENT IN AUSTRIAN CONSTRUCTION

2.1 R&D input factors in Austrian companies

In 2007 construction companies spent about 20 mill. Euro in research and development (R&D). This refers to 0.4% of total company expenditure of R&D in Austria. The distribution between basic research and experimental R&D differs in the construction sector only slightly from the material goods industry. According to the national statistical office [8] nearly three quarter of all company related expenditures were used for experimental development and one quarter for research. Only less than 2% of the expenditures were invested in basic research.

Most of the expenditures were used for continuous material costs (43%), followed by labour costs (40%) and expenditures for fixed equipment (17%). Expenditures for facilities and land only played a minor role with a share of 0.1% [3].

The number of construction research units in the company sector doubled from a low level of 40 units in 1998 to 82 units in 2006 in Austria. This is very low compared to the material goods sector with around 1,320 units in 2006 and a share of 55% of the total R&D units.

An innovation survey in construction from WIFO, the Austrian Institute of Economic Research [2], showed that the main reason for R&D activities is to get into new markets. This was for 83% of the construction and construction supply companies the most important incentive. An improvement in quality was for 78% of the companies the second strongest argument for R&D, while the motivation of R&D activities to fulfil standards, to reduce labour costs or to achieve higher production capacities were not very important.

2.2 Patent registrations in Austrian Construction

This sub-chapter shows the R&D activities in construction by analyzing patent registrations from 1998 to 2007 in Austria. All registered patents from domestic persons or companies, which must not have been granted, were used [1]. In general it is not possible to conclude directly from patent activities to the innovation output or to the success of new registered products or techniques which would positively affect a company's competitiveness. Nevertheless patent registrations show a picture of the national R&D activities.

Inventions are classified by product and process, using the International Patent Classification (IPC) system. Within this system inventions are put into eight main categories represented by the letters "A" to "H". The IPC category "E" is most relevant for the construction industry. It is divided into seven subdivisions: E01 road, rail and bridge construction, E02 water construction and soil movement, E03 water supply and waste water removal, E04 Building elements, construction, E05 locks, keys, treasures, E06 doors, windows, E07 soil drilling and mining (E21).

An exact relationship between these seven categories and the construction branches does not exist. The classes E03 to E06 are most relevant for the building sector (residential and non-residential construction). About two thirds of the construction related patents (IPC- E) were registered in this sector in Austria in 2007. About 37% of the patent registrations are counted within the clategory E04 which could be referred to the main construction sector. The IPC categories E05 and E06 reflect the innovation activities of the construction supply industry best. This sector took a share of 27% of the registered construction patents in 2007. IPC E01, E02, E03 and E21 reflect the innovation activities in civil engineering to a large extent. According to this classification 36% of the registered patents will be used in civil engineering.

In Austria the number of registered patents from domestic inventors at the national Patent Office did not change significantly over ten years. Construction related patent registrations are an exception. They declined in the period between 1998 and 2007. While 269 patents were registered in 1998 the number shrank to 236 in 2006 and to 196 in 2007. The largest downturn was recorded in the area of building construction (E04) which reached in 2007 the level of 1998. Nevertheless, in civil engineering they developed where dynamically. The number of patent registrations in this sector was in 2007 more than 50% higher than ten years before.

2.3 Sustainable developments in the Austrian construction sector

In the construction sector the pressure increases from the ecological and social perspective to fulfil the new requirements of cost and area efficient construction with a high ecological quality. Sustainable buildings and building materials are therefore one of the key issues in construction and construction related industries.

A WIFO survey [2] showed that the Austrian construction and construction material producing companies are aware of this. Already more than every fifth construction company publishes a sustainability report. Most of these companies also have a person responsible for sustainability issues and also a clear company strategy in this area. More than every fourth company of the construction supply industry (29%) and of the real estate companies (27%) have a responsible person for sustainability issues. This share is with 17% much lower in the construction sector itself.

The WIFO survey also pointed out that especially innovative companies have a strong company vision regarding sustainability. Nearly 57% of the innovative companies have a responsible person for sustainability matters and almost 40% publish a sustainability report.

Within the construction sector decisions about strategies regarding sustainability were made to a large extent (82%) by the company board or head of the company. In the construction supply industry and real estate sector the decisions are taken more decentralised.

3 PATENT ACTIVITIES ON THE EURPEAN LEVEL - SPECIAL FOCUS ON THE MATERIAL GOODS SECTOR AND ITS CONSTRUCTION RELEVANCE

This section will analyse the development of the patent activity of Austrian companies at the European Patent Office as well as the contribution of the material goods sector on the R&D activities in construction. The analysis is based on the patent registration information of the OECD patent database [7].

3.1 Development of Austrian patent registrations at the European Patent Office

The OECD patent database shows that the number of patent registrations of Austrian citizens at the European Patent Office (EPO) increased significantly since Austria's EU accession. In 1995, the year when Austria became EU member, only 674 patents were registered at the EPO. Five years later 1,170 patents (+74% compared to 1995) and in 2005 already 1,456 patents (+24% compared to 2000) were recorded. In 1995 the patent intensity, measured as domestic patent registrations at the EPO, amounted to 8.4 patents per 1,000 inhabitants in 1995. In 2005 it could be increased to 18 patents. This shows clearly the increasing relevance of know-how protection on a European level in Austria.

3.2 Construction innovations and patents of the material goods sector

Innovation activities in construction are not only set by the construction sector itself. A broad range of innovations and patents are also created within the material goods sector which are analysed in the following part.

Patens are recorded for administrative purposes and cannot be used for economic analysis. The development of the OECD Technology Concordance [4] allows the transformation of IPC-based patent information into patent counts by economic sectors. The concordance is based on Canadian patent information between 1972 and 1995. Within this time range about 300,000 patents were recorded, including the information from which sector the registration came (industry of manufacture) and also for which sector the innovation was for (sector of use). Based on these relationships it is possible to analyse the R&D relevance of the material goods sector.

Calculations show in the case of Austria that those patents which were registered from the material good sector and used in construction sector doubled from 67 in 1995 to 139 in 2005. Only in the period 2001/2002 a temporary decline could be observed. This can be mainly explained by the economic downturn in 2002, which affected the Austrian construction sector stronger than the overall economy.

Within the analysed period 1995 to 2005 about every tenth patent which was registered at the EPO was used in the construction industry in Austria. The share of construction relevant innovations with its origin in the material goods industry declined slightly, but is still well above of the EU-15 average with every 20th registered patent.

In the EU-15 area about 2,700 construction related patents were registered from the material goods industry within the EU-15. This refers to a patent intensity of 0.7 patents per 1,000 inhabitants. By contrast, Austria shows a patent intensity of 1.4.

Tab. 1) Number of construction related domestic patent registrations of the material goods sector in selected European countries from 1995 to 2005

Country	**1995**	**1997**	**1999**	**2001**	**2003**	**2005**
	Number					
Austria	67	86	110	118	116	1139
France	304	333	365	364	380	422
Germany	830	1,135	1,243	1,164	1,144	1,309
The Netherlands	94	125	122	123	152	165
Poland	0	2	2	6	7	8
Hungary	1	2	4	3	4	5
EU-15 [1)]	1,828	2,398	2,697	2,591	2,548	

S: [1]) The representation of EU-15 figures were stopped in 2005. This also leads to an underrepresentation of the figures since 2002.

In Eastern Europe (i.e. Poland, Hungary) an evaluation of the relevance of innovations from the material goods industry for construction by analysing patent registration is not very useful. In these countries patent registrations started slowly from 1990 onwards and they are still at a very low level. In 1995 only 14 patents were registered by Polish companies at the EPO, in 2005 they amounted to 115. This is still very low when it is considered that Austria's number of overall patent registrations is ten times higher while the population of Austria is only one fifth of Poland's.

3.3 Areas of construction related innovation of the capital goods industry

The previous analysis of the OECD patent data shows that many patents developed in the material goods sector are used in construction. Within the EU-15 countries the most relevant areas in the material goods sector are machinery where 30% of the construction relevant patents were registered, followed by metal production (28%) and the furniture industry (9%). Further important areas are rubber and plastic industry (7%), mineral production (6%), as well as wood production (3%). The rest is distributed evenly among the other areas of the material goods sectors with shares less than 1%. These figures reflect the average patent registrations of the material goods sector used in construction within 1995 to 2004.

Industry Sector	**AT**	**DE**	**FR**	**HU**	**NL**	**PL**	**SE**	**EU**
	Average share in % from 1995 to 2004							
Machinery	27	29	28	29	30	32	34	30
Metal	30	29	27	29	24	28	28	28
Rubber, Plastic	8	7	7	7	7	8	7	7
Furniture	8	9	10	9	8	7	7	9
Minerals	6	5	5	5	6	9	5	6
Wood	4	3	2	3	3	4	3	3
Other	17	18	21	18	22	12	16	17
Total	100	100	100	100	100	100	100	100

Tab. 2) Sectors of the material goods industry with the highest number of registered construction relevant patents.

The distribution between the European countries differs only slightly within a band of one to seven percentage points. The construction relevant patents from the machinery sector are slightly above average in Sweden (34%) while metal production (30%) in Austria takes a larger share. A shift in shared towards one sector could not be observed in the observed period from 1995 to 2004.

4 CONCLUSIONS

In the construction sector the pressure increases from the economic, ecological and social perspective to achieve the new construction requirements. Innovation is one important part in this aspect. Therefore company related R&D expenditures increased by +89% from 2000 to 2007. Public subsidies for R&D increased nearly in the same amount during this period. Also Austrian construction companies are aware of the importance of innovation. Company related R&D expenditures were significantly increasing, research units doubled in 2006 compared to 1998 and also the number of employees developed dynamically with an increase of +65%.

An analysis of the R&D activity of Austrian construction companies measured by registered patents at the national patent office showed that the number of registrations was nearly constant over the past 10 years – in construction it even declined. Only the area of civil engineering an increasing number of patents could be observed. In 2007 around 34% of the construction related patents, of the IP-Class E, can be related to civil engineering. The building construction industry had a share of about 37% and the construction supply industry of about 27%.

On the European level patent registration gained in importance. The material goods sector provides a large number of innovations for the construction industry. In Austria every 10th registered patent at the EPO from the material goods sector was used in construction. The machinery and metal producing sector provides most of the innovation.

All in all it has to be kept in mind that the relatively low number of national patent registrations in construction leads to large impact of a couple of large companies. Thus, a strong year-over-year decline nor a strong growth in registered patents does not necessarily reflect a negative or positive development of company related innovation activity. Nevertheless growing private and public R&D expenditures did not lead to more patent registrations in the Austrian construction sector.

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EXPERIENCES FROM PROJECT FOR DAM SVETA PETKA

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Abstract

This article presents the main project realization problems and Consultant experiences collected during working on project for the dam "*Sveta Petka"* near Skopje, the capital of Republic of Macedonia. A special attention is given on problems connected with construction projects determining factors, technical documentation and project management. Main idea is to give possible way of overcoming the problems that can arise from mentioned project elements. Conclusion is that, before starting on working with complex civil engineering projects, such as dams, a detailed analyse of project realization determining factors is necessary. Also, foreign project participants' offices with domestic stuff are needed. Authors believe that the gathered experiences can serve as a learning example for other parties that deal with similar projects.

Key words

Dam, delay in construction, experiences, project.

1 INTRODUCTION

The foreign participants in the Civil Engineering Projects, pursuant to the Macedonian Law on Construction [1] can undertake all the positions as the domestic participants. Due to that, there are many international Civil Engineering Projects in Republic of Macedonia. One of those projects is the project for arch dam "Sveta Petka". This is one of the three dams placed along the Treska River. The dam is in a phase of construction, and its main elements are following [2]:

- Height of the dam 64 m
- Length in the crown 118 m
- Dam volume (concrete part) 30 689 m^3
- Volume of reservoir area 9,10 x 10^6 m^3

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The reservoir formed by the dam is planned to fulfill two main aspects: industrial water supply of Skopje region and optimisation of the electricity production of three Hydro Power Plants in a casacade regime. The dam is situated in the vicinity of the capital Skopje, spaced about 20 km SW from Skopje (Fig. 1).

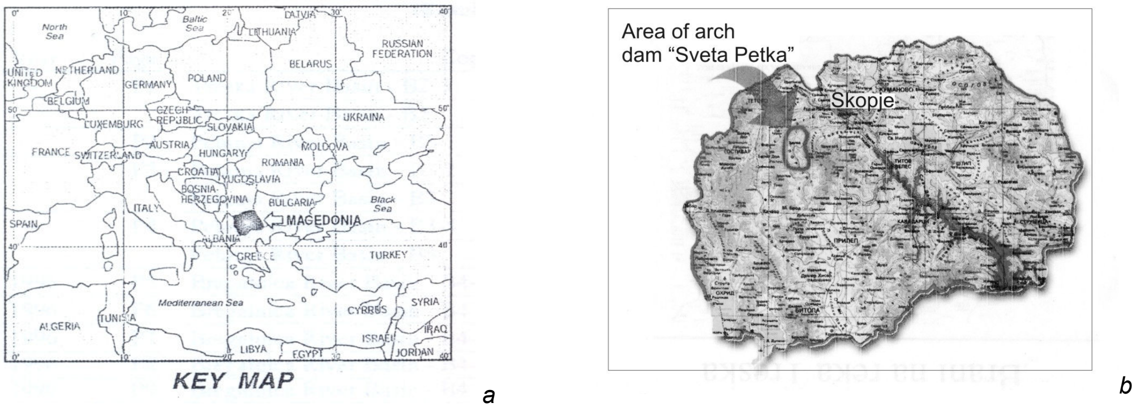

Fig. 1) Key map: a-position of R.Macedonia in a Balkan Peninsula and Europe, b-location of arch dam “Sveta Petka”

Arch dam, appurtenant structures and power plant disposition in a horizontal view is given on Fig. [2].

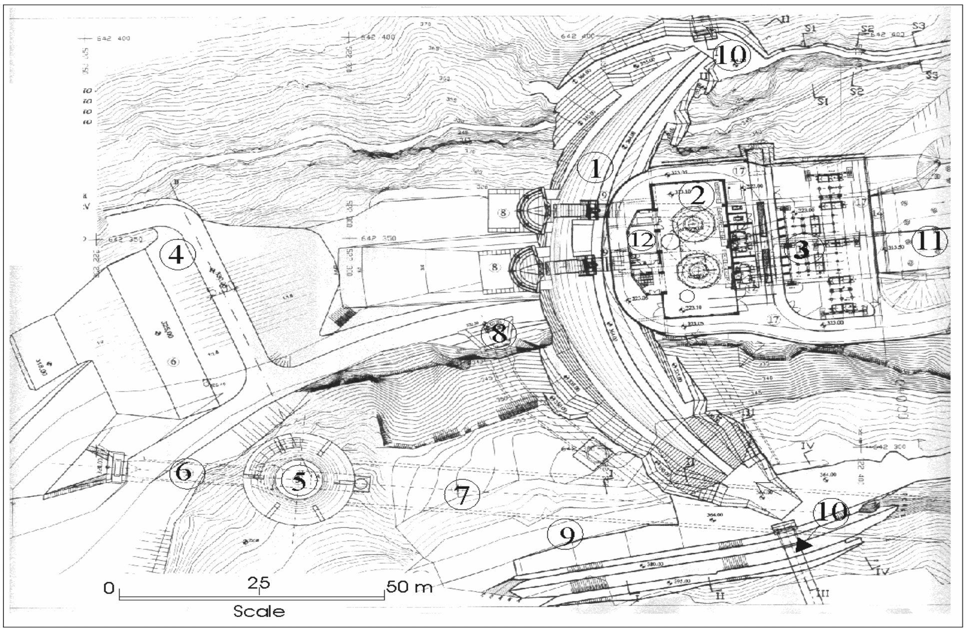

Fig. 2) Disposition of dam St. Petka: 1 - dam; 2 – power station; 3 – switchyard; 4 – upstream cofferdam; 5 – spillway shaft; 6 – diversion tunnel; 7 – spillway tunnel; 8 – bottom outlet; 9 – access road; 10 – grouting gallery; 11– regulated river bed; 12– energy transformators [2]

The construction of the whole system is divided in two main phases. In the first phase, the construction of access road, diversion tunnel and spillway tunnel was prepared by other contractors.

The Second phase is prepared according to separate Tender Dossier, and it's the realization started on 2007. At the Second stage of construction, teams from Slovenia, Serbia and Macedonia are involved. Investor is public enterprise for electricity AD "ELEM" from R. of Macedonia; Designers for the second stage of the project are: RIKOM-Skopje and Energoprojekat - Serbia; Contractor is RIKO-Slovenia with local subcontractors and Consultant is Faculty of Civil Engineering from Skopje. It is interesting to note, that the construction of the dam is using the principles of Turn Key Contract. Initial estimation of the total cost was about 60.000.000 US.

Estimation for necessary time for ending of all Civil Engineering Works was period of tree years. Because of different reasons, the initial estimation for time of construction cannot be fulfilled. At the present moment, the project is in a phase of a construction of the dam body. The reason for delays of projet lies in several main problems. Some of them are quite formal, but some problems are coused by project' participants.

In order to perceive the major problems and reasons for occurrence, the authors of the paper had analyzed own experiences obtained during participation in the realization of the project. The gathered experiences were the basis for this article.

2 KEY PROJECT PROBLEMS IN CONSTRUCTION OF *SVETA PETKA* DAM

The main project' problems we systematized into three key groups of problems which are in an interaction [4]. They refer to the 1) Construction Projects Determining Factors Problems, 2) Technical Documentation Problems and 3) Project Management Problems.

2.1 Construction determining factors problems

The realization of the project is determined by numerous complex and interconnected set of time dependent factors. Our experience shows that the influence of some factors was underestimated for the project for dam ″Sveta Petka″. As the most characteristic factors we will mention: the geotechnical factor, the climate factor and the economic factor.

- *The geotechnical factor*: the geotechnical factors have a large influence because of the heavy terrain conditions and slope-stability problems along acces road. Additionaly, some influeonces of geotechnical factor are indirect. For an example, the excavated rock material doesn‘t fulfill criteria to be used as an concrete ageagate. That was a reason for using an agregate from a quary distanced about 40 km from dam area. Also, the excess of excavated materijal occupy larger volume in landfill placed in a death volume in a reservoir area. Also, occurrences of temporary rock-falls along access road has an effect on financial aspects, because of higher finances for it's cleaning, design of protective measures etc. Anyhow, geotechnical is important factor for delay in construction, but it can be treated more or less as a natural factor.
- *The climate factor:* the dam is constructed in a mountain region with heavy climate conditions. So, the organization and technology of construction is affected with

these aspects. It seems that this factor is underestimated in a process of schedule planning in some positions. For an example, the grouting of zones between concrete elements is possible and gives best effect in winter period. Knowing that the concrete works doesn't follow the initial time schedule, it is possible to have a delay in construction for a period of one year only for this reason.

- *The economic* factor: Till now, construction takes about four years, so during this period there were changes in market conditions for material costs, transport costs, mechanisation and other costs. The describet situation, finnaly leads to higher costs in project realisation.

Beside mentioned factors, it can be noted that, there are some so-called outer factors which influenced the delays as: politycal, topographical, lawa and other factors, but such factors cannot be used as primary for time of realisation and for additional costs.

2.2 Technical documentation problems

In accordance with the Macedonian Law on Construction [1] several levels of design has to be prepared for the dam' structure: *Preliminary Design*, *Design for preparatory works*, *Basic Design*, *Detailed Design, As built Design* and *Design for the exploitation and maintain of the structure*. These levels of Design are different from design levels in Slovenia and in Serbia. That means that the phases in preparing of technical documentation and its content in R. of Macedonia are not equal with the technical documentation phases in international participant countries. This fact was as a source for many problems. For example, at the beginning of the project Investor team gave basic expected elements of the Project for detailed analyses to the Designer team and noted the levels and content of documentation that he needs. But, international project' participants had problems with the understanding of the Designs' contents and the details of their making. Additionally, Macedonia has not accepted technical specifications and standards for all civil engineering works, so all participants in the project, forced their own view about the way of application the standards, content of documentation etc. Some problems occurred because in Macedonian Law on Construction, not all sub-law procedures are finished. Not well defined aspects in the law framework, was as a basis for misunderstanding for foreign participants during technical documentation preparing.

The situation described above produced a lot of problems with participants from Serbia and from Slovenia, especially at the beginning of the project. Such situation was not easy to be managed, and needd high effort from all project participants in order to fulfil all necessary criteria about the construction. Due to that, in a project for dam "Sveta Petka" international participant local offices with Macedonian stuff had been made. So, our experience shows that every international participant in any project should have a domestic partner/consultant in the project realization.

The Design documents at the Main Design level are prepared in several phases [2]. This was necessary in order to have documents for separate construction of some dam surrounding elements. As it is mentioned, in the first stage the construction of access road, spillway tunnel, outlet tunnel, and some preparatory works are prepared, in order to diverse the river and to insure working conditions at the zone of dam foundations. The Design for temporary roads, houses for working stuff, main preparatory works, excavation for dam foundations and concrete station followed the first stage. Finally, the other structures were designed[4].

In general, this can be treated as a positive experience, having in mind that there is enough time to analyze all necessary activities on time. On the other side, the document preparation using this concept is not always without weak points. Sometimes, the longer time for Document preparation, leads to problems in communication between revision council team, designer team and investor teams. It was evident, that sometimes is heavy to fulfill all requests from all sides, because the complete procedure of document approval and answers needs time and effective communication between mentioned teams.

Beside, a longer time for document preparation, there are a cases when some key Design Books are prepared during long time. That is a case with books connected with concrete works. Namely, the preparation of optimal concrete mixtures and its testing last long time. This was a reason for some delays in construction.

2.3 Project management problems

In Republic of Macedonia standardised methodology for construction project management, which would cover all the activities and phases of the project life cycle, is not applied [3]. In addition, little attention has been paid to issues related to construction project management in the Law on Construction and the Manuals deriving from it, as well as in the remaining legal regulations [1]. Because of that, participants from Serbia and Slovenia use their own approaches and Macedonian participants use their own approaches. Such situation leads to misunderstandings in project realization. The participation of companies with different engineering experience, persons with different culture and tradition creates additional problems in coordination of the activities during the phase of project realization. So, the project realization is characterized with numerous problems. As the most characteristic we shall noted problems caused by *personal* and by *communication*. Also, problems with project *planning* should be noted.

Each participant applies individual criteria and procedures for selection of *personal*. Foreign participants have their own personal from Serbia and Slovenia who work, mostly as project managers and as designers. Disadvantages of foreign participant staff are the insufficient awareness of the actual situation about carrying out the construction works in R. of Macedonia. So, Macedonian foreign offices and domestic partners give a strong support for solving problems with personal. The Contractors are Macedonian construction companies, which very well know the construction conditions in the country, what, by our opinion have solved numerous problems.

The *communication* problems arise from the fact that the participants are with different culture, tradition and way of working. At the beginning of the project realization different ways of organization the working meetings, different ways for preparing of reports and other factors leaded to the misunderstandings in project realisation. So, some communication rules have been introduced. For example: one week meetings etc. The problems with language of

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[4] Works for concrete dam body, grouting works and all other aspects necessary for finishing of the whole struuctures.

communication shall be also noted. The flow of information was not satisfactory while the main language for communication was English, not mother tongue language for Macedonian, Serbian and Slovenian participants in the project. Although the English language was defined as a project language with the bid for the project, some optional solutions had been involved. In the project "Sveta Petka", all participants are from Former Yugoslavia' countries, so the Serbo-Croatian language is used informally on the meeting sessions. Also, Macedonian language has been used for personal communication, especially in the lastly year of the project realization.

The Gant chart is used for project *planning*. Software support is based on MS Project package. But, after *controlling* and *monitoring*, schedule for the project have been changed several times. Problems caused by project *planning* have risen because of the fact that contractors didn't follow the schedule. As a Consultant, we have problems with schedule checking, because the schedule doesn't show the really situation at the construction site. That fact is one of the reasons for problems with technical documentation reviewing and its time overrunning. So, our experience shows that making the technical documentation in phases is positive in cases when the project realization is in accordance with project schedule.

3 CONCLUSION

The project for arch dam "Sveta Petka" is one of the international construction projects in Republic of Macedonia where teams from Macedonia, Slovenia and from Serbia are involved. Positive element of international participants in the project is that this leads to the increasing and interchanges of knowledge and experiences between projects participants.

Beside positive elements, there are many negative projects elements too. Some of them are caused by the Macedonian Law on Construction and its sub-procedures but some of them are caused by the projects participants. In the case of the project for dam "Sveta Petka" these problems had their influences on increasing the costs and overrunning the project realisation deadline.

Our project participant experiences shows that every international project participant should have their offices with domestic stuff. That is as a key for solving problems with differences in law aspects, standards, technical legislative, local practice, culture and participant's working experiences. Also, project realization determining factors have to be detailed studied. Technical documentation phase making for the same level of technical documentation we suggest in cases where previous phase technical documentation changes have been minor.

What can be finnaly consudet from this experience? It is obvious, that on time and detailed analyses of all determining factors and on time prepared design documents is a main prerequisite for succesful on time construction, without large overcoming of planed costs in complex civil engineering projects. It is especcaily important for a dam structures, having in mind their structural complexity, and possible extreme influences on the natural environment.

We believe that the given experiences in this article will serve as a learning example for companies which shall work on some similar civil engineering projects.

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SECTION II

WATER MANAGEMENT AND WATER STRUCTURES

STOCHASTIC VERSUS DETERMINISTIC APPROACHES FOR WATER DISTRIBUTION NETWORK MODELING

Victor Hugo Alcocer-Yamanaka, Velitchko Tzatchkov[1]

Abstract

The results of two modeling scenarios applied to a real water distribution network are compared with field observations. The first one employs synthetic water demand time series assigned to each network node, generated using the Neyman-Scott Rectangular Pulses Model (NSRPM), and the second one the traditional deterministically based daily hour by hour water demand variation curve, as that published by the Mexican National Water Commission, commonly used for assigning nodal water demands and their time variation during the day. An important difference between the observed flow and water pressure variation and those predicted by the deterministic and the NSRPM stochastic approaches is obtained, and attributed to leaks providing an indirect but accurate way of quantifying leakage.

Key words

Stochastic water demand, Water demand series, Distribution network modeling

1 INTRODUCTION

There exist nowadays advanced computer programs for detailed hydraulic water distribution network modeling, such as EPANET, InfoWorks® and others. One of the most important variables in the modeling they do is the residential water demand, whose variation during the day is most frequently represented in the models by a smooth curve, generally on hourly scale. Real residential water demand is stochastic, however, and very different from that representation, especially at finer time scales (one minute, for example). For this reason stochastic methods have been developed in order to properly represent the residential water demand [1, 2, 3]. Similar methods have been applied in hydrology for generating synthetic series for rainfall events with different intervals and duration, where the generated series have similar or identical statistic parameters as the original (observed) series, such as mean, variance and distribution probability. A promising method of this kind to be applied in the field of residential water demand modeling is the Neyman-Scott Rectangular Pulses Model (NSRPM), as described in this paper. In the study reported in this paper it is applied to model a relatively large real water distribution network with EPANET program, and compared to field observations.

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2 STUDY SITE AND WATER DISTRIBUTION NETWORK MODEL

The deterministic and stochastic modeling schemes were applied in the Humaya district in the city of Culiacan, state of Sinaloa, Mexico because of the information available from several field studies carried out on this site [4, 5, 6]. Among these are registered field observations on water pressure and flow at supply sources and some points of the water distribution network, water level at tanks and water demand at a number of homes registered continuously every minute during several days.

The district is supplied by two sources. The first one is a single water well providing a mean flow of 51 L/s, and the second one comprises a battery of 8 water wells whose maximum capacity is 200 L/s. There exist two water tanks in the district. The first one with capacity 3,000 m^3 located at elevation 82.63 m above the sea level, and the second one with capacity 2,000 m^3 at elevation 80.00 m. According to information provided by the local water utility *Junta Municipal de Agua Potable y Alcantarillado de Culiacan* (JAPAC) in 2005 the total population of the district was 85,483 inhabitants, as computed by the number of service connections (20,353) and a mean population density of 4.20 inhabitants per connection. Waterloss by leakage is about 30%, most of it at service connection pipes, as confirmed in a study carried out during 2000 and 2001.

An all-pipe model was implemented for the water distribution network, introducing the geometric and other data in the EPANET program and running it for an extended period of 168 hours (one week). Figure 1 shows the nodes and links where model's predictions were compared with field observations. Because of limited space, the results for only one node and one pipe of them will be commented in this paper.

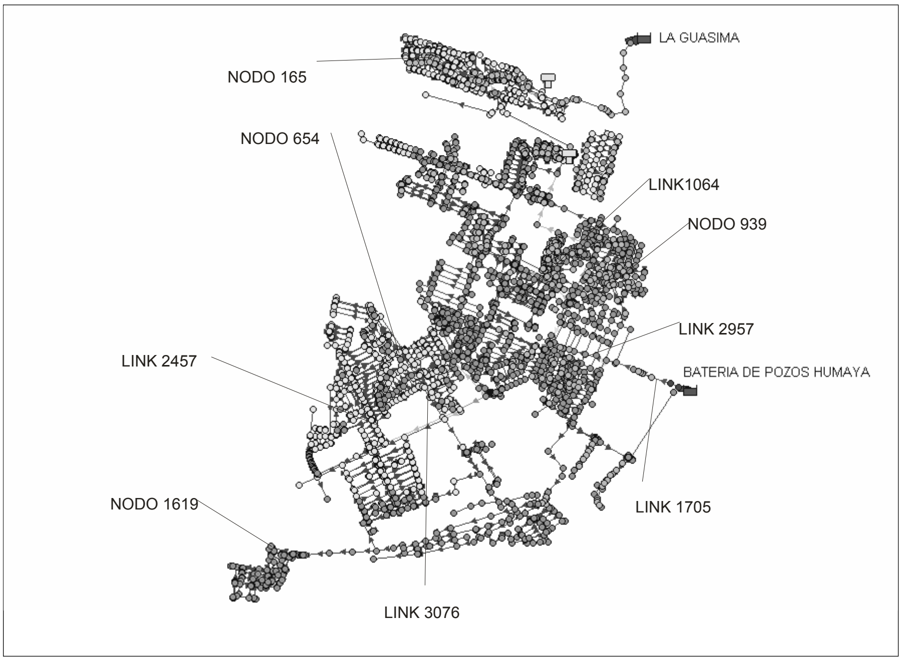
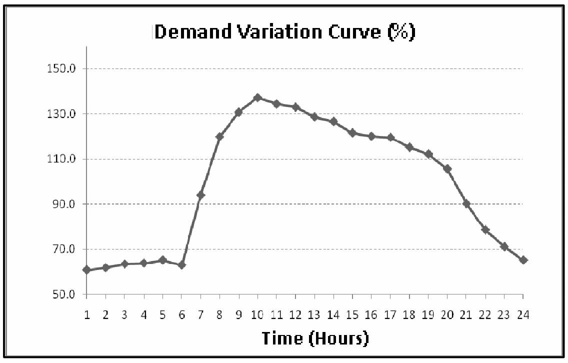


Fig. 1) Nodes and links where model's predictions were compared with field observations

3 DETERMINISTIC APPROACH USING TRADITIONAL HOURLY VARIATION WATER DEMAND CURVE

Figure 2 (left) shows the traditional hourly variation water demand curve published by the National Water Commission of Mexico [7] that is normally used in distribution network modeling. According to current international practice, similar demand curves are used in any water distribution network model worldwide. This curve was obtained measuring the total inflow to district metering areas with residential and commercial type water users. It is important to note that it includes together user consumptions and leakage, and that it is smooth, contrary to real water demand observed at homes.

Figure 2 (right) shows the real registered water demand in a house. Its pattern is obviously very different from that used in distribution network modeling. Moreover, it is stochastic with regard to the time and intensity of the water demand pulses.



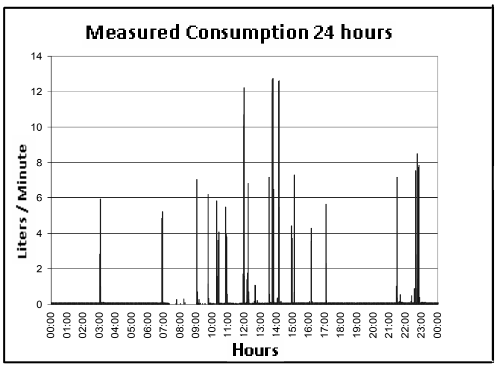


Fig. 2) Traditional hourly variation water demand curve used in Mexico

4 STOCHASTIC APPROACH

The fact that residential water demand is a stochastic process motivated a few researchers [8, 9] to model it as a Poisson process. This process is non homogeneous due to the varying water demand during the day. Each water use is represented by a rectangular pulse with random height (intensity) and width (duration). On this basis, the PRP (*Poisson Rectangular Pulse*) models have been developed [1], able to generate water demand series under stochastic criteria. It employs the following basic parameters: arrival rate or frequency of occurrence of individual pulses λ, mean pulse intensity μ_x, variance of that intensity $Var(\mu_x)$, mean pulse duration η) and variance of that duration $Var(\eta)$. These parameters have been obtained generally by registering each second the instantaneous water demand. Although such a procedure has the advantage of obtaining directly the real evolution of the water demand, it requires sophisticated equipment, large data storage capacity, and an important computational effort [1]. These reasons limit the application of PRP based methods, especially in developing countries where technology and economic resources are generally scarce.

In order to overcome these problems techniques for indirect estimation of the parameters λ, μ_x, $Var(\mu_x), \eta$ y $Var(\eta)$ have been developed in recent years, based on spatial and temporal disaggregation; [3, 5, 6, 10, 11]. In these techniques the parameter estimation is based on the minimization of an objective function that expresses the relation between the statistical moments of the observed series and the theoretical moments of the water demand model.

For applying this Neyman-Scott scheme in a water distribution network model it is necessary to assign stochastic demand patterns to each network node (each node represents a number of houses). For the model presented in this paper each pattern is represented by 10,080 numbers corresponding to each minute in one week. In order to obtain such demand patterns real water demand was registered every minute at 69 houses in the study site, divided in 3 groups by their monetary income. Since residential water use is very variable during the day, and since it is generally different in weekends, the registered demand data was divided also in 8 hourly segments, four of them for Monday to Friday, two for Saturday and two for Sunday. The mean, variance, covariance and cumulative volume for the demand series in each of these hourly segments were then computed for each of the 69 houses.

4.1 Synthetic series generation and search ranges in the optimization to obtain the Neyman-Scott model parameters

The optimization of the objective function provides the stochastic parameters $\{\lambda, x, \mu, c, \eta, \beta\}$ required for the *Neyman-Scott Rectangular Pulses Model*, *NSRPM* model. Using these parameters the synthetic series generation was accomplished by a public dominion model available at the Rainfall Data Modelling Portal, RDMP [12]. Using the values reported in [13], a search range of from 1 min^{-1} (1 minute) to 0.0404 min^{-1} (24.75 minutes) was determined for λ^{-1}. The mean pulse intensity μ_x was limited to from 1 to 6 L/min.

The parameters obtained this way were used to generate 50 synthetic water demand series, with one minute time interval, for each one of the 69 houses, and for each one of the eight hourly segments, giving a total of 27,600 series. These series were combined to obtained 69 one week one minute interval water demand patterns, each of them 10,080 data long (corresponding to the number of minutes in one week). These demand patterns were introduced in the EPANET program, and every node in the network model was assigned randomly with one of these demand patterns. In what follows, the demand assigned this way is named *stochastic* (corresponding, in principle, to the demand pattern shown in the right side of Figure 2) as opposed to the demand pattern given by Figure 2 (left side) that is named *deterministic* and assigned equally to every node.

4.2 Comparison between the results of the EPANET program with deterministic and stochastic water demand and field observations

Figure 3 compares the real observed pressure variation for node 165 with that predicted by the EPANET program for both scenarios. It is seen that the stochastic model represents better the real pressure variation. Figure 4 shows the same comparison for the water flow in Link 2957 which represents a 12 inch pipe supplying a district. It is observed that maximum flow is substantially different under stochastic water demand. Again the stochastic model represents better the real water flow variation.

Another advantage of the stochastic approach is that it allows for more accurate leakage estimations. Because of the way it is obtained (observation of the total flow entering a water distribution district) the traditional global water demand variation curve includes leakage. It can be observed from Figure 4 that water demand modeled by the global variation curve is above the real observed demand. The difference represents the leakage.

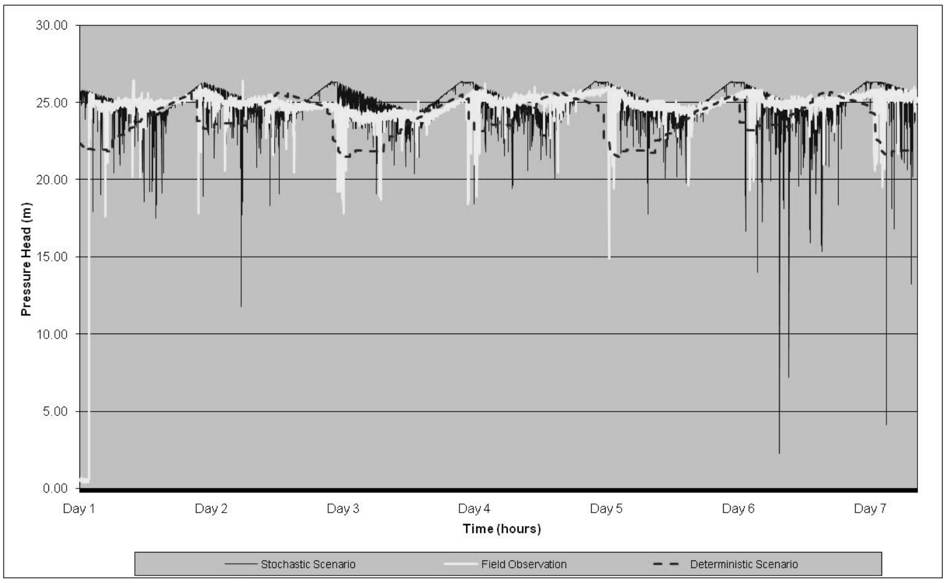


Fig. 3) Comparison between observed water pressure variation and that predicted by the deterministic and stochastic demand model for Node 165

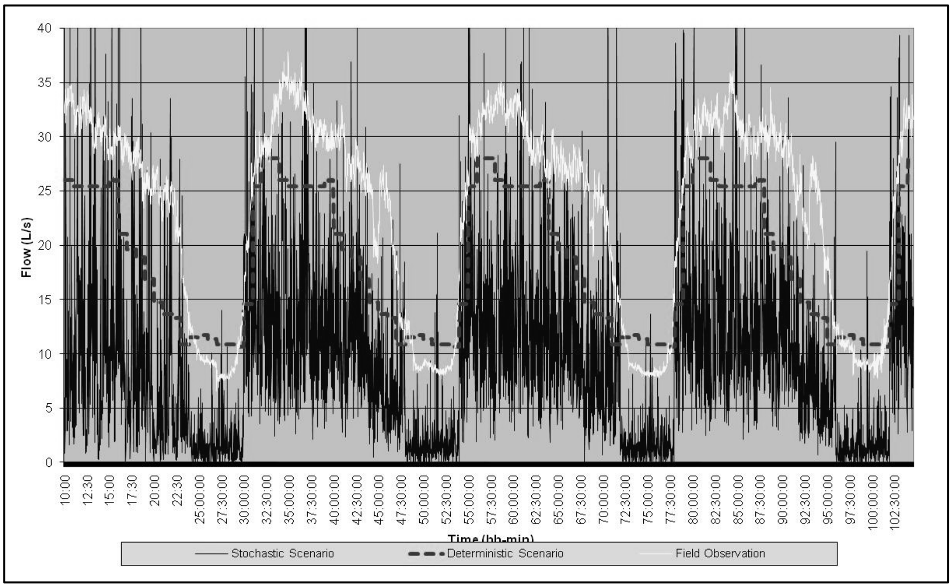


Fig. 4) Comparison between observed water flow variation and that predicted by the deterministic and stochastic demand model for Pipe 2957.

5 CONCLUSION

This paper presents the application of a methodology that considers stochastic concepts in the determination of the residential water demand. A Neyman-Scott disaggregatation scheme was developed to estimate the stochastic water demand parameters that were used to generate water demand series which introduced to a water distribution network model made it possible to obtain satisfactory results closer to its real behavior. The traditional approach based on a global water demand variation curve is simple, but tends to overestimate, and sometimes to underestimate, the computed flow and pressures and thus the designed hydraulic infrastructure. It is recommended in this paper the designers to consider this comment, and if anyway they are going to employ that demand variation curve to obtain it for each particular place where a model is to be implemented. It is believed that the work described is the beginning of the application of this approach tending to become practical and simple for the engineers and researchers involved in the water distribution network modeling. This can be achieved by programming it in a module to be added to known computer programs, such as the EPANET program. As a future work, the process could be automated including a Monte Carlo scheme in the modeling.

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MONITORING OF WATER AND SEDIMENT QUALITY IN THE SMOLNIK CREEK

Magdaléna Bálintová[1], Aneta Petriláková[2], Natália Junáková[3]

Abstract

Surface water in the Smolnik creek is contaminated by acid mine drainage (AMD) outflowed from abandoned sulphide mine Smolník. AMD with low value of the pH (about 3-4) is a result of chemical oxidation of sulphides and other chemical processes in mine. Its negative influence is evident from monitoring of the pH and metal concentrations in surface water. The pH increasing due to the mixture AMD with surface water is followed by metal precipitation and its sedimentation in water environment. Contaminated sediment is transported by erosion processes into the river Hnilec and than into water reservoir Ružín.

The paper deals with monitoring of both surface water and sediment quality degradation in contact with AMD producing from abandoned sulphide mine in Smolník.

Key words

Acid mine drainage, surface water sediment quality, heavy metals

1 INTRODUCTION

Acid mine drainage (AMD) is considered as one of the worst environmental problems associated with mining activity. Acid mine drainage from abandoned mines poses a long-term threat to the environment and directly impacts it by polluting streams, rivers, waterways drinking water, and groundwater, disrupting wildlife habitat, and destroying the natural landscape. Runoff from mining operations can have negative impacts on the surrounding aquatic environment including heavy loads of suspended solids, decreased pH levels and increased levels of heavy metals.

In Slovak republic there are some localities with existing AMD generation conditions. The most critical values were observed in the abandoned deposit Smolník. The stratiform deposit Smolník belongs to the historical best-known and richest Cu – Fe ore deposits in Slovakia. In

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1990 the mining activity at the locality was stopped. The mine was flooded till 1994. In 1994 an ecological collapse occurred, which caused the fish-kill and the global negative influence on the environment. The mine-system represents partly opened geochemical system into which rain and surface water drain. The continuation of AMD generation at the locality of Smolník is not possible to stop and there is no chance for situation self-improvement. It is necessary to respect this situation, monitor the quality of these waters and develop methods for their treatment. That was the reason for starting a systematic monitoring of geochemical development in acid mine drainage in 2004 in order to prepare a prognosis in terms of environmental risk and use of these waters as an atypical source of a wide range of elements [1-4].

The aim of this paper is evaluating the actual impact of AMD from shaft Pech (mine Smolník) on water and sediment quality in Smolník creek.

2 MATERIAL AND METHODS

In order to study the interaction between AMD and surface water and sediment, five sampling localities along the Smolník creek were chosen. Two localities were in the upper part of the Smolník creek without contamination by acid mine waters from shaft Pech (1 – outside the Smolník village, 2 - small bridge - crossing to the shaft Pech) and another two sampling localities were located under the shaft (4 - cca. 200 m under the shaft Pech, 5 – inflow to the Hnilec river). Also there was monitored the AMD quality from the shaft Pech (3-shaft Pech- accumulated AMD water tank). Sediment and water sampling localities are shown in Fig. 1.

Fig. 1) Sampling localities in the Smolník creek

The dates of sampling and the flow of Smolnik are presented in Table 1. The chosen physical and chemical parameters were determined by multifunctional equipment METTLER TOLEDO in situ and chemical analyses of water and sediment samples were realized in accredited laboratory of State Geological Institute of Dionyz Stur Spišská Nová Ves.

Tab. 1) The Smolnik flows in the dates of sampling

Date of sampling	**Flow [$m^3.s^{-1}$]**
17.10.2006	0,356
15.10.2007	0,582
18.4.2008/A	1,961
28.10.2008/B	0,414
25.5.2009	0,416

3 RESULTS AND DISCUSION

The results of chemical analysis of water samples (samples 1, 2, 4 and 5) and sediments (samples S1, S2, S4, S5) in the Smolník creek as well as AMD from shaft Pech (sample 3) and sediment from the accumulated water tank beyond below the AMD outlet (sample S3) in 2006 - 2009 are presented in Table 1 and 2.

Tab. 2) Results of chemical analyses of water from the Smolník creek and AMD from the shaft Pech in 2006 - 2009

No.	Year	pH	Ca	Mg	Fe	Mn	Al	Cu	Zn	As	Cd	Pb	$(SO_4)^{2-}$
		-	[mg/l]					[μg/l]					[mg/l]
1	2006	5,4	10,9	3,64	0,05	0,01	0,02	4	2	2	<0,3	<5	15,6
	2007	6,0	9,51	3,48	0,07	0,01	0,05	2	6	1	<0,3	<5	14,8
	2008 A	5,45	9,1	3,31	0,06	0,01	0,12	2	5	<1	<0,3	<5	15,6
	2008B	5,46	10,6	3,69	0,7	0,01	<0,2	<2	3	1	<0,3	<5	14,3
	2009	5,52	10,1	3,56	0,06	0,01	0,02	<2	3	2	<0,3	<5	14,9
2	2006	5,57	15,5	7,19	1,72	0,30	0,03	12	134	<1	<2	<5	51,2
	2007	6,58	11,1	4,45	0,79	0,09	0,28	12	25	<1	<0,3	<5	22,6
	2008 A	5,18	11,3	6,03	3,0	0,28	0,18	14	82	<1	0,4	<5	150
	2008B	5,58	13	5,27	0,62	0,12	0,12	9	38	<1	<0,3	<5	34,3

	2009	5,76	13,9	6,43	1,34	0,27	0,74	34	93	<1	<0,3	<5	141
	2006	3,88	176	344	463	36,5	107	3263	12600	18	15	71	3710
	2007	4,11	166	295	433	32,2	79,8	1379	8958	20	27	56	3220
	2008 A	4,01	170	264	291	22,5	53,9	1311	6750	50	14,9	59	4578
3	2008B	3,98	158	242	392	28,5	69,7	1642	7665	30	21,5	56	2685
	2009	3,94	176	258	351	28,4	67,6	1740	7250	50	14	61	4421
	2006	4,98	31,9	33,2	31,8	2,7	2,03	203	923	1	<2	<5	298
	2007	5,76	18,3	13,0	108	0,96	0,61	14	187	<1	0,3	<5	99,6
	2008 A	4,92	17,9	12,5	4,93	0,78	4,14	384	338	1	0,7	<5	44,7
4	2008B	5,26	23,2	17,6	16,8	1,32	0,13	50	383	1	1,5	<5	173
	2009	5,19	23,4	20,2	18,8	1,84	4,15	97	379	3	0,7	8	51,4
	2006	4,93	28	26,9	17,8	2,22	2,46	207	757	1	<2	<5	242
	2007	6,17	17,7	117	5,38	0,73	0,12	7	176	<1	0,5	<5	97,8
	2008 A	5,34	11,5	6,18	2,52	0,30	0,32	14	68	<1	<0,3	<5	53,1
5	2008B	5,2	23,7	16,8	1,11	1,21	0,02	42	349	<1	<0,3	<5	154
	2009	5,4	23,3	16,4	10,5	1,3	0,43	31	280	<1	0,5	<5	65,2
Limits		6-8,5	200	100	2	0,3	0,2	20	100	30	5	20	250

The results were compared to the limited values according to the Regulation of the Government of the Slovak Republic No. 296/2005 Coll. Stipulating requirements for the quality and qualitative goals of surface water and limit values of indicators of pollution of water wastes and separate waters.

Based on the results in Tab.2 we can state that acid mine drainage flowing from the shaft Pech has permanently an adverse effect on the surface water quality in Smolník creek and causes exceeding the limited values according to the Regulation of the Government of the Slovak Republic No. 296/2005 Coll. Due to increased flow of Smolnik creek in 2007 was pH value of samples No. 2 and 5 in compliance with limits. From chemical analysis, given in table 3, follows, that AMD exceeds each evaluated indicators, with the exception of Ca and As. After AMD dilution with surface water in the Smolník creek, the concentrations of sulphates, Fe, Mn, Al, Cu, Zn are exceeded, too.

Tab. 3) Results of chemical analyses of sediments from the Smolník creek and the shaft Pech in 2006 and 2007

No.	Year	SO_4^{2-}	Ca	Mg	Fe	Mn	Al	Cu	Zn	As	Cd	Pb
		[%]						[mg/kg]				
S1	2006	<0,01	0,45	0,93	3,96	0,108	7,02	176	171	50	<0,5	50
	2007	<0,01	0,30	0,74	3,88	0,044	7,14	103	123	35	<0,5	39
	2008 A	<0,01	0,26	0,70	3,49	0,062	6,88	114	140	31	<0,5	44
	2008B	<0,01	0,30	0,73	4,01	0,116	7,67	128	157	52	<0,5	43
	2009	<0,01	0,21	0,85	4,57	0,09	7,68	111	143	47	<0,5	35
S2	2006	1,00	0,21	0,81	6,76	0,040	7,32	234	183	84	<0,5	82
	2007	0,4	0,22	0,73	5,70	0,051	6,76	282	186	88	<0,5	100
	2008 A	0,10	0,37	0,70	4,13	0,073	6,43	252	196	64	<0,5	89
	2008B	0,75	0,14	0,72	7,27	0,051	7,21	237	180	104	<0,5	93
	2009	0,40	0,16	0,72	4,63	0,04	6,63	196	131	65	<0,5	59
S3	2006	19,08	8,73	1,38	23,6	0,096	2,52	448	313	909	<0,5	135
	2007	14,01	0,09	0,21	39,7	0,012	0,46	215	58	1465	<0,5	38
	2008 A	8,80	0,03	0,72	34,6	0,022	4,01	689	150	2206	<0,5	1557
	2008B	7,83	0,07	0,86	26,6	0,024	4,65	663	168	2439	<0,5	2731
	2009	14,12	0,10	0,21	37,4	0,01	0,74	143	45	1500	<0,5	48
S4	2006	2,42	0,19	0,64	13,8	0,051	6,09	445	172	154	<0,5	172
	2007	0,96	0,40	0,83	12,3	0,084	6,46	903	328	253	<0,5	282
	2008 A	0,30	0,57	0,78	4,97	0,067	6,16	365	214	201	<0,5	328
	2008B	1,21	0,19	0,80	8,90	0,048	6,84	295	172	161	<0,5	198
	2009	0,30	0,21	0,72	5,07	0,05	6,91	281	165	68	<0,5	101
S5	2006	0,38	0,14	0,66	7,84	0,044	6,55	506	250	97	<0,5	111
	2007	0,29	0,25	0,83	8,82	0,057	6,29	661	320	146	<0,5	159
	2008 A	0,27	0,32	0,79	6,24	0,068	6,39	404	193	135	<0,5	176
	2008B	-	0,17	0,44	13,2	0,045	7,26	527	192	83	<0,5	106

	2009	4,90	0,08	0,27	31,7	0,03	2,62	836	200	84	<0,5	15
Limits		-	-	-	-	-	-	1000	2500	20	10	750

Results of chemical analyses of the sediments were compared with the limited values according to the Slovak Act No. 188/2003 Coll. of Laws on the application of treated sludge and bottom sediments to fields. Surprisingly, only limits of arsenic concentration in all samples of sediments and concentration of lead in two samples weren't fulfilled.

According to literate date [5-6] Fe is precipitated at pH 3,5-4,5; Cu at pH 5,5-6,5; Zn at pH 5,5-7,0; Al at 4,5-5,5. This fact was confirmed by the increasing of Fe, Cu and Zn concentration in samples of sediment S4 and S5 in comparison with sediment S1 and S2.

4 CONCLUSION

Smolník deposit belongs to the many localities in Slovakia, where the unfavorable influence of acidic water on the surface water can be observed. Acid mine drainage discharged from abandoned mine Smolník (shaft Pech) contaminates the downstream from the Smolník mine works to confluence of the stream with the Hnilec river, because of decreasing pH and heavy metal production. This fact was confirmed by exceeding the limited values of followed physical and chemical parameters in water and sediments in Smolník creek according to Slovak legislation.

The variability of pH also influences the sediment-water partitioning of heavy metals (e.g. Fe, Cu, Zn, Al) in Smolník creek polluted by acid mine drainage from shaft Pech, that has been confirmed from presented results.

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EFFICIENCY OF UTILIZING ENERGIC POTENCIAL OF THERMAL WATERS

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Abstract

The primary carrier of geothermal energy is mostly thermal water, which is usually in the liquid phase, but at higher temperatures may be a wet state, or even superheated steam. This potential energy is most efficiently used for heat supply. In some locations may be available at a temperature which is significantly higher than the temperature required for heat supply in the vicinity of the source. In such cases, considering the possibilities of electricity-using ORC technology, which is capital-intensive and less effective. The article deals with the possibility of using geothermal energy in the hybrid thermal power to support electricity production from fossil fuels with much higher efficiency.

Key words

thermal waters, geothermal energy;

1 INTRODUCTION

Extremely high dependence on imports Slovakia sources of energy can be compensated for both the rationalization of their use, both by increasing the share of domestic energy sources, particularly renewable energy.

In Slovakia, the buildings involved in the total primary energy consumption by a significant amount of around 40%. Perhaps in this area there is huge potential savings of fossil fuels and so the demand side by improving the thermal insulation of buildings and using energy efficient appliances, as well as the generation, transmission and distribution of energy by increasing energy efficiency and replacement of fossil fuels, renewable resources. Important role in this area may have geothermal energy. The sources of Slovakia is fortunately quite rich, but their using is still far behind the possibilities.

Energy use of geothermal energy offers a number of technical, economic, social and environmental problems. The cardinal question is what to use it for heat or electricity.

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1.1 The physical nature of geothermal energy and efficiency of its using

Geothermal energy, unlike other renewables do not come from a fusion reaction going in the sun. Therefore, it is not actually a renewable resource in its own right. Geothermal energy is generated by the process of radioactive decay of rocks inside the Earth will get a natural flow of heat towards the surface of the Earth and widespread anthropogenic activity. The balance between production and dissipation of heat determines the so-called geothermal gradient (°C/km) and heat flux density (mW/m^2) on the surface. These indicators are relatively high in Slovakia, about 82 mW/m^2, or 38 °C/km, which is an oversized geothermal activity. As a result, we have favorable conditions for the use of geothermal energy.

Unlike other renewable energy sources that represent different forms of solar energy, geothermal energy is available to limited in quantity and decreasing with decreasing temperature. Therefore, it can not be regarded as inexhaustible resource, but a source whose life is much bigger than fossil fuels but also much less than other renewable energy sources. Therefore, the use of geothermal energy, we should observe the principles of energy efficiency, as with fossil and nuclear sources.

An objective comparison of the efficiency of geothermal energy for heat and electricity complicated by the fact that while the heat produced in the overwhelming majority of natural gas, its share in electricity generation is small. Of the known causes of the highest priority should be reducing natural gas consumption. It is clear that geothermal energy should preferably be used to supply heat. This problem, however, deserves further analysis.

Efficiency of utilization of geothermal energy, it is useful to evaluate the ability to replace natural gas. If geothermal heat G to generate the force η_G of the final energy K (electricity or heat), the specific displacement of natural gas can be expressed by:

$$\upsilon_{zp} = \frac{G_{zp}}{G} = \frac{\frac{K}{\eta_{zp}}}{\frac{K}{\eta_G}} = \frac{\eta_G}{\eta_{zp}} \tag{1}$$

where G_{zp} - the energy of natural gas needed to produce the same amount of final energy K,

η_{zp} - efficiency of final energy from natural gas.

The holder of geothermal energy is usually thermal water, is valid:

$$G = mc\Delta T \tag{2}$$

where m - the amount of thermal water,

c - specific heat capacity of water (4,2 kJ/kgK),

ΔT - cooling water for thermal use.

Specific displacement of natural gas, related to the amount of thermal water:

$$\alpha_{zp} = \frac{G_{zp}}{m} = c\Delta T \upsilon_{zp} = c\Delta T \frac{\eta_G}{\eta_{zp}} \tag{3}$$

This also influences the intensity ratio of cooling efficiency and thermal water.

1.2 Heat or electricity?

Given that in some localities of Slovakia geothermal heat can be obtained at temperatures above the temperature needed to heat supply, many consider it advisable to use it to generate electricity, or just to do it (see eg. [5] [6]) . This effort seems to be logical for two reasons:

- electricity is a valuable type of final energy and heat than we need it everywhere and always,
- the heat is used mainly for heating, which is seasonal in nature.

The justification for such a project should be supported by energy analysis focused on determining the global impact of geothermal energy in the situation of the country's economy, namely primarily to the quantities of natural gas, geothermal energy can be replaced with different modes of energy use.

This work is simplified considerations contribute to easier orientation in this field. We consider the use of geothermal energy in which the initial temperature of thermal water from $T_1 = 120°$ C reduces to $T_h = 40$ °C, respectively to $T_E = 80$ °C as shown in Fig. 1. Using the methodology described in [1] distinguish three modes of energy use:

a) in the simplest case, it is only for the use of heat in the cooling of thermal water $\Delta T = T_1 - T_h$. Given that the useful heat output is obtained from the thermal water through a heat exchanger, the efficiency is: $\eta_G \approx 1$

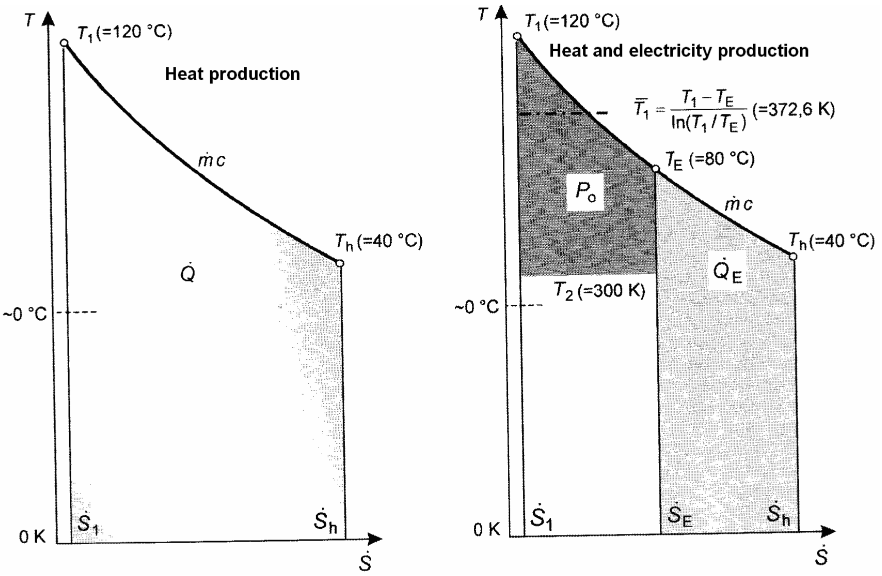

Fig. 1) The parameters of the use of geothermal energy for heat and electricity in the T-S diagram

b) in the second case we assume only the production of electricity while using the temperature difference $\Delta T = T_1 - T_E$. Conversion efficiency of a low-temperature heat to electricity is low. Even in the limit for reversing the cycle thermodynamic efficiency will be only:

$$\eta_{G0} = 1 - \frac{T_2}{\overline{T}_1} = 1 - \frac{T_2}{\dfrac{T_1 - T_2}{\ln \dfrac{T_1}{T_E}}} \tag{4}$$

where T_2 - is the temperature of the cold end (condenser) of the power plant.

In consideration of thermal parameters of the mean thermodynamic temperature of water passing the heat to $\overline{T}_1 = 372{,}6\,\mathrm{K}$. If we assume while condensing temperature of $T_2 = 300\,\mathrm{K}$, then from equation (4) to get the maximum efficiency attainable only reciprocating cycle of thermodynamics $\eta_{G0} = 0{,}195$ =19.5%. The actual efficiency will result in losses caused by any return of energy transformations significantly lower. These losses may be taken exergy effect η_{ex}, the value is estimated at about 0.5. The actual efficiency of electricity production will therefore be only about $\eta_G = \eta_{ex}\eta_{G0} \approx 0.1$ = 10%.

The conversion of low-thermal water heating to electricity is necessary to realize the direct thermodynamic cycle, working with steam or other thermodynamic substance. Water vapor is used in conventional (inorganic) Rankin cycle. It is also theoretically be used to produce electricity from heat produced at a low temperature of thermal water. Given the thermodynamic properties of water but it would be technically and economically very difficult, mainly because the cycle should be implemented in a vacuum. Therefore, in a thermodynamic cycle for electricity generation from low-temperature heat is used the working substance of low critical temperature, such as various hydrocarbons, silicone oil, ammonia and others. Instead of classical Rankinovho cycle to produce electricity from hot thermal water in practice typically uses the so-called Organic Rankin Cycle (ORC - Organic Rankine Cycle). The choice of agents working for these devices depends mainly on the temperature of thermal water. At lower temperatures proved hydrocarbons isopentane and isobutane, but some are also suitable halogenated hydrocarbons, which are used in heat pumps. At higher temperatures can be applied to the silicone oil used primarily in applications of cogeneration based on biomass or the use of high temperature waste heat.

c) The third option is a combination of a) and b). We get electricity and heat from geothermal. Can not be regarded as combined heat and power in the classic sense, because they do not make products with the same technology. We assume that the heat obtained by cooling of thermal water on $\Delta T = T_1 - T_E$ will be used only to produce electricity and cooling section obtained with the $\Delta T = T_E - T_h$ only to supply heat.

Displacement parameters of natural gas geothermal energy have been determined for three cases considered by the relations (1) and (3) and Fig. 1 (see Table 1.). Data relating to heat and electricity from natural gas have been established on the basis of relevant EU directives [7]. In case of current use to produce electricity and heat were considered:

- the parameters of the net heat production by 50% due to seasonality,

- the parameters of clean electricity to 100% for year-round use.

Tab. 1) Specific displacement of natural gas in various ways to use geothermal energy

	The effectiveness of the use of geothermal heat η_G	Efficiency of natural gas η_{zp}	Specific displacement of natural gas geothermal heat υ_{zp}		Cooling thermal water ΔT	Specific displacement of natural gas thermal water α_{zp}	
			-	%	K	J/kg	%
Heat production	1	0,9	1,11	**100**	80	373	**100**
Electricity production	0,1	0,525	0,19	**17,1**	40	32	**8,6**
Heat and electricity production	50% heat + 100% electricity		0,75	**67,6**	80	218	**58,6**

The analysis results summarized in Tab. 1. It is clear that the use of geothermal energy for heat supply can be achieved much more than the displacement of natural gas for electricity generation. Is better in terms of the joint production of electricity and heat, but still significantly worse than heat. The simplified analysis assumed that the production of electricity from geothermal energy is replaced by electricity from natural gas. However, in our share of natural gas for electricity production is insignificant. Therefore, the specific displacement of natural gas will be even smaller than is apparent from Tab. 1.

The impact of geothermal energy to increase the share of RES not depend on whether it produces heat or electricity. In Slovakia, the share of fossil fuels for electricity is significantly less than the share of nuclear and hydro power, which in terms of CO_2 emissions virtually harmless. Therefore, use of geothermal energy to heat a much greater contribution to reducing CO_2 emissions because doing so is usually replaced by natural gas, a fossil fuel.

Geothermal energy is available in the form of heat and this form should preferably be used. The analysis results show clearly that the efforts to produce electricity in Slovakia from geothermal energy, which is the carrier of thermal water at a temperature of 120-130 ° C is unnecessary to search for technological and capital-intensive solutions to the problem can be resolved much easier, more economical and yet the valuable overall effect.

Despite the fact that in Slovakia we are seeing increased interest in using geothermal energy to produce electricity. Strong motivation to do so is advantageous purchase price. **Standard**

support of electricity from renewable sources - mainly from geothermal and solar energy - preferential price to be supporting such solutions do not reduce the environmental burden, but rather increased.

A comparison of some methods of production for heating that for Building Heating greatest reduction in primary energy consumption is achieved by increasing the share of geothermal and solar energy. Urgent task of energy policy for each of the Slovak government should therefore be the creation of such frameworks in which such a trend will be more or less beneficial for all stakeholders.

Geothermal energy could be a very effective use in some district heating systems in which heat is produced from natural gas boiler, a very low exergy efficiency. To restore heat for obvious reasons, operators are considering a partial or complete fuel switch, usually to replace natural gas with biomass. In principle, this measure is right even if the energy balance of heat production from biomass is slightly less effective. Biomass is considered CO_2 - neutral fuel and, more importantly, it is a quasi-renewable energy source. However, the supply of central heating system can be used for geothermal energy should be that much "cleaner" preferred alternative. Operators, however, prefer the biomass they deem best and reliable solution. The advantages of geothermal alternatives are not sufficiently informed. The fear that fulfilled the expectations of the parameters of thermal water as well as their stability, consider it unreliable. In such cases, it is obviously better to less efficient use of geothermal energy for electricity production, which can be delivered without any major problems in the electricity system, rather than no use. Energy policy would be to find effective tools for breaking down barriers of mistrust. The possibility of failure to achieve the expected parameters, the greater the risk for production of electricity, because it is necessary to higher temperature thermal water.

2 CONCLUSION

For professionals in the newspaper plans are presented, which is calculated with an alternative use of geothermal energy to produce electricity. The concept of the project described in [5] is quite correct, because it is focused on addressing priority heating using geothermal energy. The production of electricity is calculated as one possible alternative. Beyond the idea of the project described in [6], which is aimed at generating electricity and waste heat is put to use in supplying heat in Trebišov may be reason to stop the reader, who sees it a bit. Assuming the temperature of thermal water extracted 120 °C, then the operation of only one module OEG with a power of 20 MW of firm Orma would be necessary to provide geothermal power about 200 MW. The heat supply would still remain about a further 200 MW. The total available power would thus be 400 MW. This figure is interesting in connection with geothermal potential Košice fold, which is regarded by experts as most perspective in Slovakia is estimated at 300 MW thermal power technically useful.

For the centralized heat supply in Trebišov 200 MW thermal power was too high. Moreover, the initial temperature of only about 80 °C, would be for this purpose is rather low. If you would like to operate a 20 MW module while the centralized heat supply, a large part of the heating season would have a conventional heat source of heat or thermal water to ensure a higher inlet temperature, thus the greater depth and at higher cost, if used for electricity production less the temperature difference .

The yield from 60 l/s of a production borehole, such as envisaged at Košice geothermal project would be implemented to be 20 geothermal doublets. In comparison, one of the alternatives Košice geothermal project would be implemented only eight such Doublets.

If they are near to Trebišov really as good conditions for the use of geothermal energy, it would be much more efficient to use it for heat and entrained gas from completely centralized heat supply. This can be done without such a megalomaniac project. This would achieve much greater effect on reducing CO_2 emissions is incomparably lower cost, because the heat is sufficient lower temperature, which can reach depths in smaller, lower-cost Doublets and instead of modern and especially high - ORC very expensive - technology to produce heat exchangers used thermal waters, which are much cheaper, safer and more reliable.

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ECOLOGICAL CONSIDERATIONS REFERRING TO VARDAR RIVER IN REPUBLIC OF MACEDONIA

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Abstract

The paper deals with investigations of the quality the Vardar river waters based on monitoring and testing that have so far been performed through the established network of measuring points for monitoring of water quality in the Vardar river basin. Vardar river is important for the industrial development of many cities through which it passes and it is the biggest river in which many smaller rivers empty, increasing its water quantity used by a number of small hydroelectric power plants. The present investigations have enabled a more thorough insight into the water quality of the entire basin area as well as the conditions arising from the natural effects, the built urban systems and particularly the concentration of industrial polluters.

Key words

Water quality, monitoring of water quality, chemical, bacteriological, radioactive matters

1 INTRODUCTION

The subject of investigation regarding the quality of Vardar river waters are the monitoring and the tests that have so far been performed within the established network of measuring points for monitoring of the water quality in the immediate Vardar River basin. For the purpose of many-faceted consideration of the water quality in the entire basin area, the conditions arising from natural effects and built urban systems, particularly the concentration of industrial pollution have been studied. For all the measuring points, data on chemical, bacteriological, presence of radioactive and other matters in the Vardar river from the spring to its emptying into the Aegean Sea in neighboring Greece, are given.This paper treats only the iron content in the waters of Vardar river.

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2 LOCATION OF MEASURING POINTS FOR MONITORING OF THE WATER QUALITY IN THE IMMIDIATE VARDAR RIVER BASIN AND FREQUENCY OF TESTS

The selection of locations of measuring points for monitoring the quality of surface waters has been defined from the aspect of geographical, geological, climate, hydrological and urban characteristics of the basin area, the points where pouring out of dangerous harmful matter

from landfills takes place and other factors.

The Vardar river waters are controlled at 16 points, as follows:

- Vrutok is the first hydrochemical station for monitoring of qualitative and quantitative characteristics of Vardar river waters. It is situated at an altitude of 676,34 and is lower for less than 10 metres from the spring.
- The specimens are taken six times during the year as follows: one test is done in spring, autumn and winter and three tests are done in the summer period.
- In the area following the first urban settlement – Gostivar, in the village of Balin Dol, there is a measuring point bearing the same name. At this point, the water is tested 6 times in the course of the year in order to establish the effect of the town upon the river.
- At 46,5 km downstream from the spring, at an altitude of 404,34, after the place of emptying of Pena river which is the recipient of the communal and industrial waste waters from Tetovo (at 200 metres from the town collector), in the village Sarakintsi, the quality of Vardar river waters is tested for insight into the effect of the town upon the river.
- Downstream from the spring, at a distance of 15 km from the previous measuring point, at an altitude of 380,03 metres, at the place of emptying of the technological waste waters, i.e., the industrial landfill of SILMAK, at Jegunovtse village, on the right bank, the quality of Vardar river water is controlled to define the effect of the industrial facility upon the river.
- After the Dervenska gorge, in front of the emptying point of Treska river and after Rashche village, Vardar river waters are tested each month in order to define the selfpurifying ability of this watershed.
- After the emptying point of Treska river, in front of the emptying point of Lepenets river, 99,6 km downstream the spring, in the Vlae settlement, Skopje city, Vardar river is controlled 6 times per annum to estimate the effect of these two tributaries upon the river.
- To define the effect of Lepenets river upon Vardar river, it is tested at RHZ, at 103 km downstream from Vrutok and at an altitude of 246,23 m.
- Near the village of Trubarevo, at 18,9 km downstream from the measuring point Vlae, after the point of emptying of communal and waste waters from the city of Skopje, the quality of Vardar river water is tested once in a month for the purpose of defining the influence of the city upon the river.

- After the Ator gorge, i.e, downstream from the emptying point of Pchinja river, below Bashino village, the river is controlled each month to evaluate its selfpurifying power and the effects from the tributary.
- The effect of the waste and technological waters from the lead and zinc smeltery – Veles upon Vardar river is evaluated at the place of the bus station in Veles.
- To get an insight into the effect of the industry producing artificial fertilizers HIV Veles, downstream, at Nogaevtsi village, at an altitude of 142,32, the river is tested on a monthly basis. At Staro Gradsko, at 205,1 km from the spring and an altitude of 130,7 m, the river is tested 6 times annually to define the effect of this tributary upon the river.
- Downstream from Thermal Power Plant – Dubrovo and for the purpose of getting insight into the effect of this thermal power plant upon Vardar river, the waters are controlled each month.
- Downstream of Vrutok, at 252,7 km, at an altitude of 94,27 m, at the place of entering the Demir Papija gorge, the river waters are tested 6 times annually to define the effects upon the river and the climatic changes.
- The last measuring point for monitoring the quality of Vardar river waters in R. Macedonia is Gevgeliya, at an altitude of 45,1 m downstream from the spring, at 299,3 km and on the opposite side of the state border, at 2,3 km. At this interstate profile, the river waters are tested each month.

3 METHODOLOGY OF TESTING

Systematic monitoring of qualitative and quantitative changes of surface waters in R. Macedonia is done at regular time intervals, in certain periods, at certain hydrochemical profiles. This task was realized by participation of RHZ in cooperation with the Institute for Preventive-Medical protection within the Skopje army area, Skopje. At the checking points, while using water specimens, the following measurements and tests were performed:

- Hydrometerological measurements and monitoring, water level and flowing water quantities;
- Meteorological measurements and monitoring, air temperature, level of cloudiness, type and intensity of precipitations;
- Physical-chemical indicators, water temperature, visible waste matters, noticeable smell, colour, fixation of dissolved oxygen in the water, carbon sulfide, definition of P and M alkali, free CO2 in the water and chemical consumption of oxygen KMn04 (HPK)

All the physical-chemical, toxicological-chemical, microbiological and radiological analyses have been done in the laboratories of the previously mentioned organizations whereat the following indicators have been defined: dissolved oxygen, saturation of water with oxygen, biochemical consumption of oxygen after 5 days (BPK5), evaporated (105C) and ignited (600C), residual of filtrated and non-filtrated water, organic, inorganic and total suspended matter, muddiness, specific electro conductivity, PH value, redox potential, carbonate, non-carbonate and total carbonization of ions: bicarbonates, carbonates, chlorides, sulfates, whereat calcium, magnesium, sodium, potassium and ammonium-ion are defined from the cations. Out of heavy metals, the following are defined: iron, manganese, lead, zinc, cadmium, chromium, copper, nickel, cobalt, silver and arsenic. As to radiological investigations, the total radioactivity of the water is defined. With the microbiological parameters, the following indicators are defined.

Number of bacteria in 1 ml water at temperature of 22°C and total number of bacteria, the most probable number of collophilic germs – MPN identification and bacteriophosphate.

Saprobiological investigations are separately treated.

All the investigations were carried out according to MKD standard regarding parameters for which there are prescribed methods and methodology.

3.1 Results from Performed Investigations

The present paper is aimed at getting insight into the character, the degree and the dynamics of pollution of Vardar river waters. It shows the results from the last investigations done for all the stated places. Considering the relatively big number of investigated parameters and also number of measuring places and the long time period, it is not possible to include all the investigated indicators and obtained results. Therefore, for processing, the results obtained for the most characteristic indicators were taken from the performed investigations in the analyzed period. These are classified into 5 groups as follows:

- Specific indicators (visible waste matters, noticeable colour, smell and Ph value)
- Indicators of mineralization (dry residual from filtrated water and suspended matter).
- Oxygen regime of water (dissolved oxygen, oxygen saturation, chemical consumption of oxygen (HPK) and biochemical consumption of oxygen in 5 days (BPK5).
- Microbiological indicators (the most probable number of collophormic bacteria – NBKK.0)
- Toxic-chemical indicators (nitrates, nitrites, cyanides, ammonium ion, phenols, detergents, iron, manganese, chromium, lead, zinc, cadmium, arsenic, etc.)
- Indicators of radioactivity (total beta radioactivity).

Such presentation per groups enables a better insight into the quality of water both per groups of indicators and total quality. Also, a greater objectivity is achieved in evaluation of water quality, scope and type of pollution at the measuring points and individual watersheds of Vardar river waters. The monitoring of the quality of water of Vardar river was performed at the following measuring points:

- In the Gostivar – Tetovo region

  No. 1 Vrutok

  No. 2 Balin Dol

  Br. 3 Sarakintsi

  No. 4 Yegunovtse

- In the Skopje region

  No. 5 Rashche

  No. 6 Vlae

  No. 7 RHMZ

  No. 8 Trubarevo

- In the Veles region

  No. 9 Bashino selo

  No.10 Veles

  No.11 Below the emptying point of Babuna river

  No.12 Nogaevtsi

  No.13 Staro Gradsko

- In the Negotino region

  No.14 Thermal Power Plant Dubrovo

  No.15 Demir Kapija

- In the Gevgeliya region

  No.16 Gevgeliya

For all the 16 measuring points, 15 each or a total of 240 appendices, graphs and reviews for determination of elements present in the water have been defined as follows:

Content of dissolved oxygen;

Oxygen saturation percentage;

Chemical consumption of oxygen for 5 days (BPK5);

Ph value, the most probable number of colophormic bacteria (NBKK);

Dry residual from filtrated water;

Total suspended matter;

Nitrite content;

Iron content;

Manganese content;

Lead content;

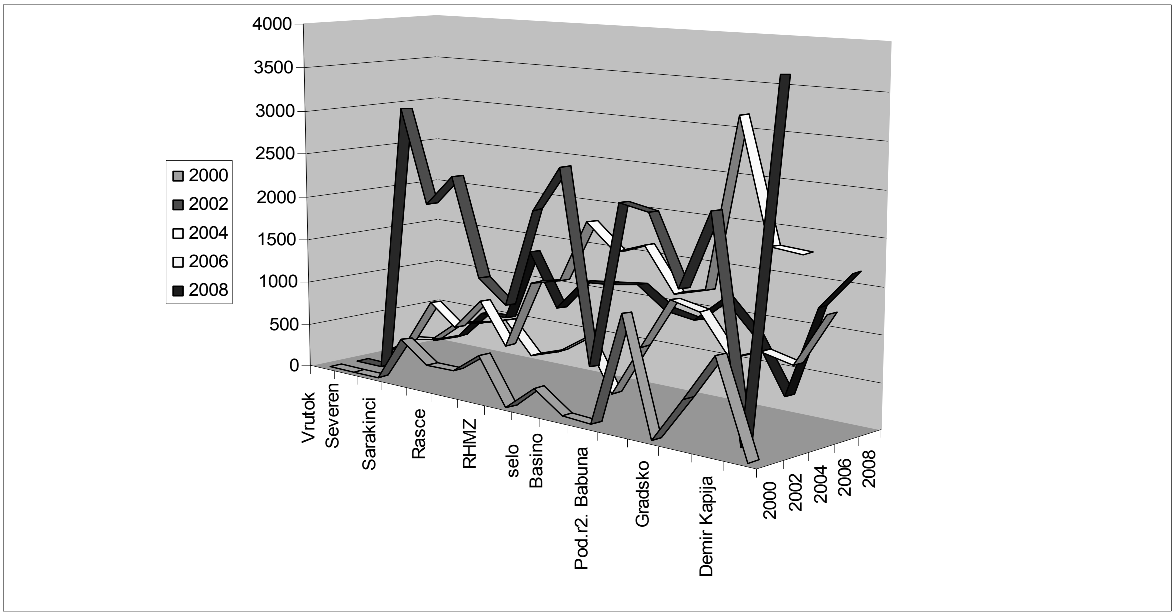
Zinc content;

Chromium content;

Kadmium content.

The iron content in the water is presented in Table 1 and the diagram shown in Fig. 1.

Fig. 1) Iron content presented in diagram



Tab. 1) Iron content in the Vardar river basin

Iron content								
Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
Years	**Severen Vrutok**	**B. Dol**	**Sarakinci**	**Jegunovc e**	**Rasce**	**Vlae**	**RHMZ**	**Trubarevo**
2000	0,00	0,00	0,00	500,00	275,00	275,00	500,00	0,00
2002	0,00	0,00	3050,00	2000,00	2350,00	1250,00	1000,00	2100,00
2004	52,50	221,80	747,50	515,00	877,50	420,00	1194,00	1270,00
2006	133,50	190,10	443,70	506,50	591,90	240,10	357,40	567,00
2008	52,80	168,40	501,50	510,70	1341,50	732,00	1095,00	1118,00

Col 11	Col 12	Col 13	Col 14	Col 15	Col 16	Col 17	Col 18
Basino selo	**Veles**	**Pod.r$_{2.}$ Babuna**	**Nogaevci**	**Gradsko**	**TEC Dubrovo**	**Demir Kapija**	**Gevgelija**
275,00	50,00	25,00	1250,00	0,00	500,00	1000,00	50.00
2600,00	500,00	2300,00	2250,00	1500,00	2350,00	1,50	3750,00
1970,00	1690,00	1810,00	1345,00	1428,50	3270,00	1986,00	1955,00
933.00	587,50	1162,70	1088,50	652,00	789,60	703,40	1288,00
1165,50	935,00	879,00	1174,00	825,50	227,800	1246,00	1654,00

4. CONCLUSIONS

The suspended matter content as indicator of mineralization varies widely. Considerably higher values of this indicator are proved in the autumn and spring period at all the measuring points as a consequence of increased river flow caused by melting of snow, i.e., intensive precipitations that cause intensive erosion processes in the basin area.

The organic pollution along the entire Vardar river course has a tendency to permanently increase. The places that are most affected by organic matter are Trubarevo, Veles, Sarakinci. Utterly dangerous is the effect of non-purified waste waters from Skopje, Veles and Tetovo upon the Vardar river waters.

The microbiological (bacteriological) pollution is constantly present in the Vardar river waters coming from the number of collophilic bacteria (NBKK), which are indicators of this pollution, which is permanently with maximum values.

Out of heavy metals, iron and manganese are regularly present along the entire Vardar river course. The iron is often with very high values (beyond category), particularly in conditions of increased water muddiness, i.e., after intensive precipitations in the basin area.

The toxic-chemical pollution of the river with heavy metals starts at measuring point no. 3 near the village of Sarakintsi and it is permanently present to a greater or lesser extent until the inter-state hydrochemical profile Gevgeliya.

At the downstream measuring points, its content is reduced (Vlae), particularly (RHMZ) and increases at Trubarevo and then permanently deteriorates down to Gevgeliya.

Regarding heavy metals, the content of lead, zinc and cadmium in the river is to be pointed out. These metals with their increased values are proved at measuring point no. 3 at Sarakintsi village, i.e., presence of cadmium at the hydrochemical profile Jegunovtse, which has been proved to have values beyond category in several tests.

Referring to toxic-chemical matter, permanent presence of cyanides is noticeable for measuring point no. 8, near Trubarevo village. The cyanides originate from the industrial plants in Skopje city.

At measuring point no. 6 (Vlae), the organic and toxic-chemical pollution of Vardar river is considerably decreased in respect to the previous hydro-chemical profiles Yegunovtse, i.e., Sarakintsi. The improvement of water quality is conditioned by the effect of the Treska river waters.

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EVALUATION OF SELECTED ELEMENTS CONCENTRATION AND PH CHANGES OF MICROBIALLY INFLUENCED CORROSION IN SEWER PIPES

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Abstract

The durability of inorganic materials is significantly affected by many biological activities and interactions. The microbiologically-influenced corrosion of concrete sewer pipes is caused mainly by the sulphuric bacteria and sulphate-reducing bacteria forming part of the biological circulation of sulphur and its compounds in biosphere. The sulphuric bacteria oxidize hydrogen sulphide produced by sulphate-reducing bacteria into sulphuric acid resulting in the acid or sulphate corrosion of cement stone. The paper is aimed on study of the microbial corrosion of concrete samples exposed to the sulphate-reducing bacteria under model conditions. The pH values, Ca and Si concentrations in leachate were measured and evaluated.

Key words

microbial corrosion, SRB, concrete, sewers

1 INTRODUCTION

Deterioration is common in structures located in aggressive environments and subject to, for instance, sulphate attack, chloride penetration and biodeterioration. Numerous studies have addressed the problem of chloride ingress in concrete structures. However, in addition to sulphate penetration, biological processes can accelerate the deterioration process by modifying severely the structural durability and reliability. This aspect is particularly important in marine structures (e.g., ports and offshore platforms), waste water treatment plants and sewage systems [1,2].

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The normal pH of sewage is slightly acidic (pH 5-6). At these pHs, hydrogen sulphide H_2S is dominate sulphide species (pKa=7.05). Hydrogen sulphide formation is a microbial process taking place under anaerobic conditions. When dissolved oxygen and nitrate in waste water of sewer systems are depleted, sulphate-reducing bacteria use sulphate as an acceptor in their use of wastewater organic matter (organic carbon) as substrate. This process results in the formation of hydrogen sulphide.

H_2S is poorly soluble in water and will partition into the headspace of the sewer based on Henry´s law. The H_2S is converted to HS^- or S^{2-} at these pHs, which pulls more H_2S into the condensate layer. In the presence of oxygen the sulphide species will react to form partially oxidized sulphur species such as thiosulphate, elemental sulphur and polysulphate species. These reactions illustrated in figure 1 [3] will provide additional driving forces to pull more H_2S into the condensate layer.

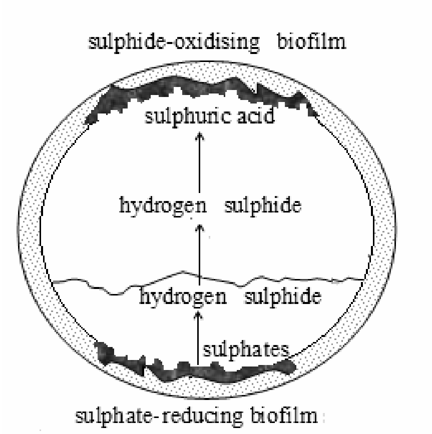

Fig. 1) Sulphide production and flux to concrete sewers

Sulphide production in gravity sewers takes place mainly in slow-flowing (< 30 cm/s), large pipes with insufficient re-aeration and at relatively high temperatures (>15 – 20 °C). Sulphide concentration of 0.5 mg/l is considered as low, the concentrations of 10 mg/l are reported as high in terms of problems that are typically reported. Although sulphide may be produced within the biofilm and the sewer sediments, aerobic conditions in the bulk water phase prevents occurrence of sulphide in the wastewater. Hydrogen sulphide does not exists in wastewaters from gravity sewers if the dissolved oxygen concentration is higher than 0.2 – 0.5 mg/l [4].

Concrete is typically highly alkaline and has a pH in the range of 11-13. The sulphate reducing bacteria mainly exist between pH 5.5 and 9, so these microorganisms cannot grow at this elevated pH so fresh concrete is protected from corrosion. The surface of the concrete does not remain basic throughout whole life. CO_2 and H_2S are both presented in the headspace of sewage collection systems and they both have acidic properties [3]. The colonization of the concrete is an excellent example of microbial succession. Once the pH of the concrete surface is reduce to 9 and with sufficient nutrients, moisture and oxygen, some species of sulphur bacteria can attach to the concrete surface and reproduce [5].

The sulphuric bacteria present also in waste water oxidize hydrogen sulphide produced by sulphate-reducing bacteria into sulphuric acid resulting in the acid or sulphate corrosion of cement stone.

This paper presents the particular results of concrete biodeterioration research carried out at Technical University and Slovak Academy of Science. Presented work is focused on the concrete biodeterioration study influenced by sulphate-reducing bacteria under model conditions.

2 MATERIAL AND METHODS

The effect of sulphate-reducing bacteria (SRB) *Desulfovibrio desulfuricans* on concrete specimens was investigated in model stationary conditions during 80 days. The calcium and silicium content in leachate as well as pH values of leachates of concrete specimens were evaluated.

Sulphate-reducing bacteria *Desulfovibrio desulfuricans* used in experiment were isolated from a mixed culture obtained from the potable mineral water (Gajdovka spring, the locality Košice-north, Slovakia). The selective nutrient medium DSM-63 (Postgate, 1984) was used for isolation and cultivation of these bacteria. SRB were classified as chemoorganotrophic, strictly anaerobic and gramnegative. Optimal growth conditions were: pH range from 6.5 to 7.3 and temperature range 30 - 37 ºC (mezofilic) and 50 -70 ºC (thermofilic).

Concrete cylinder samples of a 32 mm diameter and 15 mm height formed as a drilled core from concrete cube (150x150x150 mm) using drilling mechanism STAM were used for experiment. The cylinder specimens were rid of impurity. Concrete samples with addition of 5 and 10 % of coal fly ash respectively as well as reference samples without coal fly ash addition were used for experiment. Used coal fly ash with volumetric weight of 2381 kg/m^3 originates from black coal's burning process in Košice city heating plant (Tepláreň Košice a.s. TEKO).The control sample (reference sample without bacteria influence) was also investigated in experiment.

The experiment proceeded in glass container under anaerobic conditions (Fig. 2) at temperature of 30 ºC. The anaerobic conditions were provided for nitrogen blow in. The container contained 180 ml of selective nutrient medium with 10% of active bacteria *Desulfovibrio desulfuricans*. The concrete sample was placed on the glass basement and immersed into medium.

Fig. 2) The arrangement of experiment

pH changes in leachate were evaluated during the experiment by pH meter PHH - 3X Omega. The calcium and silicium concentrations in the solutions were determined by atomic absorption spectrometry using Varian SpectrAA-30 spectrometer. Detection was carried out by standard process in acetylene - air flame.

3 RESULTS AND DISCUSSION

The pH values of leachate after biodeterioration of concrete samples by *Desulfovibrio desulfuricans* moved into alkali region for all measured samples. The comparison of pH values for reference sample without coal fly ash and control sample are illustrated at the figure 3.

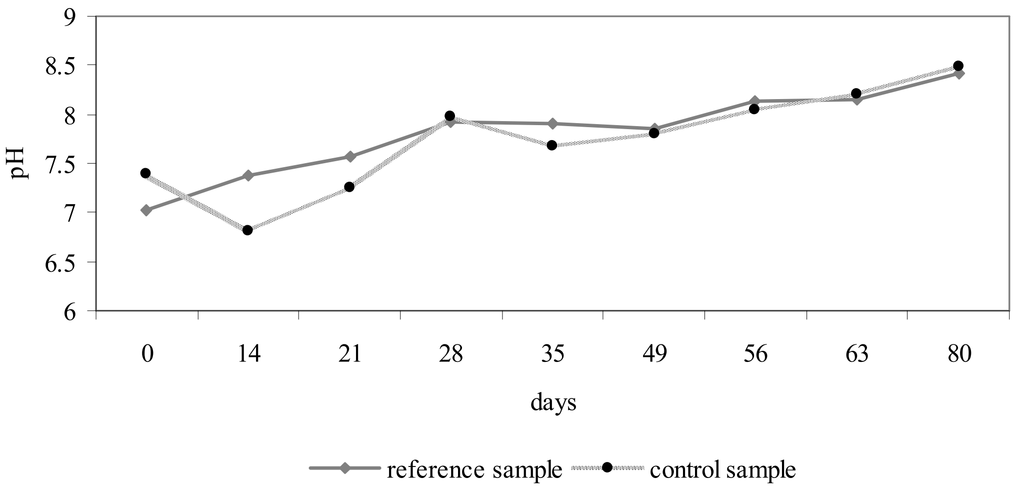

Fig. 3) pH values changes in dependence on time

The difference between pH values was noticed for reference and control samples from start to the day 49 of experiment duration. In case of reference sample, the pH values of leachate during *Desulfovibrio desulfuricans* influence increase gradually from the value of 7.02 to 8.42. In case of abiotic sample (control sample without bacteria) the pH was decreasing from the beginning value of 7.39 to 6.81 during the first 14 days. Since day of experiment 14 to the 80, the pH values increased and the final value of leachate was similar to the leachate of reference sample (8.49) [6].

The pH values increased gradually also in case of concrete samples with 5% of coal fly ash and 10% of coal fly ash since beginning value of 7.02 to the final 8.33 for both samples with coal fly ash.

The changes of calcium and silicium concentrations in leachate were observed for all samples after 80 days *Desulfovibrio desulfuricans* bacteria exposition. The results of Ca and Si concentrations measurements in leachate are illustrated at Figure 4 and 5.

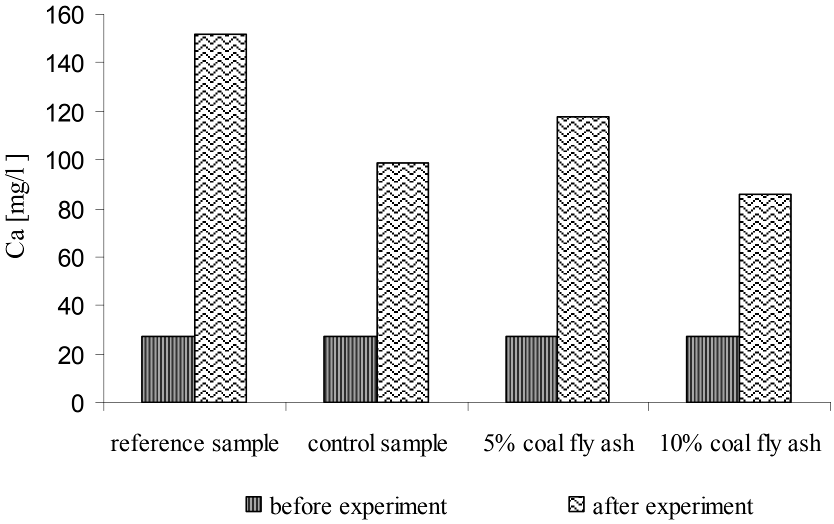

Fig. 4) Ca concentrations in leachate before and after 80 days experiment

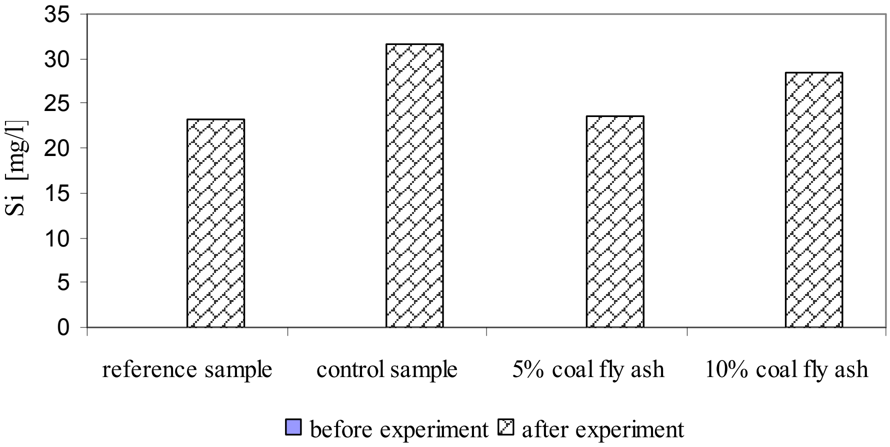

Fig. 5) Si concentrations in leachate before and after 80 days experiment

The concentration of calcium increased in all leachates several times – see table 1. The increasing of calcium concentrations was by up to more than three-fold in leachate of sample with 10% of coal fly ash, more than four-fold in leachate of sample with 5% of coal fly ash and more than five-fold in leachate of reference sample. The increasing was noticed also in leachate of control sample (3.6 x).

The biggest rise of Ca concentration was so observed for reference sample without coal fly ash and that sample seems to be the least resistible in term of *Desulfovibrio desulfuricans* influenced calcium releasing.

Tab. 1) Ca concentrations increasing before and after 80 days experiment

Sample	Increasing rate
Reference sample without coal fly ash	5.5 x
Control sample (reference sample without bacteria)	3.6 x
Sample with 5% of coal fly ash	4.3 x
Sample with 10% of coal fly ash	3.1 x

The increasing of silicium concentrations was observed for all measured leachates after experiment from zero concentration to 23.22 mg/l in case of reference sample, and 31.58 mg/l in case of control sample.

4 CONCLUSION

The paper presents the results of the particular study of various concrete samples biodeterioration influenced by sulphur-reducing bacteria *Desulfovibrio desulfuricans.* The pH changes and calcium and silicium concentration changes in leachate were observed under model stationary conditions, but these results are not yet sufficient to make the serious conclusions in term of resistibility of concrete samples with coal fly ash addition.

Acknowledgement

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THE EVALUATION OF EXPERIMENTAL PROTECTION EXAMINING OF ERODED WATERFALLS ON TUFF BEDS – EXAMPLE: THE TOWN JAJCE

Tomislav Ivanković[1], Vjeran Mlinarić[2], Zvonko Sigmund[3]

Abstract

The applicable methods for technical stabilization of waterfall are conditioned by natural, architectural, historical values of the landscape. That is a reason why concrete or reinforced concrete structures should be avoided and why binders for natural tuff detritus that do not change the shape or color of naturally hardened tuff are preferred.

In this paper the possibilities of technical interventions in waterfall area that are formed in heterogeneous tuff sediments are described. The rivers Pliva waterfall is a unique natural phenomenon, placed in the middle of an old town Jajce, and therefore is an ideal and unique test field. This landscape uniqueness, conditions the innovative approach to the waterfall erosion problem.

As a possibility of waterfall erosion protection injection suspensions were examined. Laboratory experiments have shown good results, on a large number of samples of tuff beds, when injected with micro-cement. Also the usability of other injection suspensions was examined within the research region. The injection suspensions were adjusted according to the tuff lithological composition. Comparison of the control samples have shown acceptable results of the applied methods, both in the laboratory and on the site.

Key words

Experiment, erosion, injection applicability, Jajce, tuff, waterfall

1 INTRODUCTION

Natural beauty of waterfalls is giving special ambient markings to water flows. On some locations tuff beds in waterfall regions are created and with their specific shapes enrich

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artistic impression of nature. Such phenomena can be rarely found in a very centre of a city. One example is the Pliva river waterfall which is in the centre of the old town Jajce. (Fig. 1.)

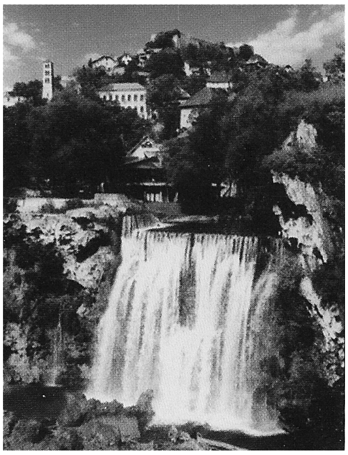

Fig. 1) River Pliva waterfall in the centre of the town Jajce

In the waterfall region, formed out of heterogeneous tuff sediments, technical interventions are conditioned with:

- Natural, landscape and historical values of the town Jajce, but also landscape's cultural values of town's wider region and surroundings of Jajce [1, 2],
- Natural markings of the Pliva river waterfall
- Lithological composition and geotechnical characteristics of tuff beds on which town Jajce was built and which form Pliva waterfalls in the centre of the town [3]
- Continuous erosion and Pliva waterfall degradation especially during the time of hydrological special occasions [4]

By analyzing the previously mentioned conditions and events basic demands on technical interventions in the very body of the waterfall are gained. Technical interventions may not degrade ambient integrity and waterfalls composition of natural beauty. Concrete or reinforced concrete structures that could help stabilize the waterfall would impact the shape of the waterfall. Even the underwater concrete structures built in the past, present a devastation of the region, which weren't efficient in stopping the degradation of the waterfalls.

Considering named restrictions, choice of stabilization methods of the waterfall is seriously narrowed. As technical erosion protection solutions of the waterfall, the next choices were available:

1. Tuff beds injection with adequate suspensions
2. Jet Grouting

By using comparative analysis of applicability for these methods of tuff beds stabilization with complex lithological and geotechnical characteristics it is necessary to find the optimal technical solution.

The town Jajce is laying on diluvia and tuff beds with thickness of up to 60 m, within which the Pliva river formed its bed and a fabulous 18 m high waterfall. Large number of constructions are characterized by local materials. With a numerous manmade structures through the history, the unique building methods and shapes and the Pliva waterfalls are forming a one of a kind picturesque phenomena which needs to be preserved.

2 LITHOLOGICAL STRUCTURE AND GEOTECHNICAL CHARACTERISTICS OF THE TUFF SEDIMENTS

Tuff is sweet water calcium-carbonate sediment that is extremely porous and evolves from algae and moss which assimilate CO_2 from the water. By reducing CO_2 from calcium-carbonate $Ca(HCO_3)_2$, calcite $CaCO_3$ is forming a shell around the calcium-carbonate and different shapes of tuff are created. Specific morphologic, geologic, biologic and hydrologic prerequisites are required for the growth of algae and moss that enable tuff production. The water needs to be clean without chemical or biological pollutions and within a very precise temperature, alkalinity, hardness and speed of travelling. Sewage and chemical pollution is speeding up the retardation and destruction of tuff. In geological past, the climate and hydrological changes were often, what changed conditions of creation and deterioration of tuff. Results of these are differences in geotechnical characteristics. There are several types of tuff:

- Compact petrified rock, partially cracked, often filled with tuff sand. In hard tuff beds, pores of smaller dimensions are found (diameter 1-30 mm) and bigger empty spaces – caverns with a diameter up to 2-3 m.

- Fine grain bounded, weakly bounded and unbounded tuff is mixed within tuff beds. Half bounded tuff was created by consolidation of tuff detritus, but hasn't gone through a phase of petrification and these tuff beds are prone to erosion.

3 CONSOLIDATION INTERVENTIONS APPLICABILITY ANALISYS

Because of specific geological structure, morphological and hydrological characteristics of the terrain, bedding and waterfalls were exposed to erosion and degradation for several times during the past. The first position of the Pliva waterfall was directly at the mound with Vrbas and today it is about 200 m upstream. There were several attempts to technically consolidate the river bed, but the natural strength of the water destructed each of those structures.

Therefore, we explored the possibility of using injection as a method of stabilizing tuff beds in a wider region of the waterfall which will enable tuff detritus to behave as hard tuff. As a research area the Pliva waterfall was chosen because of extremely non homogenous composition of the tuff beds.

For experiments next types of Portland cements were used:

- PC-45, mark A
- micro-cement, blaine (surface Area) 650 m^2/kg, mark B
- micro-cement, blaine 900 m^2/kg, mark C
- micro-cement, blaine 1200 m^2/kg, mark D

At first the injection with micro-cement was tested in a laboratory on the samples of 0.72 m^3. Penetration experiments were done by injecting samples under pressure of 4 bar with cement based mixtures. In all the used mixtures 2% of plasticizer was added, and the water to cement ratio were 3.0, 1.5, and 1.0. For the sample injected with Portland cement PC-45 hardened to unbounded part of injected sample ratio was 0.0, 0.68 for micro-cement of fineness 40µm and 1,0 for micro-cement of fineness 20µm.

By ultrasound speed testing on samples of naturally hardened tuff [vpsr(n)] and samples of tuff detritus that were injected with micro-cement of fineness 20μm [vpsr(g)] the average speed ratio was vpsr(n)/vpsr(g) =0,5. This ultrasound wave speed ratio is shows that tuff injected with micro-cement gains better geotechnical characteristics than natural tuff.

Using this acknowledgment a new experiment was done with different sample dimensions, types of micro-cement and injection pressure on samples of different length [5]. The aim of the second experiment was to check the results from the previous experiments and to find the penetration length for 4 different types of cement. This data gave us the distance between injection points on site according to the used type of cement.

Tuff sands and dust have been placed and compressed every 20 cm, into steel pipes of 100mm in diameter and a length of 0.5, 1.0, 1.2, 1.5, and 1.8 m. This way compression of sand and dust was almost like in nature. For all types of used cement the water to cement ratio was 1.0. After mixing the water and cement in given ratios, plasticizer in amount of 2% of the cement weight was added. This way prepared injection mixture was injected into the steel pipes with perforated basing, containing compressed tuff detritus. Injection was conducted under pressure of 6 bars and stopped after the injecting mass showed up on the perforated end or after 40 min of injection. After 28 days, pipes were opened, the length of bonded samples and the speed of ultrasound waves were measured. Results of this experiment are shown on Fig 2.

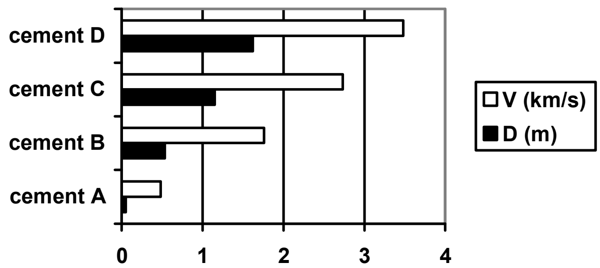

Fig. 2) Length of bonded samples D and the speed of ultrasound waves V

The experiments showed that injecting tuff with injection mixture based on PC-45 is not possible, because the injection mixture had almost no penetration in tuff detritus. However using micro-cement injection of different fineness, or different blaine, was a possibility for consolidation of tuff detritus, whereby the range of injection varied from 0.53 to 1.62 m. When blaine values are raising the primer speeds of ultrasound waves are rising as well and thereby the values of dynamical modulus of elasticity. If micro-cement of greatest fineness is used the distance between injection points can be up to 3.0 m. In that case the best lithification of tuff detritus is gained, which provides the best erosion resistance.

Due to heterogeneity of the tuff beds in the region of waterfall the variability of particle, crack and cavern porosity are changing. There are mostly tuff beds with tuff sand and dust porosity. Caverns are taking about 6% of volume of tuff beds. Caverns and larger cracks can be injected with mixtures on base of cheaper cement PC-45, and the use of micro-cement should be limited just on the tuff sand and dust. A method of graduate approach was used which enabled the evaluation of injection success by measuring the dry contents of the injection mixture in the primary and secondary injection points.

Additional control drillings showed that injection mixture based on micro-cement did not always reach the set distance of 3 m [5]. This fact was verified with cross-hole testing of seismic wave speed before and after the injection [5]. Investigations showed that there are zones in tuff sands where seismic wave speed hasn't changed even after injecting. Those are zones injected with mixtures based on cement with fineness 40µm.

Samples of injected tuff detritus have the looks of naturally hardened tuff with homogenous texture (Fig. 3.). Besides the shown geotechnical aspects, use of micro-cement has also an important visual advantage that usually has great natural values.

Fig. 3) Tuff sand and dust injected with micro-cement

Stabilization of waterfall area can also be conducted with Jet Grouting. This method enables stabilization of the ground regardless the volume of the particles. The ground structure is destructed with highly pressurized fluid flow and earth particles are mixed with cement suspension. This mixture is forming different shapes of earth with improved geotechnical characteristics. Hydrological flow destroys the ground in the diameter of 2.5 m, depending on the ground type, conduction and used fluid.

Hardness of the ground after jet grouting depends on type and volume of cement and ground. It increases with the ground particles diameter and cement volume, which are:

- Dust……………. 5-10 N/mm²
- Sand……………10-25N/mm²
- Gravel…………‹ 25 N/mm²

For tuff sand and dust jet grouting with one-fluid-direct injecting can be used. This technique is used for materials that closely represent the composition and granulation of tuff sand and dust. The body of injected mass that was dug out had the looks that resembled hard tuff with homogenous texture. (Fig. 4).

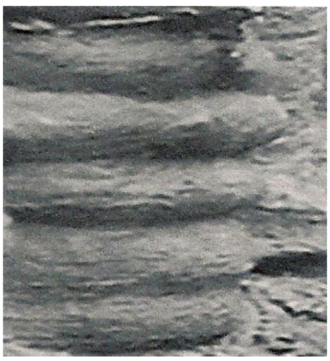

Fig. 4) Ground after Jet Grouting

Comparing the samples injected with micro-cement to samples after jet grouting it is easy to see that jet grouting leaves larger amount of pure cement. In extremely heterogeneous tuff sediments jet grouting is questionable in regions with caverns and hard tuff. Caverns filled with hard materials, because of their placement, are giving the whole region and additional security in the region of the waterfall, which is hard to achieve with jet grouting.

Jet grouting method has the advantage in achieving greater toughness and its execution is shorter. The main advantage of injecting with micro-cement is achievement of the almost natural look of tuff, a possibility to completely fill the caverns and cracks with bonding material and the possibility of conducting the works near the waterfalls.

A special disadvantage of jet grouting is a possible endangerment of waterfalls while conducting the works near the waterfall and possible damage to natural skeleton of tuff. Conducting the works with jet grouting under given circumstances needs additional investigation, and can endanger the waterfall stability.

4 CONCLUSION

The technical usability of methods for waterfall stabilization on tuff deposits depends on natural and historical values of the town area. These are also the reasons why concrete and reinforced concrete constructions should be avoided. Stabilization of tuff detritus with bonds that are giving natural looks of naturally toughened tuff should be preferred. The possible choices are extremely narrow, especially because of extremely heterogeneous lithological and geotechnical characteristics of the tuff beds.

The experiment results showed that injecting the tuff sand and dust based on micro-cement is possible. Distance between the injection points can be up to 3.0 m, if the injection mixture is made based on cement of best fineness. Jet grouting as an alternative to injecting with micro-cement has some advantages, especially due to greater hardness of treated ground and shorter execution time. Its success, though, is questionable in caverns and hard tuff region. A special disadvantage of jet grouting is a possible endangerment of waterfalls and possible damage to natural skeleton of tuff.

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WATER QUALITY IN BANJA LUKA WATER STREAMS AND THEIR SUITABILITY FOR IRRIGATION

Mihajlo Markovic[1], Ljiljana Nesic[2], Petar Sekulic[3], Svetalana Stikic[4], Tijana Zeremski – Skoric[3], Jelena Marković[5]

Abstract

Negligent or incompetent use of irrigation water may result in salinization, water-logging, impaired soil structure or nutrients leaching. With the general trends of declined quality of irrigation water, increased acreage under irrigation and use of sewage waters for irrigation, risks associated with water quality keep increasing. Six samples were collected for the assessment of water quality in the water streams of Banja Luka: two from the Vrbas River and one from each the Brkalos, Piskavica, Vrbanja and Gomjenica water streams. According to the obtained results, the analyzed water streams belong to good waters, applicable for irrigation without necessity for special measures for prevention of accumulation of harmful salts in the soil. It may be concluded that the water in Banja Luka water streams have favorable physical and chemical properties and that they may be used for irrigation.

Key words

Water quality, Banja Luka water streams, irrigation

1 INTRODUCTION

Because of the significance of water in life processes of plants, its deficiency is often a limiting factor in plant production. Waters used for irrigation contain varying quantities of soluble salts. Even low concentrations of salts can cause soil salinization if salty irrigation water is used for years. This problem is especially important in regions with arid climate (in our country, it is present in greenhouses).

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When irrigation is practiced in greenhouses, a certain amount of salt remains deposited in the soil after each irrigation. If there is a high level of sodium salts in irrigation water, it can start an alkalization process which will degrade the water-physical properties of the soil [1].

Negligent or incompetent use of irrigation water may result in salinization, water-logging, impaired soil structure or nutrients leaching. With the general trends of declined quality of irrigation water, increased acreage under irrigation and use of sewage waters for irrigation, risks associated with water quality keep increasing [2].

2 MATERIAL AND METHODS

To assess the quality of irrigation water in the region of Banja Luka, samples were collected from six different water streams: two from the Vrbas River and one from each the Brkalos, Piskavica, Vrbanja and Gomjenica water streams.

The following water quality parameters were analyzed:

- pH value
- electrical conductivity
- dry residue
- ion balance
- contents of microelements and heavy metals
- SAR (Sodium Adsorption Ratio) – as the indicator of relative activity of ater - soluble sodium in adsorption reactions with the soil.

Analyses have been conducted in the Laboratory for Soil and Agroecology at the Institute of Field and Vegetable Crops in Novi Sad, by using conventional analytical procedures. Water quality assessments were made according to the methodologies of US Salinity Laboratory, Stebler′s irrigation coefficient, Nejgebauer's water classes and Ayers & Westcot classification [3].

3 RESULTS AND DISCUSSION

Because irrigation waters typically contain high or low amounts of soluble salts and suspended particles, their chemical and physical properties are basic criteria for quality assessment. Chemical analyses include salt quantity and quality and anion and cation contents.

Lately, trace elements in effluents have come in the focus of attention. Small amounts of these elements in irrigation water may be harmful for soil and crop production. Heavy metals and various carcinogenic elements present serious health hayards for humans and animals.

The obtained values for total concentration of ionized substances and ion balance indicated that the water streams Vrbas (1 and 2), Brkalos, Vrbanja and Gomjenica fall in class C2S1, while the water stream Piskavica falls in class C1S1 as per US Salinity Laboratory classification. The former class stands for medium mineralized water with low sodium content, applicable for irrigation of soil capable of medium-intensity leaching. Crops that are medium tolerant to salts may be grown in most cases without special measures for salinity reduction. The latter class stands for slightly mineralized water, applicable for irrigation of most crops on any soil, with small chances of salinity development.

When considering quantitative portions of the analyzed ions in the studied waters, it can be seen that HCO_3^- anions and Ca^{2+} cations were predominant. Such chemical composition is characteristic for slightly mineralized waters from rivers, lakes and some groundwaters [4]. Those are low-alkaline, soft waters, which could have high mineralization only in lakes without outflow streams.

According to Stebler's irrigation coefficient and Nejgebauer's classification, the analyzed water streams belong to good waters, applicable for irrigation without necessity for special measures for prevention of accumulation of harmful salts in the soil.

According to the guidelines for assessment of irrigation water quality, i.e., a modified FAO classification [5], the analyzed samples had good quality.

The contents of harmful (Cu, Zn) and hazardous substances (Pb, Cd, Ni, Cr, As) were below the MAC values specified in ″Regulations on Allowed Concentrations of Hazardous and Harmful Substances in Soil and Irrigation Water and Testing Methods″ [6].

Tab. 1) Water quality in different water streams in the region of Banja Luka

Type of analysis	Conventional values (Ayers & Westcot, 1985)	Vrbas 1	Vrbas 2	Brkalos	Piskavica	Vrbanja	Gomjenica
pH value	6.0 - 8.5	7.94	7.98	7.96	8.12	8.04	7.97
Electrical conductivity dS/m	0 - 3	0.34	0.36	0.40	0.21	0.30	0.36
Dry residue mg/l	0 - 2000	164	138	143	70	124	193
Ca meq/l	0 – 20 meq/l	3.94	3.83	4.07	1.37	3.06	3.13
Mg meq/l	0 – 5 meq/l	0.73	0.66	0.93	0.81	0.43	1.84
K meq/l		0.04	0.03	0.04	0.03	0.04	0.03
Na meq/l	0 – 40 meq/l	0.20	0.12	0.14	0.23	0.19	0.09
SAR	0 -15	0.13	0.08	0.09	0.22	0.14	0.06
CO_3 meq/l	0 – 0,1 meq/l	0	0	0	0	0	0
HCO_3 meq/l	0 – 10 meq/l	4.29	4.18	4.96	2.63	3.60	4.70
Cl meq/l	0 – 30 meq/l	0.41	0.41	0.47	0.41	0.27	0.31
SO_4 meq/l	0 – 20 meq/l	0.36	0.34	0.94	0.15	0.07	0.9
As mg/l	MDK[1] 0,05	0.0024	0.0026	0.0036	0.0044	nd	nd
Cd mg/l	MDK [1] 0,01	nd	nd	nd	nd	nd	nd
Co mg/l	MDK [2] 0.05	0.0003	0.0001	0.0007	0.0008	0.0005	0.0009
Cr mg/l	MDK [1] 0,05	0.0008	nd	0.0002	0.0005	0.0004	0.0004
Cu mg/l	MDK [1] 0,1	0.0019	0.0013	0.0013	0.0052	0.0005	0.0009
Fe mg/l	MDK [2] 1.0	0.0044	0.0074	0.0215	0.063	0.0113	0.0148
Hg mg/l		0.0027	0.0007	0.0020	nd	0.0016	0.0017
Mn mg/l	MDK [2] 0.20	0.0036	0.0027	0.0092	0.0474	0.0081	0.0082
Ni mg/l	MDK [1] 0,1	0.0026	0.0014	0.0007	0.0029	0.0006	0.0027
P mg/l	0-2	0.0797	0.0210	0.0106	0.0115	0.0203	0.0131

Pb mg/l	MDK [1] 0,1	0.0025	0.0028	0.0012	0.0025	0.0023	0.0021
Zn mg/l	MDK [1] 1,0	0.0065	0.0117	0.0057	0.0078	0.0096	0.0126
Water classification (according to Salinity Laboratory)		C2S1	C2S1	C2S1	C1S1	C2S1	C2S1
Stebler's irrigation coefficient	> 18 – good quality 18 – 6 - medium quality 5.9-1.2 – poor quality < 1.2 – very poor quality	48.38	48.38	51.84	48.38	40.32	42.62
Nejgebauer's classification	I and II class – excellent and good waters III class - water that should be analyzed	Ia	Ia	Ia	Ia	Ia	Ia

nd - not detected
[1] MAC according to [6]
[2] MAC according to [5]

4 CONCLUSION

After detailed investigations of water quality, it was concluded that the waters in Banja Luka water streams have favorable physical and chemical properties.

Because the waters are low to medium mineralized, with a low sodium content and the contents of harmful and dangerous matter under MAC, the investigated waters may be used for irrigation without risk of their negative effects on the environment.

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MODELING OF CONCRETE GRAVITY DAMS BEHAVIOR ON ACTION OF STATIC LOADING

Stevcho Mitovski[1], Gjorgji Kokalanov[2], Ljupcho Petkovski[3]

Abstract

Prediction of the behavior of the concrete gravity dams during the construction period, at full reservoir and service period, their stress state and stability is of crucial importance for the engineers-designers in the designing phase of these complex structures. In this paper is presented advanced method for analysis of the stress state of concrete gravity dam, based on the finite element method. For the two-dimensional analysis the software package SOFiSTIK was applied. The existing numerical models should be further permanently compared and calibrated with measuring data of the monitoring system of the dam, which would enable to get more precise forecast of the dam behavior in the long service period.

Key words:

Concrete gravity dam, analysis, finite element method, stresses.

1 INTRODUCTION

The dams, having in consideration their importance, dimensions, complexity of the problems that should be solved during the process of designing and construction along with the environmental impact are lined up in the most complex engineering structures [1]. In Macedonia, up to now are constructed 26 large dams. Different types of dams are represented, having in consideration the various geological, topographical and hydrological conditions, among which 19 are embankment dams, 6 concrete arch dams and 1 concrete multiarch dam. The stored water is used for meeting the demands for water supply of population and industry, irrigation, production of electricity, flood and erosion control, provision of minimum accepted flows, recreation and tourism. The total stored water volume is about 2.4×10^9 m^3. The potential of the rivers in Republic of Macedonia is utilized to hardly 30%, and yet there is a permanent shortage of water for various purposes. Due to this fact, as well as due to strongly expressed uneven distribution of water, it is indispensably necessary to construct new dams with reservoirs [2]. One of the planed dams is Veles dam, designed as concrete gravity dam

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and when constructed it will be first of this type in Macedonia. The assessment of the stability and the behavior of the dam during construction, at full reservoir and during the service period are of vital meaning for this type of structures. This paper deals with static analysis of Veles dam, performed with application of the program package SOFiSTiK.

2 VELES DAM

Veles dam is designed as concrete gravity dam, with height above the terrain H=60.0 m. It dams the river of Vardar at site located on 6.5 km downstream of Veles (city in the central part of Republic of Macedonia on the river Vardar, at around 50 km south-east from capital city Skopje). The dam site is rather narrow, with a ratio dam height: dam length = 1:1.5. The dam will form a reservoir with surface of 8.9 km^2 at normal water level of 219.0 masl, while the total volume will be 189.0×10^6 m^3. The main purpose of the dam will be production of electric energy. The layout of Veles dam is shown on Fig. 2.

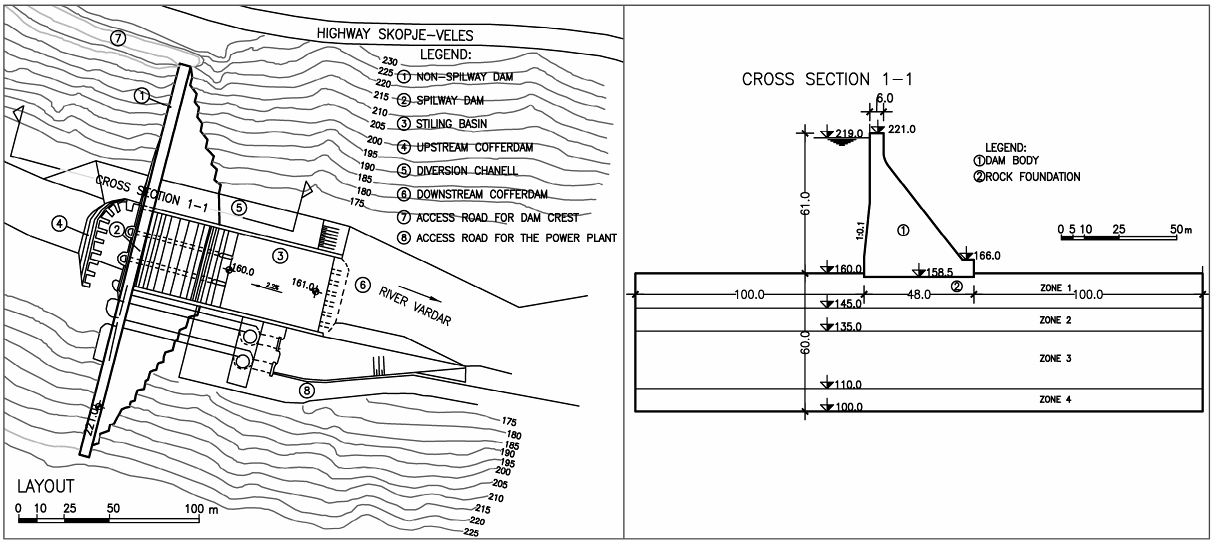

Fig. 1) Veles dam, layout and cross-section 1-1.

The dam crest elevation is at 221.0 masl, the dam foundations are at elevation 158.5 masl that gives structural height of the dam of 62.5 m. The dam consists of spillway and non-spillway section. The width of the dam crest is 6.0 m, the width of the dam is 48.0 m in the non-spillway section, 59.0 m in the spillway section and the length of the dam is 224.0 m. The necessary volume of concrete is calculated at around 207000 m^3. The spillway section has a length of 47.0 m, with three spillway bands and capacity of 2700 m^3/s. The non-spillway section of the dam (analyzed in the paper) is designed with triangle shape, with modifications on the downstream face with slope 1:0.76, while the upstream face is vertical for 20 m from the crest and afterwards it is inclined with slope of 1:0.1, also given on Fig. 1 along with the part of the terrain.

3 NUMERICAL MODEL

The dams and the appurtenant hydraulic structures along with the foundations must preserve the stability and safety at various conditions and loading scenarios during the construction of AMD service period. The dams and the appurtenant hydraulic structures manifest complex response on the action of the internal and external loadings and influences that in a way is in high contrast with their seemingly simple structural form. The dams are three-dimensional asymmetric structures, constructed of materials with complex physical-mechanical properties, founded on non-homogeneous and anisotropic mediums that generate complex interaction of the dam with the foundation and adequately a complex response on the dam and the foundation [1]. In order to convey the analysis following steps must be undertaken, conventional for this type of analysis: (1) choice of material parameters – constitutional laws, one of the most complex tasks during the analysis, (2) adoption of cross section of the dam and (3) simulation of the realistic dam construction and reservoir filling.

For the two dimensional analysis is adopted the non-spillway cross section with the terrain (Fig. 1). The length of the terrain before and after the dam considered in the analysis is in the interval (1÷2) H, where H is dam height, while the height of the dam foundation considered is equal to H [6], which defines the non-deformable boundary conditions. The terrain is divided in zones according to data from technical documentation and literature [3, 4, 5]. The program SOFiSTiK offers rich library of constitutional models for the materials, such as standard (concrete, steel, timber, soil and rock), but also and non-standard with option of self input of specific parameters. The geotechnical data for the different zones (Tab. 1) are adopted on base on the engineering geological section and engineering geological model of the terrain. The zones of deformability of the rock are considered and linear constitutional law is applied because the dam foundations stresses are used only as initial stresses in order to simulate the behavior of the dam.

Tab. 2) Parameters of the rock materials in the dam foundation

rock material	self weight γ [kN/m^3]	cohesion C[kN/m^2]	Poisson coefficient ν	Young modulus E [MN/m^2]
rock, zone 1	26.30	26.70	0.25	4.00
rock ,zone 2	26.70	38.30	0.25	5.00
rock, zone 3	26.70	0.00	0.25	8.00
rock, zone 4	26.70	8.00	0.25	10.00

The constitutional law for the concrete is adopted according to EC 2, standard concrete (20 MPa). The stress-strain dependence is given on Fig. 2, while the material parameters are given in Tab. 2. In the following equations f_{cd} is compression strength, n – exponent (n=2 for concrete type 20), ε_{C2} – strain at maximum strength and ε_{Cu2} – ultimate strain.

$$\sigma_c = f_{cd}\left[1-\left(1-\frac{\varepsilon_c}{\varepsilon_{c2}}\right)^n\right] \quad or \quad 0 \le \varepsilon_c \le \varepsilon_{c2} \qquad and \qquad \sigma_c = f_{cd} \quad за \quad \varepsilon_{c2} \le \varepsilon_c \le \varepsilon_{cu2} f$$

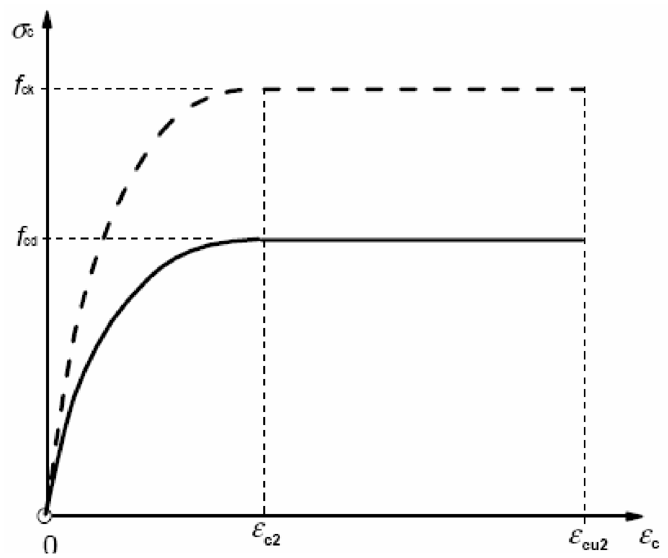

Fig. 2) Constitutional law for concrete [7].

Tab. 3) Concrete parameters.

Parameter	
Elasticity modulus (MPa)	20000
Poisson coefficient	0.15
Self weight (KN/m^3)	24.0
Compression strength (MPa)	20.0
Tension strength (MPa)	1.0
Termic conductivity λ (W/mº/K)	2.0
Specific heat c (kJ/kg ºC)	1.0

On the dam are planed monitoring devices for measuring of: stresses and temperature in the dam body and the uplift in the grouting gallery. Also devices for observation of the horizontal and vertical displacements and devices for control of the stresses in the rock foundation will be installed. The data obtained for these devices will be compared with the obtained results from the numerical model of the dam in the process of calibration that will give information about the behavior of the dam.

The static analysis of Veles dam is conveyed with application of the program package SOFiSTiK, based on the finite element method. The program offers possibilities for complex presentation of the structures and simulation of their behavior as well and including in the analysis of certain specific phenomena (automatic mesh generation based on given geometry, application of various constitutional laws, simulation of dam construction and reservoir filling in increments and etc.). The program SOFiSTiK incorporates various modules that are used for analysis of different structures. The modeling process starts with input of the dam geometry – coordinates of the geometric points, further connected with geometric lines which create geometric areas. The possibility of automatic generation of the finite element mesh requires specification of area and data for the mesh density (maximum height of the finite element) [8]. The geometric areas are assigned to groups that will enable simulation of the dam construction in layers. For the mesh generation are used quadrilateral finite elements. The quadrilateral finite element is general four side element with four nodes. At plane analysis the QUAD element doesn't poses its own coordinate system and the results are obtain regarding the global coordinate system.

4 RESULTS

The dam has been analyzed for state after dam construction and state at full reservoir. In the process of dam loading are applied three loading cases (LC) such as: LC 1 – self weight of th dam, LC 2 – temperature load taken as uniform horizontal distribution of the temperature and LC 3 – hydrostatic pressure of the water and the uplift. Maximum allowable compressible stresses for usual loading state of the dam (self weight, hydrostatic pressure and uplift) should be less then 1/3 of specified compressible strength. In this case the compressible strength is 20 MPa, so the limited compressible stress is 6.67 MPa, while the tension stress is in the interval 6-8% of the compressible stress and it is adopted value of 0.4 MPa. The assessment of the dam stability will be done through the values and distribution of the vertical stresses as primary value at concrete gravity dams. The analysis starts with simulation of the initial state apropos the stress state in the foundation under the dam, displayed on Fig. 3. Afterwards the dam construction in 13 horizontal layers is simulated with taking in consideration of the dam foundation stress state as initial state and in the end state at full reservoir up to normal water level is simulated. This enables realistic simulation of the chronology of dam loading during construction and at full reservoir. On Fig. 4 and Fig. 5 are displayed vertical stresses after dam construction and at full reservoir adequately.

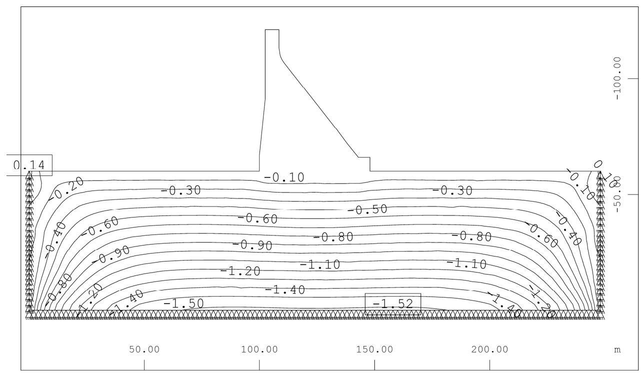

Fig. 3) Isolines of main stresses in the foundation, initial state, σ_1=(0.14 ÷ -1.52) MPa.

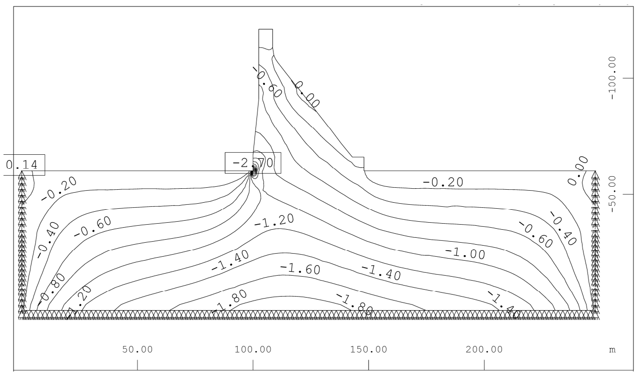

Fig. 4) Isolines of the vertical stresses after dam construction, σ_y=(0.14 ÷ -2.70) MPa.

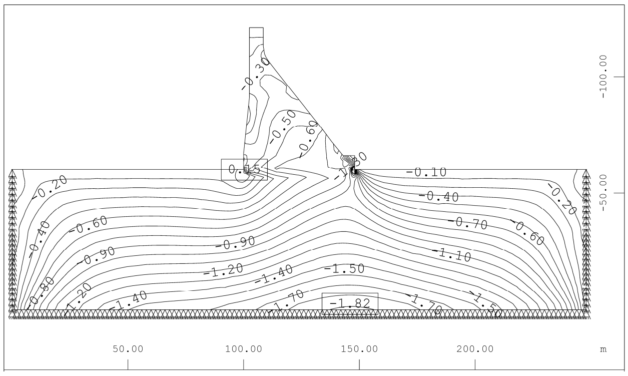

Fig. 5) Isolines of the vertical stresses at full reservoir, σ_y=(0.15 ÷ -1.82) MPa.

Regarding the stresses in the dam foundation, the maximal value of 1.52 MPa is expected having in consideration the height of the foundation (H_{RF}= 60.0 m) and self weight of the rock material (γ = 26.3÷26.7 KN/m^3). The stresses after the dam construction are mainly compressive, as expected with maximal value of 2.70 MPa, located in the upstream contact of the dam and the foundation, typical for this type of dam and loading state. The dam construction causes changes in the initial stress state of the foundation, resulting with increased stresses to 30%, with generally a similar distribution compared with the initial state. In the case of full reservoir loading state, the stresses are also mainly on compression with maximal value of 1.82 MPa, located at the bottom of the rock foundation. On the upstream face of the dam at the contact with the terrain there is tension stress with value of 0.15 MPa, that being undetectable for this type of dam and doesn't have any effect on the dam stability.

5 CONCLUSIONS

The prediction of the behavior of the concrete gravity dams during construction and at full reservoir is essential for the engineers – designers of these structures. In this paper was analyzed concrete gravity dam with application of advanced numerical approach, based on the finite element method. In full was simulated the time chronology of dam loading with what is gained realistic picture of the dam behavior in various loading states.

The dam stability is assessed on the base of the vertical stresses as primary values at this type of dams. The distribution and the values of the vertical stresses for the two loading states are typical for this type of dams. At dimensioning of this type of dams, one of the conditions that must be satisfied is to avoid tensile stresses in the dam body, condition that is fulfilled having in consideration that the stresses are mainly compressive. Tension stresses with value of 0.15 MPa appears at the upstream contact of the dam and the foundation, considered as stresses that can not affect the stability of this massive structure due to the low value (less then allowable value of 0.40 MPa). The maximal value of the stresses in the dam body is 2.70 MPa less then the allowable value of 6.67 MPa, thus satisfying the condition for allowable stresses.

The obtained data from the numerical analysis in future should be compared with monitoring data of the dam that would give additional information on the dam behavior and for the accuracy of the numerical model and the monitoring devices. This is the essence of the calibration process, which is continuous. Any disagreement between this data would indicate on improper dam behavior that would require investigation and analysis of the eventual problem and taking measures

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BASIN WATER RESOURCES IN THE CARPATHIAN AND SUBCARPATHIAN SECTORS OF DÂMBOVIȚA RIVER (ROMANIA)

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Abstract

Compared to other natural resources, water is renewable, limited, being permanently renewed within its natural circuit.

The water resources afferent to the hydrographic basin of upper Dâmbovița River are made up of karst hydrostructures, in the southern massif of Piatra Craiului and the Corridor Rucăr - Bran - Dragoslavele, with an estimated flow of 1.200 l/s, to which we can add the Upper Holocene hydrostructures present in the fluviatile terrace system from the Subcarpathian area, with 500 l/s. The surface resources are made up of the water volume flowing in the river until it enters the plain area (350 millions m^3/year).

Key words:

hydrographic basin, Dâmbovița, hydro-structures, hydrographic network, water resources.

1 INTRODUCTION

The analysis concerning the surface and underground water resources in a geographic area, for using them in the context where the human society records a continuous socioeconomic development marked by increasing needs, while the water resources remain constant or register a regress in point of quantity and quality, has been and continues to be one of the hydrological problems which are difficult to solve, given the complexity of this phenomenon.

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1.1 Setting

The Carpathian and sub-Carpathian basin of Dâmbovița River is located in the central-southern part of Romania, as part of Argeş River basin, and from an administrative viewpoint, it belongs to Argeş and Dâmbovița Counties.

Dâmbovița River has its source above 2,240 m and gathers the waters of the Carpathian and Subcarpathian area up to the area of Dragomireşti locality, on a length of 138 km (58.22% of a total 237 km), on a level difference of over 2,100 m and developing a basin area of 1,011 km^2 (35.72% of the entire basin, more exactly 2,830 km^2), of which 642 km^2 in the mountains (Fig. 1-2).

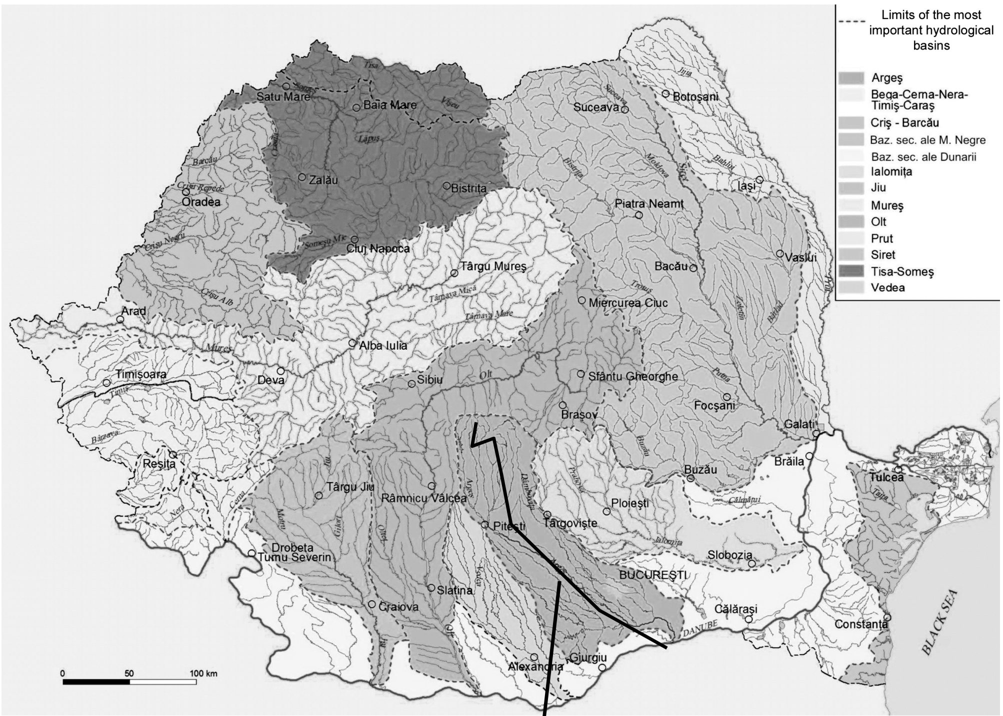

Fig. 1) The setting of Dâmbovița River, one of the main hydrographic basins of Romania

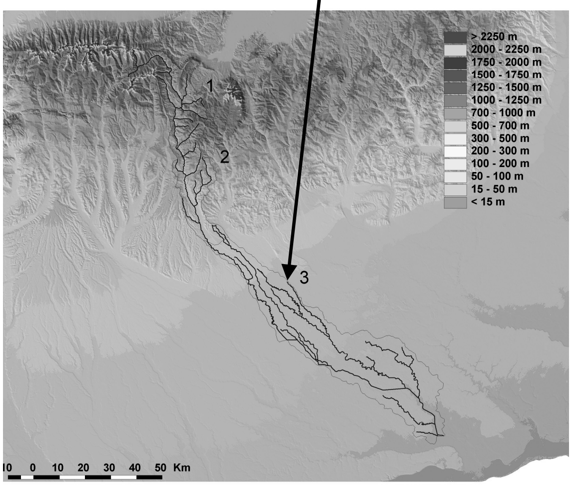

Fig. 2) Geographic position, on altitudinal units (1 – Carpathian area, 2 – Subcarpathian area, 3 – plain area)

2 WATER RESOURCES

2.1 Underground water resources

The underground waters of the Carpathian and Subcarpathian area of the hydrographic basin of Dâmbovița River are conditioned by the geological formations (tectonic, petrographic variety, physical-chemical properties of the rocks, deposit thickness etc.), being encountered both phreatic and deep-seated underground waters. They originate in the riverbed, being characterized by various hydrostructures.

The existence of certain hydrostructures in the southern sector of Piatra Craiului is conditioned by a series of *favorability factors*, such as:

- the lithological factor, through the presence of sedimentary rocks like calcareous and detritic rocks in grit stone-conglomeratic facies;

- the tectonic factor, through the crystalline bedrock and the structure of folds and fractures of the sedimentary layer;

- the climatic and hydrological factors by means of which the water-bearing structures are supplied with water.

The hydrostructure corresponding to the southern half of Piatra Craiului Massif has not yet been precisely delimited, yet it is supposed to correspond both to Piatra Craiului and to the Rucăr-Bran Corridor. I. Orăşanu *et al*. mention that it would correspond to the hydrographic basins of upper Dâmbovița in the west and Dâmbovicioara in the east, with extension southwards and eastwards in the Rucăr-Bran Corridor, going beyond the morphological limits of Piatra Craiului. In this area can be noticed three groups of more significant karstic springs: Gâlgoaiele, Izvoarele din Plai (Izvoarele din Valea Rea) and Izvoarele din Cheia de Jos a Dâmboviței. The most important underground discharge is represented by Izvoarele din Cheia de Jos a Dâmboviței (Cheia Mare), their flow reaching 800 l/s. Even since the year 1976, T. Constantinescu and, later on, I. Orăşanu *et al.* (1984), considered that the second underground karstic discharge is given by Gâlgoaie, situated on the right side of Dâmbovicioara Valley, with an average flow of 300 l/s. Here, there is a complex of four permanent springs, the main one having an average flow surpassing the value of 200 l/s. In Cheile Brusturet, on a distance of about 300 m, where the limestones are strongly techtonized, there appear several small temporary karstic springs, with flows ranging between 1 and 10 l/s. Upstream the above-mentioned gorges, on the left, one can notice the permanent spring called "La Bile", with an average flow of 30 l/s. The same authors mentioned that the waters infiltrated in Valea Seacă, 4 km upstream from the springs, end up entirely in Gâlgoaie. Izvoarele din Plai (Izvoarele din Valea Rea) comprise two karstic springs: a permanent one, with flows of about 50 l/s, and a temporary one, functioning according to the principle of the overflow. They are both situated on the right side of Dâmbovicioara. The water of these springs comes from the hydrographic basin of Peşterii Valley.

In the Subcarpathian area can be mentioned the *Hydrostructure of the Upper Holocene,* of low depth, which constituted the object of the researches in the riverside and low terrace area of the hydrographic network, for finding potable water sources (Al. Istrate, O. Murărescu, 1999). This hydrostructure is qualitatively affected by erosion and by the exploitation of the riverside building materials. The level of the riverbed has grown deeper, by 1.5-3m, in the context where the main source replenishing the underground water is the river water. It has been estimated that, for the riverside and the low terrace area of Dâmbovița, the flow reaches 500 l/s, with a surface exploitation of 250 l/s.

2.2 Surface water resources

The surface water resources are represented by Dâmbovița River, which receives in the area under analysis over 56 tributaries of different sizes.

Dâmbovița River has its sources at over 2240 m and goes through the Carpathian and Subcarpathian area up to Dragomireşti, covering a distance of 138 km (58.22% of the total length of 237 km), and a level difference of over 2100 m, developing a basin area of 1011 km^2 (35.72% of the entire hydrographic basin of 2830 km^2).

The river is fed, in the Carpathian area, by surface sources in a proportion of 78-85%, of which 50-55% is represented by pluvial alimentation, the difference coming from snow (the snow layer can last for up to 6-8 months). In the middle basin of the Subcarpathian area, the main source in the feeding regime remains the pluvial one, in a proportion of 55-60%. The participation of the snow to the formation of the liquid flow is of 15-20%, which gives a total of the supply from surface sources of about 75-80%. The underground sources participate with values that are close to those of the snow sources, between 15 and 20%.

The module flow of Dâmbovița River grows from 4.79 m^3/s (namely 18.42 $l/s/km^2$), at Podu Dâmboviței, to 9.97 m^3/s (14.92 $l/s/km^2$) at Malu cu Flori, at the entrance in the Subcarpathians. In this case, the hydrographic basin that feeds Dâmbovița River overlaps two large relief units, gathering a few tributaries whose module flow varies between 0.44-0.92 m^3/s.

Seasonally, the richest water flow occurs in May, followed by July and April. In the month of May, the river flow of Dâmbovița is of 19.3% at Podu Dâmboviței and 16.96% at Malu cu Flori. In the months of April and June, the values are slightly close to these, but go over the annual average value. Because of these conditions, in the interval April-June, Dâmbovița River has the largest water quantity, estimated around 45% (45.79% at Podu Dâmboviței and 43.17% at Malu cu Flori). The lowest water volume of the flow is recorded in the period of the months of December-January (8.55% at Podu Dâmboviței and 5.13% at Malu cu Flori), when the precipitations that fall remain stocked and the negative temperatures favor the appearance and development of the winter phenomena.

In the Carpathian area, most of the rivers have a permanent flow regime, with over 0.5 m^3/s. The water is of high quality (hydrochemical type: with calcium bicarbonate and a mineralization around 200 mg/l or even lower in the high areas). These rivers belong to the first category of quality, and are part of the class of oligosaprobic waters (up to Voineşti), the polluting sources being almost inexistent in the sector under analysis.

The anthropic lakes. On Dâmbovița River, the first arrangements were of the "storage lake" type, for instance that from the confluence area of Valea Vladului and Boarcăş, the second known under the name of Lacul lui Bunea (Bunea's Lake), covered at present by Pecineagul Lake, and the third, Cascoe Lake, situated near the place where the rivulet with the same name discharges its waters in Dâmbovița River.

Although Dâmbovița River and its tributaries from the alpine area can be arranged to supply power, at present there are just two such lakes: Pecineagul Lake and Sătic Lake.

Pecineagu Lake is situated on the upper course of Dâmbovița River, 25 km upstream from Podu Dâmboviței Commune, Argeş County. The dam, with a height of 107 m, stores a total volume of 69 millions m^3, and the volume of the lake, for the normal retention level, is of 63 millions m^3. The lake is fed with water from Dâmbovița River, with an average multiannual flow, in the dam area, of 3.41 m^3/s, to which can be added the waters of 10 tributaries caught from Oltului basin (Viştea, Sâmbăta, Apa Râului etc.). These lake's functions are: to supply with water the downstream consumers, with a flow of 6,8 m^3/s, of which 5 m^3/s for the water supply of Bucharest municipality; to supply water for the irrigation of an area of 10,700 ha in the Dâmbovița – Colentina basin and to produce power with an installed power Pi of 65 MW (120 GW/h year) and Qi of 35 m^3/s. The lake supplies water, by means of a gallery of 9.3km, to the electric power plant of Clăbucet, situated in the locality Săticul de Sus, 11 km downstream from the dam.

Upstream from Podu Dâmboviței, near the locality Sătic, another storage lake has been created, on Dâmboviței Valley, between Iezer and Piatra Craiului Mountains. Sătic Lake has been designed to hold a volume of about 100 millions m^3 of water, coming from the electric power plant of Clăbucet and a series of secondary branches from Argeş, Râuşor and Dâmbovicioara. It assures the necessary water for the electric power plant of Dragoslavele, with a Pi of 54 MW. In the future, a third storage lake is foreseen to be created in the alpine area, 6 km downstream from Dragoslavele, at the feet of Culmea Mateiaş, near the locality of Lunca Gârții. The water volume designed is about 30 millions m^3 (Gr. Pop, 1996).

In the vicinity of the boundary between the Subcarpathian area and the High Plain of Târgovişte is *Văcăreşti Lake,* situated on the middle course of Dâmbovița River. This arrangement began in 1989, the works were concluded in 1990, and it began to function in 1996. The lake's dam is 19.50 m high, 350 m long and 6 m large at the top of the dam. Behind it can be stored a water volume with a surface of 216.5 ha, at normal retention level, permanent, and 507.10 ha temporary storage. The total water volume is of 53.70 millions m^3, of which the permanent volume is of 21.85 millions m^3. This hydrotechnical work was achieved for the following purposes: to defend the capital against flooding, to supply water for Dâmbovița - Ilfov and to assure a supplementary flow of 15 m^3/s for the water supply of the Romanian capital and of the downstream consumers, to compensate on a daily basis the necessary flows for the treatment plant of Arcuda; lake for assuring the irrigation of a 10,532 ha area, the transition being made through a branch towards the storage lakes of Adunați and Ilfov (L = 5.5 km; Q_i = 8.5 m^3/s) and production of electric power through an electric power plant with an installed power Pi of 4.84 MW (8,.70 GW/h year) and a Q_i of 42.7 m^3/s. The power plant is subordinated to the other uses, functioning according to the water flows required by the Arcuda station. Other uses are: fishery in a natural regime, without added nutrients, tourism and recreation.

3 CONCLUSIONS

The water resources in the hydrographic basin of Dâmbovița River are made up of karst hydrostructures developed in the alpine area, yet insufficiently highlighted, but with an estimated flow of about 1.200 l/s, to which can be added the Upper Holocene hydrostructures of the terrace system of Dâmbovița River from the Subcarpathian area, with flows estimated around 500 l/s and exploited at the surface of 250 l/s, for supplying water to Târgovişte municipality. In point of vulnerability, the last ones have undergone changes because of the building material exploitations from the river bed, which led to a decrease of the phreatic water level of 1-3 m.

The surface water resources are made up of Dâmbovița River, which is part of the Argeş - Dâmbovița hydrotechnical system and participates to the supplying with water of Bucharest. For this reason, except for Bucharest and the surrounding areas, this water source is not used by other consumers. The average yearly flow is of 10 m^3/s at the entrance in Văcăreşti lake, almost equal to that at the entrance in the Subcarpathians (at Malu cu Flori), because in this geographic area it receives a low number of tributaries (in general, with flows of less than 1 m^3/s).

The mixed feeding regime of the upper course (which assures a maximum flow during the period April-June and a minimum flow during September-October), is similar to that of the middle course. The importance of this hydrographic artery consists in the possibilities it provides as water supply source (a volume of 350,000,000 m^3/year at the entrance in the plain area). Through the arrangement of the lakes: Pecineagu, Sătic and Văcăreşti, it has become part of the Argeş-Dâmbovița hydrotechnical system, which supplies water to Bucharest municipality, controls the high floods on this hydrographic artery and assures the water needed for irrigations in an area of more than 10,000 ha in the Dâmbovița-Colentina interfluve. It belongs, for the entire course, to the first category of quality, and in point of saprobity, it is oligosaprobic, up to Voineşti, and beta-mesosaprobic, from Voineşti downstream.

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WATER SUPPLY AND MANAGEMENT IN DÂMBOVIȚA COUNTY (ROMANIA)

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Abstract

Dâmbovița County, situated in the central-southern area of Romania, has a surface of 4,054 km², being one of the small counties of the country (covering about 1.7% of its territory) and a population of 531,011 inhabitants, in 2009, of which 163,933 live in the urban area (7 towns), and 367,078 in the rural area (82 communes, with 353 villages).

The territory of Dâmbovița County is included in two main hydrographic basins, *Buzău-Ialomița* and *Argeş-Vedea*, being managed respectively by the Water Directorate of Buzău-Ialomița and the Water Directorate of Argeş-Vedea, both subordinated to the Romanian National Water Administration.

Key words:

water resources, water supply, population, human settlements, management, Dâmbovița County.

1 INTRODUCTION

1.1 Surface water resources and their quality

The water resources of Dâmbovița County are made up of surface waters (rivers and lakes) and underground waters (Table 1).

Tab. 1) Surface water resources of Dâmbovița County

Water course	Length (km)	
	In Dâmbovița County	In Romania
Ialomița	158	417
Dâmbovița	115	286

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Water course	Length (km)	
	In Dâmbovița County	In Romania
Sabar	80	174
Ilfov	92	96
Cricov	70	80
Argeş	54	350
Potopu	45	45
Neajlov	44	186
Colentina	40	101
Pâscov	38	38
Şuța	36	36
Ialomicioara	27	27
Bizdidel	22	26
Crivăț	22	29
Slănic	30	30

The water resources that can be used theoretically and technically, both from surface and underground sources in the hydrographic basin of Ialomița, for the year 2009, are presented in table 2.

Tab. 2) Water resources that can be used theoretically and technically in the hydrographic basin of Ialomița River (2009)

Surface resource (thousands m^3)		Underground resource (thousands m^3)	
Theoretical	**Usable**	**Theoretical**	**Usable**
293,284	172,000	120,000	70,000

The volumes of water taken from the two sources mentioned above and distributed to the population and to different activities (energy producers, public institutions, industrial-like farming units, irrigations, aquaculture etc.), were at the end of the year 2009 of 15,266.436 thousands m^3, of which 7,991.274 thousands m^3 represents surface water and 7,275.162 thousands m^3 is underground water.

The evaluation of the running water quality in Dâmbovița County, for the year 2009, relied on the processing of the primary data resulted from the physical-chemical analysis of the waters, carried out in the laboratories of the Water Management System of Dâmbovița (Sistemul de Gospodărire a Apelor Dâmbovița) (for the hydrographic basin of Buzău - Ialomița) and the Water Directorate of Argeş - Vedea (for the hydrographic basin of Argeş - Vedea).

In general, in Dâmbovița County can be mentioned two categories of impact on the quality of the water courses: the impact produced by used urban insufficiently treated (industrial-domestic) waters, discharged in the river courses (Ialomița – receiving used waters from the localities Fieni, Pucioasa, Târgovişte; Neajlov – used waters of the treatment station in Găeşti Town), and the impact produced on the water courses that go through the activity area of the oil derricks: Grupul de Zăcăminte Moreni - Răzvad - Gura Ocniței (Cricov, Pâscov, Cezeanu), Grupul de Zăcăminte Strâmbu - Cobia - Leordeni - Ludeşti (Cobia, Potopu, Strâmbu, Saru, Slănic, Ilfov). High values, above the admissible limits for the first class, have been recorded for the indicators chlorides and oil products, following the impact of the technological and oil field waters from these oil areas.

A special situation is represented by Slănic Rivulet, whose source and upper course are situated in the area of the salt folds Gura Ocniței - Aninoasa, Răzvad zone, its salinity being given both by the natural salt deposits it goes through and by its being polluted following the oil extraction activities.

From the comparative analysis of the river sectors divided on quality classes in the year 2009 compared to the year 2008, we can see several significant changes for the first and second class of quality, in the sense of the decrease of the weight of the first class and the increase of the second class in the year 2009. At the same time, the most significant weight went to the river sectors belonging to the second (38.7%) and third (30.7%) quality category - Fig.1-2.

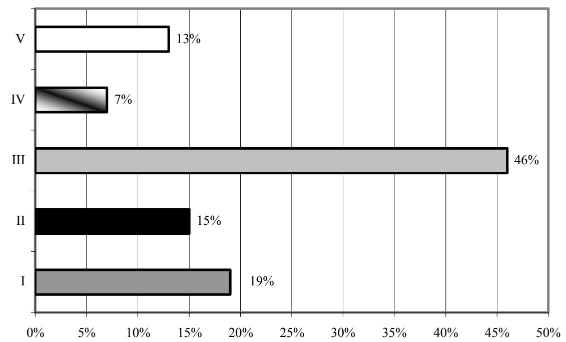

Fig. 1) Repartition of the water courses in Dâmbovița, on quality classes (2008)

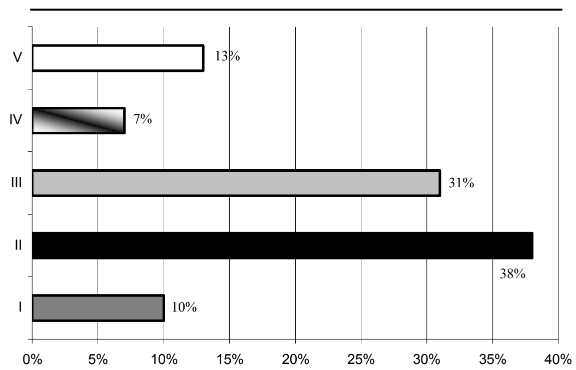

Fig. 2) Repartition of the water courses in Dâmbovița, on quality classes (2009)

1.2 The underground water resources and their quality

We can mention the fact that the major polluting factors, which affect as well the quality of the underground water, are grouped, just as in the case of the surface waters, in the following categories: oil products (mostly in the impact area of the oil derricks Târgovişte and Moreni), industrial waste (trading companies from the urban centers of the county), chemical products (fertilizers, pesticides) used in agriculture, which cause a diffuse pollution hard to detect and prevent, domestic products and farm products, heavy metals, non-correlation of the increase in the production capacity and the urban development with the modernization of the sewerage works and the realization of treatment stations, inadequate exploitation of the existing treatment stations, lack of an organized system for the collection, depositing and management of the waste and mud resulted following the treatment of the used industrial waters.

In this context, the Water Directorate Argeş - Vedea (by means of 23 survey drillings carried out inside the basin) and Buzău-Ialomița with survey drillings in Gura Ocniței, Bucşani, Bilciureşti, Băleni, Mărceşti, Comişani, Dimoiu, on the territory of Dâmbovița County, highlighted the fact that certain quality indicators went over the admissible limits according to Law no. 311/2004 and Order no. 137/2009, for iron and manganese in the points Raciu, Sălcuța, Tătărani, Voineşti, Ioneşti, Gura Foii, Găeşti etc. (for the hydrographic basin Argeş - Vedea), and for the basin of Ialomița values above the admissible limit were recorded for the indicators: ammonia nitrogen, nitrates, chlorures and sulphates. So, the pollution of the underground waters is more often than not an almost irreversible phenomenon with serious consequences on the use of the underground reserve for water supply. The depollution of the underground water sources is extremely difficult and sometimes impossible.

2 DRINKABLE WATER SUPPLY

The analysis concerning the surface water resources in the area of Dâmbovița County highlighted certain qualitative and quantitative appreciations on some parameters such as the flows or the annual volumes of the small hydrographic arteries, at the confluence with the larger ones, and, in the case of the large water courses, the input and the output volume in the geographic area under analysis. In this context, Dâmbovița River has an average flow of about 10 m^3/s, at the entrance in Văcăreşti Lake, having a water volume of 350 millions m^3/year, while the water resources of Ialomița River, in Târgovişte, are of 7.97 m^3/s (251.4 millions m^3/year). The estimation of the quantity and quality of the underground and surface hydrographic resources and at the same time the analysis of the way the water courses are organized and arranged in tiers, in a seasonal and annual regime, the analysis of the flowing regime and of its impact on the human settlements can lead to an estimative ratio between *the water resources and the water demands of the population.* The calculation of the necessary water for the localities has been achieved in the conditions of the existence of a centralized water supply system and in agreement with the normative acts in force, respectively STAS 1341/1991. This legislative act foresees a need of 100 l/day of warm water and 280 l/day cold water/person in the urban area, the result obtained by cumulating them being of 380 l/day/person and 110 l/ day/person in the rural area, via a system of individual domestic pumps, or 65 l/day, which is water in the water supply system brought by street pumps.

The potable water supply for the *urban localities* is assured mainly from sources in the vicinity of the towns, especially underground sources. In this sense, for *Târgovişte municipality* the supply comes exclusively from underground sources (the maximum flow being of 0.509 m^3/s), namely underground water from a low depth, in Dragomireşti south and north, Gheboieni - Măneşti, situated on the left bank of Dâmboviţa, while the average depth sources are situated on the interfluve between Ialomiţa and Dâmboviţa in the area of the localities Lazuri - Văcăreşti, and Hulubeşti - Butoiu, in the zone of the Cândeşti Piemont. For *Moreni municipality*, the underground sources from the areas Iedera, Ruda, Ciocoieşti, Săcuieni, are supplemented by surface water from the water station from Paltinu (Câmpina, Prahova County), with a maximum flow of 0.0673 m^3/s. *Pucioasa* Town is mainly supplied from surface waters, from Ialomiţa River, the maximum flow being of 0.076 m^3/s; the urban locality of *Găeşti* uses deep sources (getting water from Argeş front); *Titu Town has deep sources* (with two water catching fronts in the area of Branişte locality – the first being 1200 m long, contains 12 drillings, 5 functional and 7 in conservation; the maximum authorized daily volume being of 950 m^3/day - 10,9 l/s and the average annual volume being of 242.72 thousands m^3; the second front has a length of 200 m and benefits of six drillings, of which three are active); *Fieni locality* benefits of the underground sites from Gâlma area and drains from the terrace of Ialomiţa River, and *Răcari Town,* of deep sources (with three drillings, of which the front length reaches a maximum daily volume of 98.85 m^3/day and an average yearly volume of 29.58 thousands m^3). In the rural area, the water of the public supply system is assured from underground sources.

The water supply network of Dâmboviţa County has grown continually during the last few years, especially in the rural area, because of the investments made using the SAPARD program, and also those approved by means of different normative acts (HG. no. 687/1997, HG no. 577/1997, OG. no. 7/2006) – only in 2009 were provided with supply systems 29 communes, the total water supply network of the county being of 971.30 km. The total potable water volume distributed to consumers was by the end of 2009 of 8991.6 thousands m^3, respectively 64.4% of the county population (157.245 people) has access to drinkable water distributed in a centralized system, with a sanitary authorization. At the same time, at the end of the year 2008, in Dâmboviţa County there were 177 localities with potable water distribution network, representing 49.2% of all the localities, and the simple total length of the water distribution network was of 1,411 km (fig. 3).

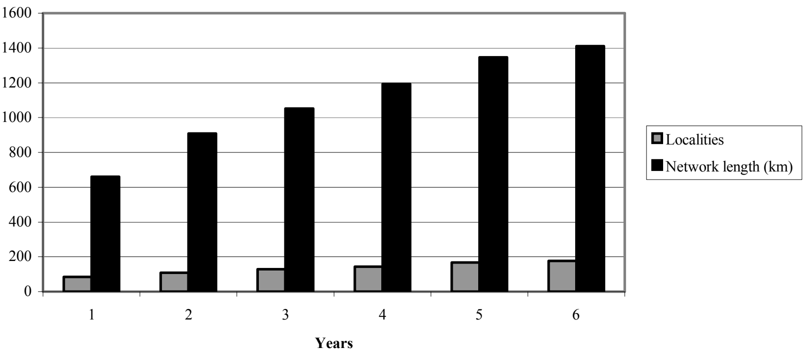

Fig. 3) The evolution of the number of localities with potable water distribution network and of the length of the water distribution network in Dâmboviţa County (2003-2008)

3 ASPECTS CONCERNING THE WATER SUPPLY MANAGEMENT IN DÂMBOVIȚA COUNTY

The territory of Dâmbovița County, as we have mentioned, is provided with water by two firms: S.C. Compania de Apă Târgovişte - Dâmbovița S.A. and Serviciul Public Județean de Alimentare cu Apă şi Canalizare.

The Water Company Târgovişte - Dâmbovița (Compania de Apă Târgovişte – Dâmbovița) gives special attention to the quality of the water it provides to the population. From this viewpoint, the institution assures the water quality by means of adequate treatment technologies, by means of the sanitary protection of the water sources, respecting the legislative provisions (Law concerning water quality no. 458/2002, completed and modified through the Law no. 311/2005 and Governmental Decision no. 974/2004), in point of: the sanitary authorization of all the water points; the determination of the water quality, monitoring sections in such a way as to cover all the supply area; control monitoring, comprising the control of the efficiency of the water treatment technology (disinfection) through microbiological analyses and the control of the drinkable water quality through physical-chemical analyses.

The Departmental Public Service of Water Supply and Sewerage (Serviciul Public Județean de Alimentare cu Apă şi Canalizare) carries out activities related to the catching and treatment of raw water, transport and distribution of potable water and industrial water to the users, physico-chemical biological and bacteriological analyses on the drinkable water. At present, it assures the supplying with potable water of 13 communes, and is about to take over as well the potable water stations of 8 more county communes.

The water supply management has as main targets: ensuring the quality and quantity of potable water in the urban and rural area; realizing sewerage systems and extending the existing ones in the urban and especially in the rural area; retechnologization and modernization of the treatment stations; protecting the waters against pollution, etc.

At present, there is a project being carried out, entitled: *Extinderea şi modernizarea sistemelor de alimentare cu apă şi canalizare în județul Dâmbovița* (The extension and the modernization of the water supply and sewerage systems in Dâmbovița County), comprised in the *Programul Operațional Sectorial de Mediu* (Environmental Sectorial Operational Program), and the implementation and conformation to the provisions of the European directives concerning drinkable and used urban waters will be achieved, according to the engagements of adhesion to the EU, until 2015, for potable water, and until 2018, for used urban waters.

4 CONCLUSIONS

In agreement to the above-mentioned provisions and engagements assumed by Romania in relation to the EU norms, in the domain of water supply for the population, several engagements have been approved and are under way: for the *rural area*: the realization of the sewerage network for the localities of the county, according to the "Engagements" resulted following the negotiation of Chapter 22 "Environment" - 3 localities (2013), 11 localities (2015), 33 localities (2017), 21 localities (2018) -, and also treatment stations in the localities of Dâmbovița County (14 until 2015; 33 localities - 2017; 21 localities - 2018); and for the *urban area*, by means of the same program are targeted: sewerage networks: 2013 - Moreni, Pucioasa, Titu; 2015 - Fieni, Răcari and treatment stations: 2010 - Târgovişte, Găeşti; 2015 - Moreni, Pucioasa, Titu, Fieni şi Răcari.

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EVALUATION OF NITROGEN AND PHOSPOHORUS DISTRIBUTION BETWEEN SURFACE WATER AND SEDIMENTS IN SELECTED WATER BODIES

Aneta Petriláková[1], Magdaléna Bálintová[2], Michal Orendáš[3]

Abstract

Surface water quality is considerably affected by eutrophication caused by high content of nutrients especially of compounds of nitrogen and phosphorus. The paper deals with an assessment of the surface water quality in the watercourse Topľa and the small water basin Hrčeľ in relation to nitrogen and phosphorus contents in sediments. Influence of pH on nitrogen and phosphorus leaching from sediments is presented, too.

Key words

Surface water, nitrogen, phosphorus, eutrophication

1 INTRODUCTION

Eutrophication has many negative effects on aquatic ecosystems. Perhaps the most visible consequence is the proliferation of algae, which can turn water a turbid green and coat shallower surfaces with „pond scum“. This increased growth of algae and also aquatic weeds can degrade water quality and interfere with use of the water for fisheries, recreation, industry, agriculture, and drinking [1].

Eutrophication affects most fresh water worldwide. Greater attention is focused on phosphorus in regard to the difficulties in controlling the exchange of nitrogen between the atmosphere and water, and fixation of atmospheric nitrogen by some blue - green algae [2].

The aqueous environmental chemistry of phosphate involves a wide variety of reactions and several transport processes that tend to make phosphorus unavailable for aquatic plant growth. One of the most important of these processes is the transport of phosphorus to the sediment by chemical and biological activity. While there is some recycling of phosphorus from sediments

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to the overlying waters, this return is usually relatively small, with the result that the sediments serve as sink for phosphorus [3].

2 RESULTS AND DISCUSSION

To study the interaction of nitrogen and phosphorus between surface water and sediment were sampled water and sediment from the river Topľa near the village Sačurov (Vranov nad Topľou district) and from the small water basin Hrčel (Trebišov district) (Fig. 1).

Fig. 1) Area of sampling

The total concentration of nitrogen and phosphorus in water samples was determined in the laboratory of Civil Engineering Faculty of Technical University of Košice. The mineralization of samples was carried out in mineralised box DRB 200 (Hach Lange) and for the determination of N and P was used Colorimeter DR 890 (Hach Lange).

The content of P_{total} and N_{total} in sediment samples was determined in the Accredited test laboratory of State Geological Institute of Dionyz Stur according to STN EN ISO/IEC 17025:2005.

Leaching of nitrogen and phosphorus compounds in the aquatic environment has been tested in leachates prepared were prepared from 5 g sample and 50 ml of distilled water. After 24 hours, the leachate were subsequently filtered and analyzed.

Effect of pH on the release of nitrogen and phosphorus compounds in the aquatic environment was studied using solutions with pH 5.01 (prepared from distilled water and 10% HCL), pH 6.32 (distilled water) and pH 7.71 (preparation with 0.1 mol.dm^{-3} NaOH). The samples were leachated 24 hours.

To determine the pH of water samples and leachate was used multifunction device MX 300 X- mate^{pro} (METLER TOLLEDO).

3 RESULT AND DISCUSSION

3.1 Evaluation of the content of total nitrogen and phosphorus in the samples taken from the river Topľa

The six sampling sites of sediment and water was selected on the river Topľa. The results of chemical analysis of nitrogen, phosphorus and pH measurements are shown in table (Table 1). Results of nitrogen and phosphorus as well as pH in water samples were compared with the general requirements for the quality of surface water under the Regulation of the Government of the Slovak Republic No. 296/2005 Coll.

Tab. 1) Comparison of the contents of nitrogen, phosphorus and pH in water with recommended limits

No. samples	N_{total} (mg/L)	P_{total} (mg/L)	pH
1	0,9	0,19	**5,63**
2	7,8	0,13	6,08
3	3,1	0,13	6,15
4	3,3	0,14	6,0
5	3,8	0,20	6,06
6	4,0	0,16	**5,8**
limite	**9**	**0,4**	**6 – 8,5**

Samples of water from sampling sites 1 and 6 (first and last sampling point downstream) did not fulfil the recommended value of pH. The values were lower than pH 6, so in the acidic areas.

The contents of the P_{total} and N_{total} in the Topl'a sediment are presented in Tab. 2.

Tab. 2) N_{total} and P_{total} content in the samples of sediment

No. samples	N_{total} (%)	P_{total} (%)
2	0,19	0,050
3	0,04	0,032
4	0,24	0,063
5	0,06	0,055
6	0,06	0,043

As it results from Table 2., there is no dependence between concentrations of the followed elements. It means that the increasing of nitrogen concentration doesn't mean simultaneous trend of the increasing or decreasing the phosphorous concentration.

Comparison of total nitrogen in water and sediment from different sampling sites is shown in Fig. 2.

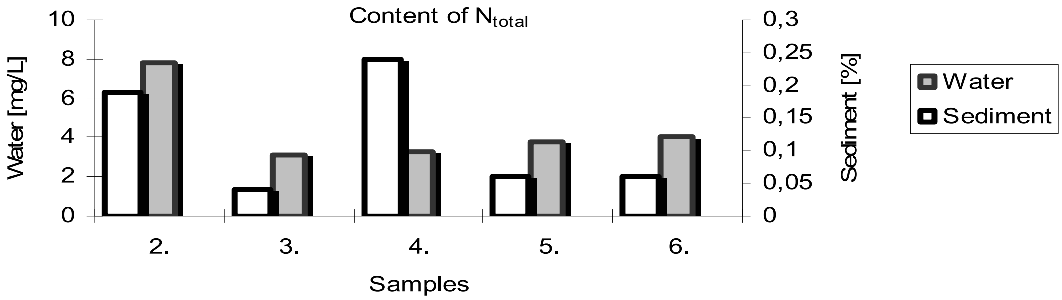

Fig. 2) The content of N_{total} in water and sediment

From the figure 2 it is clear that there is dependence between the concentration of nitrogen in the water and the percentage of nitrogen in the sediment exception sample No. 4. Comparison of total phosphorus in water and sediment in each sampling sites is shown in Fig. 3.

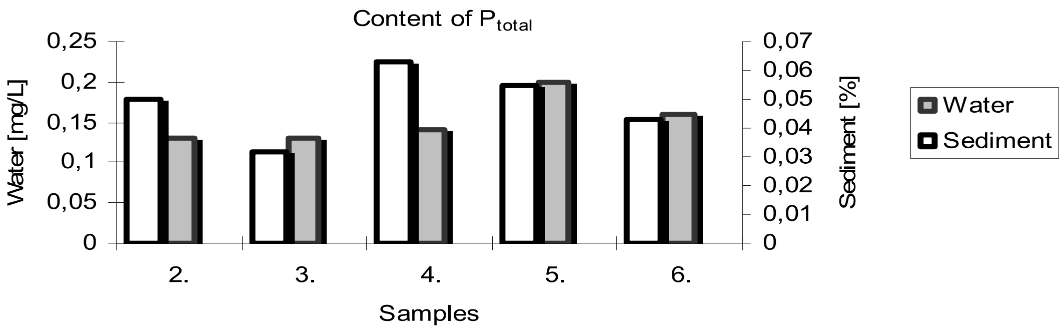

Fig. 3) The content of P_{total} in water and sediment

From Fig. 3 it is clear that there is no relationship between the concentration of phosphorus in water and the percentage of phosphorus in the sediment sampling sites. The sampling point No. 2 and No. 4 is even the opposite trend.

3.2 Assessment of the total content of nitrogen and phosphorus in water samples from the small water basin Hrčeľ

From the small water basin Hrčeľ was sampled water (seven samples) and sediment samples (three samples) (figure 4). Results of chemical analysis of water samples for N_{total}, P_{total} pH are shown in Tab. 3 and they are compared with the general requirements for the quality of surface water under the Regulation of the Government of the Slovak Republic No. 296/2005 Coll.

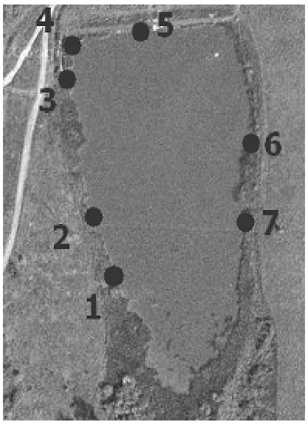

Fig. 4) The water sampled points in small water basin Hrčeľ

Tab. 3) Comparison of the contents of nitrogen, phosphorus and pH with recommended limits

No. samples	N_{total} (mg/L)	P_{total} (mg/L)	pH
1	4,6	0,16	6,65
2	3,8	0,20	6,66
3	3,5	0,10	6,64
4	4,1	0,12	6,50
5	5,1	0,17	6,46
6	2,8	0,16	6,42
7	2,0	0,18	6,31
limite	**9**	**0,4**	**6 – 8,5**

The concentration of nitrogen on the left side of the small water basin is visibly lower than the right, and decreases with distance from the dam (but this does not apply to water samples from sampling points 1 and 2). The values of nitrogen and phosphorus in the table are for better illustration shown in the figure (Fig. 5). From the figure 5 it is clear that there is no relationship between the concentration of phosphorus and nitrogen concentration.

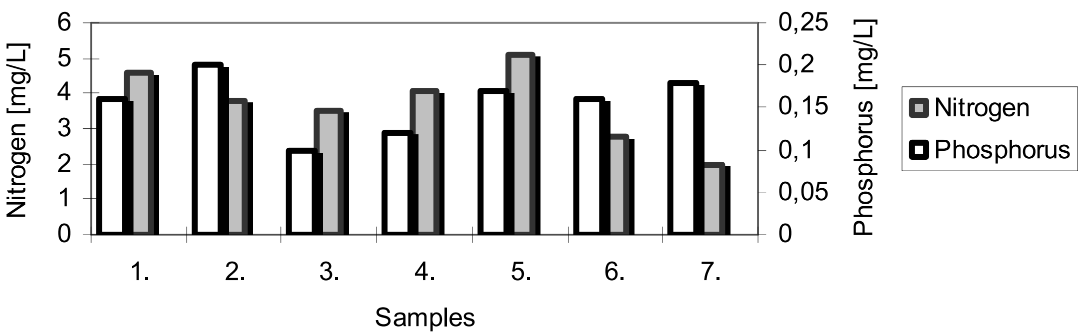

Fig. 5) The concentrations of N_{total} and P_{total} in different sampling locations

Recommended pH value for all samples was fulfilled at all sampling points. Measured values for pH ranged from acidic areas. The figure 6 shows that the pH values increase from sampling location 7 (the farthest point from the small water basin on the left side).

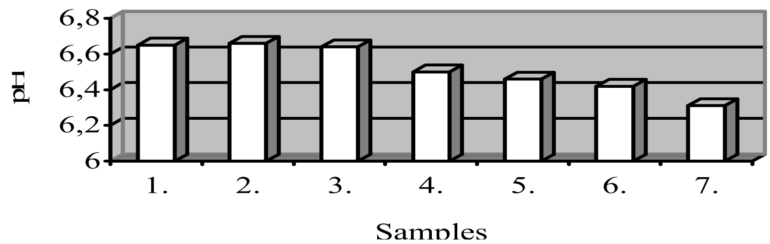

Fig. 6) The pH of water samples

3.3 Effect of pH on leaching of nitrogen and phosphorus from selected sediment samples

To evaluate the impact of pH on leaching of nitrogen and phosphorus from sediments were used in two samples of sediments: from the river Topľa, the sample No.4, from the small water basin Hrčel, the sample No. 1, witch are leached in solutions with different pH values as follows: 5,01; 6,32; 7,71.

The total concentrations of nitrogen, phosphorus and pH were subsequently determined. Results of sediment from the river Topľa are presented in the table 4.

Tab. 4) Comparing the contents N_{total}, P_{total} and pH of leachate samples of sediment from the river Topľa

label	N_{total} content (mg/L)	Limit for N_{total}	P_{total} content (mg/L)	Limit for P_{total}	pH
$3_{pH:5,01}$	6,4	9 mg/L	0,26	0,4 mg/L	6,93
$3_{pH:6,32}$	6,1		0, 28		6, 94
$3_{pH:7,71}$	6,6		0,33		6,93

The table shows that increasing the pH has a significant impact on nitrogen content, while total phosphorus concentration increases with increasing pH. Results for samples of sediment from the small water basin Hrčeľ are presented in Table 5.

Tab. 5) Comparison of N_{total}, P_{total} content, and pH leachate from the sediment of small river basin Hrčeľ

label	N_{total} content (mg/l)	Limit for N_{total}	P_{total} content (mg/l)	Limit for P_{total}	pH
$1_{ph:5,01}$	15,2	9 mg/L	0,25	0,4 mg/L	6,66
$1_{pH:6,32}$	16,9		0,26		6, 59
$1_{pH:7,71}$	15,5		0,27		6,64

The table shows that, as in the previous sample of the sediment with increasing pH have a significant impact on the nitrogen content, respectively highest concentration was at pH 6.32, while total phosphorus concentration increases with increasing pH.

From Tab. 4 and 5 shows that the pH of the leachate from sediment sample No. 3 of Topľa was in the range of 6.93 to 6.94 and pH of leachate from sediment sample No. 1 of a small water basin Hrčeľ was in the range of 6.59 to 6.66. This can be evaluated as a buffer effect of sediment on water.

4 CONCLUSION

Concentrations of total nitrogen and total phosphorus in water samples from the river Topľa fulfiled the recommended requirements for general quality of surface water under the Regulation of the Government of the Slovak Republic No. 296/2005 Coll. excepting of pH value in two from the six taken samples.

Concentrations of total nitrogen and total phosphorus in samples of water from the small water basin Hrčeľ also fulfiled the recommended requirements. The results of the determination of total nitrogen concentrations in the leachates of sediments from the small water basin Hrčeľ shows that samples did not fulfil the recommended requirements for general quality of surface water in accordance with the Regulation of the Government of the Slovak Republic No. 296/2005 Coll. while total phosphorus concentration limits fulfiled.

Based on the presented results cannot be concluded that there is a direct relationship between concentrations of N_{total} and P_{total} in sediments and surface water at the same evaluated sampling sites.

ACKNOWLEDGEMENTS

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BED LOAD RETENTION IN RIVERS – A SUSTAINABLE AND ENVIRONMENTALLY COMPATIBLE ALTERNATIVE

Georg Schuster[1], Cedomil Josip Jugovic[2]

Abstract

The equilibrium of sediment transport in rivers is often disturbed, due to the anthropogenic impacts. The first measure to avoid harm related to this imbalance ought to be a retrogression of the bed load transport. However, often just the symptoms of this imbalance, like the appearance of aggradations in rivers are being removed by excavation. Thus, already during the next flood the aggradations reappear, reduce the discharge cross-sections and provoke overflows.

In the following article, a bed load retention structure is presented, which provides a sustainable and environmentally compatible alternative to the existing common methods. This structure fulfils the requirements of appropriate sediment modulation, while supporting both, the river continuum, as well as the biological continuity.

Key words

Sediment transport, flood water protection, hydraulic engineering

1 INTRODUCTION

In anthropogenic influenced regions, disequilibrium in the river and stream sediment budget often takes place. For this disequilibrium, variable explanations can be found. Finally, two basic principles can be distinguished:

- Changes in sediment input
- Changes in sediment transport

The aggradations with anthropogenic or native source origin are treated as a serious problem in the field of hydraulic engineering and especially in the field of the flood risk management. [1] [2] The cause for these aggradations can be the excessive sediment, as well as a reduction of the sediment transport. Thus, hang slides and reduction of vegetation provoke additional sediment input and thereby aggradations. However, aggradations occur also by the reduction of the transport capacity due to the widening of the flow cross section, reduction of the flow

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velocity through barriers, or reduction of the bed slope between the bed drops. If aggradations are caused by a reduction of the transport capacity, it makes more sense to set a measure to increase the sediment transport, if this is possible. Otherwise, the retained material will be missing downstream and this may cause degradations. [3] These degradations of the river bed have a substantial impact on the environment and river morphology. Hence, it is always important to critically analyze whether a real surplus of material, or an imperfection in the geometry exist.

Additionally to the ecological and economical demands, also the European Water Framework Directive must be respected. Thus, the transmissibility of the river-systems is an essential requirement for achievement of the environmental objectives, established under this Directive. Thus, all intended measures must ensure a non-selective biological transmissibility.

2 TECHNIQUES TO AVOID THE AGGRADATION INDUCED OVERFLOW

In particular, if essential aggradations arise, during flood events the danger of overflow arises too. Hence, appropriate instruments must be found in order to keep the flow section free. There are a number of measures, which can be implemented. However there are also important ecological and economical requirements to fulfil:

- Protection against floods provoked by aggradations
- Sustainability
- Environmental compatibility

2.1 Excavation

The usual response to the occurring aggradations after floods is excavation. The background to such decisions can be found in the public interest. By the past flood events, when the damages were obvious, often quick measures were required. Excavation is indeed a quick technique to restore the river bed, but it is neither sustainable, nor ecologically sensitive. Although after the excavation the river bed looks apparently reconstructed. However, due to the fact that the cause for disarranged sediment transport has not been identified, new aggradations may arise, during the next flood due, and provoke a new overflow. Furthermore, excavations have a serious impact on the stream's physical parameters such as channel geometry, bed elevation, depth, velocity, temperature, roughness, turbidity, sediment transport, substrate composition and stability [4] [5]. Moreover conventionally excavation can cause, beside the adverse effect on the hydromorphology, a serious ecological damage. Dredging in water bodies induces water turbidity and destruction of the river bed through material removal, as well as through passing over by heavy vehicles. Mainly suspended sediment has an essential impact on the underwater fauna. According to Hartmann [6] fishes are able to avoid turbidity. Smaller organism in ground near sediments, as well as microbes in the upper interstitial have nearly no ability to take refuge. Following to Brandt [7], particularly high concentration of suspended silt over longer duration is harmful for the fish respiration. Beyond that, also the extensive blockage of the interstitial must be taken into account.

2.2 Bed load retention basin

Usually, the bed load retention basins consist of a distinct expansion of the river profile and an optional bypass channel. This approach is much more sustainable than a river excavation. Yet, it is also more sophisticated and time consuming. Bed load retention basins are a very common solution for mountain stream and torrent control. Due to the abrupt widening of the cross section and further additional obstacles, the flow velocity reduces essentially. Thus, the transported material is deposited and the driftwood is hold back by special structures. When the retention basin is full, or after larger flood events, the reservoir is being emptied by dredging. The clearance is executed during periods of low water discharge.

During the low water periods, the runoff can be routed through a special bypass channel or directly through the retention basin. In mountain creeks and rivers presents the discharge through the sediment-filled retention basin usually no problem for the fauna, because steep and shallow flow conditions, which develop in these filled retention basins, correspond to natural habitats. Though, in lower mountainous regions, such flow conditions are a barrier for the typical species. Above all, also the clearance has a similar environmental effect like the conventional excavations.

2.3 Bed load retention sidearm

A bed load retention sidearm works very similar to a bed load retention basin. Yet, the bed load retention sidearm operates in a shunt circuit. This means, that the main discharge stays in the natural river bed, while the excessive contingent of the bed load is diverted into an artificial sidearm. The design of the bed load retention sidearm is composed of three main parts:

- Intake structure
- Accumulation reservoir
- Downstream water outlet

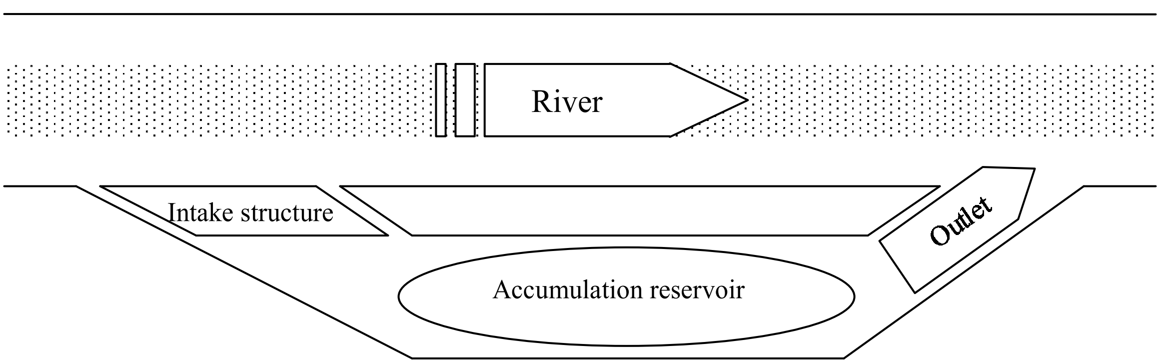

Fig. 1) Basic design of a bed load retention sidearm

The distribution of the discharge and the bed load between the main channel (river) and the sidearm (accumulation reservoir) is controlled by a diversion structure (intake structure). The intake structure is positioned at the beginning of the sidearm. It is build up of three main elements:

- Low weir

- Side weir
- Flushing channel

The low weir in the main channel stabilises the river bed in front of the diversion structure and initiates bed load movement in direction of the flushing channel, and thus improves the bed load extraction even at lower discharges. The main function of the side weir is to cause a lateral drift which provides an efficient bed load extraction by high discharges. The flushing channel begins with the opening in the side weir on its downstream end, at the intersection between the side weir and the low weir. The main function of the flushing channel is to provide a permanent water/sediment discharge into the sidearm, especially at the low discharges. In the flushing channel, a super critical flow regime prevails by all the discharges.

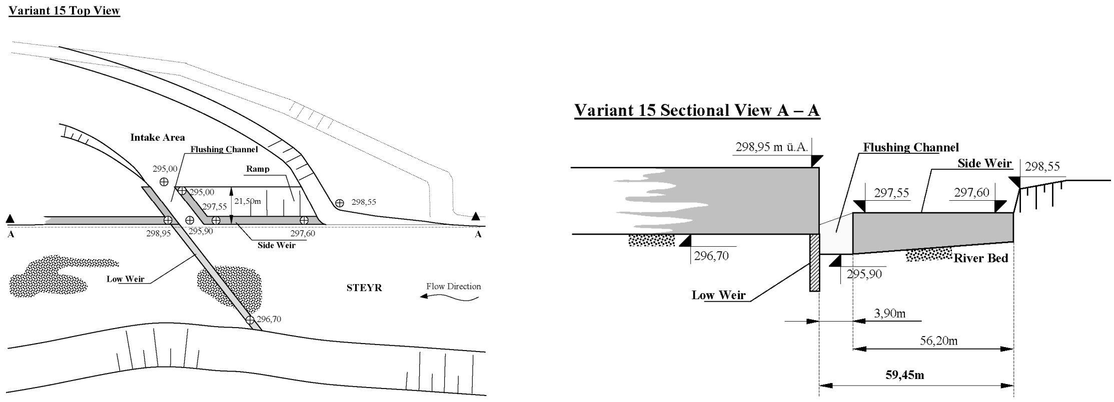

Fig. 2) Basic design of a bed load retention sidearm

By higher discharges, the main part of the bed load is being extracted into the side arm, while in the same time, the major water discharge portion still flows in the main river channel. In the low discharge period, just small quantities of water and sediment are feed into the side arm, what enables undisturbed dredging works there. The quantity of bed load extraction into the side-arm depends on the discharge in the river. The maximum of the material extracted into the sidearm depends on the entrance design, and may amount up to 90 percent of the transported bed load in the channel. However, the implemented entrance design must be adequately adapted to find the right balance between the extracted and further transported bed load.

An example of a good functioning bed load retention sidearm has been designed for the city of Steyr in Austria. Firstly, the origin of the occurring aggradations has been investigated. It has been observed, that the major part of the sediment stems from the Steyr River, which flows into the Enns River. Due to the several hydro-electric power plants, nearly no more bed load transport proceeds in the Enns River. Therefore, nearly the whole material from the Steyr River deposits in the Enns River and is not further transported. By the reduction of the river profile, the aggradations provoke overflow. So, a sustainable solution has been found by the implementation of a bed load retentions sidearm. It has been situated on the upper edge of the city, in order to extract the material before it reaches the city and possibly causes aggradations.

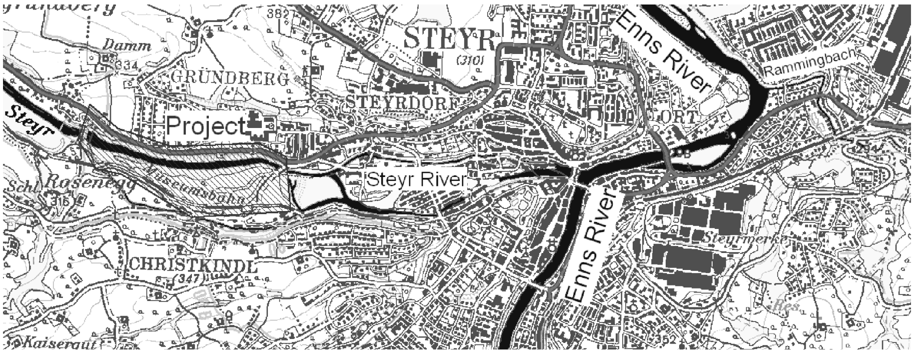

Fig. 3) Map of the town Steyr

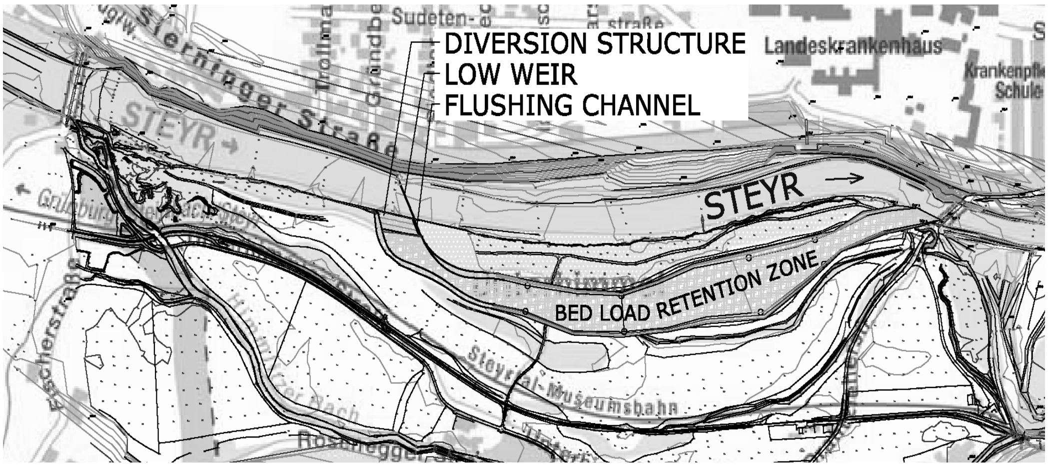

Fig. 4) General Map - "Bed load retention sidearm – Steyr" in Himmlitzer Au

The quantity of the bed load extraction into the side-arm depends on the discharge in the Steyr River. The maximum of the extraction rate lies between 70 and 90 percent of the transported bed load in the Steyr River and is reached by the discharges of a 10- to 30-years return period. This approach of the maximum extraction rate represents a compromise between the higher floods including higher bed load transport and smaller floods with smaller transport capacity but higher probability of occurrence. However, it represents the optimal solution of the bed load retention according to the given objectives.

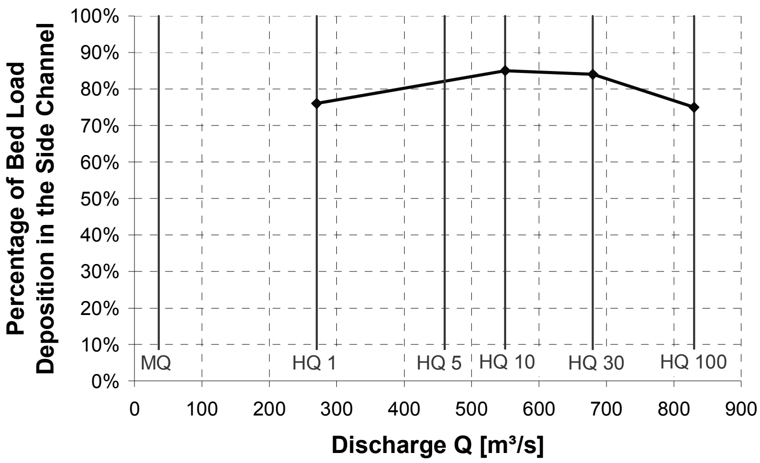

Fig. 5) Bed load extraction efficiency of the side-arm

3 CONCLUSION

In a case of an imbalance in bed load transport of a river, firstly the origin must be found. Thus, it may be possible to find a sustainable, close to nature solution. Such a measure makes usually more sense than the other measures, because the river continuum remains unaffected. Is the maintenance of a balanced bed load transport due to the obligatory boundary conditions not possible, an adequate sediment equilibrium must be reconstructed by external measures.

Excavations are a quick and easy method to reduce temporally the flood risk. Yet, the removed material comes back with the next flood. This is beside the ecological also an economical disadvantage.

A classical bed load retention basin affords an effective and sustainable protection against floods induced by aggradations. However, this solution has some ecological disadvantages. Further on, as a result of the missing intake structure, compared to the bed load retention sidearm, the retained bed load fraction cannot be controlled so exactly as with a sidearm.

A bed load retention sidearm provides an environmentally compatible reduction and extraction of the transported material with the possibility of removing the excessive material to a separated side channel. Thus, the possible negative environmental impact is being minimized. Additionally, a non-selective ecological passage for fish and organisms of the river bed is available for a wide bandwidth of discharges. Furthermore, by this solution, in the accumulation reservoir, no regions isolated by aggradations should arise. At the same time, the designed facility provides the required bed load extraction rate, according to the present discharge. Thereby, it fulfils its function of reducing the dangerous excessive bed load transport during the flood water events.

Thus, the bed load retention side arms afford a sustainable and environmentally compatible alternative to the common method of the bed load regulation.

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BANK STABILIZATION OF RIVER AND RESERVOIR

Miloslav Šlezingr[1]

Abstract

If we consider tree species growing on banks, it is important to notice the effect of underground and aboveground parts. The root system grows through the soil profile and binds soil particles, thus reinforcing riverbed banks. Roots also grow into the zone of continuous flooding where they are a sought-after refuge for water fauna. The aboveground parts of plants relieve the pressure of running water, protect banks against direct effects of waves, drifting of ice and in combination with nonliving reinforcing structures they act as long-term, durable and reliable stabilisation of banks.

Key words

Bank, stabilization, river, reservoir,

1 INTRODUCTION

In 2009 the decision was made to reduce the level of water in Brno Valley Reservoir with the aim to achieve an improvement of the unbearable quality of the water in the reservoir. The long-term underestimation of many factors affecting water quality had resulted in an uncontrollable growth of cyanobacteria (blue-green algae).

Fig. 1) A view of Brno Reservoir with the reduced water level

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As the water level in the reservoir was reduced for about a year, it was possible to take a number of partial “sanitary” measures in the surroundings of the reservoir and subsequently also directly in the water environment

2 THE MEASURES TO IMPROVE THE WATER QUALITY

This is the list of measures proposed to help improve the water quality in the reservoir:

1. The reduction of the water level by about 10 m will considerably reduce its volume and thus also the living space for the development of the cyanobacteria.
2. The naked banks will be exposed to air oxygen which will lead to the death of inocula in these areas.
3. The development and the very survival of inocula is highly negatively affected by changes in pH. For this reason, the naked banks will be limed regularly.

Fig. 2) Liming of the naked parts of the Brno Reservoir bottom and banks

4. Another very important factor is the reduction of the amount of nutrients (nitrogen and mainly phosphorus) in the sediment. The nutrients will be partially used by the abundant growth of weeds (greenery of grass and herbs). These will be mowed regularly and burnt at best outside the spaces of the reservoir.
5. The reservoir banks will be stabilized because about 1/8 of the total amount of the sediment came to the reservoir as a result of bank disintegration.

Fig. 3) An example of abrasive damage to the Brno Reservoir banks

6. During the season, aerators will be installed in the remaining volume of water. These will drive the air into the water environment which will make the conditions for the development of cyanobacteria significantly more unfavourable.

7. The recreational and other facilities on the banks of the reservoir will be consistently inspected, especially as regards the disposal of wastewater, and this consistent inspection will follow in the years to come.

8. A part of the sediment will be excavated in selected areas, especially with the purpose to maintain the navigable depth for ships and to provide an easier access to the docks. (Excavation and removal of all the sediment would certainly represent a significant step towards the improvement of water quality. However, as the estimates show there is about 4 million m^3 of it in the reservoir, such a step is rather unfeasible.)

Fig. 4) The sediment on the reservoir bottom appears when the level of water is reduced

9. An effort (long-term intention) will be made to minimize the amount of organic remnants, soil and other material washed into the reservoir.

10. The main requirement, which is the minimization of the amount of nutrients transported by streams to the reservoir (the nutrients get into the streams mainly due to the facts that wastewater is insufficiently treated, organic remnants and soil from the surrounding lands are washed into them, there are some local sources of pollution, etc.), is predominantly a matter of obtaining sufficient financial means for building and intensification of wastewater treatment plants.

11. Others (limiting the negative influence of people recreating, water transport, etc.)

The Department of Water Structures, Faculty of Civil Engineering, Brno University of Technology, together with the Department of Landscape Management, Faculty of Forestry and Wood Technology, Mendel University in Brno, were asked to cooperate on the solution of the issue of the reservoir bank stabilization. At the beginning of 2009, the project was made to stabilize the most endangered and damaged parts of the banks of Brno Reservoir, it means areas called Rokle and Osada.

Besides listing the proposed partial solutions for the improvement of water quality in the reservoir, we would like to recap the proposed measures implemented in the bank area of Rokle.

The proposal focused on the stabilization of the bank by means of bank reinforcement. The main stabilization material was quarry rock laid at least in two layers and installed in the sloped bank with 1 : 3 up to 1 : 4 gradient. This rock stabilization structure was covered in 0.2 mm thick layer of soil and seeded with grass mixture. Subsequently, suitable woody vegetation has been and will be planted.

3 CONCLUSION

Further, let us concentrate on the assessment of the implemented bank stabilization. It has been done along about 400 m of the bank, i.e. in the entire area of the greatest damage. To take the necessary measures, the most suitable period was used – the period of significant water level reduction.

The basis of the solution was the treatment of the band damaged by abrasion – its sloping, removal of unsuitable woody vegetation, roots, remnants of the previous ineffective stabilization, etc. Then rock with mean grain of 0.5 m in diameter was brought and levelled, in two layers at minimum. In the end, the rock stabilization was covered in soil and seeded with suitable grass mixture.

The presented photodocumentation shows that the stabilization was conducted very well and now, a year later, it still works properly. The basis of its efficiency is the prevention of the development of abrasion platforms and the consequent retreat of the shoreline. Unfortunately, the created root system of the grass mixture was insufficient, therefore a large part of the soil was washed out or fell among the rocks. That is why we concentrated on the proposal, development and verification of a reinforced grass carpet which would significantly help with the biotechnical stabilization of the bank (Project of Specific Research BD 1200000 VUT 2010).

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LOCATION OF INCEPTION POINT ON LOW GRADIENT STEPPED SPILLWAYS

Miroslav Spano[1], Vlastimil Stara[2]

Abstract

Stepped chutes have been constructed on several water structures in the Czech Republic. The main advantage of these structures is large energy dissipation which results in smaller dimensions of stilling basin downstream. The main disadvantage is flow bulking caused by aeration and therefore the necessity to propose higher side walls of the chute. Very important task here is to find the location of inception point where the aeration of flow starts. Within a framework of hydraulic research on stepped chutes performed in Brno University of Technology a location of inception point on two low gradient steeped chutes was investigated. The paper summarizes results from this research.

Key words

Stepped chutes, aeration of flow, inception point.

1 INTRODUCTION

There are 17 important dams equipped with stepped chutes in Czech Republic [1]. All of them had been built at the beginning of 20th century. A good example is a stepped chute on the Bystřička dam, see Fig 1.

The main advantage of stepped chutes is energy dissipation which positively affects dimensions of stilling basin. The dissipation is higher in order of tens percent compared to a smooth chute, see [2] or [3]. Also, the cavitation risk is decreasing thanks to self aeration of flow. Presence of air concentration near to the solid surface (i.e., 4 to 8%) prevents cavitation damage, see [4]. And, a strong oxygenation of flow increases the water quality ([5] and [6]). Construction technology of cascades is compatible with slipforming and RCC (roller compacted concrete) placing methods. Therefore, no additional technologies are needed during construction.

The main disadvantage of stepped chutes is the flow bulking due to the aeration. This must be considered when proposing side walls. A higher dynamic straining of the step edges belongs

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to disadvantages too. The proposal of stepped chutes is more complicated in comparison with smooth chutes because a strong aeration combined with several flow regimes have to be considered.

Fig. 1) Upstream view on stepped spillway of the Bystřička dam (taken by Povodí Moravy, s.p.).

Within this study the location of inception point (where the aeration starts) had been measured and assessed. Measurements were performed on two scaled hydraulic models built in the Laboratory of hydraulic research at the Brno University of Technology. Each model represents a low gradient stepped chute. Within the work presented all dimensions and results are recounted to the real.

2 HYDRAULIC MODELS AND EXPERIMENTAL SETUP

Two hydraulic models had been built. Both were scaled in length scale $M_L = 20$ with respect to dominance of gravity forces, flow over spillway was modelled according to Froude similarity. The first model represents a true stepped chute on the Bystřička Dam. Slope of this chute is $\alpha = 13.5°$. Basic step height and length are $h = 1.25$ m and $l = 5.03$ m respectively. Detailed description of the model can be found in [7]. The second model represents a chute with simple sharp edged steps. Its slope is $\alpha = 10.0°$. Height of steps is $h = 0.6$ m and length of steps is $l = 3.4$ m. Twelve steps were modeled with simple smooth approaching part.View on both models is shown in Fig. 2.

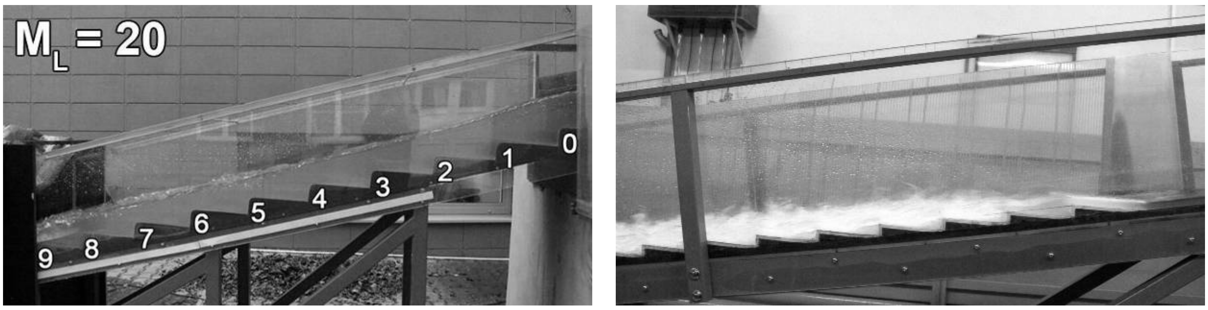

Fig. 2) View on the models, right: first model (Bystřička dam), left: the second model.

The flow on the model is provided by a water supply circuit of the laboratory. The discharges were controlled with an induction flow-meter. The precision of this equipment is ±1.5 %. The water levels were measured using a point gauge. Precision of measurement was determined to ±3 mm. The exact location of inception point was estimated using an image analysis of the photos taken.

3 LOCATION OF THE INCEPTION POINT

The point where the aeration starts is called the inception point. The aeration starts when the turbulence intensity of flow is high enough to overcome gravity and surface tension forces, see [8]. The location and type of air inception mainly differs with flow regime reached. Three flow regimes are known at stepped chutes. Those are the nappe flow regime, transition flow regime and skimming flow regime, see [5]. Within this study the results for skimming flow regime are presented since most of real chutes are designed for this regime.

The location of inception point is generally computed from regression function upon statistical evaluation of measurements. Here, Chanson [5] recommends following formulas for computation of inception point location.

$$L_I = a \cdot k_s (\sin\alpha)^b \cdot F*^c \tag{1}$$

$$d_I = a \cdot k_s (\sin\alpha)^b \cdot F*^c \tag{2}$$

$$F* = \frac{q_w}{\sqrt{g \cdot \sin\alpha \cdot k_s^3}} \tag{3}$$

where L_I is distance of the start of growth of the boundary layer to the inception point of air entrainment [m], d_I – water depth at inception point [m], q_w – unit discharge [$m^2.s^{-1}$], $g = 9.81$ $m.s^{-2}$ – gravity acceleration [$m.s^{-2}$], α - channel slope [rad], k_s – chute roughness [m], F* - Froude number defined in terms of the roughness height [-], a, b, c – regression coefficients (note that values of regression coefficients in formulas (1) and (2) are not the same). Values of these coefficients presented in [5] are valid for steeper chutes mainly ($25° < \alpha < 50°$).

4 RESULTS AND DISCUSSION

The exact measurement of L_I is not easy (sometimes even impossible) due to inflow conditions at the chute, see [7]. Therefore, in this case the L_I was expressed as a distance between the first step brink and the location of inception point. According to [7], the role of inflow conditions at the first step brink is significant. More turbulence intensity at the inflow leads to earlier aeration of flow. So, the effect of inflow conditions should be taken into account. Upon information above and results of measurement reached (see below), formulas (4) and (5) were introduced for computation of inception point location respecting the flow conditions at the first step brink.

$$L_I = a \cdot \frac{F*}{Fr_1^2} + b \tag{4}$$

$$d_I = a \cdot \frac{F^*}{Fr_1^2} + b \qquad (5)$$

$$Fr_1 = \frac{q_w}{\sqrt{g \cdot \sin\alpha \cdot y_1^3}} \qquad (6)$$

where Fr_1 is Froude number at the first step brink [-], y_1 – water depth at first step brink measured perpendicularly to pseudobottom [m].

Results of measurements are summarized in Table 1. Graphical relation of L_I and d_I as a function of Froude numbers ratio are shown in Fig. 3 and Fig. 4 respectively.

Tab. 1) Measured locations of inception point.

Chute	Q	q	y_1	Fr_1	F*	F^*/Fr_1^2	L_I	d_I
	$m^3.s^{-1}$	$m^2.s^{-1}$	m				m	m
α = 13.5°, h = 1.21 m, l = 5.03 m, k_s = 1.32 m	71.75	5.13	0.85	4.32	2.24	0.12	9.15	0.48
	101.36	7.24	1.30	3.23	3.16	0.30	14.76	0.70
	107.33	7.67	1.31	3.38	3.35	0.29	13.85	0.83
	177.38	12.67	1.85	3.33	5.53	0.50	27.79	1.29
α = 10.0°, h = 0.60 m, l = 3.40 m, k_s = 0.59 m	17.89	1.83	0.23	12.73	3.09	0.02	4.40	0.28
	26.83	2.75	0.28	14.21	4.64	0.02	5.20	0.30
	35.78	3.67	0.38	11.99	6.18	0.04	6.40	0.36
	44.72	4.58	0.48	10.55	7.73	0.07	7.40	0.52
	53.67	5.50	0.52	11.23	9.27	0.07	8.00	0.56
	62.61	6.41	0.64	9.60	10.82	0.12	9.20	0.64
	72.09	7.39	0.74	8.89	12.46	0.16	10.00	0.70

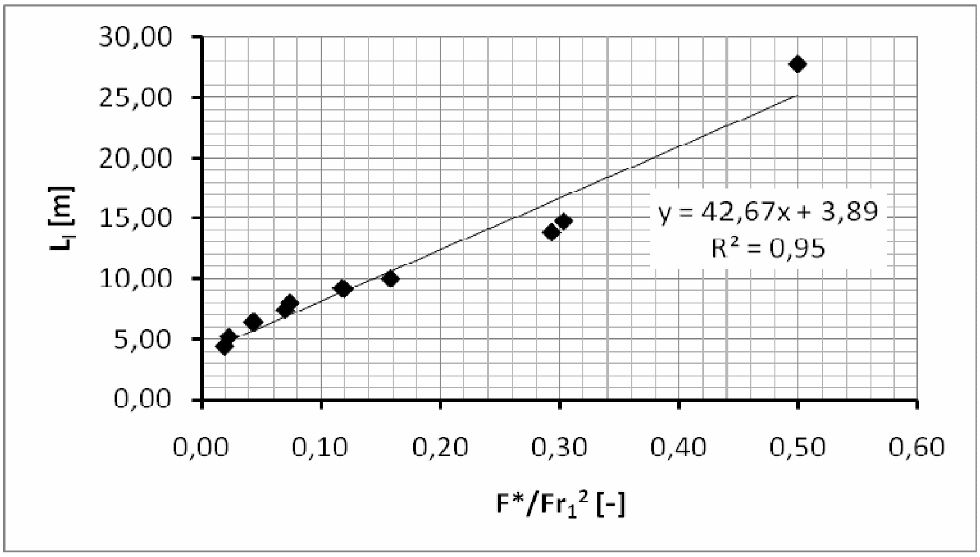

Fig. 3) Distance between the first step brink and the location of inception point as a function of Froude numbers ratio.

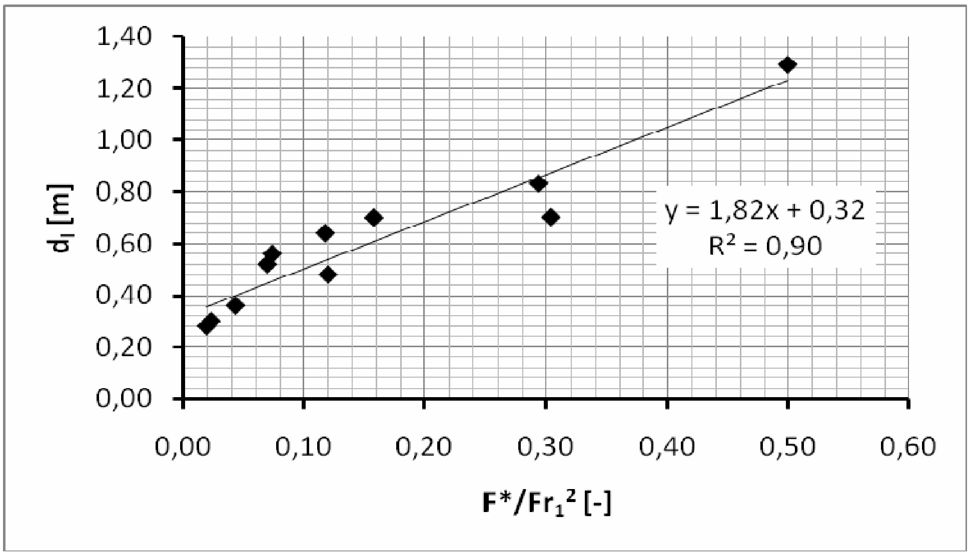

Fig. 4) Water depth at inception point as a function of Froude numbers ratio.

Results from experiments shows that formulas (4) and (5) might be used for prediction of inception point location. Table 2 summarizes values of regression coefficient used in these formulas.

Tab. 2) Values of regression coefficient used in formulas (4) and (5).

L_I		d_I	
a	**b**	**a**	**b**
42.67	3.89	1.82	0.32

Since proposed formulas are linear it has some limitations obviously. Those were determined upon measurements performed. Limitations for use of formulas (4) and (5) are as follows:

- skimming flow regime is reached on the chute,
- the chute gradient is low, $10° < \alpha < 13.5°$,
- supercritical flow occurs at the first step bring, $3.2 < Fr_1 < 14.2$.

5 CONCLUSION

Within the hydraulic research performed on two stepped chutes the location of inception point was investigated. Results of measurement showed that the inflow conditions significantly affect the aeration on the chute. Therefore, new formulas (4) and (5) were introduced for estimation of the inception point location. However, simple linear dependence between inception point parameters (L_I and d_I) and flow parameters (Froude numbers ratio) has obviously some limitations. These are also presented within this study.

6 ACKNOWLEDGEMENT

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WATER MANAGEMENT ACTIVITIES IN THE SAVA DRANAGE BASIN IN CROATIA

Marija Šperac[1], Anamarija Grgurovac[2], Jasna Zima[3]

Abstract

The Sava river basin is a major drainage basin of the Suoth Estern Europe covering the total area of the 97 713 km^2. The Sava river basin area is shared between four countries: Slovenia, Croatia, Bosnia and Herzegovina and Serbia. Water way mostly doesn't regulate. It caused flooding area from time to time.Major characteristics of these drainage basin are extremly biological and landscape variety. Paper provides the characterization and assesment of water resources in the Sava river basin , including an additional consideration of the important issues such as flood management and development of navigation in the basin. The great project in area is project for multipurpose Danube-Sava canal .This project is very significant for traffic and economic connection of Sava basin, Danube basin and Jadran in Croatia and in other graviteted areas.

Key words

The Sava river basin, water management, navigation, flood protection, nature park

1 INTRODUCTION

The Sava has the largest discharge of water to the Danube of any tributary and is the second largest by catchement area.

The Sava is shared by Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro and the joint management arrangements will be a pilot example for the implementation of the European Union's Water Framework Directive for the Danube and Europe. (Fig. 1)

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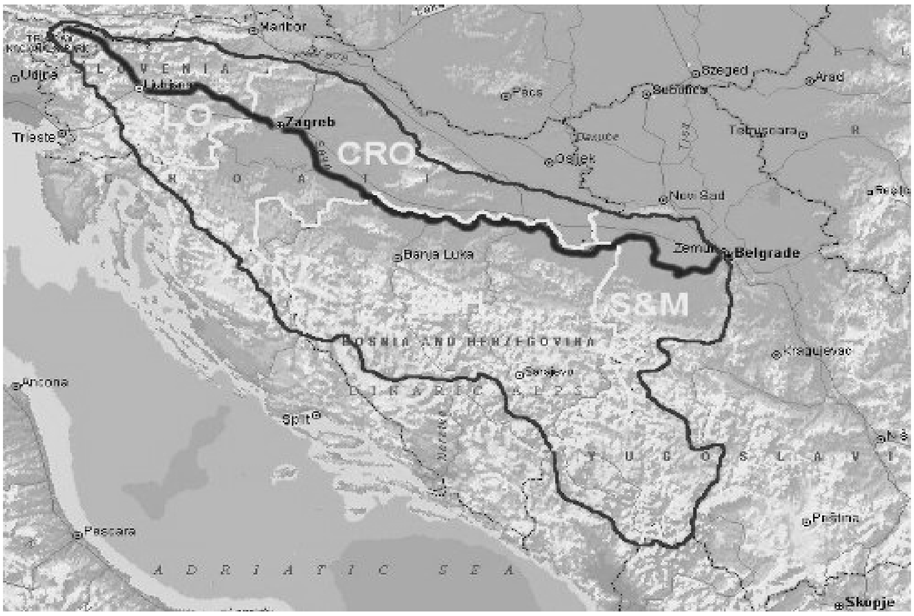

Fig. 1) The Sava drainage basin

The Sava rises in the mountains of western Slovenia, and passes through the lowlands of Croatia before forming the border between Croatia and Bosnia and Herzegovina. Continuing through Serbia, it reaches its confluence with the Danube in Belgrade (with an average flow of 1.564 m^3/sec). Its main sub-tributaries are the Krka, Kupa, Una, Vrbas, Bosna, Drina and Kolubara. The Sava basin has a size of 95.419 km^2, which makes it the second largest after the Tisza basin.

The Sava River basin, including its tributaries, covers nearly half the territory of the Republic of Croatia (25.374 km2), an area in which approximately one half of Croatian population resides (2.2 mil),and forms a 313 km long border with the Republic of Bosnia-Herzegovina . To preserve the desired water quality of the Sava and its alluvium in the entire territory, it is crucial to control pollution from major cities, such as Zagreb and Slavonski Brod, as well as from agricultural surfaces and farms in the fertile Pannonian plane. Naturally, it is equally important that the Sava entering Croatia from the Republic of Slovenia is of adequate water quality. The Lower Sava is vitally influenced by its tributaries from Bosnia-Herzegovina - the Una, Vrbas and Bosna Rivers.

All settlements in the Sava alluvium use groundwater resources for water supply, whose quality is endangered by sewage and solid waste from large towns, farms, agriculture and transport. Floods or draughts often endangers large surfaces of arable land surrounding smaller rural settlements, whereas the risk from accidental spills and illegal dumping is significant.

The Sava connects three European capitals: Ljubljana in Slovenia, Zagreb in Croatia and Belgrade in Serbia.

2 WATER MANAGEMENT ACTIVITIES

2.1 Navigation and traffic

The Sava is navigable for 593 km, from its confluence with the Danube until the mouth of the Kupa at Sisak. Smaller crafts can navigate further upstream until Zagreb, but the plans of dredging it to become fully navigable are scrapped. The river is open for international flowing and conditions with regard to available depth are varying according to the meteorological circumstances.

The Sava Valley is also a natural route for land traffic, which includes the railway and highway Belgrade-Zagreb and routes of oil and gas pipelines from Croatia to Serbia. As a result of all this traffic and densely populated and industrialized areas it flows through, the river is very polluted and not much has been done to improve its conditions.

Fig. 2) Water way on the Sava

With the digging of the channel Vukovar - Šamac, the river Sava acquires greater importance in the traffic connection of Europe and the Adriatic Sea. This fact is very important for the development of other contents on the river Sava and in Slavonski Brod, such as the harbour and the warehouse, the shipyard etc. The multi-purpose canal will be used for shipping, irrigation, drainage and low-water management. The new canal will shorten the waterway between Croatia and Western Europe by 417 kilometres, and by 85 kilometres to Eastern Europe. [1]

2.2 Flood management

Hystorical development and existing status of the flood protection system in the Sava river basin [2]

- Partial local flood protection measures before sixties;
- Large floods during sixties;
- Holistic approach in the WATER MANAGEMENT PLAN FOR THE SAVA RIVER BASIN, UN, Polytechna - Hydroproject, Prague & Carlo Lotti, Rome, 1972;
- Main Objectives:

  - adequate flood protection of urban, rural and agricutural areas,
  - drainage and irrigation of agriculture areas,

- navigation,
- energy production;

Development of flood protection system during seventies and eighties (40 % of planned system is finished);

- The concept of using lowland, naturally inundated areas in any future solution for flood protection as well has been favourably evaluated by ecologists. Part of this lowland area in Croatia, with an area of about 50.000 ha was in 1990. proclaimed the Lonjsko Polje Nature Park;
- New moments and proposals in the ENVIRONMENTAL IMPACTS STUDY OF THE MIDDLE POSAVLJE SYSTEM, 1999;
- Project "Inland Waters" - Futher Development of the System.

2.3 Nature Park Lonjsko Polje

Nature Park Lonjsko Polje is located in the central part of the Croatia, bounded by the slopes of Moslavačka Gora and the highway Zagreb-Slavonski Brod on the north side, and the Sava River on the south side. (Fig. 3)) On the surface of 50.650 ha alternate landscapes of meadows and pastures with riparian lowland forests and old oxbows. It is composed of three fields: Lonja field, Mokro and Poganovo and ornithological reserves Krapje Đol and Rakira.

Nature Park is the largest protected area, not only in Croatia but also in the Danube River basin, which is included in Ramsar List of Wetlands on the 3rd February 1993. Rivers Sava, Una, Kupa, Lonja and Struga meet on the area of Nature Park. The Dynamics of these rivers are very complex, therefore, in this area floodings are unpredictable and may occur at any time of year.

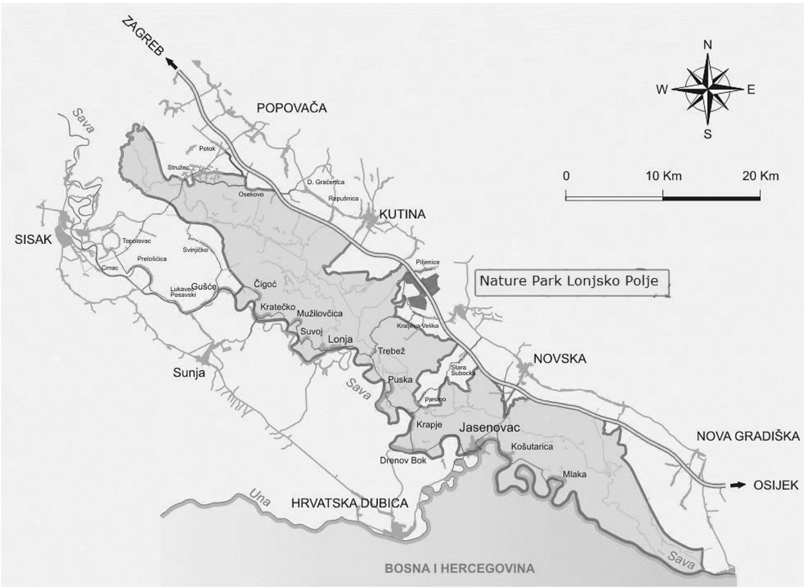

Fig. 3) The spatial location of Nature Park Lonjsko Polje

In the area from the confluence of Sutla and Sava to Mačkovac near Gradiška, on a yearly average 205.000 ha of land are flooded, in a 50 year event 280.000 ha were flooded and in

100 year event 292.000 ha. Of the total flooded areas on the Lonjsko Polje goes 132.650 ha, and in Mokro Polje 35.200 ha. Accumulation retentive capacity of 50-year high water was estimated to 1.780 hm3, a 100-year-old high water 1.975 hm3. Flooding areas are located between the elevation 85 and 138 m.s.l. There are 22 river oxbows throughout the Nature Park, located near the main flow and most of them don't have direct connection with the river Sava, and they are not subject to effects of floods, but only action of rainwater and groundwater. Water is the ruler of the Lonja field, and it can be operated only by combining the wisdom and professional work. Lonja Field is located in Central Posavina region where the climate is moderately continental. In some years periods of drought and periods of high precipitation can appear. According to its Lang's rain factor the area has the characteristics of a humid climate. [3]

The system of flood control depends on the dynamics of flooding, which must meet the requirements of all users of space, provide security from floods, conserve space and time for spawning fish, conserve biodiversity and function of alluvial wetlands, preserve and maintain traditional agriculture and natural and cultural heritage of Lonjsko Polje. In the present state of development of flood protection 53% of estimated space are qualified for the controlled manipulation of water management, and there are 219% more retention space for the uncontrolled collection than they would be in the final stage of development of the system. Two sluices have been built, Prevlaka and Trebež, a spillway on the Odra Canal and two framework dykes along the Lonjsko Polje, Mokro Polje and Kupčina. Overall 40% of the planned works are performed. Changes in water levels on the river Sava in the present state of development in relation to the natural state of water at frequencies of 1%, were estimated for the water-profile Crnac (Sisak) -11 cm, Jasenovac +29 cm and Mačkovac -28 cm. Trends in mean values of maximum flow are in a narrow range of 1.685-2.353 m^3/s. The aim of building this system is to control high water in order to protect against high water. One of the system benefits is such that in the dry season when there is a requirement, forest retention properties can be flooded occasionally. Reducing flood provides a better development of plant communities, the achievement of optimum moisture in the soil, and improve overall water regime. It is possible to preserve value of the Lonjsko Polje only by reasonable use which includes the use and management of the river Sava catchment area, whose task is to ensure the least possible effect on the natural balance, biodiversity and landscape diversity.

Fig. 4) Wetland area of Nature Park Lonjsko Polje

2.4 Pilot River Basin Plan for Sava River

This project improves management of the Sava river basin and establishes cooperation mechanisms between the countries belonging to in three pilot river basins located in Bosnia-

Herzegovina, Croatia and Serbia-Montenegro in particular. It harmonizes methodologies for implementing the EC Water Framework Directive (WFD). [4]

The project enhances water management cooperation among Sava countries using an integrated water management approach as outlined in the EC WFD and the International Commission for the Protection of the Danube River (ICPDR) issue papers. The project has among others successfully:

- Facilitated co-ordination of the WFD-related support projects in the Sava basin (CARDS Regional with CARDS national, EAR Serbia and Montenegro, GEF Sava and others);
- Supported the capacities of the Sava Commission being responsible for trans-boundary coordination of water management activities in the Sava River Basin;
- Trained and strengthen personal and institutional capacities in B&H, Croatia and S&M needed for the preparation of Sava RBM Plan and implementation of WFD;
- Implemented key principles of WFD in three pilot rivers aiming at identifying a harmonized methodology that can be applied in a generic style to other sub-basin of Danube river basin in general and Sava river basin in particular;
- Identified synergies between this project and other ongoing projects relevant for the implementation of WFD in the Sava river basin (UNDP/GEF project aimed at developing Sava RBM Plan, CARDS national projects, EAR's projects in S&M; ISPA project in Slovenia, etc.);
- Raised awareness and knowledge about the EU-WFD in the beneficiary countries in general and among the local water users in particular

3 CONCLUSION

The Sava river basin is a major drainage basin of the Suoth Estern Europe covering the total area of the 97.713 km2. It conect four countries, integrated water management activities is necessary for developement in basin. Many international organizations with different projects are include in water management in Sava drainage basin. [5]Especially dimension of this basin is natural park Lonjsko Polje.

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NITRATE CONTAMINATION OF GROUNDWATER: DETERMINANTS AND INDICATORS

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Abstract

Nitrogen is an important input to agricultural production but also detrimentally affects the environment. Using data on more than 1000 Austrian municipalities, we provide a statistical analysis of (1) the determinants of nitrate concentration in groundwater, and (2) the predictive abilities of the Nitrogen Balance as agri-environmental indicator. We find that the proportion of cropland exerts a positive effect on the nitrate content in groundwater. Also environmental factors are found to be important. Higher average temperature and higher average precipitation lead to lower nitrate pollution of groundwater. We also show that the Nitrogen Balance proves to be a good predictor for nitrate pollution, but its predictive power can be improved if average precipitation of a region is accounted for.

Keywords

Nitrate concentration, groundwater, Nitrogen Balance, agriculture, regression analysis

1 INTRODUCTION

Excess supply of nitrate in agricultural production can lead to environmental damage, causing contamination of the air, soil as well as (ground)water. Choosing appropriate policy measures to tackle the problem of nitrate contamination is challenging, since the determinants of nitrate pollution of groundwater are not obvious [1-4]. We provide a systematic, statistical analysis of the determinants of nitrate contamination of groundwater in Austria. We constructed a comprehensive data set on the Austrian situation and aim to point out factors which should be taken into account when designing policy measures. This includes agricultural practices prone to pollute the quality of groundwater and the role of certain external factors such as weather conditions or soil characteristics.

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To formulate policy objectives, monitor policy compliance and effectiveness a meaningful criterion is needed [4-6], such as the agri-environmental indicator - the Nitrogen Balance - provided by OECD. As mentioned in OECD (2008) "this calculation can be used as a proxy to reveal the status of environmental pressures (...)" [7]. As the Nitrogen Balance is a theoretical concept and as such captures the potential nitrate pollution in a region, it is “not necessarily indicative of actual resource depletion or environmental damage” [7]. Consequently, the pressing question arises to which degree the indicator is capable of reflecting actual nitrate pollution effects. Does the Nitrogen Balance provide an indication as to the level of actual nitrate pollution?

In the next section we introduce our data sources, the calculation of the Nitrogen Balance, and methodological issues. Then, present a statistical analysis of the determinants of nitrate concentration in groundwater. In section 4 we investigate the predictive power of the Nitrogen Balance by linking it with measured nitrate concentration levels in Austrian groundwater. We conclude in section 5.

2 DATA, CALCULATION AND METHOD

The concentration of nitrate in groundwater in mg/l is provided by the Umweltbundesamt [8]. This data is available on a quarterly basis from 01/1992 to 04/2008 on municipality level in Austria. The cross section dimension consists of 1238 municipalities. We aggregate the quarterly values to annual average values for each municipality (*Nitrate*). We are presented with an unbalanced panel data set, i.e. nitrate concentration is not available for every time period in each of the municipalities.

We include data on precipitation in mm (*Precip*) and the maximum temperature in °C (*Temp*) provided on a daily basis for the years 1975 to 2007 by ZAMG (Zentralanstalt für Meteorologie und Geodynamik) [9]. We aggregate the weather observations to annual average values for each municipality.

The Integrated Administrative and Control System (IACS) database provides information on cropland (in hectares) for approximately 70 crops, and information on farming systems (conventional or organic) on farm level on an annual basis for the years 1999 to 2008 [10]. We aggregate these crops into four crop groups: (i) oil seed and protein crops, (ii) cereal and maize crops, (iii) row crops and vegetables, and (iv) arable grassland. These groups are aggregated on municipality level and included into our regression models as proportion of total municipality territory (*Landuse_j*). The sum of the proportion of permanent grassland and the proportion of cropland is referred to as agricultural land (*Prop_AL*). The indicator for organic or conventional farming practices (*Cult*) takes a value between 1 and 2, where 1 represents the organic and 2 the conventional farming system.

Finally, we integrate two indicators of soil quality: Field water capacity (*fwc*) at 33 kPa in topsoil (cm3/cm3) and the volume of stones in topsoil (*vs*). Both variables are taken from the European digital soil map [11] which provides several data entries per municipality. We aggregate these values on municipality level and assume the values to be time-constant. A high field water capacity implies less leaching. The volume of stones in topsoil is an indicator for the permeability of the soil. Summary statistics of the relevant variables are reported in Table 1.

Using the described data, we calculate the Nitrate Balance (*NBal*) in kilogram nitrogen per hectare agricultural land on a municipality level for the years 2003 through 2007 on the municipality level according to the OECD and EUROSTAT Gross Nitrogen Balance Handbook [12]. The indicator is computed as total nitrogen inputs minus total nitrogen outputs. Total inputs are the sum of (i) biological nitrogen fixation (nitrogen fixed in the soil), (ii) atmospheric deposition of nitrogen compounds, (iii) livestock manure, and (iv) mineral fertilizer. Total nitrogen outputs include most importantly withdrawals of harvested crop- and grassland commodities.

To conduct the analysis we perform regression analysis. Since many of our explanatory variables are (almost) time constant, we apply a clustered pooled Ordinary Least Squares (OLS) estimator with White standard errors to account for possible heteroscedasticity in the data. Standard errors are then clustered by the cross-section dimension as observations of one particular municipality over a period of time are not independent [13]. To analyze the predictive power of the Nitrate Balance in section 4, we use fixed effect estimation.

3 DETERMINANTS OF NITRATE CONCENTRATION IN GROUNDWATER

We investigate the degree to which particular land use and farming systems are related to nitrate concentration in groundwater.

$$\begin{aligned} Nitrate_{it} = {} & \beta_0 + \beta_1 Precip_{it} + \beta_2 Temp_{it} + \beta_3 Cult_{it} + \sum_j \beta_{4j} Landuse\_j_i \\ & + \beta_5 fwc_i + \beta_6 vs_i + \sum_k \beta_{7k} Year_{kt} + \varepsilon_{it} \end{aligned} \tag{1}$$

$$\text{where}$$

$$j \in \{oilseed\ \&\ protein, arableland, cereal\ and\ maize, rowcrops\ \&\ veg, grassland\}$$

$$and\ k \in \{1999,\ldots,2008\}$$

The results are reported in Table 2. Estimating equation (1), we find that all crop types exert a statistically significant positive effect on nitrate contamination of groundwater, except the proportion of arable grassland. We also find that municipalities with more conventional farming systems experience significantly higher levels of nitrate in groundwater. This is expected, due to more intense use of mineral fertilization in conventional agriculture.

Municipalities where precipitation levels are high, experience lower nitrate levels in groundwater. Increased rainfall fosters crop growth and in consequence nitrogen uptake. Also, high precipitation sums could control for the geographical location of the municipality. Alpine municipalities (mostly located in the provinces of Salzburg, Tirol or Vorarlberg) have average annual precipitation sums higher than the Austrian average. As there is less agricultural activity at high altitudes, one would expect lower nitrate concentrations in these regions.

The average maximum temperature exhibits a negative effect on nitrate concentration, which suggests that in municipalities with higher temperature, higher evapotranspiration rates and biomass production takes place that in turn reduces leaching of nitrate into groundwater [14].

4 THE NITROGEN BALANCE INDICATOR AND ACTUAL POLLUTION

4.1 Fixed Effects

To investigate how well the Nitrogen Balance and its components respectively capture nitrate content in groundwater we consider a fixed effect panel estimation. The following equations are estimated for the years for which the Nitrogen Balance could be calculated (i.e. 2003-2007):

$$Nitrate_{it} = \alpha_i + \beta_0 + \beta_1 Precip_{it} + \beta_2 Temp_{it} + \beta_3 NBal_{it} + \varepsilon_{it} \tag{2}$$

$$Nitrate_{it} = \alpha_i + \beta_0 + \beta_1 Precip_{it} + \beta_2 Temp_{it} + \beta_3 Fert_{it} + \beta_4 Withd_{it} + \varepsilon_{it} \tag{3}$$

The results, reported in Table 2, indicate that the Nitrogen Balance is a suitable indicator to predict actual environmental pollution. High values of the indicator are associated with high nitrate concentration in groundwater. Quantitatively though, the Nitrate Balance explains relatively little of observed nitrate concentration in groundwater. The estimated coefficient of β_3 implies that an increase of the average Nitrate Balance indicator by 10 kilogram nitrate results in an increase of only 0.35 milligram per liter in nitrate concentration of groundwater.

We also assess the effect of its separate components (equation 3), concentrating on the measure of fertilization (nitrogen input) as well as withdrawal by harvested crops and forage (nitrogen output). As expected, we find a positive influence of nitrogen input and a negative one of nitrogen output on observed nitrate concentration. Also weather related factors are important in explaining nitrate concentration in groundwater, as already discussed in the previous section.

4.2 Accounting for Fixed Effects

We account for the fixed effects of the previous regressions by including site-specific characteristics and assess whether the Nitrogen Balance performs better as a proxy for actual environmental pollution once these site specific characteristics (proportion of agriculturally used land, soil quality and farming systems of the respective municipality) are taken into account. We estimate the following regression equations using the technique of clustered pooled OLS:

$$\begin{aligned} Nitrate_{it} = {} & \beta_0 + \beta_1 Precip_{it} + \beta_2 Temp_{it} + \beta_3 PropAL_{it} + \beta_4 Cult_{it} + \beta_5 fwc_i + \\ & \beta_6 vs_i + \beta_7 NBal_{it} + \sum_k \beta_{8k} Year_{kt} + \varepsilon_{it} \\ & \text{where } k \in \{2003,\dots,2007\} \end{aligned} \tag{4}$$

We find that the Nitrogen Balance exerts a statistically significant positive effect on Nitrate concentration and suggest that it is a suitable indicator for nitrate concentration in groundwater. We also assume that site specific variables might play an important role in determining the predictive power of the Nitrogen Balance. To test this hypothesis, we introduce interaction terms into the regression equation:

$$Nitrate_{it} = \beta_0 + \beta_1 Precip_{it} + \beta_2 Temp_{it} + \beta_3 PropAL_{it} + \beta_4 Cult_{it} + \beta_5 fwc_i + \beta_6 vs_i + \beta_7 NBal_{it} + \beta_8 NBal_{it} \cdot Feat_{it} + \sum_k \beta_{9k} Year_{kt} + \varepsilon_{it} \quad \text{where } k \in \{2003,\ldots,2007\} \tag{5}$$

The variable *Feat* captures characteristics, such as precipitation, temperature, farming systems, volume of stones or field water capacity. The results demonstrate that of all exogenous factors only precipitation is crucial when determining the explanatory potential of the Nitrogen Balance (cp. Table 2). If high average precipitation is observed, the Nitrogen Balance does particularly well in predicting environmental problems, i.e. the marginal effect of the indicator is significantly influenced by the level of precipitation.

5 CONCLUSION

We identify likely determinants of nitrate contamination of groundwater. We find that increased agricultural activity (especially if crops are conventionally cultivated) leads on average to higher nitrate concentration in groundwater. Additionally, environmental factors such as weather and soil quality play an important role. Higher average temperature and higher average precipitation as well as a high level of field water capcity lead to lower nitrate pollution of groundwater.

Nitrate pollution from agricultural land uses is usually considered to be a non-point source pollution problem and specific polluters are hard to identify and depend on site specific factors. Thus, agri-environmental indicators are required that establish the functional relationship between pollution and agricultural activity in the context of site characteristics to allow effective policy regulation.

The Nitrogen Balance has been identified by the OECD as a priority agri-environmental indicator, meant to measure the potential damage to the environment through nitrate excess.

We assess the explanatory power of the Nitrogen Balance when it comes to measuring actual pollution levels. We find that the indicator exerts a positive influence on nitrate levels in groundwater, and thus conclude that it is a good predictor for environmental pollution.

In addition, we find that the predicitve power ofthe indicator can be improved when specific environmental conditions are taken into account. We find that the higher average precipitation in the region, the more useful is the indicator as a predictive tool. Our analysis suggests that the indicator should be enriched with these site characteristics if its purpose is to predict actual environmental pollution. This idea is also supported by the quantitatively relatively small effect of the Nitrate Balance on observed nitrate pollution, discussed in Section 4.

ACKNOWLEDGEMENT

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7 APPENDIX

Tab. 1) Summary Statistics of relevant variables.

Variables	Measurement unit	Observations	Time Period	Mean	St. Dev.	Min	Max
Nitrate	mg/l	15423	1992-2008	20.62	28.69	0.00	801.21
Precip	mm	14169	1992-2008	2.78	1.30	0.96	10.84
Temp	Degree Celsius	14169	1992-2008	12.58	2.65	3.22	23.54
Landuse_oilseed&prot.	%	9974	1999-2008	0.03	0.04	0.00	0.33
Landuse_arablegrass	%	7856	1999-2008	0.04	0.04	0.00	0.61
Landuse_cereal&maize	%	7856	1999-2008	0.19	0.21	0.00	3.57
Landuse_rowcrops&veg	%	7856	1999-2008	0.02	0.05	0.00	0.80
Prop_AL	%	9974	1999-2008	0.46	0.31	0.00	5.20
Cult	1 - 2	9228	1999-2008	1.87	0.21	1.00	2.00
fwc	cm3/cm3	1087	time constant	0.38	0.04	0.27	0.47
vs	%	1087	time constant	8.63	4.07	1.00	15.00
Nbal	kg/ha	4870	2003-2007	39.99	24.05	-28.24	143.69
Fert	kg/ha	4870	2003-2007	99.20	42.98	0.08	181.92
Withd	kg/ha	4870	2003-2007	99.76	29.88	0.02	172.61

Tab. 2) Results of Regression analysis (equation 1-5).

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Nitrate	Nitrate	Nitrate	Nitrate	Nitrate
Precip	-0.649**	-0.274***	-0.286***	-2.287***	-3.546***
Temp	-1.022***	-0.257***	-0.246***	-1.310***	-1.294***
Fwc	-104.5***			-203.3***	-202.7***
vs	0.119			0.164	0.175
Cult	2.949*			6.149***	5.708***
Landuse_oilseed&protein	65.60*				
Landuse_arablegrass	24.21				
Landuse_cereal&maize	24.61***				
Landuse_grassland	56.63**				
NBal	-15.94***	0.0347***		0.0654***	-0.0275
Fert			0.0350***		
Withd			-0.0261**		
Prop_AL				18.36***	18.28***
Precp* Nbal					0.0366**
Constant	60.39***	20.17***	20.59***	95.52***	98.94***
Observations	7036	4811	4811	4423	4423
Adjusted R-squared	0.30	0.95	0.95	0.24	0.24

* p < 0.1, ** p < 0.05, *** p < 0.01

GEOGRAPHICAL APPROACH TO FLOOD RISK ANALYSIS

Martina Zeleňáková[1]

Abstract

Natural disasters such as floods have constituted a major problem in many countries worldwide. In recent years, the growth of population and diffusion of settlements over flood vulnerable areas have increased the impact of the floods worldwide. Floods have caused immense economic and social losses, mainly as a result of unplanned urbanization, uncontrolled population density and not strictly inspected construction by authorities. The main aim of this paper is to present way of flood risk map generating for decision makers by using the effective factors causing floods.

Key words

Floods, type of soil, geographical information systems

1 INTRODUCTION

In the last decade, Slovakia is increasingly affected by floods. Floods constantly point to the fact that the company is very vulnerable to flooding. These floods have been recorded in substantial material damage and there are exceptional cases of loss of human life. Only in the last 11 years have caused floods in Slovakia, the loss of 54 lives and affected more than 2500 villages and towns. From the flood reports processed by Slovak Hydrometeorological Institute it is clear that the flood damage suffered by the streams in Slovakia, in different river basins managed by the Slovak Water Management Enterprise, s. c. were affected far right in eastern Slovakia. Scope and extremity of flood episodes point to the need to build a comprehensive proposal eventually completion of flood protection measures in potential flood areas. Since man is unable to prevent hydrological cause of flooding, it must calculate the risk of floods and minimize its impact. For this reason it is necessary to determine the best characteristics of potential flooding, so that the possible effective draft of floods mitigation and floods protection measures. To assess the degree of flood protection and appropriate measures are currently applied data collection and evaluation and assessment of their confidence in the methods of risk analysis, which consists of flood risk assessment in the watersheds, so that the risk to determine the potential of this area. Proposal for flood protection measures are fully devoted to the management of flood risk. The main objectives of management determine the Directive of the European Parliament and Council Directive 2007/60/EC on the assessment and management of flood risks.

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The main objective of this paper is to assess flood risk in river basins in the eastern Slovakia for the management. The paper deals with addressing the issue of risk assessment of floods in river valleys in the eastern Slovakia and the objective is to characterize the flood risks in the area with the chosen method.

2 MATERIALS AND METHODS

The method of flood risk assessment at the eastern Slovakia at river basins Hornád and Bodrog is based on an assessment of two main factors influencing the formation of flooding. These are the kinds of soils of the selected area (the permeability) and annual rainfall in the area. Using the risk matrix is determined the acceptability of risk in the selected area. This method of risk assessment is carried out by the ArcGIS program.

2.1 Hornád and Bodrog river valley

The morphological type of terrain in Hornád river valley is dominated by rolling hills, highlands and lower highlands. The southern sub-basin is part of a plane and Slovak Kras and is formed by moderately higher rugged highlands. Geological structure of the territory determines the hydro-geological conditions of the basin. We meet here with all the geological formations from palaeozoic to quaternary. Sub-basin of the Hornád valley can be assigned to areas with a strong predominance of impervious, respectively poorly permeable rocks with moderate to low permeability. Well-drained rocks with high permeability are only in Spiš and Gemer areas and in Slovak Kras near Košice.

Territory of Bodrog basin is located in two orographic subassemblies, which are the Carpathians and Pannonian Basin. The morphological type of the relief is predominantly plane in the southern part, hilly in the northern part. Bodrog river valley has varied climatic conditions. Precipitations are highly differentiated. The highest annual totals are mainly at east border mountains and Vihorlat where rainfall totals is about of 1.000 mm. Decrease of total precipitation is quite intense direct to the south - annual totals fall to below 800 mm. Lowland part of the Michalovce - Lastomír and Medzibodrožie belong to among the driest in the eastern region (550 mm rainfall per year).

2.2 Causes of floods

The cause of flooding is extremely heavy rains or rapid melting of snow combined with a significantly reduced ability to detain stormwater in areas (mainly because of damage of the country – e.g. drained wetlands, farmland, and drainage) [1]. Extensive concrete surfaces in towns contribute to the rapid runoff of rain waters and desertification under the built-up areas, including the reduction of groundwater supplies and climate change in cities. These factors cause changes in runoff ratio and increase the risk of local flooding. The dried soil without erosion measures (such as arrays of tens of hectares of area without any vegetation, whether erosion measures) acts as an impermeable layer. The damaged area can thus easily rise to flood wave, which is within a few tens of minutes, respectively hours raise to 3 or 4 meters, at the creek where the water level is usually 20 or 30 cm. Bridges are at risk because of their possible obstruction at the time of torrential rain. The problems in the basin are not culverts and bridges, but the damaged country which can not retain rainwater.

Previous long-term applied technological processes and the way of water management in the country causes acceleration of runoff water from our territory. This is the common denominator of the causes of flooding.

Among the factors that affect flooding include: the shape of the basin, the size of the basin, inundation area, rainfall, soil type and permeability, forestation areas, land use, etc.

3 RESULTS

The primary impulses of torrential floods are usually extremely intense precipitation which falls in the short term for relatively small and sharply defined area (several km^2). Despite the relatively high density of precipitation stations in Slovakia (700) is almost certain that through this network measurements can be recorded only about a third of extremely high short-term totals. Cores storm with peak rainfall usually have less than 3 km diameter, but rain gauge stations are spaced an average of 8 km.

The total catchment's hydrological response to intense rainfall is determined by its natural environment, a whole complex of characteristics of the river basin. Dominant factors represent a set of variables, for example area and shape of the basin, slope and orientation of slope, slope length and flow, river network density, relief dissection, hydro-geological structure, soil and vegetation cover, retention capacity of the basin, and more. Some of them may be a process initiated by the torrential rain even accelerate, respectively amplified. The intensity and frequency of precipitation events, which are capable of extreme runoff and subsequent flooding in Slovakia during recent years has increased significantly.

End of the second and the beginning of the third millennium has brought to the region of the eastern Slovakia in the short term many large floods with devastating consequences. The damage caused by floods is a common effect of two independent mechanisms natural conditions and maybe more - the human activities in the basin.

3.1 Flood risk assessment in the model territory

In the analyses, some of the causative factors for flooding in watershed are taken into account as annual rainfall, size of watershed, basin slope, gradient of main drainage channel, drainage density, land use and the type of soil [2]. A case study of flood vulnerable areas determination in Hornád and Bodrog river basins in Slovakia is employed to illustrate this approach.

Basically two phases are applied in this study to analyse the flood vulnerability: to determine the effective factors causing floods and to apply several approaches to multi-criteria evaluation in a geographical information systems (GIS) environment to evaluate in finding the flood vulnerable areas. The first step in determining the factors is on the basis of an analysis of existing studies and knowledge. A criterion is a basis for a decision that can be measured and evaluated [3]. Then map layers representing the criteria and referring to as criterion maps are produced. A GIS application is used for managing, producing, analyzing and combining spatial data. The data needed in this study are produced from collected or existing data by using different kinds of spatial functions and analysis.

Assessment of flood risk for the purposes of this paper is based on soil type and annual precipitation in the model area.

In this step, the flood risk in Hornád and Bodrog river valley was assessed on the basis of two main factors influencing the emergence of flooding - the annual rainfall and soil types. The evaluation was carried out using the matrix method of risk.

The model area was represented by soil types divided into five classes - see Tab. 1), Fig. 1).

Tab. 1) Soil types

Soil types	Content of clay particle	Class
predominantly sandy	1-10%	1
mostly loam-sandy	10-30%	2
predominantly loam	30-45%	3
mostly clay-loam	45-60%	4
clay	more than 60%	5

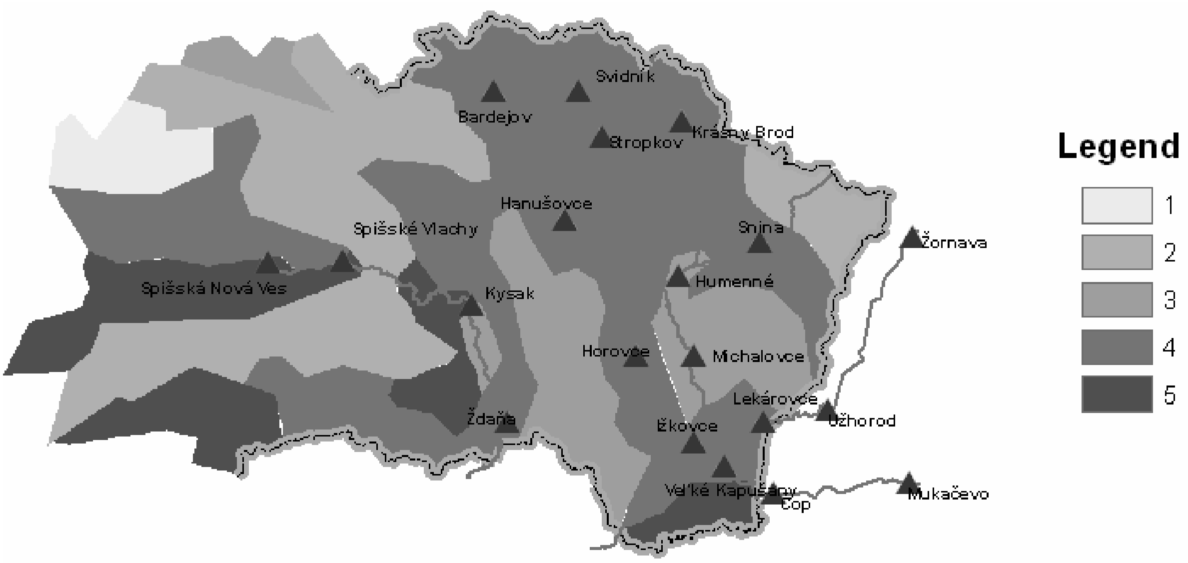

Fig. 1) Soil types in eastern Slovakia

In terms of average annual precipitation the area was divided into five classes - see Tab. 2), Fig. 2). Rainfall means all forms of precipitated water falling from air to ground - rain, snow, hail, dew, etc. Their number is given by the amount of water in millimetres (1 mm height of water equivalent to 1 litre of water from the surface of 1 m^2).

Tab. 2) Annual precipitation

Parameter	Class
0-600	1
600-800	2
800 - 1200	3
1200 - 2000	4
more than 200	5

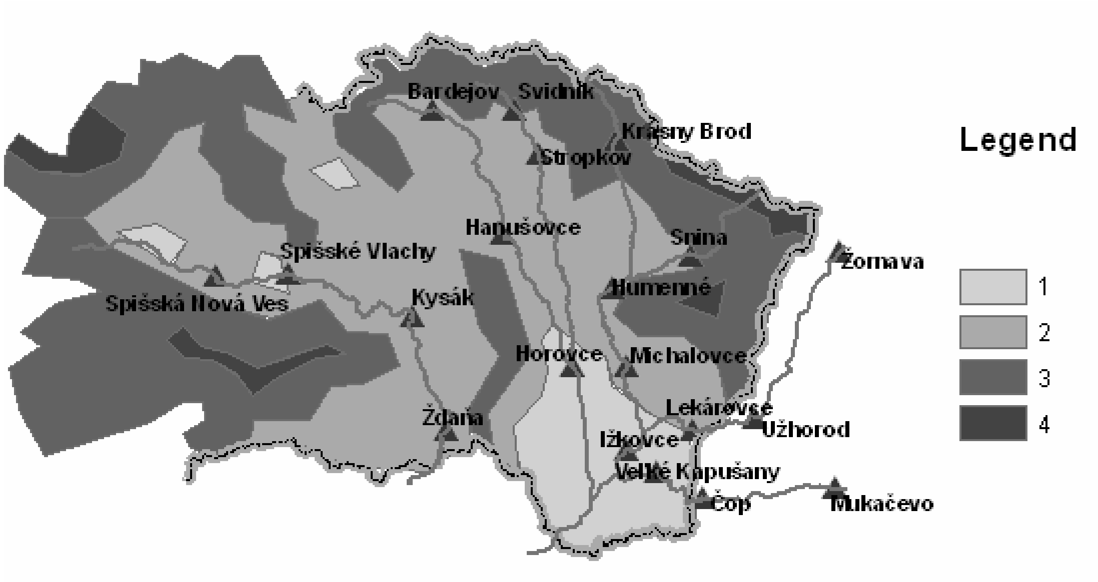

Fig. 2) The annual rainfall in eastern Slovakia

In deciding whether the level of flood risk is acceptable or unacceptable, was assessed annual rainfall and soil type in Hornád and Bodrog basins. An example of such an acceptance of flood risk assessment risk matrix is shown in Tab. 3).

Tab. 3) Flood Risk Assessment Matrix [4]

Annual precipitation	**Soil types**				
	1	2	3	4	5
1	acceptable	acceptable	acceptable	moderate	moderate
2	acceptable	acceptable	moderate	moderate	undesirable
3	acceptable	moderate	moderate	undesirable	undesirable
4	moderate	moderate	undesirable	undesirable	unacceptable
5	moderate	undesirable	undesirable	unacceptable	unacceptable

Graphic presentation of the results of the flood risk assessment is carried out using the ArcGIS software [5]. For each river basin is the acceptability of the risks indicated by a colour matrix of risk acceptance based on risk assessment - see Fig. 3).

The flood risk assessment showed that almost at the whole of eastern Slovakia is the flood risk moderate, which means that there is a need for constant monitoring of the situation. In the northern part of eastern Slovakia – Bardejov, Svidník, Stropkov, Snina and Humenné there is undesirable flood risk as well as in Hornád basin - especially in Ždaňa, Kysak, Spišská Nová Ves. In these areas it is necessary to design flood protective measures to reduce the risk of flooding. Only in the minimum of assessed area the flood risk is acceptable.

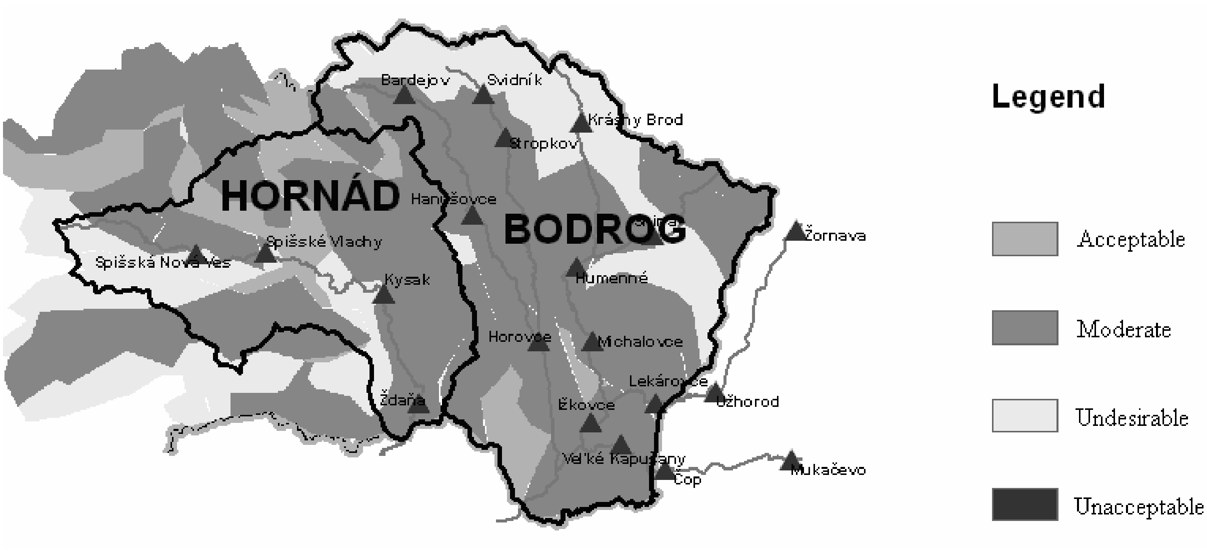

Fig. 3) Map of flood hazard areas

4 CONCLUSION

Geographic approach to flood risk assessment provides a descriptive presentation of the results obtained. Created thematic maps show the suitability of using ArcGIS software wherever it is necessary to make quick and effective decisions in emergency relief efforts for flood protection needs. People must learn to live with floods in the future. The value of the property threatening flooding is increasing. Therefore, attention must focus on the whole society to prevent and protect itself from big water to reduce or damage minimized.

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THE ENVIRONMENTAL IMPACT ASSESSMENT WORLDWIDE

Lenka Zvijáková[1], Martina Zeleňáková[2]

Abstract

The Environmental Impact Assessment (EIA) process, which originated in the United States in the late 1960s and early 1970s, has been adopted extensively in the rest of the world. The U.S. model and that of other developed countries share basic principles and reflects commonly agreed-upon approaches to similar problems. Development in the issues in the assessment of environmental impact is still positive, upward trend. Presented contribution provides an overview of EIA procedures employed by a variety of countries, to establish an appreciation of the extent to which EIA has been absorbed into decision-making structures, and to give insight into the variety of ways in which EIA can be undertaken.

Key words

Environmental Impact Assessment (EIA), process, EIA procedures, countries, world

1 INTRODUCTION

Constructing roads and airports to improve transportation services, building dams to supply water, and establishing power plants to generate electricity are all necessary for people to have a comfortable life. However, no matter how necessary those development projects are, the negative impacts on the environment must be considered and the project justified in relation to environmental considerations. It is therefore very important in the design stage of a project to take into account not only the social and economic aspects of the project, but also environmental protection considerations. These issues are addressed to some extent by effective EIA [1].

EIA is now applied worldwide. Its potential role in attaining sustainable development objectives was explicitly recognized during the 1992 Earth Summit held in Rio de Janeiro (United Nations 1992).

EIA can be broadly defined as the systematic identification and evaluation of the potential impacts (effects) of proposed projects plans, programmes or legislative actions relative to the physical – chemical, biological, cultural and socioeconomic components of the total

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environment [2]. EIA is a planning tool that is now generally accepted as an integral component of sound decision-making. The objective of EIA is to foresee and address potential environmental problems/concerns at an early stage of project planning and design. EIA systematically examines both beneficial and adverse consequences of the project and ensures that these effects are taken into account during project design. It helps to identify possible environmental effects of the proposed project, proposes measures to mitigate adverse effects and predicts whether there will be significant adverse environmental effects, even after the mitigation is implemented [3].

EIA process, which originated in the United States in the late 1960s and early 1970s, has been adopted extensively in the rest of the world. The U.S. model and that of other developed countries share basic principles and reflects commonly agreed-upon approaches to similar problems. While EIAs in developing countries are based on the same set of principles, their implementation often falls considerably short of international standards. They frequently suffer from insufficient consideration of impacts, alternatives, and public participation. In the worst case, they are not conducted at all [4].

The paper provides an overview of EIA procedures employed by a variety of countries, to establish an appreciation of the extent to which EIA has been absorbed into decision-making structures, and to give insight into the variety of ways in which EIA can be undertaken.

2 SOURCES OF INFORMATION ABOUT EIA

For those with access to electronic communications, further information about EIA procedures worldwide can be obtained from the Internet. If you use the search parameter "Environmental Impact Assessment" you will find thousands of “hits". However, there are two particularly useful sites that will provide links to a variety of EIA information related to the activity and procedures in particular countries, as well as that related to the theory and practice of EIA. First there is the homepage of the University of Manchester Impact Assessment Research Centre (at <www.sed.manchester.ac.uk/research/iarc/>). This site identifies a range of information assembled by the Centre, such as EIA Newsletters, EIA Centre publications, a list of Centre training activities and documents regarding developing country initiatives in EIA. In addition, the International Association for Impact Assessment (at <www.iaia.org>) provides information on international organisations involved in EIA. There is also information related to electronic networks and EIA contacts to facilitate the development of networks which support EIA training and processes. In particular, it provides links to professional interest sites and environmental learning exchanges that outline international experience and practice [11].

A list of key EIA agencies and organisations can be found below in. This contact list is general and selective. International organisations of relevance to EIA can divide on [6]:

- *United National Organisations*
- *Organisation for Economic Co-operation and Development*
- *Multi-National Aid Agencies and Development Banks*
- *International NGOs*
- *International & National Agencies*

Further dissemination might take place at an international level through certain EIA networks identified below.

3 SOURCES EIA STATUS WORLDWIDE

The field of environmental impact assessment has been evolving rapidly worldwide. Figure 1 compares the relative status of EIA by continent [5].

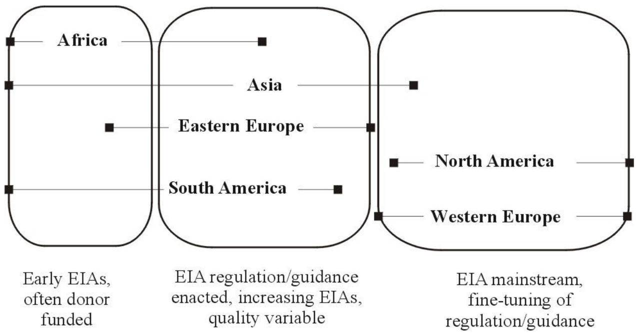

Fig. 1) Current status of EIA systems worldwide [5] adjusted by authors

Since its conception in the late 1960s, governments in more than 100 countries have adopted provisions for the implementation of EIA as a means to scrutinize the technical and environmental options of development projects and hence alleviate their potential negative impact [7].

The high level meeting of the African Ministerial Conference on the Environment (AMCEN) on Environmental Impact Assessment in Durban June 1995 was a landmark event in the development of EIA in *Africa*. In 2000, a consultative meeting on Environmental Assessment Capacity Development in Africa was held in The Hague during which the Capacity Development and Linkages for Environmental Impact Assessment in Africa (CLEIAA) was formed. It is therefore noteworthy that the CLEIAA initiative was realized in response to a priority action identified at the AMCEN meeting. It has been instrumental in facilitating Africa wide discussions and consultations on the trend, status, challenges, and way forward for EIA capacity building in Africa [8].

Feedback obtained from some African countries and a desk review of the institutional and regulatory frameworks for EIA in 23 African countries showed that all countries have established administrative bodies for EIA. The majority of countries (18 out of 23) have an enabling legislation and / or specific legislation/regulations on EIA in place. Even though the Namibia EIA bill is still in draft, the country's Mining and Petroleum Acts of 1992 and 1991 respectively, require Proponents to conduct EIAs. Ten of these countries have explicit formal provisions for public participation [8].

All countries in *South and Central America* have environmental protection legislation that includes requirements for at least some aspects of EIAs. Specifically, in South America the development of EIAs has been hampered by political instability, inefficient bureaucracy, economic stagnation, and external debt [9].

The European Union (EU) currently comprises 27 member states. The states have extremely varied institutional structures and decision-making mechanisms based on centuries of independent development. For this reason, the legal measures implemented by the various member states differ tremendously even where the required outcomes are identical. Most states produce legislation at a national level, but a significant number have a greater degree of regional autonomy with devolved law making powers [10].

It follows from the information provided by member states that the number of EIAs carried out in member states varies significantly from state to state. As for the overall number of EIAs carried out between years 2002-2006, the figure is comparatively low for Austria (25-30 EIAs are carried out annually), and very high for France (around 5,000 EIAs), Germany (more than 1,000 EIAs) and Sweden (1,600 EIAs) [12].

The countries of Southeastern Europe (Albania, Bosnia and Herzegovina, Croatia, Kosovo UN, Macedonia, Montenegro, and Serbia) have relatively less developed EIA systems, but they also are starting to harmonize their EIA legislation with that of the EU [4].

The process of environmental impact assessment in the conditions of *Slovakia* is regulated by Act 24/2006 Coll. on environmental impact assessment and on amendment to other laws. In 2008, the Slovak Ministry of Environment issued 189 final position statements to the proposed activities [13]. The environmental impact assessment in the *Czech Republic* (hereinafter referred to as the EIA and SEA processes) is regulated by Act No. 100/2001 Coll., on Environmental Impact Assessment, as amended, which superseded the original Act No. 244/1992 Coll.

Figure 2 lists the screening approaches applied in the Slovakia and Czech, as well as certain features closely related to the screening method, such as the legal context of EIA regulations, EIA authority and type of and administrative framework for EIA procedures.

Country	EIA Legislation	EIA Authority	EIA procedure National/Sectoral/Regional	Screening Tools Types	Lists	Thresholds	case-by-case analysis
Slovakia	National Level	Ministry of Environment	EIA procedures under land-use planning procedures.	2-level procedures for Annex I part A –compulsory and Annex I part B screening Need for the full (detailed) EIA for Annex I – part B projects is determined by the initial (preliminary) EIA's results.	1 List (2-columns table)	Columns A (compulsory EIA) and B (screening)	Column B projects below or in-between threshold values
Czech Republic	National	Ministry or Provincial authorities under land use planning	under land use planning regulations	*Fact-finding* procedure and Full EIA	2 lists	both lists	second list (projects requiring *factfinding* procedures)

Fig. 2) Screening approaches applied in SR and CR, [14] adjusted by authors

EIA regulations were established in most *Asian countries* in the 1980s and 1990s. The Asian countries vary in terms of legislation, ranging from none (Myanmar), to very recent and not widely applied legislation (Laos and Cambodia), to extensive and robust EIA regulation set within a broader planning framework (Japan, Hong Kong, South Korea) [4]. Within the Asian-Pacific area EIA has a reasonably wide acceptance, and most of the larger countries have some procedures in place. The strength of the evolution of EIA in the region can be seen in the growth of discussion about EIA and associated networks of professionals and practitioners [11].

4 COMPARATIVE ASSESSMENT OF EIA SYSTEMS IN ANY COUNTRIES OF THE WORLD

The importance and benefits of monitoring and auditing in the EIA process has been repeatedly highlighted in a wide range of literature. Most comparative EIA studies have focused on Southeast Asia, Western Europe and, to a lesser extent Latin America and in the Middle East and North Africa (MENA) region [7]. Tab. 1 gives an overview of the evaluation of EIA system in the world.

Tab. 1) Evaluation of EIA systems, [7] adjusted by authors

Source	Continent/region	Title of article/book
Asian Development Bank (1997)	South Asia, Southeast Asia, Pacific Islands	Environmental Impact Assessment for Developing Countries in Asia
Bond and Wathern (1999)	European Union (EU)	Environmental impact assessment in the European Union
Briffett (1999)	East Asia	Environmental impact assessment in East Asia
Brito and Verocai (1999)	South and Central America	Environmental impact assessment in South and Central America
Clark and Richards (1999)	North America	Environmental impact assessment in North America
Kakonge (1999)	Africa	Environmental impact assessment in Africa
Rzseszot (1999)	Central and Eastern Europe and the former USSR	Environmental impact assessment in Central and Eastern Europe
Wood (1999)	Comparison between selected countries	Comparative evaluation of environmental impact assessment systems
Glasson and Salvador (2000)	EU, United Kingdom (UK)	EIA in Brazil - a procedures-practice gap. A comparative study with reference to the European Union, and especially the UK.
Lee and George (2001)	Almost all continents	Environmental assessment in developing and transitional countries
ESCWA (2001)	Western Asia	A study on the evaluation of environmental impact assessment in selected ESCWA countries
Cherp (2001)	Central and Eastern Europe and the former USSR	EA legislation and practice in Central and Eastern Europe and the former USSR: A comparative analysis.
Espinosa, Alzina (2001)	Latin America, Caribbean	EIA in Selected Countries of Latin America and the Caribbean: Methodology, Results and Trends
World Bank (2002)	Europe and Central Asia	Environmental impact assessment system in Europe and Central Asia Countries.

World Bank (2006)	East and Southeast Asia	EIA regulations and strategic environmental assessment requirements: Practices and lessons learned in East and Southeast Asia.
Ahmad and Wood (2002)	MENA	A comparative evaluation of the EIA systems in Egypt, Turkey and Tunisia
CITET (2003)	METAP Countries	Working together to strengthen the environment: strengthening EIA systems in the Mediterranean Region
K. El-Fadl and M. El-Fadel (2004)	Middle East and North Africa countries	Comparative Assessment of EIA Systems in MENA Countries
Mayer and others (2005)	EU	Projects subject to EIA, D 2.4 Report WP 4
Economic Commission for Africa (2005)	African Countries	Review of the Application of Environmental Impact Assessment in Selected African Countries
Rebelo and Guerreiro (2006)	Kenya, Tanzania, Mozambique and EU	Comparing EIA procedures and contents in Kenya, Tanzania, Mozambique and EU
Ahmed (2008)	US, WB, EU	A comparative Study of International EIA Guidelines and the Sudan EIA Experience
Hayashi (2008)	Japan, England, Canada and South Korea	How to Improve Japanese EIA legislation by Utilizing International Experience
Jennifer C. Li (2008)	Southeast Asia - the Mekong River Basin countries	EIA in Developing Countries: An Opportunity for Greater Environmental Security?
YESA (2008)	Bolivia, Mozambique, Ukraine and Vietnam	A Comparative Review of Environmental Assessment Practice in Bolivia, Mozambique, Ukraine and Vietnam

Cross country evaluation of EIA systems is implemented the world in any country and states.

5 CONCLUSION

The governments of the vast majority of industrialised and industrialising nations have adopted EIA procedures. There is considerable variety in the way in which these procedures are applied, but they all have broadly the same intent; to assess potential effects before proceeding with actions. Well functioning institutions and appropriate regulatory frameworks and procedures are important prerequisites to the effective application of EIA worldwide.

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THE THROUGHPUT OF THE DRAINAGE-RETAINING CHANNEL BOTONEGA IN ISTRIA, CROATIA

Elvis Žic[1], Ivan Marović[2], Nevenka Ožanić[3], Ivana Sušanj[4]

Abstract

The drainage-retaining Botonega Channel represents one of the most significant water-managing facilities of the Istrian peninsula. The Botonega Channel original purpose was the protection against high waters from the Botonega accumulation as well as external waters of streams Zamask, Zigante, Senica, Matisko and St. Cirijak streams. The Channel is closely related to the overall water flow regime and throughput of the lower and central Mirna River basin. The Channel's main purpose today is the irrigation of the Mirna River downstream areas. The appearances of high waters in the last two decades have caused major hydrological problems in wider catchment area of the Mirna River. The Botonega accumulation and the Botonega evacuation channel played a very important role in reducing large water waves, particularly in the central and lower part of the Mirna River basin. Basic characteristics of the throughput capacity of the drainage-retaining Botonega Channel in winter and summer time are shown in this paper as well as are the significant appearances of its deformability during last ten years. Measures and criteria for the throughput capacity increase of the channel and decrease of its erosive activity are also presented.

Key words

the Botonega Channel, throughput, erosion, vegetation, irrigation, rehabilitation measures

1 INTRODUCTION

The drainage-retaining Botonega Channel is located in the central part of the Istrian peninsula, close to the Botonega accumulation (Figure 1). The Botonega toponym has a two basic versions: Butoniga and Botonega (Bottonega). The Butoniga toponym is older and means „left tributary“ [1]. Toponym Botonega (Bottonega) appears later, in the Venetian Republic period, meaning "rapidly flooding” or torrential watercourses.

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The Botonega accumulation was designed as a multifunctional water-management facility for the purpose of protection against floods (approx. $2*10^6$ m^3) and irrigation of agricultural lands in the Mirna River Valley (approx. 17.500 ha) in the function of drainage-retaining Botonega Channel [2]. With a total capacity of $19,7*10^6$ m^3 Botonega accumulation represents a major hydro-technical facility in terms of water richness in the area of the Mirna River basin [1,2]. The construction of the Botonega accumulation proved very efficient particularly during the big flood periods (November 1991, October and December 1992, September 1993, August 2002) when it protected the drained agricultural lands in the central and down part of the Mirna River basin and all water facilities against disastrous incoming water waves that reached the maximum average hourly flow rate of 301,4 m^3/s [1].

The drainage-retaining Botonega Channel plays a major role in terms of evacuation of large waters from the Botonega accumulation. The Channel is bound to the total water regime and the lower and the central part of the Mirna River basin discharge. The propagation process and forming of the flood waves are highly influenced by solutions of large waters evacuation through the Botonega Channel and by its maintenance over the year. It has been observed that the channel flow can vary a lot depending on the state of vegetation cover. Similarly, years-long maintenance works and cleaning of the channel caused the flow to increase which can be proved primarily by higher water levels and larger quantities of released water from the Botonega accumulation [3,4].

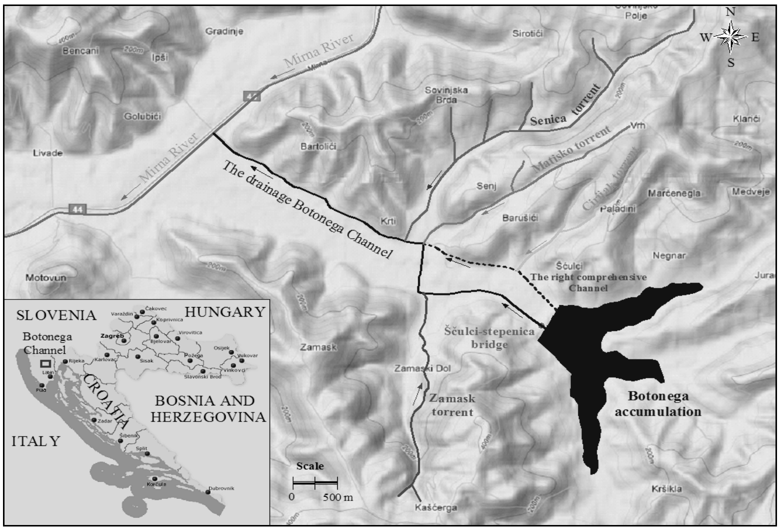

Fig. 1) General layout of the drainage-retaining Botonega Channel with belonging lateral tributaries

2 GEOMORPHOLOGIC CHARACTERISTICS OF THE BOTONEGA CHANNEL

The drainage-retaining Botonega Channel was built in 1971 according to the main project "Protection against outer waters of the Botonega Valley". The Channel represents the main drainage basin of outer waters (Zamask, Žiganti, Senice, Matisko, St. Cirijak torrents and belonging watershed) and evacuation organs of the Botonega dam (Figure 1). The Project envisaged that the drainage Botonega Channel would evacuate the flow almost 100 m^3/s (if we take into account also outer waters) during a 20-year reflective period.

Overall channel length includes the length from the water level recorder Ščulci-Stepenica (nearby the Botonega dam, chainage 6+012,93 km) to the confluence of the Mirna River (chainage 0+000,0 km) which is shown in Figure 1. From chainage 0+000,00 to 3+769,67 km, the design flow rate of the Botonega Channel is 98,54 m^3/s (beside the roughness coefficient n=0,027 $m^{-1/3}s$), from 3+769,67 to 4+443,15 km it is 76,29 m^3/s, from 4+443,15 to 6+165,90 km it 55,5 m^3/s, while from chainage 6+197,00 km the flow rate is 60,93 m^3/s [2].

The drainage-retaining Botonega Channel is typical and complex trapezoidal earth channel with inundations on both sides. According to the original project, the Botonega Channel has three characteristic sections. Up to the distance of 3+769,67 km, the profile is complex, with 3,0 m wide bottom, 1:2 slopes, 6,0 m sides and 3,0 m wide left defence bank. The Channel bottom slope at this section is I_1=1,3 ‰. There are two 1,03 m high stairs at this section. From chainage 3+769,67 km to 4+443,15 km the Channel bottom slope is I_2=1,0 ‰, the Channel width is 3,0 m and slope is 1:2. The third section of the Botonega Channel (from chainage 4+443,15 km to 6+029,0 km) is characterised by I_3=1,5‰ bottom slope, 3,0 m wide bottom and 1:2 slopes. The left and the right sides of the inundations are 4,0 m wide. The Botonega Channel was built of earth material (clay), the slopes and embankments are covered with grass, while the stairs, a part of the channel under the bridge and the confluence in the Mirna River, as well as confluences of larger torrents, are coated with concrete six-sided prisms. Today's natural channel is characterised by extremely changeable bottom slope along the flow, while its geometry on cross sections significantly changed with respect to the original project profiles (Figure 2). The Botonega Channel has two small stairs with altitude difference of 1,03 m (chainage 2+078,00 km) i.e. 1,04 m (chainage 2+950,00 km). The Channel tortuousness is not that pronounced. However, two extremely sharp turns of the Channel (chainage 3+800,00 km and 4+500,00 km) and nine mild curves are dominant. Rush changes of the flow course in the Botonega Channel are caused by the inflow of the lateral tributary Zamask (chainage 4+500,00 km) and by the right retaining channel (chainage 3+800,00 km).

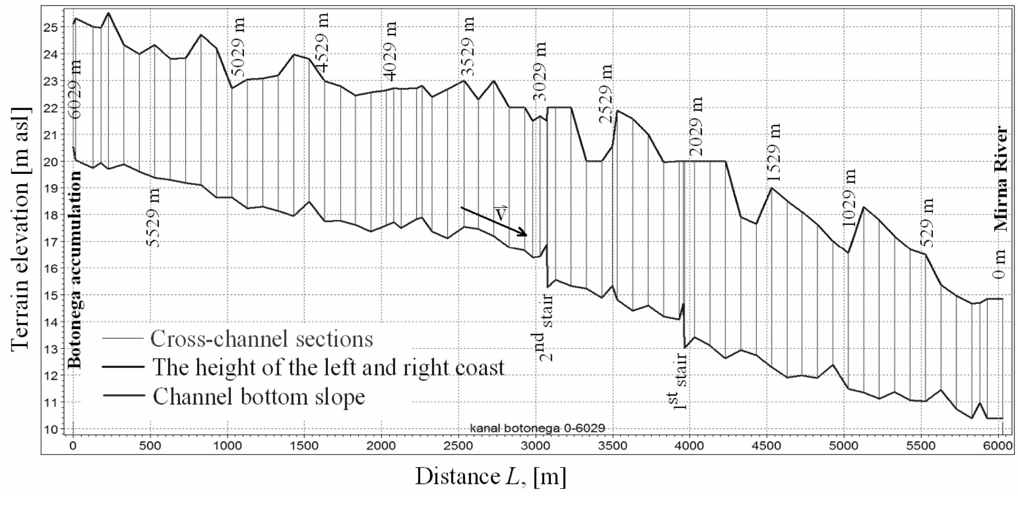

Fig. 2) Longitudinal view of the Botonega Channel bottom slope (current natural riverbed)

Geometric changes of the Botonega Channel depend on large waters periods in winter and autumn and they are manifested by periodic channel expansion and shrinking. Such systematic channel expansion or shrinking is a consequence of a permanent exchange of water regime and deposits which are formed due to changes in confluence (Figure 3).

Fig. 3) Water erosion influence on mild curves of the Botonega Channel

Granulometric composition significantly influences the longitudinal slope along the Botonega Channel. Due to reduced grain size along the Channel, the drift moves more and more in form of suspension. Geometric changes of cross profiles of the Botonega Channel depart less from design profiles for the upper channel flow. Large deformability of the Channel in the lower flow, shown in Figure 3, is the consequence of the settlement of its slopes caused by larger throughput water quantities which fill the Channel from lateral inflows [5,6].

3 HYDRAULIC RESEARCH ON THE BOTONEGA CHANNEL

In the area of the Botonega Channel very little systematic scientific researches have been conducted and works published regarding discharge determination. The measurements of the state weather department of the Republic of Croatia (*Meteorological and Hydrological Service*, *DHMZ*) which have been continuously carried out on the Botonega Channel, reveal that 55 m^3/s flow foreseen by the design is not sufficient for the evacuation of large waters from the Botonega accumulation. To that effect, we started to do researches which would re-examine hydraulic characteristics, including primarily the harshness of the Botonega Channel, and their influence on the capacity, that is, the water throughput in the Channel. Further reason for the aforementioned testing were more emphasized influences of the seasonal changes on the Channel plant cover.

The Botonega Channel is not influenced by the sea surge. It is partly controlled by two hydrological water gauges, one of which, the water gauge Motovun, has been in use since 1977 while the water gauge on the Porton bridge, since 1971. The above two water gauges have preformed a lot of water measurements (in different hydrological and hydraulic conditions) for the purpose of defining consumption curve. The most important variable sizes that affect the development of the Channel are the bottom material fleshiness, sediment transfer, longitudinal channel slope and the relationship *B/H* between width and depth of the cross section [5,7]. In terms of throughput reduction of the Botonega Channel, an important role is played by the vegetation and material that formed the Channel (Figure 4).

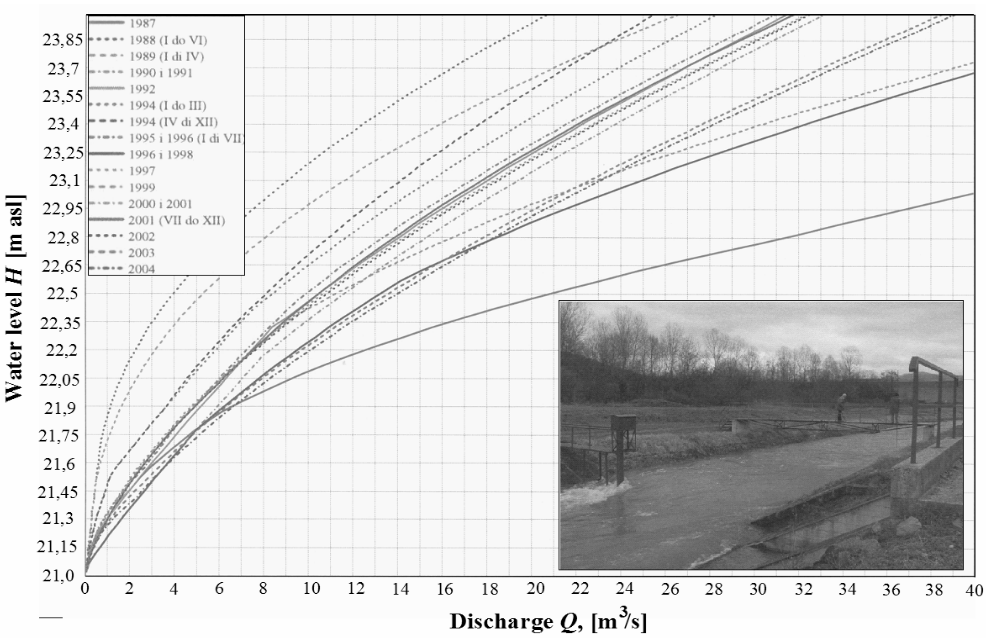

Fig. 4) Consumption curve on the water gauge Ščulci-Stepenica profile

Within the scope of the Botonega Channel throughput determination, five series of flow measurements depending on the amplitude of water level were conducted (Table 1). Hydraulic measurements were performed during 10-hour period from 8 to 18 hours at various sluice gate openings on the occasion of water discharge from the Botonega accumulation that took place on. By means of the computer program MIKE 11 (1D numerical model for unsteady flow), the kinematical analysis of changes in geometric and physical quantities in the Botonega Channel according five measuring series of drainage-retaining Botonega Channel were performed [8]. In continuation of this work, only some of the most significant physical quantities that are important for the present state of the Botonega Channel are analysed.

For the flow rate Q_2=17,202 m^3/s the flow velocity range is about 1,44÷3,04 m/s, at the flow rate Q_3=9,924 m^3/s it ranges between 0,961÷3,01 m/s, at the flow rate Q_4=6,043 m^3/s it ranges between 0,726÷3,0 m/s and for the flow Q_5=2,01 m^3/s it ranges between 0,375÷2,78 m/s. In some places, speed values that were created in order to reduce horizontal surface that was formed as a result of channel slopes slumping are quite high. By numerical simulation model with five different measurements of flow and roughness coefficients (from n=0,015 to n=0,07 $m^{-1/3}s$), the average velocities between 1,3÷2,0 m/s were obtained. Such velocities are too high for earth channels, therefore it is no surprise that many points of the Botonega Channel are subject to erosion. The speed should not be higher than 1,0 m/s thus, it is recommended that the Botonega earth channel be wider with milder slope, allowing a possible installation of additional stairs [6].

Tab. 1) Flow measurement on the measurement bridge Ščulci Stepenica, the Botonega Channel, (Chainage 6+012,93 km), Date of measurement: March 02 2008 (DHMZ Service)

Station name	Stream	Date of measurement	Water-level (cm)	Throughput (m^3/s)	Average velocity (m/s)	Flow area (m^2)	Sluice-gate opening (m)	Water level in the accum. Botonega (m asl)
ŠČULCI STEPENICA	BUTONEGA 1st measurem.	02.03.2008.	188	20,674	1,30	15,90	0,80	39,25
ŠČULCI STEPENICA	BUTONEGA 2nd measurem.	02.03.2008.	168	17,202	1,20	14,30	0,65	39,20
ŠČULCI STEPENICA	BUTONEGA 3th measurem.	02.03.2008.	119	9,924	1,00	9,80	0,35	39,13
ŠČULCI STEPENICA	BUTONEGA 4th measurem.	02.03.2008.	88	6,043	0,85	7,10	0,20	39,11
ŠČULCI STEPENICA	BUTONEGA 5th measurem.	02.03.2008.	37	2,010	0,50	4,10	0,05	39,11

Great variability of flow speed in the Botonega Channel is the result of significant changes in the flow area along the flow which can be characterized as the impact of attrition. The largest changes of flow area on the existing natural bed appear in places of hydraulic jump (two specific water stairs). Flow areas are within the range of 3,32÷14,56 m^2 at flow rate Q_1=20,674 m^3/s, 2,71÷13,33 m^2 at flow rate Q_2=17,202 m^3/s, 1,57÷10,33 m^2 at flow rate Q_3=9,924 m^3/s, that is, between 1,05÷8,32 m^2 for the flow of Q_4=6,043 m^3/s and 0,46÷5,36 m^2 for the flow Q_5=2,01 m^3/s [6].

Hydraulic analysis shows that Manning roughness coefficient varies along the Botonega Channel depending on the water depth and different measured flows. The average value of roughness coefficient n at flow rate Q_1=20,674 m^3/s is n_1=0,0303 $m^{-1/3}s$, at flow rate Q_2=17,202 m^3/s it is n_2=0,0304 $m^{-1/3}s$, at flow rate Q_3=9,924 m^3/s it is n_3=0,0327, while at flow rate Q_4=6,043 m^3/s and Q_5=2,01 m^3/s it equals n_4=0,0344 $m^{-1/3}s$ and n_5=0,0382 $m^{-1/3}s$ respectively [6]. Variability of roughness coefficient along the Botonega Channel may be the consequence of sporadic stumps and trunks and the appearance of erosion activity along the Channel [6].

4 CONCLUSION

Design hydrological parameters on the basis of which the Botonega accumulation was built in 1988 depart significantly from actually perceived parameters [2,4]. This can be supported by the fact that the calculated 100-year maximum inflow into the accumulation is 120 m^3/s, while the observations up to date revealed that even in two cases maximum rates were greater than 300 m^3/s [4]. Therefore, the project assumptions about the flows into the drainage Botonega Channel are questionable. For the purpose of preservation and revitalization of the Channel it is necessary to take into account the hydrological and geological features of the area, both by monitoring on the measurement bridge Ščulci Stepenica and by basic hydrological measurements on the drainage-retaining Botonega Channel. In this way, one could influence the formation of flood waves i.e. a more effective evacuation of high waters through the drainage-retaining Botonega Channel.

In this work the hydraulic analysis of the Botonega Channel based on the development of numerical 1D unsteady flow model has been shown. The Botonega Channel throughput was determined according to five flow measuring series. The analysis revealed that for the measured flows the Botonega earth channel presents relatively high roughness coefficient (between 0,028 and 0,044 $m^{-1/3}s$), and that it does not meet requirements in terms of channel throughput [6]. Obtained water flow velocity values are too high for this type of earth channel, the consequence of which are the observed, strong erosion activities and subsidence effects of unstable channel slopes. Although the channel is not operative throughout the year, it should be constantly maintained (primarily in winter and early spring) because of its evacuation role and it should cover a greater cross-sectional area, as well as have a milder bottom slope. When the flow rate is greater than 22,0 m^3/s, localized water spills over the main riverbed occur, which represents a danger for the areas without lateral embankments and inundations. The future research should be aimed at ensuring appropriate flow measurements in different conditions, including hydrological ones, as well as at linking such measurements (real input hydrograph) with a dynamic research on sediment transfer and deposition.

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SECTION III

LANDSCAPE FORMATION AND PROTECTION

RECREATIONAL HORSEBACK RIDING IN THE SOUTHERN MORAVIA REGION

Gabriela Čáslavská[1], Jitka Fialová[2]

Abstract

Recreational riders have a positive relations to the nature, often romantic, or sometimes idealized. These positives are however limited by the little knowledge of the rules of staing in the countryside, resulting not only from the Forest Act. With higher level of knowledge of these rules can be the recreational riders good "guests" of the forest. Foresters, however, have to hear of the desire of riders after a rest, varied terrain and roads suitable for their horses. Marked hipotrails do not have to be the only option to restrict the movement of horses in the forest, as most riders often move within a radius of 10 km from the stables. This environment is perfectly awared of riders. So the reprehension should be enough or signs indicating various restrictions on specific roads.

Key words

horse, hipotrails, questionnaire

1 INTRODUCTION

Trail riding is a form of leisure activity which uses a horse as a companion or as a means of transport. In the Czech Republic, where the law allows a free entrance to forests, horse riders can freely and without any charges use all forest roads. The number of rental stables in the surroundings of cities has increased recently. Forest roads, especially in the surroundings of larger stables, are damaged as their surface is in the wet eroded by horses. In the Czech Republic, forest owners are responsible for repairing roads, whereas stable owners, who earn money from operating horses on the forest roads, do not have to make any financial contributions. In many cases, foresters call for marking of riding trails as these would bring relief from the load of horses on the forest and also some limits for the horse riding activity. However, the foresters do not know the requirements of riders considering the riding trails and the riders and stable owners are not willing to mark and maintain the trails themselves, at their own expense. Therefore, in many cases the marking of riding trails remains a dream of

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foresters, or a proposal which has not been implemented, and horse riders use the entire forest road network without any limits.

The aim of the paper was to find out the structure of trail riders' priorities, to clarify the needs and requirements of horse riders, and to explore their interest in solving the above mentioned problems, so that foresters could respond to the ascertained facts and provide sufficient space in forests for all groups involved.

Barchánková [1] says that there is a new initiative in the Czech Republic to establish a complex network of trails for horse riding – riding trails. The purpose of marked trails is the facilitation of passage through the landscape for riders on horses so that this more and more popular recreation becomes safer, more comfortable and accessible to a wider range of interested people. However, this is advantageous not only for riders but also for the landscape itself and landowners. These trails in the landscape allow for the regulation of the movement of horse riders to some extent and for their concentration on the roads where the damage to the roads themselves, but also to fields and other growths and grounds, would not occur and where conflicts arising from trespassing to private properties would be prevented.

The structure of the ownership of lands where riding trails go is as follows: about 60% of them are state-owned (State Land Resources, Forests of the Czech Republic), 30% are properties of companies and cooperative farms, and 10% is privately owned property. [2]

As follows from the text above, riding trails are experiencing a boom and great hopes are connected with their establishment. Also forest managers tend to welcome this solution as the intensive horse riding activities start to disrupt forest roads.

Andrlová (2009) lists these advantages the establishment of riding trails would bring:

- riders will prefer marked trails to unmarked terrain for a number of reasons;
- safe movement of riders and horses;
- prevention of damage caused by riders who would get lost and ride through stands, over agricultural lands or pastures;
- higher comfort of equipment for horses in stations outside the season will considerably improve the conditions for local horse owners –stable owners.

The advantages of riding trails as listed by Andrlová [3] are indisputable but only for those cases when a horse rider travels through a landscape which is unknown to him or her.

2 METHODOLOGY

The data for the study were obtained by means of a questionnaire. The aim was to identify the requirements and needs of active horse riders in detail, and thus to provide data for a potential use by foresters. The questionnaire was distributed directly, by personal contact. This method was chosen predominantly for reasons of maximum reliability and truthfulness of results. As trail riding is a varied activity, the respondents could mark more replies suitable for them. In total, 49 questionnaires were collected within five months.

3 RESULTS

The size of a group of horses in the terrain affects the intensity of the terrain use and the demands on the roads on which the group rides. The results show that over 60 % of riders move in the terrain on their own or in pairs. This fact is caused by the fact that the most of the respondents are private horse owners who ride their horses independently because to be organized in a larger group is time-demanding and more limiting for riders. However, this raises the danger of riding on narrow forest paths and through stands; a larger group is more conspicuous and needs more spacious roads, therefore, riders in a group do not seek the above mentioned ways so often. The rules of riding trails recommend riding in groups of three to eight riders.

The number of trails used by horse riders mainly depends on the terrain and its potential. Riders often create and use new paths in places which are not really suitable. The reason for this is mainly the road surface - gravel roads are not appropriate for horses and riders search for other alternatives. Moreover, the horse riders seek peacefulness, varied terrains suitable for horse training and they wish to explore new places as prevention against boredom and monotony of known roads, mainly in the locations where a limited number of riding routes are available. Over a half of the respondents like to take more than 5 different riding routes.

Although in the Czech Republic there are hundreds, maybe thousands of marked riding trails, only 2 % of recreational riders take them regularly and 4 % of them take them exceptionally. That is a very poor result considering the organizational and financial costs of the establishment of these trails. Most private horse owners go for short rides several times a week, which is logical due to the time-demanding character of riding and the necessity for horse's regular movement (it is healthier for a horse to take a short ride three times a week than go for a day trip once a week). In rental stables the situation is similar as the clients prefer paying for 2 x 2 hours of riding than 4 hours at a time. Horse riding is demanding for the physical condition and an untrained rider cannot sustain a day or half a day in the saddle. As a consequence of these shorter rides, the riders know the surrounding terrain very well and they do not need the marked trails not to enter the forest stands. Quite the contrary, they enter the stands intentionally and they create new paths. Another huge problem mentioned by the respondents is the unsuitable surface of marked riding trails. Then the rider has no other option than to go around, which is in stark contrast to the primary purpose of the trails.

In the Southern Moravia Region riders use field and forest roads in 70 % of occasions and meadows and field in 24 % of occasions. Roads are used seldom (6 %), probably only when a road has to be crossed and cannot be avoided. The specific use depends on the specific conditions. Forest roads are used for trail riding in the same proportion as field roads, again depending on the location of the stables and the vicinity of these roads. Quite a high proportion of riders ride on fields, although some of the respondents claimed they use fields only after the harvest. To a certain extent this confirms the above mentioned fact that horse riders prefer riding through the terrain (fields and meadows) than on roads or forest roads with unsuitable surfaces. In the other options riders mentioned local specifics (a vineyard, a sandpit, a park, etc.), including a ride through a stand. We are again facing the romantic desire of horse riders to 'ramble freely'.

On average, 70 % of riders prefer an unstabilized field or forest road and 25 % prefer fields or forest stands. Probably, these riders are naive enough to think that horses cannot destroy the environment. Fortunately, the practice shows that when riders do not have any reason (an unsuitable surface, etc.) for abandoning the road, most of them do not enter the stand or the field.

The most frequent offence the riders admitted was entering stands. However, only a half of the riders who mentioned this knew that it is a breach of a regulation. In the Southern Moravia Regionc, out of around 90 % of the riders who enter stands 85 % have a reason for this behaviour. Therefore, foresters should not only criticize the recklessness of riders but they should look for the reasons why the Forest Act is breached. If the riders in the location in question are informed about the Act and if they have a sufficient number of suitable roads without constrictions, they will not have any reason to ride through the stand.

Another frequent offence against the Forest Act is the disturbance of peace and quiet when riders speak loudly or shout to other riders. This is not a problem of riders only, similarly to smoking or dropping litter. Horse riders pasture horses in forests on 20 % of occasions but these are mainly short moments when a rider is sitting in the saddle or holding the horse on the lead or the bridle. Another breach of the Forest Act is cutting or breaking a tree to make an obstacle. However, this deed is not very frequent as the riders prefer using occasional natural obstacles.

56 % of the respondents committing offences were not aware that they breached the Act. Undoubtedly, the number of the occasions when the Act is breached would be reduced if the trail riders were better informed. This kind of information is mainly important for owners of rental horses and private horse owners because they ride regularly in specific areas. Another recommendable measure is the placement of informative boards at the roads which horse riders often take. The boards have to include the reasons for particular bans so that the forest visitors could not gain a feeling that they are ordered around by foresters.

90 % of the respondents would be willing to obey a ban to ride on a muddy road (they replied yes and it depends on the situation). Their notes show, and it is logical, that they would need to have the option to ride somewhere else. Therefore, if foresters need to solve a problem of several muddy roads that are often used by hikers they can make an agreement with the riders or install a sign so that the riders know they have to go around the road in the wet.

74 % of the respondents are not willing to tolerate a complete ban on entry. This also confirms the significance of riding in the forest for many riders. 84 % of the riders agree that they could use step only on common roads used by both riders and hikers; on the other hand, only 39 % are willing to dismount the horse and lead it. 33 % of the respondents would only use the marked trails if the trail network was dense enough and consisted of roads with a suitable surface.

Moreover, most of the respondents (57 % yes, 33 % it depends on the specific situation) are willing to solve the problem of disturbing the game ‘under the hide’ and not to ride to these places when agreed. Naturally, the trail riders would still need to have enough passable places.

Paying contributions was refused by 37 % of the respondents and 32 % of the riders were not willing to take part in voluntary work.

4 DISCUSSION

It was found out that most riders who travel in forests are private persons riding their own horses. Trail riding is a leisure activity performed by a wide range of people who are not organized or educated in any way; furthermore, there is no larger association or organization for these people in the Czech Republic. Therefore, it is impossible to communicate with them at a regional or a state level; problems must be tackled and information transmitted at a very local or a personal level. There is the advantage of the positive attitude of riders towards the environment, which they have in common with foresters – this could serve as the common point for their mutual communication.

Due to their positive relationship towards the landscape, trail riders are willing to tolerate a number of restrictions if their basic requirement to be able to ride into forests is met. A ban on entry is not a suitable solution for them. On the other hand, the marking of a local network of riding trails with restrictions in troublesome areas (e.g. ban on entry in the wet, only step on common roads, or the ban on riding past a specific hide in specific evenings) seems to be an advantageous solution.

The following points summarize the results of the paper:

- if a forester wishes to face the issue of trail riding, he or she should first go to the stables in the vicinity and find out what kind of riders there are, if they ride in forests, if they are private owners of horses and if they have a riding ring or a hall or if their only possible ride is in the surrounding landscape;
- ideally, the sufficient solution will be an agreement with the riders and explanation of provisions of the Forest Act, or of markings in the forest (e.g. the ban of riding on a specific road in the wet) or information signs along roads;
- if there is the need to mark specific riding trail in the location, it is necessary to mark a sufficient number of them as soon as possible (4 at minimum);
- the trails have to be accessible from individual stables and the density of the trails should be the highest in the vicinity of the stables as riders usually go within 10 km around the stables;
- all trails need to have a surface which is suitable for horses; an unstabilized road or path is the best; a road with sharp gravel is totally unsuitable;
- the terrain and the roads should be of various kinds;
- if trail riding has already started in the location, it is advisable to find inspiration in riders themselves and e.g. mark also beaten paths if they are attractive for riding (for example a steeper hill in an otherwise flat landscape);
- the trails should be singled out for horses and they should cross other hiking or biking trails as little as possible because recreational riders mainly seek peace and quiet;
- the trail riders' priorities should be taken into account – first, it is the surface of the roads, then their distance from the stable with respect to the planned ride, further, small frequency of people and cars; a meadow where the horse could be fed would represent a certain attraction;
- when a forester sees a horse rider in the stand, he or she should first find out the reason why they are there and only then explain the Forest Act to them [4];

- in the case of ranches where paid rides are organized, it would be suitable to charge profitable mass activities in the area of their forests with a flat fee.[5]

5 CONCLUSION

Trail riding is a popular leisure activity. This branch of horse breeding and utilization has seen an unprecedented boom in the last ten years; horses have become affordable and the number of stables which hire out horses for rides or provide housing for privately owned horses has risen too. However, the intensive use of horses brought about the danger of damage to unstabilized forest roads and more frequent collisions with other forest visitors, especially in suburban forests used for recreation. The objective of the paper is to provide foresters with information on the interest group of recreational riders, mainly their requirements concerning the forest environment. The used data consisted of 62 questionnaires. The interest group of trail riders contains people of various ages and positions, because horses are now affordable as a hobby for nearly all active people. Moreover, besides the active movement in the country and an interesting way of spending the free time, a horse offers social contact with other people and a sort of partnership.

The relationship of recreational riders to the environment or the country is positive, sometimes romantic or even idealized. However, these positives are limited by the little knowledge of the rules of the Forest Act and other regulations which specify how people should behave in the countryside. With better knowledge of these rules, recreational riders may be welcome visitors to forests. The task for foresters is to consider the recreational riders' wish to find peacefulness, a varied terrain, and roads suitable for horses. Marked riding trails are not the only option for regulating the movement of horses in forests. Most riders travel within 10 km from the stables so they know the area very well. Therefore, an agreement with the riders or signs on specific roads could suffice.

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REMEDIATION OF LANDFILL IN CARSTIC AREA

Mario Farkaš[1], Tihomir Dokšanović[2], Danko Fundurulja[3]

Abstract

Paper presents actual problems in Croatia on landfill construction in carstic area. City of Pula has a landfill situated in sensitive area geologically known as carst. This means that these unfavourable geological conditions put special attention on design and construction of landfill, due to high risk of pollution of underground water. Uncontrolled landfill was used for waste deposition before it was decided to proceed with remediation of this location, according to actual design practice and environmental conditions (EIA). Paper elaborates investigation, construction and monitorig phases related to remediation. Problems regarding geology, geotechnics and barriers will be presented and discussed in termes of present rules and specific risks connected with carstic area.

Key words

Karst, landfill, underground water, environment, pollution, waste

1 KARST TOPOGRAPHY

1.1 Karst

Karst is a landscape or terrain that results from the chemical weathering (corrosion) of bedrock types that are soluble in water. These bedrock types are primarily carbonate rocks (limestone and rarely dolomite), salts and gypsum (least elastic and flexible). There are many cavities in karst because of corrosion. Porosity is one of the dominant characteristics of karst rocks. That is how numerous caves and pits are formed. However, the reaction of the karst process is reversible, that is, the reverse course is also possible: in specific conditions calcium carbonate will be extracted again.

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1.2 Karst in Croatia

In Croatia karst covers its Dinaric area (see Fig. 1.). It could be said that the town of Karlovac is the so called "boundary rock" dividing karst areas of Croatia from non-karst ones. Southern suburbs of Karlovac are situated on the undulating area and these hills are made of carbonate rocks and belong to the tectonic unit of the Dinarides. Therefore, almost the entire part of Croatia south of Karlovac is karst area and the other part north of this town is not, although there are isolated karst areas in the Pannonian Croatia (on Slavonian mountains Medvednica and Žumberk). Landfill that is associated to this paper is located in carstic area near city of Pula.

Fig. 1) Carstic area (marked dark) in Croatia (marked with white line)

2 METHODS FOR MONITORING

Landfills located on carstic areas often are at considerable risk of failure from sinkhole collapse and release of landfill content to the groundwater. Conduit flow can quickly transport harmful contents to large distances, exceeding the capability of a monitoring system to detect the initial release. The occurrence of pollutants in groundwater has lead the government of RH to draft regulations for its management.

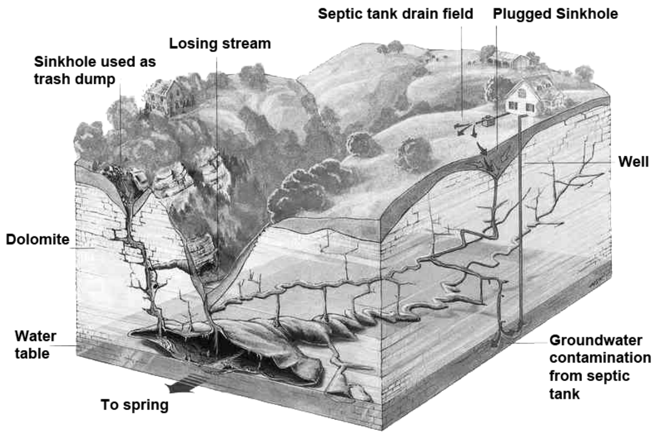

Fig. 2) Possible penetration of pollutants in carstic areas (Mark Raithel illustration)

A conduit may be a complex combination of geological features (see Fig. 2.), making the exploration and groundwater monitoring of the pathway difficult. Recommended methods for completing a site investigation can include a study of the source of recharge water to artesian springs using chemical fingerprinting methods. A detailed review of geological literature and drilling logs can produce a conceptual model of conduit pathways, and a computer-generated scale model of the site can be used for an exploration program. A fracture trace analysis, together with electromagnetic and spontaneous potential geophysics, can confirm the locations of major faults and fractures in the area. Water quality logging along the length of open boreholes provides a cross-sectional view of the conduit network. Conducting chemical tracing of groundwater along the flow conduit is an effective means of describing a complex flow pathway, and rate of groundwater flow. Quasi real time electronic sensor technology offers an alternative to traditional quantitative dye tracing.

3 EXAMPLE OF LANDFILL REMEDIATION IN PULA – KAŠTIJUN

3.1 Location

Kaštijun landfill is situated south of Pula in coastal, lowland area which is poorly populated. Precisely speaking the landfill is situated in the area of Banjola, which is at 47 meter above sea level. Kaštijun distance from city of Pula is 5 km, Banjola 2 km and from city of Medulin 4 km (see Fig. 3.). Location is accessible by a paved road RC Pula - Premantura. The designated location around the landfill is overgrown by grass and low bushes.

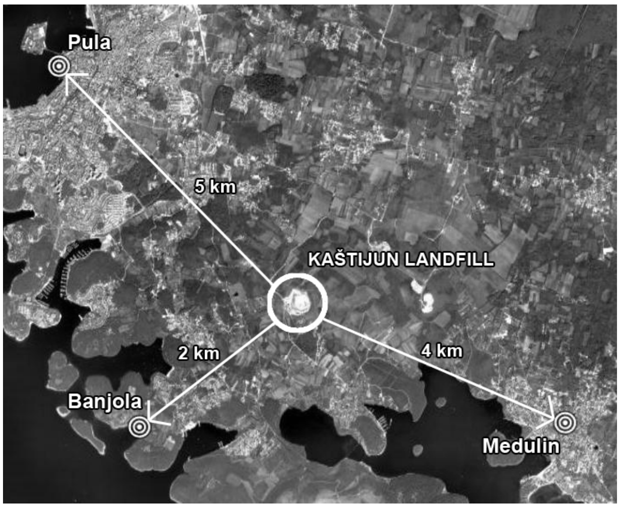

Fig. 3) Location of Kaštijun landfill

3.2 Investigation work

Waste disposal on this location started in 1964. This wild landfill used to burn until 1978 when the first remediation project was made that defined two important measures for landfill remediation: fire extinguishing and closing area with a fence. Today`s remediation started in 1991 when a company IPZ Uniprojekt MCF d.o.o. began to conduct investigation work in laboratory and in situ. It has been determined that there are dangerous paths which can spread contamination by: direct contact, air, soil, underground and surface water. Local history of the landfill was researched prior to investigation work through interviews with local population and assessment of quantities and types of disposed garbage. On the bases of work carried out horizontal and vertical landfill borders were defined. Landfill area was divided into individual sectors depending on given data and any further investigation has been calibrated to those sectors. 12 boreholes have been drilled with total depth of 76 meters along with 9 georadar profiles with total length of 4127 meters and depth varying from 10 to 60 meters. Samples were taken from the drilling cores and landfill base and taken to chemical analysis for the purpose of defining chemical composition and permeability. Aside from samples being taken from the landfill body there were 6 other exploitation drill holes located upstream and downstream which served for irrigation, also 2 other water samples were taken from the Pomerska bay.

Fig. 4) Kaštijun landfill before remediation

With the findings from the research conducted so far, geological and hidro geological characteristics were determined. From the geological aspect location itself is of simple structure with prevailing thick to massive limestone of upper Cretaceous age, covered thin or thick layers of red soil (terra rosa). Two crack systems 45 meters deep, filled with water were discovered near the landfill which indicated there is a direct threat to the water supplies. With geological survey the following layers of landfill were discovered:

Tab. 1) Kaštijun landfill cross section (reference [5])

Depth (m)	**Material description**
0-1	soil with pieces of wood, plastics and glass, organic waste partially decomposed; smells like waste, light grey
1-2	organic waste partially decomposed, with pieces of glass, plastics, sheet metal and paper; smells like waste, light grey
2-3	decomposed waste – humus, pieces of plastics; smells like mud, black
3-4	entirely decomposed waste – humus, pieces of plastics; smells like mud, black
4-4.5	humus waste, without odor, dark brown
4.5-5.5	limestone (construction waste); without odor, white
5.5-7.5	humus with pieces of cloth, sand, construction materials and plastics; smells like mud, black

7.5-9	humus, humus with sand, plastics, stone; without odor, black
9-11	humus with pieces of rubber and plastics; without odor, black
11-11.5	gravel, sand with burned waste; without odor, black
11.5-12	dross with mesh (industrial waste)
12-13	humus (incineration mark), pieces of rock and glass; without odor, black
13-16	humus, pieces of rock and glass; without odor, black
16-18	ashes mixed with gravel, glass and iron (grey, dusty, sandy)
18-19	ashes (black, grey)
19-20	red soil (water traces on 18th meter), dry red soil
22-22.5	red soil
22.5-23	limestone (cenoman age), compact, white

Research results indicated that the basic soil is very good and firm, and there is no need for construction of the lower hydraulic barrier, and after final closing the Kaštijun landfill will not represent any danger to the environment.

3.3 Remediation work

Remediation technology of Kaštijun landfill is divided into the following stages:

- remediation of current state:

  - terrain preparation

  - gathering, compacting and covering of scattered waste

  - perimeter canals construction

  - environmental protection construction (cover caping with gas and drainage collection)

- transition to the sanitary acceptable landfill technology:

  - area preparation for waste deposition

  - supporting facilities construction

  - spreading waste into layers and it`s compression

  - daily waste coverage with inert material

  - area landscaping

  - monitoring (during construction and after closing)

Fig. 5) Kaštijun landfill during remediation

This work technology enables remediation of existing landfill and closing it after filling with waste. The construction of waterproof cover will be conducted by constructing a “sandwich” layer which is composed of layer of gravel and pipes for collecting gases, a layer of bentonite or clay soil which are well compacted. On top of the “sandwich” layer there will be a layer of fertilized soil with drainage system that collects seepage water. On the side where the landfill is at it`s deepest it is necessary to construct 2 to 3 wells in order to extract existing leachite water from the landfill bottom. Wells for extraction of gas are foreseen on the entire surface of the landfill. Sanitary technology deposition can be utilized after landfill remediation. With the already mentioned covering “sandwich” layer of disposed materials other measurements are foreseen to enable the following: prevention of rainfall leakage into landfill body, waste decomposition and alongside of sanation, deposition of waste. By enforcing stated demands sanitary landfill decreases it`s influence to the environment. Foreseen measures of environmental protection are:

- surface and underground water protection
- air protection
- fire hazard protection
- vermin protection
- protection against spreading of unpleasant odor

3.4 Monitoring work

The remediation project monitoring program has to be implemented in a time period of at least 30 years after landfill closing, which is predicted after construction of the waste disposal center in 2012, or after cease of deposition with every regard to the safety of the location itself and the surrounding area. In order to accomplish given goals it is necessary to monitor the following data: volume and intensity of rainfall, air temperature, evaporation, humidity and strength and direction of prevailing winds at the nearest representative weather station; two wells upstream of the landfill and three wells downstream provide us with water samples that should be chemically tested 2 times per year; sampling and chemical testing of the water gained from seeping through the landfill body should be performed 4 times per year through a well drilled in the landfill body; gases within the venting channels should be analyzed 4 times per year; the water from derivation ditches should be tested during rainfall 2 times per year.

4 CONCLUSION

Considering available criteria related to foreseen impact of landfills to environment it might turn out the case that karstic areas are not suited or not even allowed for landfills. However, if in certain circumstances study of particular situation in karst can offer clear and reliable picture of critical elements a landfill can be engineered with enough safety. The remediation solution of landfill in Kaštijun was implemented with favorable investigation work results which enabled cost reduction upon remediation realization with satisfactory environment impact. Strict monitoring program according to EU guidelines and the possibility of a quick intervention in case of unwanted events ensure that it operates under controlled conditions. The final purpose of the area after remediation is an important factor which has great influence on choice of remediation technology that should transpire to bring a newly shaped area into a state that does not contrast from the environment and fits into the surrounding terrain.

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INFLUENCE OF LOW ENERGY AND PASSIVE CONSTRUCTION ON THE ENVIRONMENT

Petr Horák[1], Olga Rubinová[2]

Abstract

The paper analyzes the impact of buildings on the environment. As an evaluation criterion are considered CO_2 emissions. Emissions arise from the operation of building energy and emissions are also entered in the form of embodied energy in building materials.

Key words

CO_2 emissions, energy consumption, embodied energy.

1 INTRODUCTION

Own energy consumption is one of the few facts, which interested users when buys a new product that consumes energy. It does not matter whether it is a home appliance, automobile, or even family house. In the field of civil engineering, users usually are interested in "how much spending money" for the heating season. This view certainly has the greatest impact on the user's wallet, but from the perspective of environmental protection is inadequate. To properly evaluate the impact of buildings on the environment, we must do so on the basis of emissions, which are produced by building. It is not enough just to evaluate the energy consumption for heating the building. It is necessary to go more in depth into the calculations also include the so-called embodied energy [1]. That means the energy that was needed to produce building material, its transport and assembly on construction. Adding to the embodied energy to the energy needed for heating and operation of the building, we get a clearer picture of the overall production of emissions of the object. So we can reliably assess the actual impact on the environment, see e.g. [2].

This article evaluates the standardized family house in terms of total energy required to build and operate the building for 50 years. Evaluation criterion is the total energy and equivalent of CO_2 emissions that are produced during the expected lifetime. The issue of emissions from various types of energy analyzed [3]. In the following calculations are considered for the materials value of CO_2 emissions arising from mining, processing and transport to use.

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2 DESCRIPTION OF RATED BUILDING

For the experimental evaluation was selected real simple standardized object. It is a single-storey, cellarless family house with a saddle roof, see Figure 1. The house has dimensions of 14,3 x 10,1 m. Building volume is 434,7 m^3, the ratio of A / V = 1.Object really exists and there is heating system consisting of electric direct heating radiators. This heating system is therefore considered in our calculation.

Fig. 1) Rated building, views

In the experiment were chosen 4 options of external cladding to determine which type of cladding will be most suited. Variants are listed in Table 1.

Tab. 1) Type of external cladding

Variation	Type of external cladding
1	Brick block + mineral wool
2	Porous concrete block
3	Wooden building
4	Concrete block + polystyrene

In all four variants is thickness such that the resulting value of overall heat transfer U-(W/m2K) is the same:

- Wall U = 0,20 W/m^{2}K
- Floor U = 0,31 W/m^{2}K
- Ceiling U = 0,20 W/m^{2}K
- Doors, windows U = 1,10 W/m^{2}K.

Table 2 shows the total mass of materials used for different variants of the object.

Tab. 2) Weight of used materials

Material	**Variants, weight (t)**			
	1	**2**	**3**	**4**
mortar, plaster, concrete	149,4	147,6	132,4	149,7
porous concrete	6,8	59,4	6,8	37,1
brick	89,6	0,2	0,2	0,2
facing and paving	0,8	0,8	0,8	0,8
mineral wool	0,1	0,1	15,3	0,1
polystyrene	4,7	4,7	8,5	13,2
gypsum plasterboard	3,3	3,3	7,6	3,3
wood	9,1	9,1	11,8	9,1
paste-board, foil	0,8	0,8	0,8	0,8
steel	1,9	1,9	1,8	2,0
window (m2)	1,1	1,1	1,1	1,1
Boards of wood	0,2	0,2	4,7	0,2
sum	268	229	192	218

3 INPUT FOR THE EVALUATION OF BUILDING

Because all variants have the same heat loss, also have the same operational power consumption. This operational power was determined according to Decree No. 148/2007 Coll. The building consumes annually 68,7 kWh/m^2.year (out of which is 21.5 kWh/m^2.year for heating), a total of 32.3 GJ/year of electricity. This operation energy must be converted by energy conversion factor, which includes the effects of energy production and distribution, so we get the so-called primary energy [4]. Conversion factors of primary energy and production of emission was determined by [5] and is listed in the table. 3.

Tab. 3) Emission and conversion factors for different energy sources [5]

Material	**Emission of CO_2 (g/kWh)**	**Primary energy conversion factor (kWh/kWh)**
Natural gas	249	1,14
Brown coal	452	1,21
Wood pellets	42	0,14
electricity – various sources	647	2,65

Value of embodied energy and CO_2 production are quite controversial in the literature [6], [7] and [8]. But this is understandable. On the total energy has a major influence many factors (technology, materials, transport and others). Therefore, literature suggests a large dispersion of values for the same materials. If we want accurate results, we would do an analysis for a particular object by including all factors. In our case, we used to calculate the values of embodied of energy and CO_2 equivalents according to Table 4, based on the above literature.

Tab. 4) Embodied energy and equivalent CO_2 production

Material	**CO_2 (g/kg)**	**Energy (MJ/kg)**
mortar, plaster, concrete	120	0,8
porous concrete	300	1,1
brick	400	3,3
facing and paving	300	2,8
mineral wool	1200	17,5
polystyrene	2300	94,9
gypsum plasterboard	400	5,3
wood	-1400	2,72
paste-board, foil	2200	52,7
steel	2000	38,6
Boards of wood	-150	13,7
windows	g/m^2	MJ/m^2
windows	55000	1439

4 OUTPUT

Based on these inputs were obtained the following results. Table 5 summarizes the energy for individual variations. Table 6 shows the summary of equivalent CO_2 emissions for individual variations.

Tab. 5) Summary of energy

Variation	**Embodied energy (GJ)**	**Operational energy for 50 years (primary energy) (GJ)**	**Total energy for 50 years (GJ)**
1	2676	4240	6916
2	2315	4240	6554
3	2963	4240	7202
4	3104	4240	7344

Tab. 6) Summary of emission CO_2

Variation	CO_2 in embodied energy (t)	CO_2 in operational energy for 50 years (primary energy) (t)	CO_2 in total energy for 50 years (t)
1	127,6	288	415
2	99,0	288	386
3	105,6	288	393
4	112,2	288	400

If we look at the first variant of the traditional (brick blocks + mineral wool), so here is the volume of building materials 38% of concrete and mortars, and 26% brick blocks and this 64% of the total material consists of 40% of all emissions. While the windows are insignificant in terms of volume, their emissions are 58% of all emissions in the embodied energy. Details are shown in Figure 2.

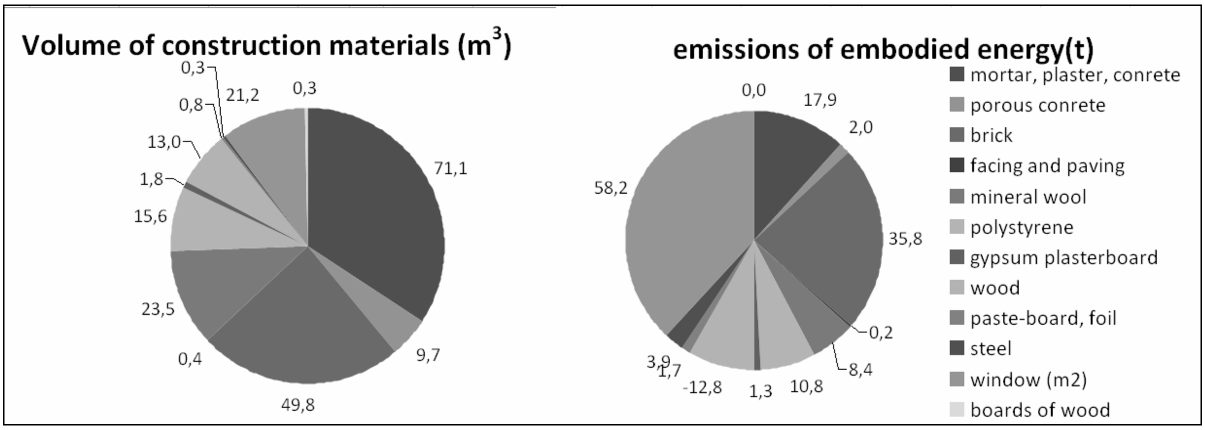

Fig. 2) The volume of construction materials and their emissions

The graph in Figure 3 shows the total energy consumed in 50 years the use of the building, embodied + operational energy (expressed as primary). Also contains the total amount of emissions CO_2 equivalent energy consumed in 50 years the use of the house (embodied + operational energy).

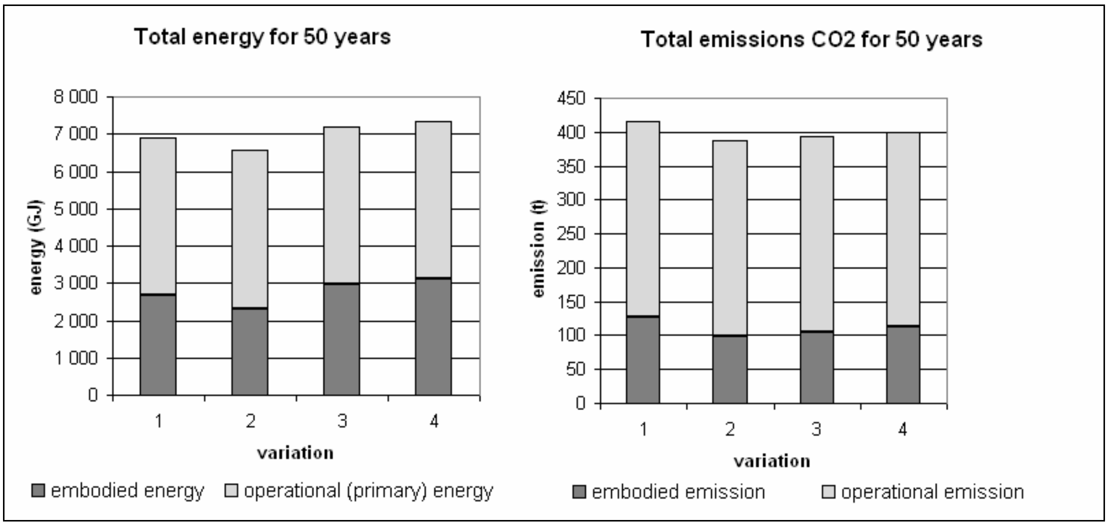

Fig. 3) Total primary energy, embodied + operational, total quantity of emissions CO_2

5 CONCLUSION

Based on the results we can conclude that a particular type of external cladding the building has not a large influence on total energy consumption in turn to equivalent CO_2 emissions. The results are almost equal. Best in terms of CO_2 emissions and total energy consumption is object made of porous concrete block (option 2). Value of embodied energy and equivalent CO_2 emissions depends greatly on the tables of the available literature. It is obvious that in practice these tabular values can vary significantly, depending on the boundary conditions (technology, materials, transportation and others).

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FOREST ROAD NETWORK DESIGNING: OPTIMIZATION CONSIDERING ALL FOREST FUNCTIONS

Petr Hruza[1]

Abstract

New approach to forest road network designing is based on the idea of the equal value of all forest function and on the principle of sustainable forest management. While the traditional projects had considered the technical-economical aspects only and disregarded other forest function, the new way completes the traditional criteria by other functional criteria coming from real potentials of forest ecosystem. The aim of the study was to determine how the implementation of other forest functions into the process of planning and designing of forest road network would influence and change its parameters. The parameters were not significantly changed which makes the new integrated technical-economic-ecological conception suitable for daily use.

Key words

Opening-up the forest; forest road network; forest function; forest road parameters

1 INTRODUCTION

A former approach to particular forest functions preferred a wood-producing function and other functions were jointly termed “non-wood-producing functions”. It corresponds to the conception of the forest transportation network projects based particularly on technical-economic criteria. Plans of the forest road network result primarily from morphological factors of topography (technical aspects) and from the diagram of synthesis according to Benes. [1][2] The optimum density of main forest roads is determined by the minimum of the summary curve of costs for the construction and maintenance of main forest roads and costs for skidding operations (economical aspects). Opening-up of forests is all the time developing process including new findings on functioning forest ecosystems and newly used logging and hauling technologies. Also constantly completed and specified data on databases of geographical information systems provide better possibilities to decide the location of the forest road route. A new philosophy of management in forest stands results from an idea on the equivalence of all forest functions and their respecting on the principle of sustainable management. However, the equivalent importance of forest functions does not mean their

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parity in terms of a value. It refers to equivalence from the viewpoint of the society importance. [3] [4]

In the process of planning the forest road network, respecting all functions of a forest ecosystem has to be taken into account, namely: bioproduction, ecological-stabilization, hydric and water-management, edaphic and soil-conservation, social-recreation, sanitary-hygienic. The new conception of the forest road network project (respecting all forest functions from the viewpoint of integrated forest management) results from the traditional approach of opening-up the forest on the basis of technical-economic criteria. The plan of opening-up the forest is extended by “functional criteria” which emerge from real potentials of functions. The realistic potentials of forest functions are quantified functional capabilities of actual forests under optimally possible conditions. [3][4] The value scale of every function has seven degrees (values 0-6, real potential functionally unsuitable to extraordinary real potential).

These functional criteria make possible to complete technical-economic aspects by respecting all forest functions. Thus, from the technical-economic approach technical-economic-ecological conception becomes which will contribute to reduce negative impacts of the construction of a forest road network on the environment.

2 OBJECTIVES AND METHODS

The aim of the study was to determine how respecting all forest functions in the proposal of a forest road network will manifest itself in the change of parameters of opening-up the forest as compared with the present condition and as compared with the proposal of an optimized road network according to Benes. [5]

The study stems from results of Benes [5], uses and extends his methodology of the design of a forest road network in the “gravitation area” of the Útěchov stream in the Křtiny Training Forest Enterprise. Under the term “gravitation area”, a transport area is considered from which timber haulage is concentrated into one place. These gravitation segments generally correspond to smaller watersheds of an area of about 500 ha being specified by a watershed divide. In the gravitation area of the Útechov stream, Benes [5] proposed the optimization of a forest road network on basis of technical-economic criteria. The area of the Útechov stream gravitation territory amounts to 375 ha. With a respect to new approaches to methods of forest management and a worldwide requirement to use functionally integrated forest management respecting forest functions the optimalization of a forest road network proposed in this way was extended by a spectrum of functional criteria. The new proposal of opening-up the forest can be termed “integrated” on the basis of a technical-economic-ecological conception. In planning a forest road network we take into account stands with the high value of a real potential with an endeavour the stands to be disturbed as little as possible. Thus, the road network is directed to stands of the low value of a functional potential. The proposal has to fulfil the primary requirement to respect the forest topography and parameters of main forest roads. These are given by the CSN 73 6108 standard “Forest road network”. [6]

In the first stage, maps of real potentials were prepared for particular forest functions their values being differentiated in colour. Following functions were assessed: bioproduction (BP), ecological-stabilization ES), edaphic and soil-conservation (EP), hydric and water-management (HV), social-recreation (SR) and sanitary-hygienic (ZH).

To display real potentials were used forest general maps 1:10 000. Values of the real potential for forest functions were differentiated in colour for particular parts of stands. Subsequently, a proposal of the optimum opening-up the "gravitation area" was prepared. The plan resulted from the terrain configuration excluding stands with the high value of a real potential. Maps prepared in this way were used as a basic layer for further processing. Maps of the present condition of a forest road network and a plan of the road network optimization according to Benes (1991) were used as other layers. In each of the three layers, parameters of the opening-up Density of main forest roads (HS), skidding dostance (DS), geometrical skidding distance (DG), theoretical skidding distance (DT), effectiveness of opening-up the forests (U) were evaluated.

In the second stage, a possibility was studied if it would be possible to use only one map basis for route location and forest road network optimization, namely the total real potential of a forest function (RPFL) representing all functions (it refers to the sum of values of the real potential of particular functions). In such a case, important changes in the evaluated parameters of opening-up the forest should not become as compared with parameters of evaluated proposals of individual functions.

3 RESULTS

For the present condition of a forest road network, the plan of its optimization according to the traditional technical-economic approach after Benes [3], for each of the forest functions and subsequently for the total real functional potential were implemented through the evaluation of parameters of opening-up the "gravitation area" and their comparison.

3.1 The present condition of a forest road network

The present density of the hauling road network amounts to 37.4 m/ha at the length of main forest roads 12 040 m the effectiveness of opening-up being 39.3%. At present, the mean skidding distance is 225 m. A mean geometrical skidding distance amounts to 170 m. A theoretical skidding distance amounts to 67 m.

3.2 The proposal of a forest road network according to Benes [5]

Through the optimized proposal according to technical-economic criteria the density of main forest roads decreased by 8.7 m/ha to 28.7 m/ha. The effectiveness of opening-up increased almost two-fold by 24.3% to a value of 63.6%. A mean skidding distance decreased from the original value by 56 m to 169 m. A mean geometrical skidding distance reached a value of 137 m being decreased by 33 m. A theoretical skidding distance reached a value of 87 m.

3.3 Plans of a forest road network taking into account real potentials of particular forest functions

Proposals were assessed of the forest road network optimization involving functional criteria for every particular forest function. In total, six proposals were evaluated. The density of a forest road network ranged between 24.8 and 28.9 m/ha. A mean skidding distance ranged from 162 to 182 m. A mean geometrical skidding distance ranged between 138 and 156 m. A theoretical skidding distance reached a value of 86 to 101 m. The effectiveness of opening-up ranges between 62.1 and 67.7%. Based on the results obtained it is evident that the framework of the forest road network optimization does not change fundamentally when including functional criteria. In any function an important change in the parameters of opening-up did not occur. It means that any of functions in the gravitation area of the Útechov stream cannot be termed as determining. The size of a deviation in particular parameters of opening-up is minimal and constant. In any of functions marked fluctuations do not occur.

3.4 The plan of a forest road network respecting the total real potential of forest functions

A final proposal consisted of the optimization of a forest road network created on a map of the total real functional potential. Final values of parameters were compared with a plan based on technical-economic criteria. The density of a main forest road network reaches a value of 25.8 m/ha. A mean skidding distance is 180 m. A mean geometrical skidding distance is 153 m. A theoretical skidding distance is 97 m. The effectiveness of opening-up reaches a value of 63.3%. It means that it is possible to use the map of the total real functional potential instead of maps taking into account real potentials of particular forest function.

4 CONCLUSION

It is possible to state that taking into account determined forest functions in the proposal of opening-up a gravitation area important changes in values of particular parameters of opening-up the forest as against Benes's [5] proposal did not occur. Significant differences do not occur in values of parameters in proposals according to particular functions (bioproduction (BP), ecological-stabilization (ES), edaphic and soil-conservation (EP), hydric and water-management (HV), social-recreation (SR) and sanitary-hygienic (ZH) and a proposal which was prepared on a map representing the synergy of forest functions, ie for the total sum of values of real potentials.

This finding makes possible to use only the condition of a total real potential (RPFL) (with respect to all forest functions) depicting the sum of values of real potentials of all functions as a basis for the proposal of a forest road network. The new conception of the forest road network optimization results from a traditional approach when technical-economic aspects are completed by aspects of particular functions. Thus, from a technical-economic approach becomes an integrated technical-economic-ecological conception.

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BRIDGES IN FOREST TRANSPORTATION NETWORK

Pavla Kotásková[1]

Abstract

Bridges are an integral part of technical facilities of the forest transportation network. Their skeletons were built in the past years using varios structural materials, but properly designed and preservative-treated timber bridges have demonstrated good performance with long service lives, given proper maintenance. Glulam is a very versatile material that provides distinct advantages over sawn lumber. Because it is a manufactured product, glulam can be produced in a wide range of shapes and virtually any size. Glulam also provides increased strength over sawn lumber. also provides better dimensional stability because it is manufactured from dry lumber as compared to most large sawn lumber members, which are sawn green and seasoned after installation.

Key words

Timber bridges, glulam, deck constructon, prestressed wood panels

1 INTRODUCTION

With respect to the environment protection, it is necessary for the forestry purposes to design functional constructions which will become inseparable from the landscape. Constructions and buildings from natural materials are suitable not only from the point of view of aesthetics and ecology but also because they contribute to a general positive psychological impression. Therefore, the best materials seem to be stone and wood, wood being the most natural. Bridges are often constructed in remote, badly accessible locations; therefore, it is necessary to choose the kind of construction and technology appropriate for the specific local conditions.

It was assumed in the 20th century that wood will be replaced with concrete, steel and plastic, and that the significance of wood will decrease prospectively. Also in the bridge constructions, wood was replaced by concrete and steel as more significant materials with higher strength characteristics, mainly for bridges of larger spans and higher loads. However, the construction of wooden bridges and footbridges is on the rise again, mainly because of the possible use of glued laminated (glulam) timber. Thanks to glulam timber it is possible to design even large-span wooden bridges for relatively high loads as the timber is able to support short-term overload without unfavourable effects. Another considerable advantage of

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wood is its effect on the environment. From the environmental point of view, wood is a completely trouble-free material with minimum energy costs on extraction, processing and waste; it is a renewable resource of material and also a material which has a calming effect on people's minds.

2 THE HISTORY OF WOODEN BRIDGE CONSTRUCTIONS

As Kuklík [1] states, the oldest historical wooden bridges were built around the year 600 BC. One of them is the famous beam bridge over the Tiber river in Rome, built in 625 BC. In 54 BC specialized squads of the Roman army built a 430 m long wooden bridge over the Rhine river. At the turn of the Christian era an arch bridge over the Danube was built, in 103 AD. The clearance of the bridge spans was 35 m, the width of piers 18 m and the bridge was 1070 m long. The first wooden bridge over the Vltava in Prague was probably built in 795 AD but it is not known for how long it survived.

In the ancient history, there were quite a number of wooden bridges and footbridges in our territory. Timber was used especially for the bridges on forest roads it was easily accessible there. However, the research into current bridges showed that the majority of bridge constructions today are of steel or reinforced concrete. The main support structure is often made of rolled I-beams and the deck – the road support structure – of cross beams made from steel pipes, square or round logs laid without gaps.

Later, reinforced concrete constructions started to be used for bridges in forest road networks; they were monolithic, more often prefabricated – bridge sections dimensioned for common road load-bearing capacity (class A) were used. However, these were uneconomical for forest roads with load-bearing capacity class B. Another disadvantage was the transport and the necessity to assemble the heavy elements at the place, mainly remote mountainous areas presented a significant challenge. Advantages of reinforced concrete bridges are their high bearing capacity, resistance against the climate, lower consumption of steel compared to metal bridges. On the other hand, the disadvantages of monolithic reinforced concrete bridges include higher laboriousness (it is necessary to assemble the scaffolding and the formwork) and the longer time needed for the construction.

A lot of older wooden constructions have manifested a long-term bearing capacity and resistance. Wood is a suitable material not only for bridges with small load and short span. Examples, mainly from abroad, show that it is possible to span even larger distances for class A. These bridges are usually constructed as truss or arch bridges. (Fig.1)

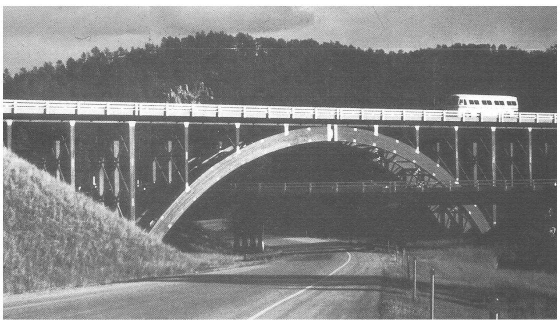

Fig. 1) A pressure treated glulam timber highway bridge in the natural area in Northern America (South Dakota). The span of arches is 47.5 m. The upper bridge is a composite from glulam timber beams and concrete.

3 CONSTRUCTIONS OF WOODEN BRIDGES IN THE LANDSCAPE

Wooden bridges are usually proposed for the places where it is required for the construction to fit in the landscape, i.e. to meet some aesthetic and also environmental criteria. This concerns the following:

- bridges (for logging and hauling machinery) on forest roads
- bridges and footbridges for cyclists and pedestrians
- temporary bridges

Currently, there is a need for small spans but high load-bearing capacity of bridges on forest roads as the load imposed by hauling machinery and the transport of long logs is significant. Very often, for design loads massive square logs cannot be used for the main support structure as the resulting dimensions are too large.

Moreover, we often need pedestrian bridges or bridges for cyclists, i.e. bridges with lower bearing capacity but sometimes large spans. The support structures of wooden bridges can be of several types. Most wooden bridge constructions are based on tried and tested basic systems or their combinations; others have originated in modern technologies based on timber.

The beams of the main support structure are constructed from round logs, square logs, glulam timber or plywood. Nowadays, the most frequently used material is glulam timber, from which profiles with the required dimensions can be produced. Glulam timber provides higher design strength than common timber and better utilization of available stocks of timber as it allows for the production of large wooden constructional elements from smaller timber profiles.

4 DECK CONSTRUCTION

Currently, for the deck construction it is possible to use planks, round logs, square timber, nailed laminated timber, glulam timber or wood-based boards, also composite girders with compressed concrete layer and the wear course. In simple bridge systems, e.g. panel-type constructions, the main support structure and the deck fuse. If panels are used, the deck also serves as a bracing element and for the transfer of horizontal forces.

4.1 Sawn lumber planks

Sawn lumber plank decks are the oldest and simplest type of timber deck. They are constructed of lumber planks, 3 to 6 inches thick and 10 to 12 inches wide, that are placed flatwise and spiked to supporting beams. The planks are generally laid in the transverse direction and are attached directly to closely spaced timber beams with spikes. They are also used longitudinally on transverse floorbeams. Plank decks are most practical on low-volume or special-use bridges. They are not water-tight and afford little protection to supporting members from the effects of weathering. Asphalt paving is not practical on plank decks because of large deck deflections that cause asphalt cracking and deterioration.

4.2 Decks for Temporary Bridges

Decks for temporary bridges are usually made of decking. Decking is square timber, roundwood, logs or pole timber laid tightly together on the main support structure consisting of square or round timber. However, round logs or pole timber do not provide smooth and safe ride, therefore, a simple layer of non-cemented rock of 10 cm in diameter is installed on their surface; this also protects the decking from the direct contact with vehicle wheels.

4.3 Nail-laminated lumber

Nail-laminated lumber decks are constructed of sawn lumber laminations that are generally 2 inches thick and 4 to 12 inches deep. The laminations are placed with the wide dimension vertical and nailed or spiked together to form a continuous surface. Nail-laminated decks are most commonly used in a transverse orientation on sawn lumber or steel beams spaced 2 to 6 feet apart. Their use has declined significantly since the introduction of glulam. The design is generally not suitable unless supporting beams are closely spaced. As beam spacing increases, deflection of the deck and dimensional changes, from variations in moisture content, cause delamination or loosening of the deck, reducing structural integrity and service life. [2]

4.4 Glued- laminated timber

Gluing allows for the production of wooden panels with large dimensions. Prestressing prevents the creation of cracks during their work as a consequence of tension in bending perpendicular to the grain. [3]

Glulam decks are constructed of glulam panels that are normally 5-1/8 to 8-3/4 inches thick and 3 to 5 feet wide. Glued panels are the most common type of a wooden deck. They are used in two basic systems – unconnected and connected by means of pins. Glued decks are stronger and more rigid than traditional plank or nailed laminated decks thanks to the homogenous bond among the lamellas. Glued panels can also be constructed so that they provide a water-resistant surface and protection for supporting beams and other elements. Moreover, their higher rigidity provides a better foundation for an asphalt roadway which is often used as the surface. (Fig. 2)

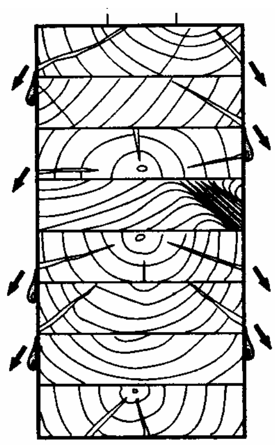

Fig. 2) Glued-laminated timber

4.5 Prestressed Wood Panels

There is an advantageous alternative for forest roads and the roads in the landscape and that is wooden panel bridges of the QS system, which are created from planks standing next to each other and connected (tightened) transversally by prestressed steel tie bars (Fig. 3). A bridge of this type for the spans usual on forest and field roads can be transported to the obstacle by means of a heavy vehicle which is used in forestry for the transport of long logs and barking machinery. QS panel bridges are also suitable as temporary bridges because the constructional elements can be easily mounted and reused and no wood protection or protection against corrosion is necessary for temporary arrangements. To insert the prestressing forces into the panel the edge girders from hardwood are used. The cooperation of several planks in the transmission of the load improves the bearing capacity due to the smaller scattering of strength. When prestressing decreases as a consequence of wood shrinking and shaping, the structure can be retightened (by means of nuts). This technology has spread to new bridges as well, especially in Switzerland, and several of these bridges were built in European countries. The span of road bridges, constructed from one QS panel, can be 7 m up to 9 m, dependent on the load class. The span of pedestrian bridges and bridges for cyclists can reach up to 12 m. QS panels can also be used as a deck (the bearing structure of a roadway) for bridge beams with larger spans. [4]

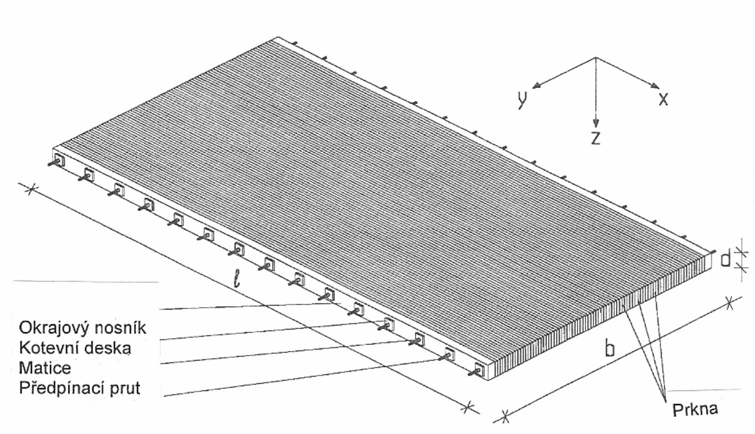

Fig. 3) A deck composition – prestressed timber panel of QS type

4.6 Composite Wood-concrete Constructions

The composite wood-concrete construction is a combination of a lower wooden glued construction and an upper concrete slab. The combined effect of the concrete with wood is guaranteed by special anchors. This creates the composite wood-concrete construction in which the specific features of both materials are used. In a simple span, concrete resists compression, whereas wood transfers tension. In intermediate supports of continuous spans, they work in the opposite way.

The advantage of this construction is its easy and fast assembly as the bridge panel is produced in the production hall and then fitted by means of a crane to support bearings prepared in advance at the construction site.

5 ADVANTAGES OF PANEL DECKS

- A panel performs several functions together: transmission of load, load distribution, wind bracing, supporting foundation for the surface layer or protection of a lower construction (when the deck is used for a road bridge).
- Moreover, their production and assembly is easy. They can be produced in the production hall and transported to the construction site, or they can be produced at the construction site.
- Thanks to the prestressing, the stronger planks cooperate with the weaker ones and this improves the bearing capacity.
- A panel provides a good foundation for the surface finish (e.g. asphalt).

6 CONSTRUCTIONAL WOOD PROTECTION OF WOODEN BRIDGES

Constructional measures start with the construction design which should prevent water penetration into wood and allow for fast waste discharge as much as possible. Pedestrian bridges and bridges for cyclists can be designed as covered. If a partial or a complete covering of the main construction elements is not possible, unnecessary or inadequate content of wood moisture can be prevented by means of a suitable solution of individual constructional details.

- In covered constructions, the roof sloping, the type of roofing and sufficient overhangs are important.
- It is necessary to prevent standing water on wood surfaces – attention has to be devoted to gradients and areas of cross sections, sloping surfaces are more suitable than horizontal ones. If there are horizontal wooden elements, it is necessary to guarantee water runoff by at mininum a natural fall and to leave gaps between the elements so that water could flow off and air could circulate between them. In the cases when wooden decks work as the upper covering or wear surface, it is necessary that there is at least 2 % gradient and water discharge provided. Separate decking elements are to be laid with 10–20 mm gaps.
- It is not recommendable to use wood species susceptible to cracks.
- It is advisable to avoid openings, cuts, etc. where water could gather. Wooden elements can be also protected against rain and water by sheeting, or easily replaceable wooden planks.
- The geometry of the constructions and the details of joints have to be designed so that water does not gather in the joints, or so that water can evaporate thanks to air circulation.

7 CONCLUSION

Although wood is today often replaced with other materials, it is undoubtedly an appropriate material for the construction of bridges and footbridges. It is a highly aesthetic and natural material which will not stand out in a natural landscape. Thanks to the up-to-date technologies presented in the paper it is possible to design wooden bridges for small, medium but also large spans. However, to ensure their long life and proper function, constructional protection of wood and chemical surface treatment are necessary.

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LANDSCAPE CHARACTER ASSESSMENT - A BASIC TOOL FOR BUILDINGS ALLOCATION IN LANDSCAPE

Petr Kupec[1], Martina Buršová [2]

Abstract

The article presents some general approaches to landscape character assessment. It is based on generally used methodologies in the Czech Republic (e.g. Vorel at al 2004) and original extensions developed according to original works of authors. The assessment is generally conceived as an examination of influence of the conception on the environment [SEA], according to law No. 100/2001 Sb. on examination of influence on the environment. The concerned landscape area is specified as the basic parameter for evaluation the presence of natural, cultural and historical characteristics is described in it. Also technical characteristics of localities [present condition, access road, place distance] are examined as well as assessment of suitability of locations to the valuated building.

Key words

Impact assessment, landscape character, wind-power stations, Vsetinsko, buildinngs allocation in landscape

1 INTRODUCTION

Landscape character protection (regarding to the Nature and Landscape Protection Law, Law No. 114/1992 Col.) is defined before all as its protection against influences lowering its aesthetic, natural and cultural values. One of the most important influences that significantly affected landscape character are landscape constructions. Landscape character assessment is very important tool that can help to minimize negative effects of landscape constructions allocation to landscape character.

The article presents example of landscape character assessment of proposed wind-power station in Vsetinsko Region but presented approaches and procedures can be used generally in case of solving similar landscape problem (small landscape constriction allocation).

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2 MATERIAL AND METHODS

2.1 Locality

The area of interest is situated in the eastern part of the Czech Republic, in the northeast part of Zlinsky District, close to the border with the Slovak Republic. It is under the competence of municipality with extended authority Vsetin. The area of interest includes cadastral areas of 13 municipalities: Bystřička, Hošťálková, Jablůnka, Janová, Kateřinice, Lhota u Vsetína, Liptál, Malá Bystřice, Pržno, Ratiboř, Růžďka, Ústí a Vsetín. The area of interesting locality is 229,40 km^2.

The area of interest is located in rugged landscape of Western Carpathian geo-morphological region (Hostynske vrchy and Vsetinske vrchy Hills). Geology of the area of interest is formed by agglomerates, sandstones and claystones of solansky, zlinsky and belovezsky measures [1].

Soils in the area of interest include brown soils, luvi-soils, pseudogley-soils, kambi-soils (typical, acid and podzolic) and podzolic-soils. The area of interest is located in the Vsetinska Becva River catchment area. Regarding to Quitt climate classification [2], interesting area lies in the cold region CH7, valleys are classified to the coldest moderately warm region MT2.

Potential vegetation of the area of interest is created by forest vegetation formations, especially beech forests and fir-beech forests. Spruce-fir-beech forests occurres only smaller sites in the tops of the hills of Moravskoslezske Beskydy Hills and Vsetinske vrchy Hills. Forest vegetation slightly prevails the nonforest vegetation in the area of interest. There are cultural meadows and semi-cultural meadows and pastures presented here as the main types of nonforest vegetation.

2.2 Method

Landscape character evaluation was in the Czech Republic solved, among others, in the work of following authors: Mimra, Sklenička [3], Bukáček, Matějka [4], Low, Míchal [5], Vorel et al. [6]. They works are concerned with the methodology of landscape character evaluation respectively with evaluation of the influences of different objects to the landscape character. It can be claimed that there is no obligatory methodology of landscape character evaluation in the Czech Republic at present.

Solved strategy (allocation of wind-power stations in Vsetinsky region) was evaluated with using self methodology. The basis for creation of mentioned methodology were the Law No. 100/2001 Col. and particular outputs and approaches obtained from the sources mentioned above (especially Vorel et al. [6]).

The basic principle regarding to the Vorel et al. [6] methodology is the space and character differentiation of landscape. It is done in three steps:

1. Determination of the area of interest - so called "Respective Landscape Space" (RLS)
2. Self landscape character evaluation
3. Evaluation of impacts to the landscape character

Evaluation of influences of possible wind-power station allocation to the landscape character of Vsetinsko region was elaborated by quantification of the solved area relevant parameters.

Methodology process included following steps:

1. Determination of the localities convenient to wind-power stations allocation - it was done regarding to the area morphology (altitudes and terrain horizontal and vertical articulation) - the localities with altitude more than 600 m above the sea level are suitable for wind-power allocation.
2. Definition of the natural characteristics - all types of protected areas regarding to the Law No. 114/92 Col. in the area of interest.
3. Definition of the cultural and historical landmarks creating the landscape character.
4. Determination of the Respective Landscape Space - it was done only in case of localities situated out of the Protected Landscape Area Beskydy (buildings allocation is strictly forbidden here).
5. Evaluation of the area of interest technical possibilities, especially presence of access road and necessity of forest stands liquidation. Also the distance from the nearest residence was taking into account regarding to future noise production of wind-power stations.
6. Evaluation of the convenience of particular localities to the wind-power allocation on the basis of the presence and quantity of evaluated parameters and their technical abilities.

3 RESULTS

Regarding to the above presented methodology 16 localities were taking account into the evaluation. The Respective Landscape Space was defined in case of every of them and evaluation of the relevant characteristics was done (see example in table 1).

Tab.1) Evaluation of landscape character parameters and determination of technical abilities of model locality

	Landscape character parameters	**Point value.**
Natural characteristics	PLA Beskydy	1
	SCI Beskydy	1
	SPA Horní Vsacko	1
	NR Klenov	1
	NM Svantovítova skála	1
	NM Louky pod Štípou	1
	RBC Bystřička	1
	Local ASES	1
Σ affection		**8**
Cultural and historical characteristics	Campanile Malá Bystřice	1
	Bystřička Reservoir	1
Σ affection		**2**
Technical abilities	**Description**	**Valuation**
Access road	Public road: Road of III. class Vsetín-Bystřička, distance from locality: 2,5 km	unsuitable
	Another access: Forest road of 2L class distance from locality: 230 m	
Locality current status	75 % Covered by forests	unsuitable
Distance from residences	200 m	unsuitable

Notice: PLO - Protected Landscape Area, SCI - Sites of Community Importance, SPA - Special Protected Area, NR - Natural Reserve, NM - Natural Monument, RBC - Regional Bio-corridor, ASES - Areal System of Ecological Stability

The Respective Landscape Space of locality is 23,41 km^2. Table No. 1 shows which natural, cultural and historical characteristics (parameters) are presented in the Respective Landscape Space (the point value of parameter presence is 1 if it is completely presented in RLS and 0,5 if it is presented partly). Also the technical limits of locality are shown in table 1 (valuated only as suitable or unsuitable).

Final evaluation of all localities is realized by the sum of their point value (range between 4,5 - 13 points). When the sum of point value is higher, the affection of landscape character in the locality is higher.

Localities were sorted to the five classes of affection of landscape character with interval approximately 20% (see table 2)

Tab.2) Classes of affection of landscape character in Vsetinsko Region and number of localities in particular classes

Class	Interval	Affection	Number of Localities
I	0 – 2	no	0
II	2,5 – 5	moderate	4
III	5,5 – 8	middle	4
IV	8,5 – 11	high	5
V	11,5 – 13	very high	3

4 CONCLUSION

As it is shown in table 2 when construction are allocated in landscape, the landscape character is nearly always influenced. The task of the Landscape Character Assessment is to minimize mentioned influences. The solution from the landscape character point of view consists in identification of localities where are the influences potentially lowest. These localities should be defined in territorial planning documents and separately valuated in EIA (Environment Impact Assessment) process in case of realization

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TECHNOLOGY OF EARTHWORKS PERFORMANCE DURING THE CONSTRUCTION OF HIGHWAYS, WITH SPECIFIC EXAMPLE FOR THE HIGHWAY BAR-BOLJARE IN MONTENEGRO

Jelena Lukić [1], Miloš Knežević[2], Mladen Gogić[3]

Abstract

The technology of the earthworks performance in the construction of highways is shortly described in this work. The short view on mechanization for earthwork performance is given here, as well as the overview of general technical conditions for its performance. Also, the ways of selection and planning of technique and technology of earthworks is analyzed here. On the concrete example for Bar-Boljare Highway in Montenegro (section Smokovac-Uvač) the proposed technology of earthworks performance is presented by the flowchart and technological card of process, and the proposal of narrower selection of mechanization for implementation of planned works is also presented.

Key words

Earthworks, performance, mechanization, excavation, dike, narrower selection

1 INTRODUCTION

Studying of the earthworks technology is actually studying the application of certain construction machinery and devices in mutually connected action that gives at the end the product, a natural earthy material that is refined into a useful building. Earthworks are generally performed using machinery, which has, due to intensive development of machines production, reached very large effects, which greatly facilitated and speeded up performance.

The percentage of use of machinery is very important because in addition to achieving higher performance compared to manual work, multiple cut works are achieved. With good technology performance and good selection of machines preconditions for the implementation of activities in quality and cost-effective manner are created and in the planned time, which is a common goal of both, the investors and contractors.

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2 EQUIPMENT FOR EARTHWORKS PERFORMANCE

Basic machinery for earthworks and transport include: dredger, dozer, scraper, graders, loaders and tippers.

Construction dredgers include various forms, types, subtypes and similar types of machines intended for the excavation, the excavation of hard soil and rocks as well as the loading or disposal of excavated material.

Bulldozers are often applied for cleaning and removal of humus ground, making the snuffers and the embankments, fill, excavation with filling of all kinds of land, creation of profiles, the smaller depth excavation, digging out of hard soil, pushing scraper during the digging, and spreading of excavated and loaded material.

Basic functions of *graders* are: a fine planning of soil, making of the layer, sand spreading, gravel and crushed stone, arrangement of slopes and slush, removal of humus, easy removal of material, arrangement of shoulders, mixing and merging of different materials, and cleaning of the snow.

Scrapers are machines for digging of the soil with simultaneous transport and unloading of excavated material, and they can dig and load earth of I, II and III categories without roots and rocks.

Loaders are construction machinery used for loading of the material into transport vehicles, and if necessary when the material is lightweight and thin can be carried out by digging with loading.

Transport of the material is carried out principally by vehicles on pneumatics. From this kind of vehicles hauliers with trailers or half-trailers as well as dump trucks and tippers are used.

3 GENERAL TECHNICAL REQUIREMENTS FOR EXECUTION OF WORKS

3.1 Excavations

Excavations include: excavation of the surface layer of fertile soil (humus), all broad categories of excavation of earth materials and rock (all excavations for the stairs, the cuttings and related works), on the deviations of roads and waterways regulations, and all extensive excavations at the performance of structures, including the excavations of the foundations of structures, drainage and other pits.

3.1.1 Excavation performance

All excavations should be made according to the designed or required cross sections. Groundwater and extensive excavations, excavations for foundations and drainage pits should generally be carried out using the machinery and other assets in order to limit manual work to a minimum. Bad wearable ground should be excavated with the proper machinery to suit specific load carrying surface. For planning of slopes and bottom it is necessary to provide partial manual labor, especially for removal of bulk excavated material. Hard, and occasionally soft rock should be excavated by drilling machine, deep and re-mining of large blocks, if that is required for earmarked use of the excavated hard rock. Slopes of excavated inclinations depend on the category of soil, moisture content of materials and its layers. Decayed layers of earth materials, which appear in excavations, including decayed layers at the top and middle rotten zones, should be used if there are conditions for that. On the slopes with inclinations up to 20 °, on which embankments will be constructed, steps in width from 1.0 to 1.5 m should be excavated in fundamental soil.

Organization of the excavations shall be such to prevent bigger disturbances and interruptions due to atmospheric or other waters.

Digging in the bad wearable ground must not be opened long: the advance of excavations should be mandatory and in accordance with backfilling, or by arrangement of the slope.

The material, obtained by excavation should be used primarily for the purpose of contracted production. The remaining surplus should be removed - according to the provisions of the design documents - or in backfills or in landfills.

3.2 Embankments, backfills, spikes and layers

The work includes: mechanical spreading of materials for embankments, mechanical and / or manual spreading of material in backfills of the ground, canal ditches, construction pits, melioration canals, mechanical and / or manual spreading of material for the layer, wetting, mixing, rough planning and compacting of material in the embankments, backfills and posts in the measures and quality, specified in the project documentation, development of the layer in the measures and quality specified in the project documentation and technical conditions.

3.2.1 Working technique

Incorporating the embankment, backfills, posts and layers can begin when the plain ground of ground layer - basic ground is arranged in accordance with the requirements of the project documentation and technical conditions and when executed work is taken from the supervisory engineer. At the corresponding prepared plain ground of ground layer arrival of material may begin only after it is approved by the supervisory engineer. The material for embankment is generally not allowed to be placed on the plain ground of ground layer, but only on already spread layer material. The prepared material should be unloaded in front or by the side and mechanically pushed away to the place of installation. In the transverse direction each individual layer of material should be outspread in a one-sided or two-sided cross slope, which is supposed to amount at least 3% at coherent earth material, and at incoherent earth material, electro-filter ash, raw materials and consolidated and stabilized coherent earth materials cross slope layer must be similar to the designed road surface slope. If arranged plain ground of fundamental ground has no proper minimum cross slope for drainage (3%) because of the given and terrain conditions, a minimal cross-slope should be provided with the first incorporated layer of the embankment.

Material may not be spread out and / or embedded into frozen surfaces, nor should the frozen material be embedded in the embankments.

Compaction must generally take place from the outside edges toward the middle of the compacted surface and from lower edge toward the higher layers. For provision of appropriate compressibility and carrying capacity throughout planned width of the layer should be expanded on each edge for the planned layer thickness of 10cm.

4 SELECTION AND PLANNING OF EARTHWORKS TECHNIQUES AND TECHNOLOGY

The selection of technique and technology for performance of surface earthworks in fact is choosing the necessary construction machinery with the planning of its work and performance. This choice can be implemented in all phases of the construction project and by all project participants.

The final planning application, in any way selected earthworks techniques and technologies, in principle is carried out with complete and utter responsibility by the contractor because usually he is the only one who takes part in all forms and periods of the selection.

The selection of earthworks technique and technology is executed in such way:

- **a wider selection** which implies the framework selection of construction machinery types for the implementation of selected techniques and technologies of considered earthworks, and as
- **short list** that includes determination of the type, size and number of machines in the selection of certain types of construction machinery and other belong mechanical - technological equipment.

5 EARTHWORKS PERFORMANCE TECHNOLOGY FOR THE HIGHWAY BAR-BOLJARE

Within this document the earthworks performance technology on construction of the highway Bar-Boljare in Montenegro is treated, on the section Smokovac-Uvac, according to the General solution of the design, namely the appropriate technical requirements.

Earth-moving machine is intended mainly for earthworks with the required percentage of manual labor and finishing excavation in the sense of achieving the projected dimensions of excavations.

Proposed technology performance is presented in the flow chart (Figure 1, Figure 2, Figure 3) and technological process map (Figure 4, Figure 5).

As for the selection of execution machinery for performance of scheduled works depends on the chosen working methods and construction technologies, then the state of the available machinery, the financial status of Contractor, the state of market for machines, conditions of staff and the possibility to maintain machines. Having in mind the above, this document proposed narrow selection of machines for the execution of the planned works, Table 1.

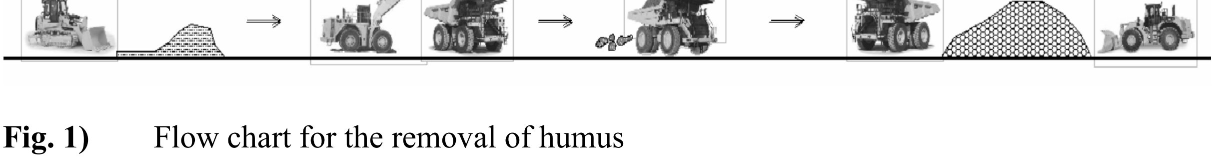


Fig. 1) Flow chart for the removal of humus

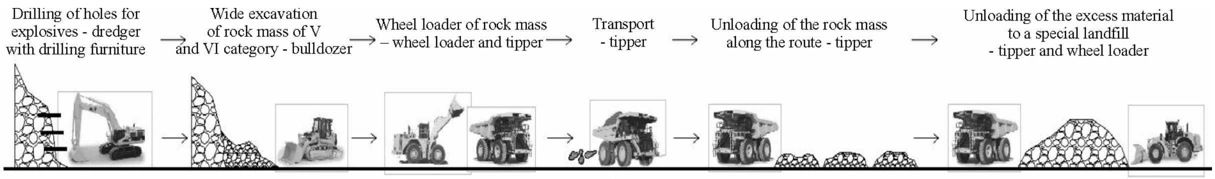


Fig. 2) Flow chart for a wide excavation in mass rock of V and VI category

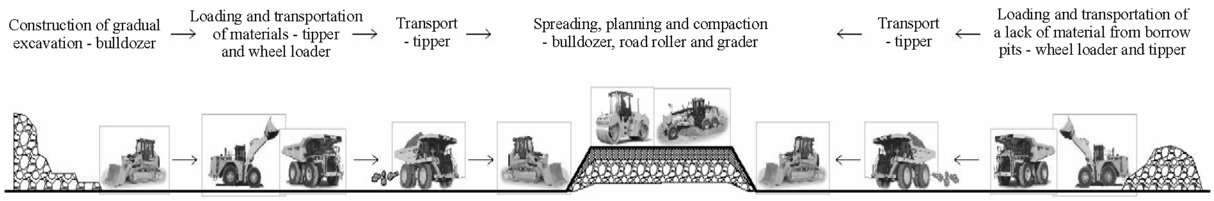
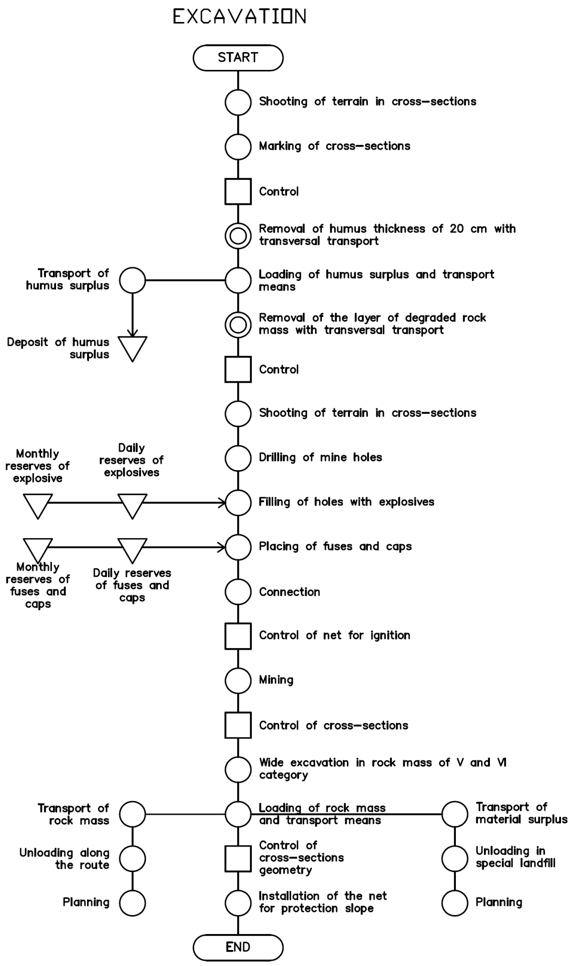


Fig. 3 Flow chart for the embankment of crushed stone material from the excavation

SHORT LIST THE MACHINERY FOR EARTHWORKS									
	TYPE OF WORK	COMBINATION	TYPE OF MACHINE	PRACTICAL EFFECT Up [m³/h]	REQUIRED NUMBER OF MACHINES n	TOTAL PRACTICAL EFFECT nxUp [m³/h]	PRICE OF THE MACHINE OPERATION K_h [€/h]	PRICE OF ALL NECESSARY MACHINES nxK_h [€/h]	TOTAL PRICE OF ALL MACHINES IN COMBINATION $\frac{\Sigma nxKh}{(minUp)}$ [€/ m3]
	(1)	(2)	(3)	(4)	(5)	(6)=(4)*(5)	(7)	(8)=(5)*(7)	(9)
EARTHWORKS	LARGE EXCAVATION OF ROCK MASS OF V AND VI CATEGORY	I	CATERPILLAR BULLDOZER D5N XL	40.45	1	40.45	74.27	74.27	17.98
			WHEEL LOADER VOLVO L60E	37.96	1	37.96	53.25	53.25	
			MERCEDES ACTROS TIPPER 2641	4.07	10	40.70	55.51	555.10	
		II	CATERPILLAR BULLDOZER D6R LGP	67.50	1	67.50	115.88	115.88	15.28
			CATERPILLAR WHEEL LOADER 930 G	55.94	1	55.94	88.80	88.80	
			MERCEDES ACTROS TIPPER 3341	5.14	11	56.54	59.09	649.99	
		III	BULLDOZER KOMATSU D65EX-15	95.11	1	95.11	112.18	112.18	**12.46**
			WHEEL LOADER KOMATSU 380-5	61.94	2	123.88	68.24	136.48	
			MERCEDES ACTROS TIPPER 4141	6.82	14	95.48	66.87	936.18	
	TREATMENT OF SUBLAYER	I	CATERPILLAR BULLDOZER D6R LGP	67.50	1	67.50	115.88	115.88	2.76
			VIBRATORY ROLLER CATERPILLAR CS433E	112.32	1	112.32	70.52	70.52	
		II	BULLDOZER KOMATSU D65EX-15	95.11	1	95.11	112.18	112.18	**2.24**
			VIBRATORY ROLLER CATERPILLAR CS533E	166.14	1	166.14	100.52	100.52	
	CONSTRUCTION OF THE EMBANKMENT OF CRUSHED ROCK MATERIAL FROM EXCAVATION	I	MERCEDES ACTROS TIPPER 3341	5.14	14	71.96	59.09	827.26	16.36
			CATERPILLAR BULLDOZER D6R LGP	67.50	1	67.50	115.88	115.88	
			GRADER CATERPILLAR 120H	397.98	1	397.98	90.72	90.72	
			VIBRATORY ROLLER CATERPILLAR CS433E	112.32	1	112.32	70.52	70.52	
		II	MERCEDES ACTROS TIPPER 4141	6.82	14	95.48	66.87	936.18	**13.21**
			BULLDOZER KOMATSU D65EX-15	95.11	1	95.11	112.18	112.18	
			GRADER VOLVO G720G	469.00	1	469.00	107.94	107.94	
			VIBRATORY ROLLER CATERPILLAR CS533E	166.14	1	166.14	100.52	100.52	

Tab. 1) A short list selection of earthworks machinery



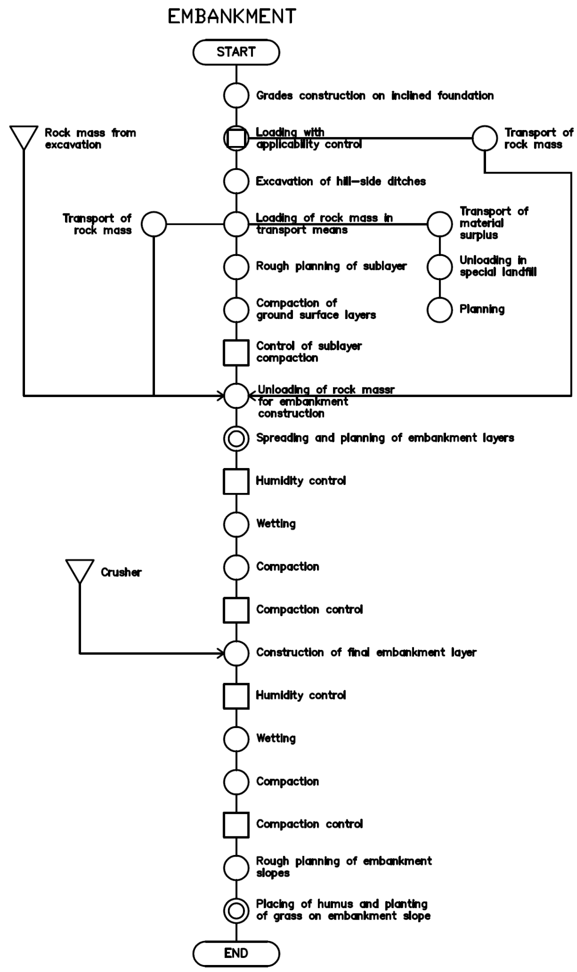


Fig. 4) Map of the technological excavation process

Fig. 5) Map of the technological process for embankment

6 CONCLUSION

Earthworks performance technology is a separate task for each structure in relation to its type, size, complexity and uniqueness, as well as the location of construction. This is reflected at structures in road construction, especially for highway construction, where the earthworks are of large scale and importance and of which depend all the other works.

The solution for earthworks performance technology for each structure means a particular task which solving starts at the designing phase and is carried through all other stages of the final materialization on the terrain.

A good example of these findings is construction of the highway in Montenegro, which is planned on the terrain that is very inaccessible and belongs to one of the hardest in Europe. All this represents a challenge for contractors, who primarily by selecting appropriate earthworks performing technologies should respond all requests and eventually bring high-quality facility, in prescribed deadlines and to achieve planned positive financial effect.

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ECODUCTS STRUCTURE SYSTEMS IN THE REGION OF CENTRAL EUROPE

Jan Pěnčík[1]

Abstract

Construction of huge road structures such as motorways cannot bring irreversible effects or damages of biological relations which in case of road structures can affect large areas or can bring isolation of populations. High capacity and intensively used roads makes mainly for bigger mammals with difficulty overcome barriers that cause fragmentation of landscape and populations. For maintaining possibility of animal migrations are in present for newly constructed motorways in place of biocorridors designed special structures – ecoducts. The paper deals with a comparison of a current state in ecoducts build-up in Central Europe region – Czech Republic, Slovakia and Austria. It shows different shapes and types of construction systems and construction technology.

Keywords

Sustainable, structures, fragmentation, biocorridor, ecoducts, Central Europe

1 INTRODUCTION

For many animal types are roads and motorways or more precisely traffic hardly surpassing barriers with consequence in smaller or bigger isolation of local populations [1]. Practical consequence can be briefly characterized as restriction of common movement of animals in landscape, fragmentation of biotopes leading to isolation of partial populations (Fig. 1) with negative impact on their genetic diversity and collisions of vehicles with animals.

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Fig. 1) Roads and motorways = barriers caused landscape fragmentation and isolation of local populations of animals

High capacity and intensively used roads makes mainly for bigger mammals with difficulty overcome barriers that cause fragmentation of landscape and populations [2]. This forms so called “island” populations that are very vulnerable. Population fragmentation is becoming one of most threatening factors in Europe for many animal species mainly for populations of bigger mammals. Arising possibility of population fragmentation can be derived from density of highway network (Fig. 2 and 3).

	Belgium	Czech Republic	Denmark	Germany	France	Netherlands	Austria	Slovakia	United Kingdom
Highway (km)	1747	518	1010	12037	10379	2342	1677	316.2	3657
Area (1000 km^2)	30.511	78.866	43.094	357.021	547.030	41.576	83.853	49.034	244.870
Network density	57.3	6.6	23.4	33.7	19.0	56.3	20.0	6.4	14.9

Fig. 2) Motorway network density (km/1000 km^2) in selected countries - year 2004 [3]

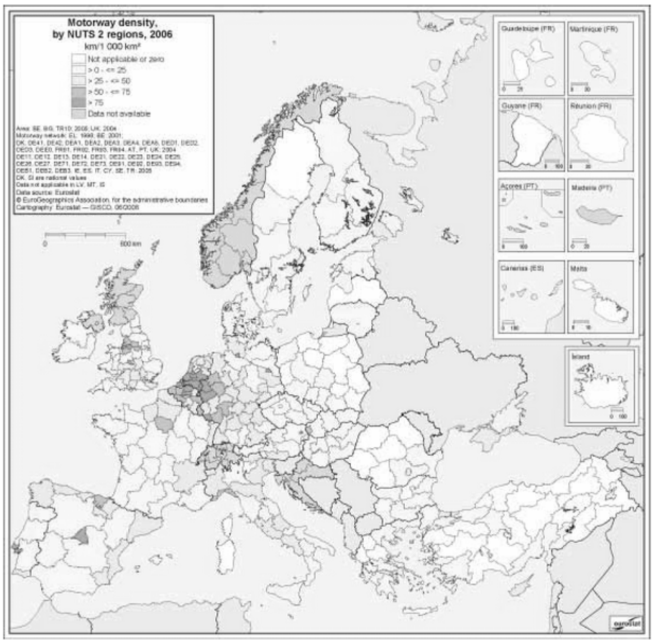


Fig. 3) Motorway density from 2008 [4]

Ecoduct	Subways	Culverts	Pipe culverts
			Frame culverts
		Bridges over road	Multipurpose bridges
			Particular bridges
			Large nature bridges - total span over 100 m
	Overpasses (green bridges)	Bridges across road	Multipurpose bridges
			Particular bridges - ecological footbridge, bridge
		Tunnels	Tunnel - ecological tunnel

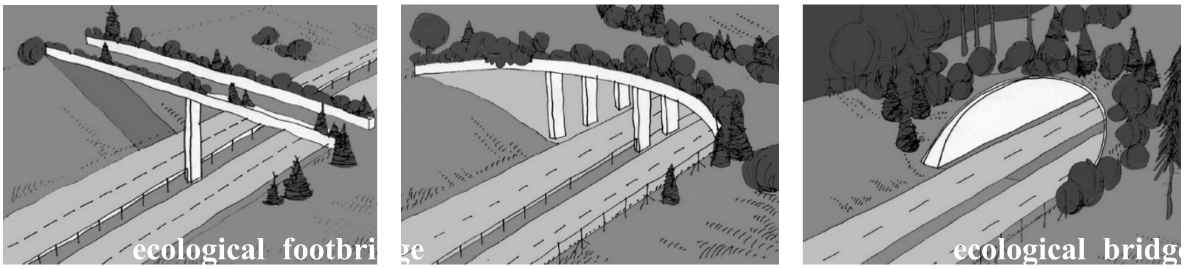


Fig. 4) Division of ecoducts with dependency on location of ecoduct with respect to surrounding terrain and road [5]

2 STEPS FOR MINIMIZING OF NEGATIVE IMPACT OF ROADS AND TRAFFIC TO ANIMALS

To prevent direct collision of animals with traffic are along most of the roads mainly highways made fences that hamper entering of bigger animals on roads. It is precaution that in case of proper realization and servicing fulfills its function however at the expense of maximum of barrier effect restraining overcome of the road.

For maintaining possibility of animal migration even over mentioned restrictions and neglect the fragmentation of landscape and animal populations are in present for newly constructed motorways in place of biocorridors designed special structures – ecoducts. Ecoducts that serve primarily for animal migration or primarily for transfer of road over natural obstacle with secondary function of animal migration can be divided according to several criteria's. For example dependency of location of ecoduct with regard to surrounding terrain and road (Fig. 4) or according to animal category for which is ecoduct made.

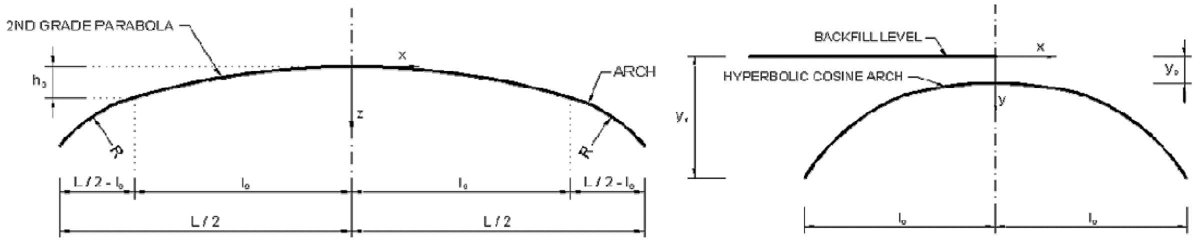
From (Fig. 4) overpasses (green bridges) is possible to divide on ecological bridges eventually foot bridges over roads and tunnels. Ecological bridges over roads are in most cases build in place of crossing of constructed road with forest or field roads. They are in most cases suited for transfer of roads over motorways with supplementary function of use for transfer for small and middle-big animals or for all animal categories. Last type of green bridges is ecological tunnel it means structures longer than 50 m. Ecological tunnels are most ideal from all types of ecoducts transferring highway under level of biocorridor.

3 STRUCTURE SYSTEMS OF GREEN BRIDGES

Green bridges are most often designed as ecological bridges over roads and their part are forest or field roads. In most cases are supporting structures of green bridges designed as cast in place or prefabricated buried frame structures with constant or variable thickness build before the road is put into operation.

Central line has shape of straight or broken axis or curve. The shape of curve is preferred because frame structure with straight or broken axis does not fit naturally into the landscape. In case of use the frame structure with broken axis, the structures are completed about molding with curve shape. The shape of curve in shape of 2^{nd} grade parabola, 2^{nd} grade parabola with circular arches near foots or more enable shape of hyperbolic cosine (Fig. 5) is also used because of better static behavior. While using mentioned curved shapes it is possible to design shape of supporting structure according condition of elimination of bending moments from vertical load caused by backfill. So, it will make possible to decrease claim on quantity of reinforcements, construction height, structure members and also price of structure.

a) b)



$$z = x^2 \Big/ \left(\frac{l_0^2}{h_0} \right) \qquad y = y_0 \cdot \cosh(\alpha x)$$

Fig. 5) Supporting structure with 2^{nd} degree parabola with circular arches near foots (a) and shape of hyperbolic cosine (b)

Ground plan is mostly straight since this shape fulfills esthetical aspects and naturally fits into landscape that is artificially split by motorway and creates migration paths for all animal categories. Besides straight ground plan is for economical reason also used hyperbolic one. Disadvantage of this shape is reducing of width of ecoduct that is one of the important factors influencing function of ecological bridge. Where is possible are build ecological tunnels serving only for animal migration. Again are discussed spilled frame cast in place or prefabricated reinforced concrete structures with constant or variable thickness with center line in shape of arch or dome.

3.1 Innovative method of design and construction of ecological bridges

As a result of GAČR 103/08/1278 and 103/09/2071 project was designed new innovative method of design and construction of ecological bridges [6]. The great difference from common design and construction process is they are to be constructed during the operation of the motorway. Short time closures of one carriage way are acceptable but the traffic cannot be interrupted as a whole for more hours. The structures have to be lightweight and easy to assemble – the use of pre-cast concrete and composite structures is quite logical. These presumptions lead to two possible structural arrangements: a hinged arch, and a lightweight integral frame structure.

The construction of supporting structures with regard to the shape is convenient to use reinforced concrete, or can be use also other materials as a steel, wood, wood-religious mix concrete.

4 STRUCTURE SYSTEMS OF GREEN BRIDGES IN THE REGION OF CENTRAL EUROPE

4.1 Czech Republic

The construction of ecoducts or green bridges (bridges, tunnels) in the Czech Republic began in 1999 when the first Czech ecological tunnel was built on the R35 motorway near the village Dolní Újezd (Fig. 6a). Other green bridges are made on the R4 motorway near the village Drhovle or road juction Nová Hospoda (Fig. 6b), ecological bridge near the village Jenišov on the R6 motorway (Fig. 7a) and ecological tunnel on the D47 motorway near the village Hrabůvka (Fig. 7b). On the motorway D11 are built two ecological tunnels near village Žehuň and Voleč (Fig. 8a and 8b). Except mentioned green bridges are in the design, construction or before finishing of ecological tunnels or bridges on the motorway near the D47 near the village Suchdol nad Odrou (Fig. 9a), on the Prague's circle on the motorway R1 ecological tunnels Cholupice I and II (Fig. 9b), Šabatka and Osnice.

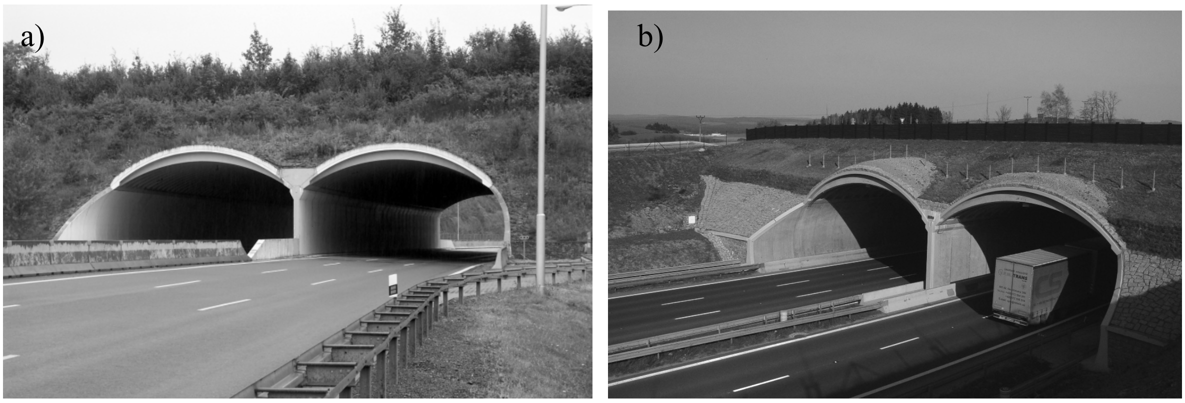


Fig. 6) Ecological tunnel Dolní Újezd (a) and Drhovle (b)

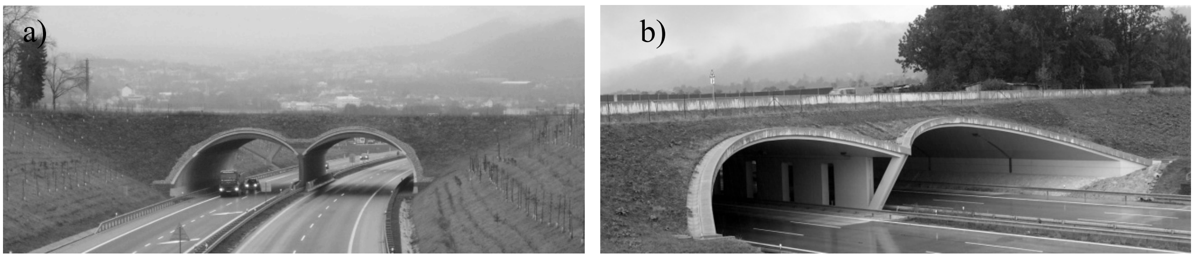


Fig. 7) Ecological bridge Jenišov (a) and ecological tunnel Hrabůvka (b)

a)

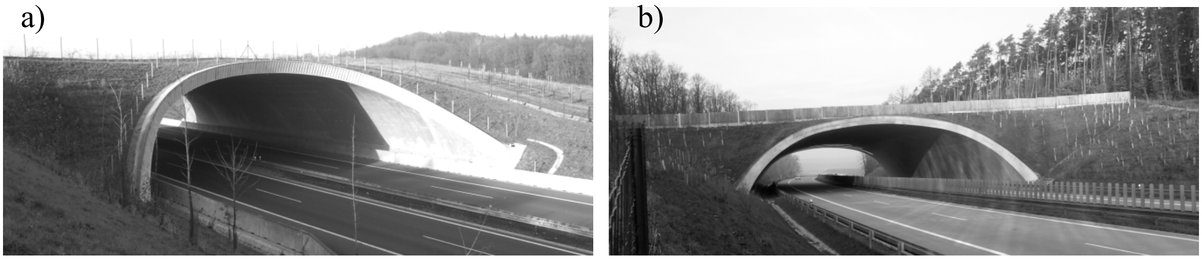


Fig. 8) Ecological tunnel Žehuň (a) and Voleč (b)

a) b)

Fig. 9) Ecological Suchdol nad Odrou (a) and Cholupice I (b)

The (Fig. 6 to 9) shows that in the Czech Republic is used frame structure system with supporting structure with shape of 2^{nd} grade parabola with circular arches near foots and shape of hyperbolic cosine. All green bridges are designed as reinforced structures built as cast in place or using prefabricated technology.

4.2 Slovakia

Fig. 10) Ecological tunnel Lučivná (a) and Jánovce (b)

First realized green bridges (ecological tunnel and ecological bridge) in Slovakia are built near Poprad on the motorway D1. Ecological bridge (Fig. 10a) with hyperbolic ground plan is designed as three joint structure system with shape of 2^{nd} grade parabola. Supporting structure is made of glued wood lamellas girders. Similar bridge is in Germany in Maklenburg. It is very elegant structure. For construction were used progressive materials and technologies. Ecological tunnel Lučivná (Fig. 10b) is excavated reinforced concrete tunnel made of two tunnel tubes. In transversal direction structure acts as dipole frame. It is very successful example of green bridges.

4.3 Austria

On Austria motorway A4 and A6 are green bridges designed as two-span reinforced concrete frames with molding of curve shape. As from (Fig. 11)

Fig. 11) Ecological on motorway A4 (a) and A6 (b)

From (Fig. 11) is seen that this frame supporting structure with broken axis completed about molding of curve shape fulfills esthetical aspects and naturally fits into landscape.

5 CONCLUSION

For maintaining possibility of animal migration and neglect the fragmentation of landscape and animal populations are in present for newly constructed motorways in place of biocorridors designed special structures – ecoducts. In most cases are supporting structures of these structures designed as cast in place or prefabricated buried frame structures with broken axis or axis of curved shape. Curved shape better fulfills esthetical aspects and naturally fits into landscape. This form of shape is used mainly in countries of Central Europe. The examples from Austria shows that adding an additional parts (molding of curve shape) to frame supporting structure with broken axis the results also fulfills esthetical aspects and naturally fits into landscape.

ACKNOWLEDGEMENT

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FACTORS INFLUENCING DESIGN AND FUNCTION OF ECODUCTS - GREEN BRIDGES

Jan Pěnčík[1], Marek Foglar[2]

Abstract

For maintaining possibility of animal migration over motorway roads are in present for newly constructed roads in place of biocorridors designed special structures – ecoducts. These structures serve for minimization of animal population fragmentation. During their designing it is necessary to take into account for what animals are determined, their location in terrain preferably in place of their current natural migration traces. The way of designing and implementation must enable their further functional use. Therefore is necessary to chose proper shape and used materials and also modification of their surroundings and access places. Among factors influencing design, location and function of ecoducts (green bridges) are width, surface treatment, surface ordering, location, loads etc. Mentioned factors are discussed and are assumed generalized conclusions and recommendations.

Keywords

Fragmentation, ecoducts, design, location, function

1 INTRODUCTION

One of the basic pillars of *sustainability* is an ecological pillar; others are economical and social-cultural pillars. From ecological point of view there are three basic protective elements: protection of sources, ecosystems and of the human health. Solutions that respect only some elements may act negatively on other. Laws of respective countries clearly establish which structures are necessary to subject process of assessment structure impact on nature (EIA) [1] and [2]. Construction of road structures such as roads and motorways cannot bring irreversible effects or damages of biological relations which in case of road structures can affect large areas or can bring isolation of populations. For many animal types are roads and motorways or more precisely traffic hardly surpassing barriers with consequence in smaller or bigger isolation of local populations (Fig. 1) [3]. Practical consequence can be briefly characterized as restriction of common movement of animals in landscape, fragmentation of biotopes leading to isolation of partial populations with negative impact on their genetic diversity and collisions of vehicles.

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2 GREEN BRIDGES

To remove the two negative effects of isolation and fragmentation of populations and reduce the territories for individual populations by "perforation" are in present for newly constructed roads and motorways in place of biocorridors designed special structures. These special structures are called *ecoducts* which can be put into the group of *green structures*. Division of ecoducts with respect to surrounding terrain and road or motorway can be found in [4]. The ecoducts are divided into subways and overpasses called *green bridges*.

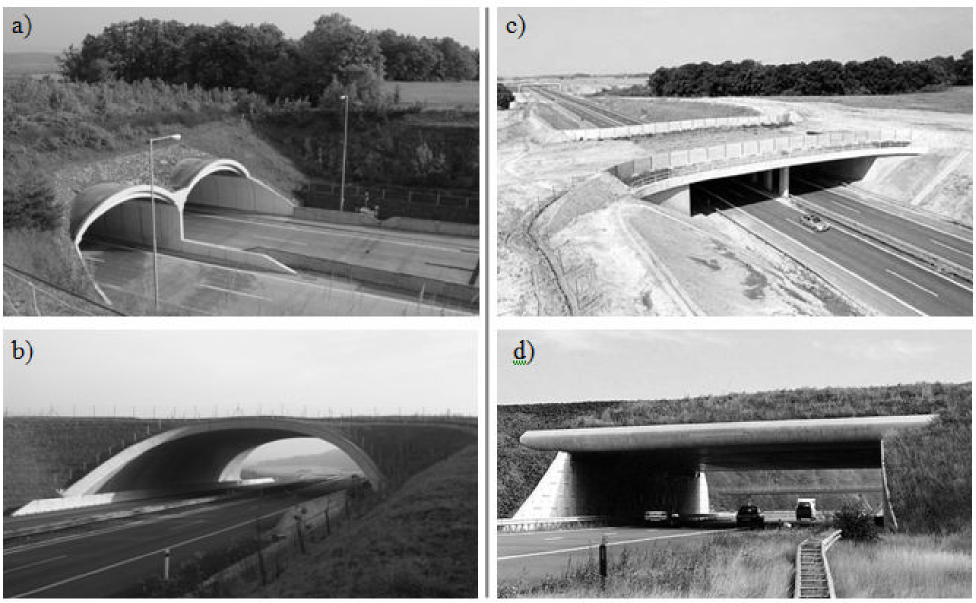
The effect of loss of animals due to conflicts with the means of traffic may be removed by means of complementary facilities and equipment to prevent entry of animals on the road.

Fig. 1) Negative effects – killing of animals, isolation and fragmentation of populations

3 FACTORS INFLUENCING DESIGN AND FUNCTION OF GREEN BRIDGES

Among factors influencing design and function of green bridges are width, surface treatment, surface ordering, technical equipment and loads.

Fig. 2) Shape of the structure – parabola (a) or hypcos (b) and frame (c)



3.1 Load

The load is the factor affecting the shape and size of cross sections of individual parts of the structure of green bridges. Type and size of load to be considered in the proposals depends on the structure surface and method of use of green bridges. In the case that the construction will be used only for transfer of animals via the road can be designed and constructed to assess the load that correspond bridges for pedestrians. The present use for migration of animals and convert forest and field trips over roads it is necessary to consider the size of load corresponding to the maximum load transferred to the class of road.

3.2 Shape of the structure and construction technology focused to material

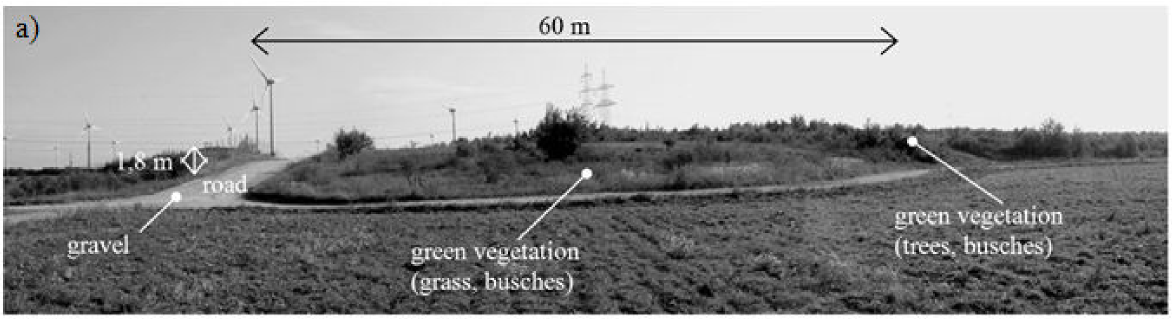
The shape of the structure and use of green bridges technology is mainly based on the nature of the load. Self weight load is critical for these structures. Backfill has a beneficial effect on the carrying capacity, can be considered as a co-supporting element. With regard to the nature of load it is advantageous to design in the shape of arc with constant or variable thickness in shape of parabola or of shape of hypcos. In those forms the structure does fit naturally into the surrounding landscape. Sometimes the structure of green bridges is designed as frame structure (Fig. 2).

The construction of supporting structures with regard to the shape is convenient to use reinforced concrete, or can be use also other materials as a steel, wood, wood-religious mix concrete. Technology can be chosen in the form of prefabrication or cast-in-place construction.

3.3 Width layout

The width is the factor affecting the function of green bridges (width is a size of green bridges in axis of road). It is not possible to uniquely determine optimal width of green bridges for animal migration because width is directly related with animal size. In case of big animals is recommended standard width 45 ± 5 m. For green bridges connecting several biotopes and that will be used except by big animals also by small one is recommended minimal width more than 50 m. In case of small animals is recommended minimal size 20 m.

On (Fig. 3) are shown two examples of different surface ordering and two different width layouts which consider and in consider general recommendations



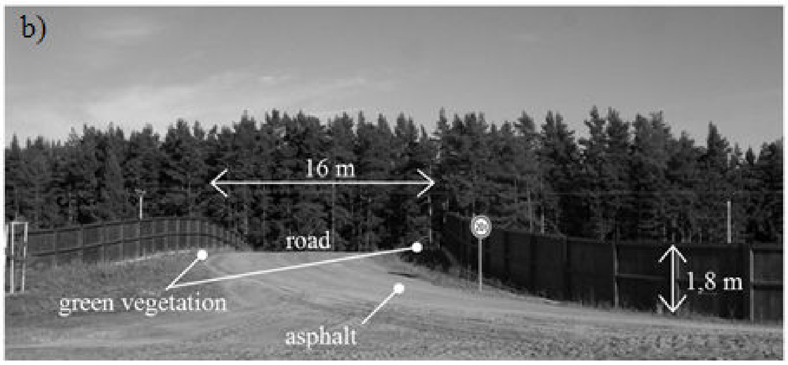


Fig. 3) Examples of different surface ordering and two different width layouts which consider (a) and in consider (b) general recommendations

3.4 Surface ordering

Ordering of surface is based on way of use of green bridges. Even minimal presence of human may discourage animal from using of green bridges. That is why is necessary to prevent human in using green bridges for example by dense vegetation or elevated banks [5]. In cases where is necessary to use green bridges besides for animal migration also for transfer of forest or field roads is urgent to separate them. Roads should be designed on sides followed by continuous stripe of green vegetation, see (Fig. 3).

3.5 Surface treatment

Next factor influencing functionality of green bridges is surface treatment. Green bridges surface treatment must be done so it does not segregate green bridges from surrounding environment. At the same time is necessary to make visual separation of this structure from highways or motorways. Surface treatment should be designed in way it will imitate character of surrounding biotope and habitat. Planting should conform to ecological aspects and should be done with timber species growing in proximity of green bridges. If there is forest or field road as part of green bridges its surface should have similar properties as hardness as surface or surrounding terrain. For example gravel or mold in special cases asphalt, see (Fig. 4).

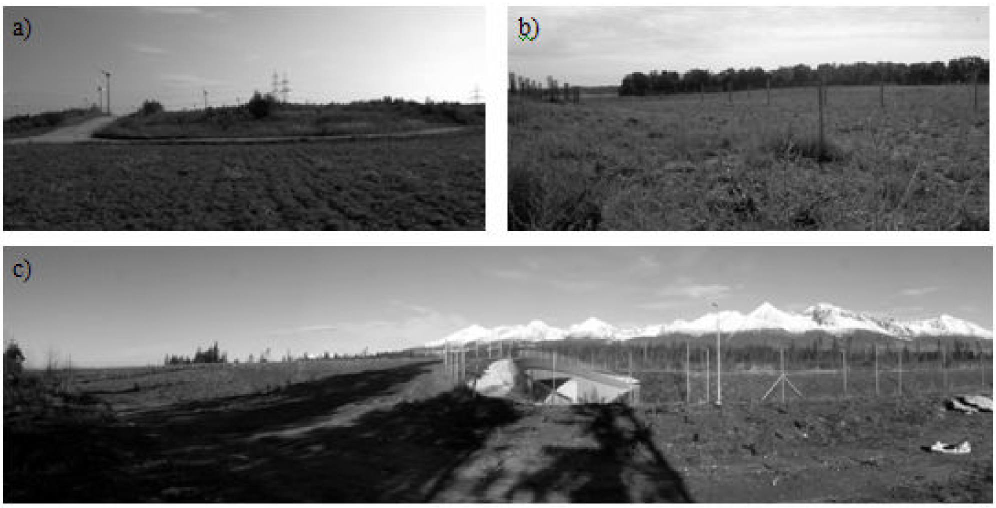


Fig. 4) Examples of different surface treatment – Austria A4 (a) and A6 (b) motorway, Slovakia D1 motorway (c) and Czech Republic R35 (d) and D11 (e) motorway

4 CONCLUSION

Generally, the issue of biodiversity and hence the populations of large mammals is indirectly addressed at European level through the general principles of decision-making process (92/43/EEC) that at the national level is required.

Analysis of an ecological pillar of sustainability with focus on preserving of sources and ecosystems in case of road structures has been implemented in this article. As part of these complex constructions are special structures – ecoducts, that are used for minimization of animal population fragmentation. For part of these structures i.e. green bridges are mentioned factors that influence their functionality as width, surface treatment, location, surface ordering and loads. Ways of designing with introduction of their usability are documented on several examples of realized green bridges in several countries.

ACKNOWLEDGEMENT

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CREATION AND PRESERVATION OF THE LANDSCAPE IN THE PROCESS OF SPATIAL PLANNING FOR THE CITY OF VRANOV NAD TOPĽOU

Zuzana Rusičová[1], Martina Zeleňáková[2]

Abstract

The country is one of the fundamental elements for urbanization, human activities, economic and industrial growth and social development. Urbanism is a systematic and continuous process which solves the demands and needs of society. Landscape creation and preservation is also a continuous, ongoing process that should be part of the urbanization process. Appropriate urbanism should respect the demands and requirements of the country, and improving the ecological stability of the territory.

Key words

Environmental assessment, land using, landscape planning, spatial planning

1 INTRODUCTION

Changes in the landscape result from infrastructure, housing or industrial developments cause impacts on the natural environment with fragmentation and habitat loss being some of the main threats [1]. The task of spatial planning and environmental impact assessment is to create a symbiosis between economic development need of new capital construction, which has always make certain claims to the territory and between the interests of the environment in terms of minimizing the negative response of investment in construction environment in accordance with the principle of sustainable development using capital construction to improve the current environmental situation [5].

2 CREATION AND PRESERVATION OF THE LANDSCAPE IN SPATIAL PLANNING

The basic tool for solving problems of the country is landscape planning and spatial planning.

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Creation of the landscape and preservation may apply through landscape design, which outlines the creation strategy of the landscape, but the proposed management of the landscape, laying down specific measures to target quality of the landscape's territory.

A crucial tool in solving the problems the landscape is spatial planning. The planning is to reconcile the various activities in the territory of each other and with environmental conditions. The part of the spatial planning is landscape (landscape-ecological) planning. Landscape planning is the design of ecologically optimum layout and land use, evaluating the viability of the country, addressing the ecological stability, heterogeneity, biodiversity and environmental functions in the landscape [4].

Creation of the landscape has a specific place in the spatial and landscape planning. It ensures implementation of the objectives addressed in the planning at the level of regulatory and land-use decisions. Landscape design participates in the conservation of natural and cultural heritage of the territory under the target quality of the landscape. Inclusion of buildings and functional areas to the country is an important task of the country creation. Development of construction is associated with the risk of visual impact on the landscape appearance.

2.1 Planning of future land use in spatial planning and priority areas

Spatial planning (urban planning) systematically and comprehensively address land use, establishes the principles of organization and substantive and time-coordinated construction and other activities affecting the development of the territory. It creates conditions to ensure continued compliance of all natural, civilization and cultural values in the territory, particularly with regard to environmental preservation and creation of its components. Land use planning is the task of planning in order to control territory and changes in the use of the property. It provides the regulatory of the territory use in relation to individual sectors of human activities, reviewing the levels of protection and boundaries of individual protected areas, conservation of natural habitats of endangered plant and animal species [2].

Conflicts of interest in land use in favour of the nature and landscape protection or anthropogenic use address the land use plan. To fulfil this role, the land use plan specifies the so-called priority areas / sites in the land use in terms of its potential – Fig. 1). In the priority area of some form of land use or function of land use is given priority over all other uses and forms of functional areas [3, 5].

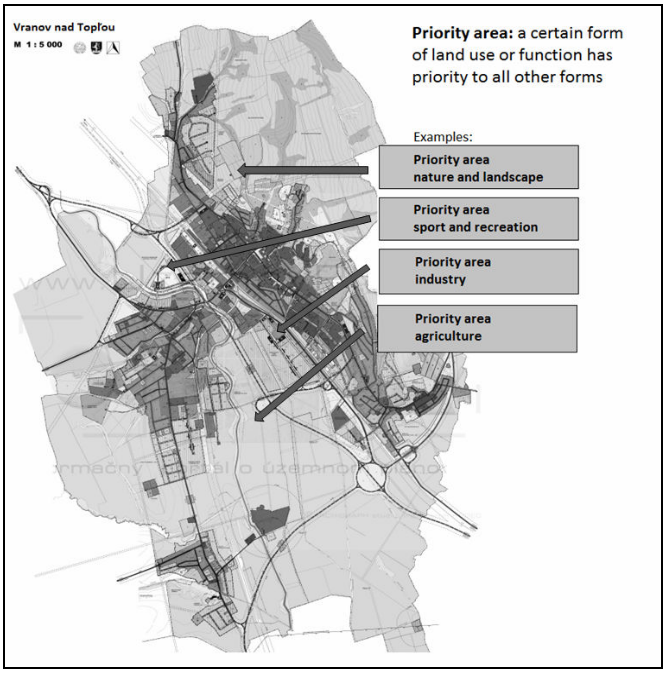

Fig. 1) Priority areas in a section of the spatial plan, Vranov nad Topľou, Slovakia

The priority areas for conservation of nature and landscape recovery is landscape planning. Landscape-ecological plans, part of the land planning documentation, provide assistance, such as the location of sensitive areas for fauna and flora. These areas are identified in the draft local plan as priority areas for nature and landscape. Green areas (corridors and biocentres) provide ecologically stable areas are not suitable for other anthropogenic uses. It also plans to offer proposals for future development for anthropogenic use, while considering the environmental, social and economic aspects [2, 5].

3 ENVIRONMENTAL ASSESSMENT OF LAND USING

New proposals for land use within the development plan are subject to environmental assessment. Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) are two essential tools for creation and preservation of the landscape and minimizing the impact of physical and landscape plans and have a strong legislative grounding [2].

Environmental Assessment is a procedure which ensures that the environmental implications of decisions are taken into account before the decisions are made. In principle, environmental assessment can be undertaken for individual projects such as a motorway or an airport (EIA) or for plans and programmes (SEA) - Fig.2). Examples for environmental assessment would be assessments of a Regional plan, a Land use plan, a Spatial plan or a Development plan [3].

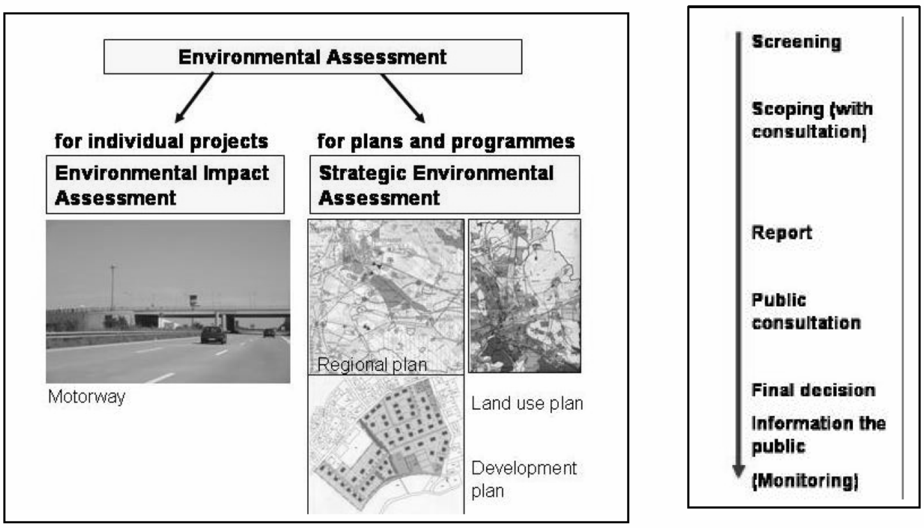

Fig. 2) Overview – The environmental assessment and the procedure [3]

The environmental assessment will be conducted for public and private projects in terms of land use before being approved, which is likely to have significant adverse impacts on the environment. Used for example for infrastructure projects - roads, water works, railway, land planning documentation, industrial or recreational purposes and also for the strategic documents (policies, plans and programs) [4].

In the evaluation of strategic documents (SEA) may also contribute to finding the best location for placement of new areas in terms of its future land use e.g. for industry or recreation. Plan places the following areas as applicable – e.g., depending on the availability of communications, airports and railway stations. Evaluation of strategic documents indicates that environmental risks are associated with different areas. For example, the area is not suitable when it is near flood areas and the possibility of damage to buildings in flood (Fig.3), or the area affected by the biodiversity of the country, or relevant in terms of cultural heritage. For such advice is provided through the information landscape-ecological planning [5].

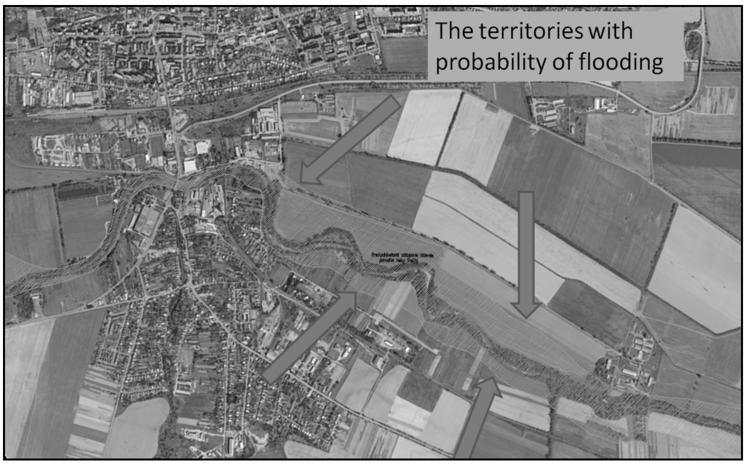

Fig. 3) The territories with probability risk of flooding, Vranov nad Topľou, Slovakia

The environmental assessment contribute to greater environmental harmony, more sustainable - better planning, landscape planning and building the foundations for it [1, 2, 5].

3.1 Creation an preservation of the landscape in the city Vranov nad Topľou

Overall, the current landscape structure of the city Vranov nad Topľou described as disturbed and very disturbed, especially by intensive agricultural production (area Čemerné and the southern part of city), extensive road routes and rail, and pipelines, water supply for settlement. Other proposed investments in the city will only worsen the situation.

Smaller areas of forest are found only in the north and northeast of the city and formed the basis for ecological stability of the territory. Flora and orchards produce vegetation belt around existing settlements. There is the first degree of protection (general protection).

Territorial system of ecological stability (TSES) is created by biocentres, biocorridors and interactive elements at different hierarchical levels - supra-regional, regional and local. The city Vranov nad Topľou does not process local territorial system of ecological stability. To the district of the Vranov was developed regional TSES for district of Vranov nad Topľou (1995) and within the researches and analysis on the City land use of the city was prepared landscape-ecological plan (KEP) [6, 7].

TSES of the city is now created by: biocentres - regional biocentre Topľa, sector from Ortáše (area Čemerné, location Lomnica - Ortáše); regional biocentre Lysá hora - Inovec (northern part of the city); local biocentre Hora; and biocorridors - regional biocorridors waterstream Topľa; local biocorridor Rakovec in regional route biocentre Chám - valley of stream Rakovec and regional biocentre Topľa, sector from Ortáše; local biocorridor linking biocentres - regional biocentre Lysá hora - Inovec and local biocentre Hora; local biocorridor in a regional route biocorridor Topľa – Kručovský kanál - Kanál Čičava - Povrazy - local biocentre Hora - regional biocentre Lysa hora - Inovec. Local biocorridors connect regional and local biocentres in landscape with valuable parts of nature (Fig. 4)).

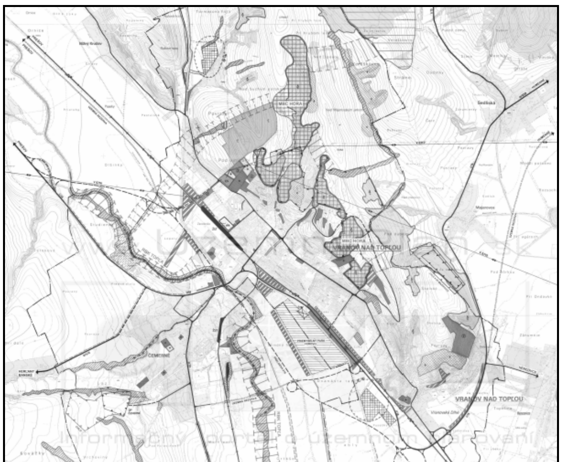

Fig. 4) Landscape - ecological plan of the city Vranov nad Topľou, Slovakia [6]

To increase the stability within spatial planning of the existing local area biocentres and biocorridors require reforest and restructuring in the range of 20-80%. It also requires a new proposed local trail corridor in the regional biocorridors Topľla - Kručovský kanál - kanál Čičava – Povrazy - Local biocentre Hora [6, 7].

3.2 Solve of problems in planning

The comparison of environmental aspects in the process of environmental assessment, the scope of the likely environmental conflicts (collisions) in the area can be identified. Based on this information may be to consider alternatives and decide on areas with the best suitability for its use with the smallest environmental conflicts [1].

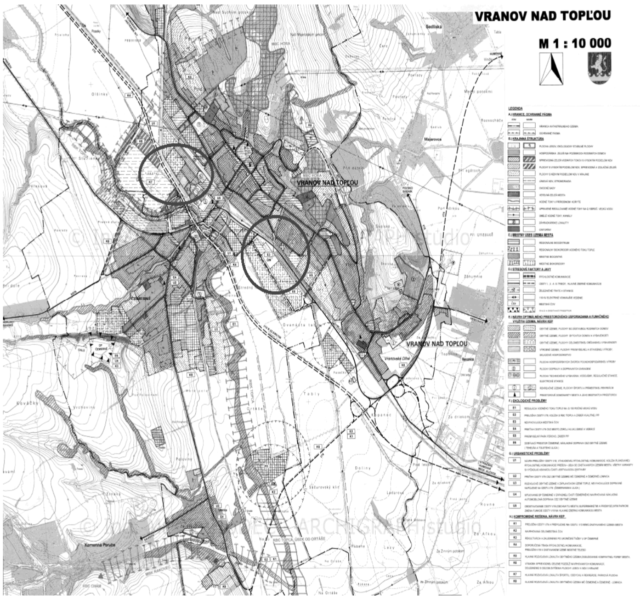

Fig. 5) Locations of possible cumulative effects, Vranov nad Topľou, Slovakia

The current outstanding natural phenomena stress in the city Vranov nad Topľou are: air pollution and dust loading, noise pollution (along the rail and road I/18, I/79, street Duklianskych hrdinov is quite large), soil contamination, water pollution, groundwater pollution [7].

In Fig. 5 is a landscape-ecological plan for the city Vranov nad Topľou delineating the locations of possible overlapping effects - proposals for the construction of new roads, design of the sites for industrial use, for residential development - new houses, and for sporting and recreational use areas of the city. These proposals take up large areas where the natural environment as construction of roads, trails and buildings. As a result of this construction are expected to have significant effects on the hydrological regime changes in the landscape. On this basis, the SEA may reduce the burden of design and scale of development. In order to maintain the natural biological activism to achieve stationary land and water balance, KEP proposes measures to improve the landscape view - suggests extensive forests and forest countries [2, 5, 6].

4 CONCLUSION

The results of the environmental impacts are the basis for a proposal on future land use in the planning, which is used to solve problems and reconcile human activities, determines the spatial arrangement of regulatory and operational use of the territory. It also sets out the principles of natural resource potential of the area and that activity within the territory does not exceed the acceptable load, create and maintain the ecological stability. It is part of the processing of ecologically optimal spatial arrangement of the territory.

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AN EXAMPLE OF THE CLIMATE IMPACT ON THE LANDSCAPE AND ARCHITECTURE CHANGES

Božo Soldo[1], Matija Orešković[2], Aleksej Aniskin[3],

Abstract

Extreme droughts have appeared in the year 2003, and extreme precipitation in the year 2006. on the area of northwest Croatia. Its influences on arhitecture and landscape will be shown in this paper. Quantities of precipitation within a certain area and during a certain period of time vary from time to time and are related to season of the year and soil moisture. In a more general sense, precipitation certainly has an effect on the state of the surroundings, i.e. the landscape; this paper deals with the influence of precipitations and droughts on architecture, i.e. buildings and structures. in a technical sense. The central examples are: - influence of extreme precipitation on landscape by appearence of sliding of natural slope, and influence of extreme droughts on the soil of buildings' foundation where the moisture content is reduced.

Key words

precipitation, landscape, landslide, drought, moisture, soil, constructions, damage

1 INTRODUCTION

The increasing of the water level and it's retaintion under the construction in the geotechnical profession is clearly known to cause different effects depending on the composition of the soil.

By increasing the water level it is possible that under the construction consistency of the soil decreases and this causes rapid settlement, which clearly causes damage to the building.

Reduction of the water level and soil drying below foundation caused soil settlement, which directly damage the construction, ie, leads to the appearance of cracks in the building.

The above phenomena and their direct impact on the construction shall be described in the following paper.

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2 CAUSES OF SETTLEMENT AND CHARACTER OF DAMAGES

a) hydroconsolidation b) soil swelling

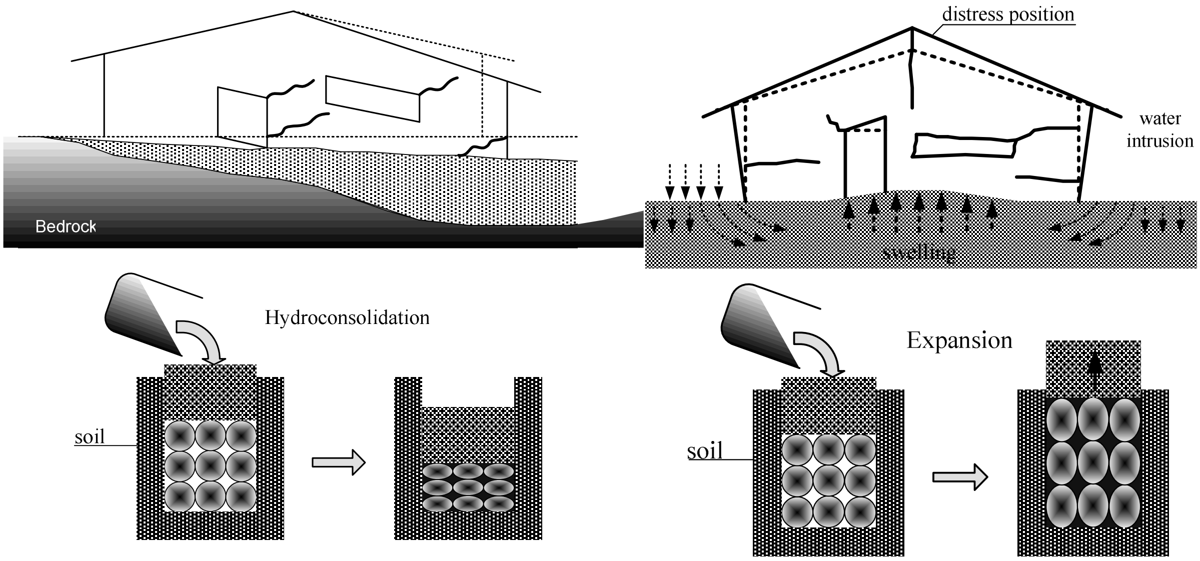

Fig. 1) Settlement, changes in soil consistency

By increasing the water level it is possible that swelling of the soil appear under the building, causing stress on the contact area of the construction and soil, as shown in the following figure.

Swelling of the soil is a dangerous threat to the construction, especially because it has the potential of spreading of the expansive type of soil that is far greater than their shrinkage. Excess of the moisture can get into the soil in various ways: by cracking or leakage of plumbing pipes, high level of groundwater and surface water that is the most common cause of swelling (especially in a poor or no drainage performed, and from the rain).

a) soil drying b) crack details on the building

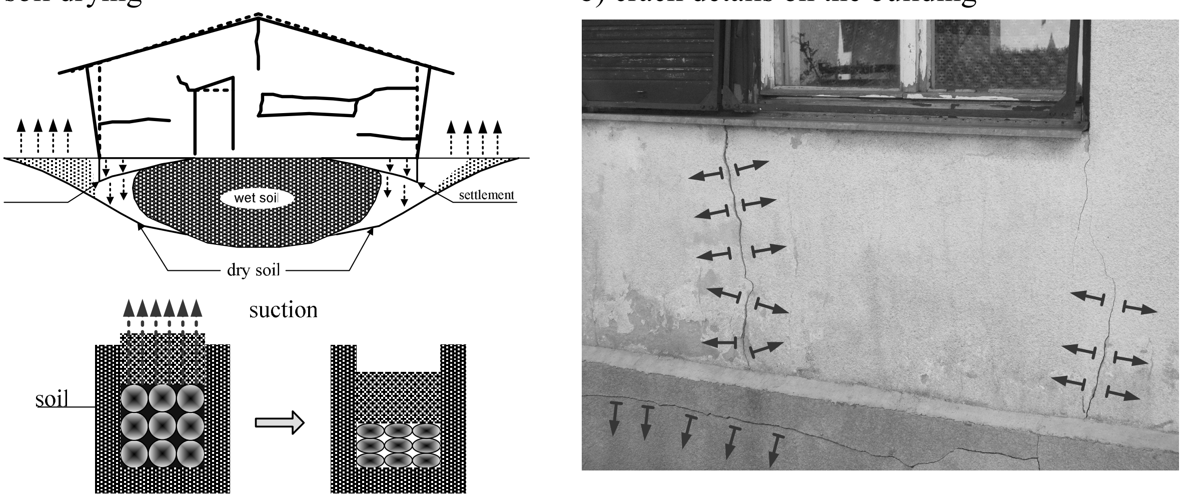

Fig. 2) Soil drying and cracking

Very often shrinkage of the soil leads to settlement, particularly at construction with shallow foundations. The water evaporates from the soil especially in the long hot and dry periods, the soil is shrinking, and if the impact of shrinkage reaches below the foundations of constructions causing settlement and cracks in construction. Clayey soil settlement in Croatia reaches a depth of 1.0 to 1.5 m, today, in some cases due to the impact of global warming settlement reaches to 2.0 m. In India shrinkage reaches 2.0 to 3.0 m, in Java 4.0 - 5.0 m, and there are construction foundation in clay are very deep.

During construction of the foundation soil can have an optimum moisture, but during dry periods it can be lost, leading to settlement of the construction. Settlement are larger at the ends of the construction because in this part the soil dries out quickly.

Such occurrences have been recorded in Croatia, as shown in the diagram, Figure 3).

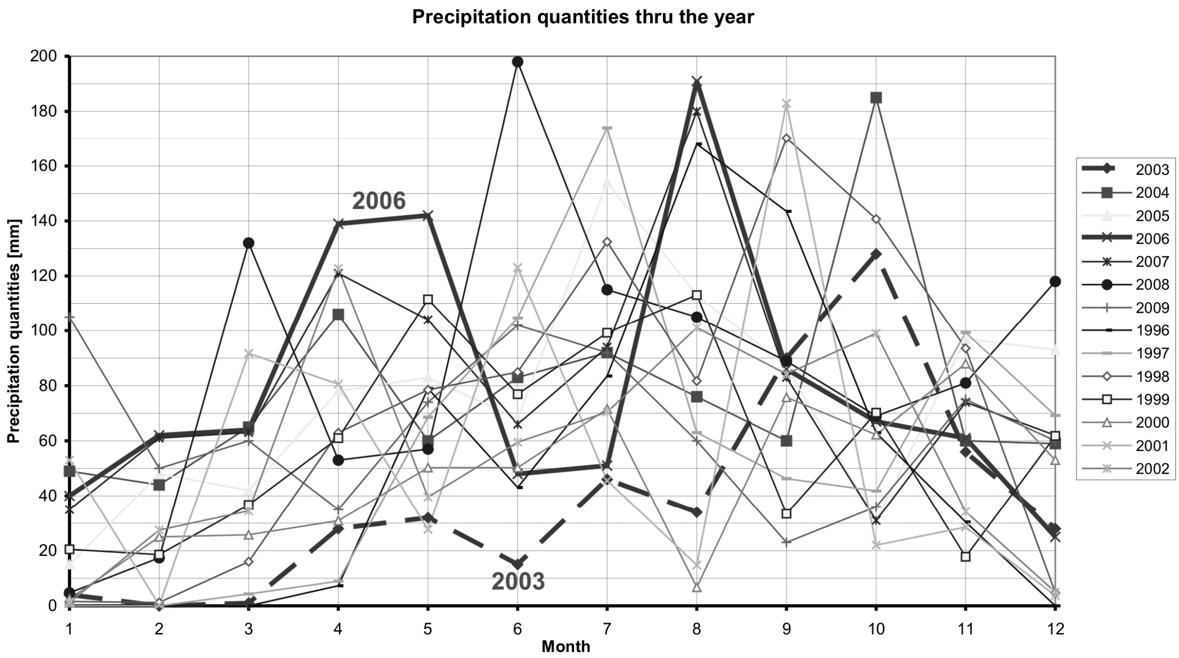

Fig. 3) Diagram of presipitation in northwestern Croatia,1996. - 2003.

As an extreme case of soil drying emphasizes by the Year 2003., as shown in the diagram. The whole year was dry, so the problem of soil drying under the foundations occurs frequently. On the other hand, the Year 2006. was permeated by continuous precipitation with the fine rain that was slightly watering soil that led to the maximum saturation after the winter and slow melting of snow. It is logical that in this rainy period the evaporation of water from the soil is minimal. After all these bad events for slope stability heavy rainfall have happened in the month of June with a height of about 150 mm, of which only the last day of heavy rainfall was 35 mm height. This was just a peak when they could the accelerated slips substantially visible with 1 m / hour velocity. The slips on the roads was even greater than 1 m, and in a extreme cases amounted to several dozen meters. Slip occurred in the moments of strongest showers or shortly thereafter.

The sunshine is most at the corners of construction that are facing the southeast and southwest. The soil is dried, and the corners of the building frequently break and crack. (Figure 4)

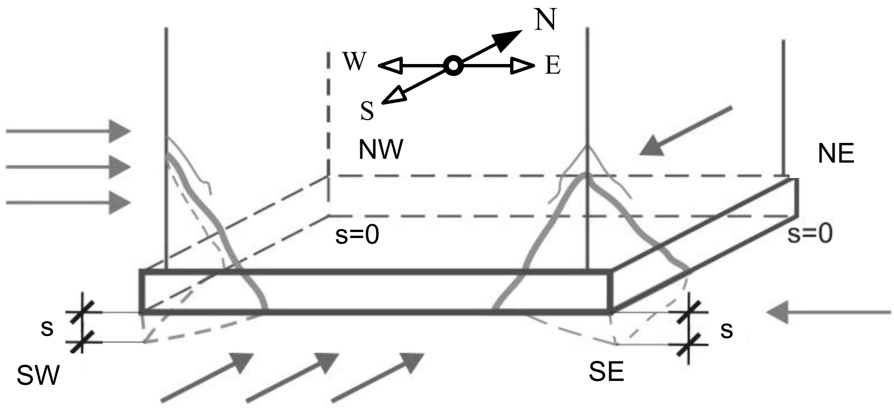

Fig. 4) Damage to the building due to soil shrinkage

The soil dries at least in the corners of the construction toward the northeast and northwest and in this corners cracks do not occur. If we mark the initial porosity of soil with n, porosity after shrinkage with $n_{S'}$, and on the border of shrinkage with n_S, we can determine the settlement of soil layer with thickness h.

$$s = h\frac{n - n_S'}{1 - n_S'} \tag{1}$$

The table shows the relation of parameters (porosity w moisture n) before and after drying:

Tab. 1) Relation of paremeters w, n, γ_w, i γ_s before and after drying

Before drying (moisture)	w	$\frac{n \cdot \gamma_w}{(1-n)\cdot \gamma_s}$
	n_s	$\frac{w \cdot \gamma_s}{\gamma_W - w \cdot \gamma_s}$
After drying	w′	$\frac{n_S' \cdot \gamma_w}{(1-n)\cdot \gamma_s}$
	$n_{s'}$	$\frac{w_S' \cdot \gamma_s}{\gamma_W + w_S \cdot \gamma_s}$

On the border of shrinkage porosity is:

$$n_S = \frac{w_S \cdot \gamma_S}{\gamma_W + w_S \cdot \gamma_S} \tag{2}$$

If we combine these equation and the expression of settlement we obtaine:

$$s = h\frac{\gamma_S \cdot (w - w_S')}{1 + \gamma_S \cdot w} \Rightarrow s = h\frac{\gamma_S \cdot \Delta w}{1 + \gamma_S \cdot w} \tag{3}$$

The lowest soil moisture is on the surface, gradually increases in depth, while the depth to which affects drying *h*, moisture is constant.

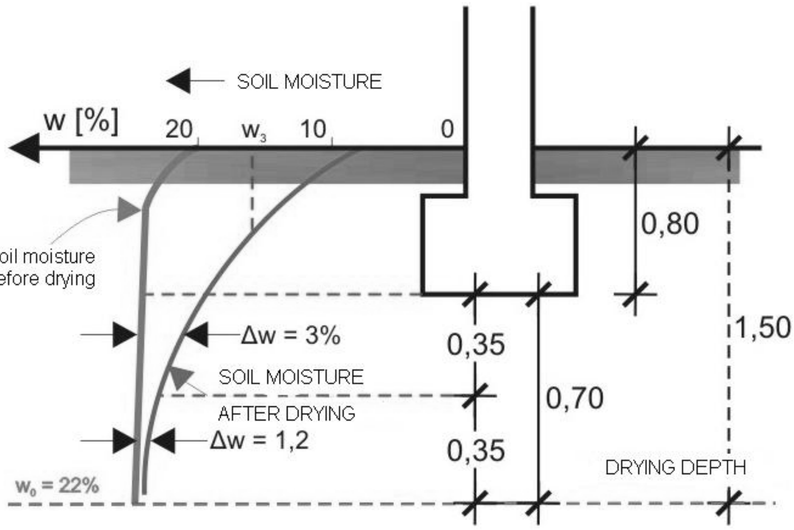

Fig. 5) Settlement of a foundation due to droughts

3 COMMON AND POSSIBLE SOLUTIONS

It is very often that settlements appears at constructions with daylight basement, and constructions without basement with foundations in the clay at a lesser depth than the depth of drying. In this case, the settlement due to shrinkage can be disabled if around the construction in the dry period, water is poured over or around an construction performs an impermeable layer of asphalt, with the layer minimum width of approx. 3 m around the construction (Figure 6b).This prevents the intense evaporation of water and soil shrinkage. It is often trees planted near the construction, which can also adversely affect soil, because tree by the roots absorb water (poplar, etc.) as noted in the previous chapter.

If you have excessive water saturation, then very desirable and a good solution is drainage, Figure 6a.

a) drainage b) tight asphalt layer

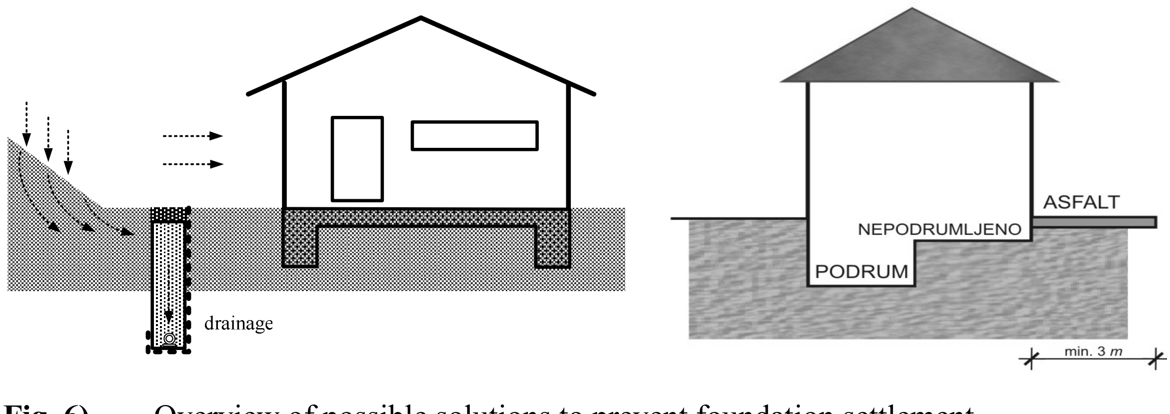

Fig. 6) Overview of possible solutions to prevent foundation settlement

4 CONCLUSION

Increase or decrease the water level under the construction greatly affects the construction, and sometimes leads to a rapid settlement or uplift, depending on the type of soil on which the constructon is built. The paper presents the most common phenomena and processes which can easily occur if it do not take in consideration in design phase. Swelling and shrinkage of soil (due to drying) may have consequences in which construction is damaged (cracking).

Apart from the water early in the design of constructions should take consideration of the terrain morphology, location of future constructions, and especially the type of soil, because they do not respond equally to water saturation or the drying out.

This text can be used as a remark in the design, rehabilitation design and especially in forensic identification and clearance causes of construction damage.

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AN EXAMPLE OF EXAMINATION OF THE BANK SLOPE AND WATER WAVERING CONTACT

Božo Soldo[1], Matija Oresković[2], Aleksej Aniskin[3]

Abstract

Waves and water level variations through a short period of time have an influence on the canal slope stability. When the canal slopes are made of a natural material the water wavering cause their erosion. The way new slopes are going to be formed or how they are going to be made in a natural material, inter alia, depends on dimensional and geotechnical characteristics. The results shown in this paper can be useful when projecting and/or recovering banks' slopes (for slopes that are in contact with water wavering)

Key words

Waves, water level, canal slope, stability, erosion, projecting, recovering, results analysis

1 INTRODUCTION

In engineering practice when it is construction of the canals often encounters the problem of erosion due to wave action on a canal side slope. Erosion of canal slope belongs to the harmful effects of water. Change of water waves shapes or it's "flattening" may be affected by various actions. Its shape changes in the relationship of time and / or spatial redistribution of water quantity. Construction should resist hydrostatic and hydrodynamic effects of water. The effect of water on canal slopes can be: the formation of sliding surfaces, settlement of embankment, percolation of water through the body of the embankment and foundation soil (leaching of fine particles), elevation and cracking of the embankment if it is based on the ground that changes volume with changes in humidity, fluvial erosion damage due to adverse routing, damage due to wave, damage due to overflowing, etc.

The subject of this research is the canal of approximately 7 km length, approximately 90 m wide, with a slope inclination 1:1,25. Water action causes increasing damage over time on the canal constructed in natural gravel material. During consideration of recovery solutions for damage sites of drainage channel slope, it is necessary to make technical and economic comparison for different variants of recovery. The comparison is conducted based on: -

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assessment of safety and stability of certain solution; - quality of solutions regarding the recovery permanence in long term exploitation, and - level of technological complexity

as well as costs of particular recovery solution.

Following text displayed some characteristics and features that is certainly good to have in mind when designing and / or recovery and similar actions.

2 RESULTS OF APPLYING THE SELECTED MODEL AND ANALYSIS OF EROSION CAUSES

According to literature - Mitteilungen der Forschungsanstalt für Schiffahrt, Wasser und Grundbau, Berlin 1981, Heft 43 by H. Wagner the results of wave formation experiment in the canal and canal erosion with the slope formation are shown. This results can be useful while projecting and reparing similar canals. Obtained results are shown in sequence:

Analyzing the possible inclinations of bank slopes, it can be drawn the most important inclinations, i.e. projected inclinations, and those resulting from the experiment (Fig. 1)

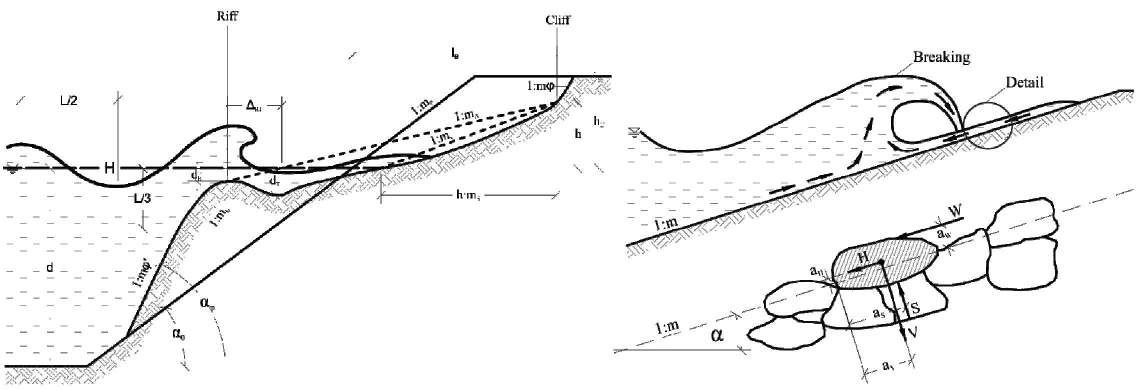

Fig. 1) Form and angles of canal slope, form of shock wave and force polygon on canal lining

In the mentioned paper among the designated values are shown values in the picture, as follows: slope angle, angle of internal friction, volume material weight, volume water weight, shock wave height, wavelength, diameter of material particles and other coefficients.

H. Wagner [1] gives an expression for the time required to achieve equilibrium angles:, the average duration of the wave period and inclination angles of slope (Fig. 1 and 2).

To select the angle of slopes due to the appearance of the canal, required time, and other parameters, as well as the most important one, if it is a grain of D_{50} can be used diagram (Fig. 2) which gives us a direct connection between the required selected angle depending on the grain D_{50}.

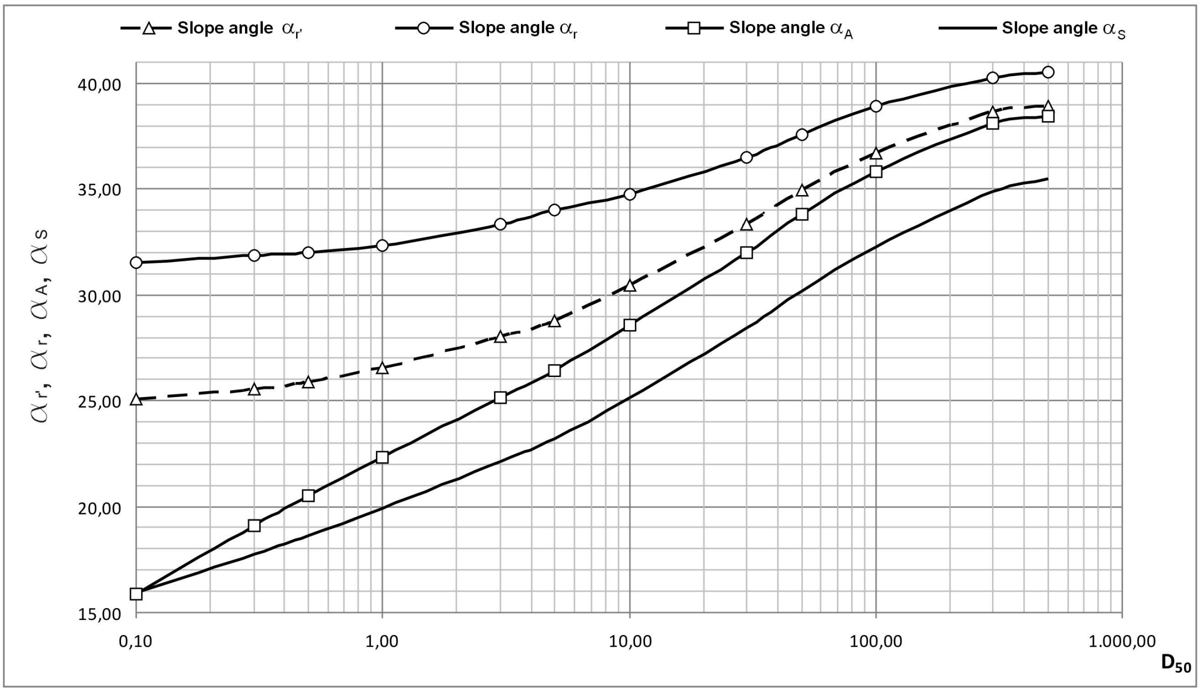

Fig. 2) Relationship diagram D50 and generated corresponding slope

The idea of researching this diagram occurred when projecting recovery of hydroplant ''Varazdin'' drain slope in Croatia. Other characteristics of the observed canal on which this diagram depends are similar to characteristics from which it's has emerged ([1] H. Wagner). The formation of the material in a shorter period of time corresponding to data from the diagram and to the material for the grain D_{50} from 0.1 to 1 mm.

According to forces polygon, for unit volume of immersed soil, the sum of immersed unit weight $\gamma' = \gamma_{sat} - \gamma_w$ and flow pressure $S = i \cdot \gamma_w$ gives resultant p deflected from γ′ for angle δ. Since the stream water pressure gradient $(i = \Delta h / L)$ i.e., potential difference Δh and filtration path L, in case of water flow parallel to the slope it can be written as: $i = \sin\beta$. Deflection angle of the resultant p from the vertical component γ′ can be calculated from the force polygon: $\delta = arctg[(S \cdot \cos\beta)/(\gamma' + S \cdot \sin\beta)]$.

In case of incoherent material the slope degree in extreme situations can be the same as internal friction degree of that material (β=φ). In the situation of a 1:2,5 slope, for material with friction angle φ≈34°: $F_s = tg\varphi / tg\beta = tg34 / tg21.8$; $F_s = 1{,}69$. In the situation of water filtration parallel with the slope: $F_s = tg\varphi / tg(\beta + \delta) = tg34 / tg(21{,}8 + 16{,}8)$; $F_s = 0{,}85$. This case is observed for materials D_{50} from 0,1 to 1 mm.

When it's about material grain D_{50} approximately from 0.1 to1.0 mm, with condition that the pressure flows parallel to the slope it's noticed that minimal angle of slope inclination formed is equal to half of the angle of friction, ie. $\alpha_{\min} = \varphi / 2$.

Shape granulometric curve significantly affects the angle of shear resistance. With the increase of the coefficient of uniformity void ratio at same expenditure of work to compaction, will be lesser, and thereby increases the impact of fastening, so the friction angle φ is larger.

For the considered case required i.e. minimum angle of internal friction of the material of slope must be $\varphi \geq 39^{\circ}$ with the safety factor $F_s \geq 1$, that must be suitable crushed stone material. But still with any other material there is the threat of breaking out instability i.e. falling out of grains, which is also primarily in relation with time and other characteristics.

The project task was to recover slope with inclination 1:2.5, and also slope with additional berm with a stability problem. There were many solutions for the recovery, such as: above all with different grading of crushed stone, with natural materials in Reno mattresses. As noted above, formed angles depend on the time of wave action, and so solutions have duration.

During the recovery of the observed canal it was the case of solutions berm stabilisation on canal slope. It is thought to stabilize berm with better material that can be selected from the above diagram. The berm on the slope is a new load and causes destabilization of slope and in this case of the berm recovery decided to the combined solution. As the most difficult case was the construction of berm with gabion walls, which are supported by the micropiles.

3 CONCLUSION

During recovery and/or construction work on hydrotechnical structures in this case the canal, in addition to the geometric values and characteristics it is good to keep in mind, and dispose with as much material characteristics and their parametric relationships. Here is presented an example of behavior of canal slope of different materials at a particular activity. With notes on various incoherent materials of canal slope lining, mentioned different solutions for the recovery of canal slopes, recovery solution duration and other specifics that sometimes difficult to see.

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ENCLOSURE TO THE ANALYSIS OF FLEXION OF TRANSVERSE WEIGHTED CONSTRUCTIONS ON THE GROUND

Božo Soldo[1], Matija Oresković[2], Aleksej Aniskin[3]

Abstract

Analysis results of conduction of transverse loaded beam on the ground (foundation carrier) are shown in this paper. Calculation analysis is based on a numerical method of final subtractions and analytical method of so-called two-parameter soil model. With analytical methods of calculation of beam flexion the main problem is the selection of parameters. The central task in this analysis is selecting parameters for so-called dual-parametric model i.e. selecting two parameters, and their influence on the results

Key words

foundation carrier, finite difference method, two-parameter soil model, results analysis

1 INTRODUCTION

Today in engineering practice are often encountered constructions based on the so–called belt foundations. In such cases it is necessary to design the beam for that we must to determine all the internal forces in the beam and the ground reaction force on the contact surface of the foundation-soil.

For foundation beam on the ground, in response to the known effects of external load, appear unknown reaction pressures, whose total value is known, but not the distribution along the beam. The so-called contact problems studied by many researchers. Problem of foundation beams on the ground in the history studied by Winkler and Zimmermann (one-parameter or Winkler soil model).This model is still widely used in everyday engineering practice. Main problem in one-parameter soil model is the selection of parameter (parameter depends on the value of the load and the loaded area, etc.). In addition to this in the literature there are other models such as two-parameter model [1] (Vlasov, VZ, Leontiev, N. N) which will be described in this paper.

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This paper deals with the two-parameters model of soil, especially with selection procedures of subgrade reaction coefficient and the so-called parameter N as a force in the membrane. Two-parameter model of soil is derived from the basic Winkler's model. This model allows connection of Winkler‘s springs with stretched elastic membrane, making it possible to model soil properties as related continuum. In one-parameter and two parameter model of soil basic problem is the selection of parameters (parameters are not physical, and depend on the value of the load and shape of loaded area). In the literature can be seen experimental results, as in recent times [5] B. Ivandić, K.: Testing of Rectangular Beams on a Layered Soil - Soil Mechanics and Foundation Engineering, New York, Vol.47, No. .2., pp. 40-44, July, 2010.

The research results of two-parameter model of soil will be compared with the results of that are presented in the article: [6] Soldo, B., Dragojevic, N., Oreskovic, M.: Analysis of Bending of Foundation Girders on the Ground, Journal Geotechnical Engineering, Volume 15H, 2010, Ppr10.069., and they are based on the numerical method of finite differences.

2 ANALYTICAL METHOD OF TWO-PARAMETER SOIL MODEL

Two-parameter model of soil is derived from the basic Winkler model. This model is defined by two independent elastic constants and allows connections Winkler’s spring with stretched elastic membrane and elastic layers, which allows the occurrence of shear strain.

Filonenko-Borodich (1940th-1945th) proposed a model that connects the spring (Winkler model) with an elastic membrane with rigidity T.

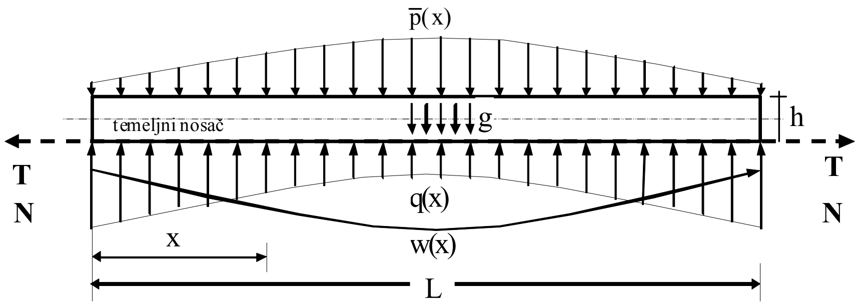

Fig. 1) Foundation beam: external load, settlement and soil reaction

The equation for the soil reaction pressure then takes the form:

$$q(x) = kw(x) - T\frac{d^2w(x)}{dx^2} \quad (1)$$

where: T - rigidity of the membrane, k - subgrade reaction coefficient

In mid-twentieth century, in 1949. authors Vlasov and 1966. Vlasov and Leontiev develop a two-parameters soil model.
The differential equation of beam loaded with concentrated forces at the edge for the two-parameter model based on the hypothesis Leontiev and Vlasov is:

$$EI\frac{d^4w}{dx^4} - N\frac{d^2w}{dx^2} + kw = 0 \tag{2}$$

where : k - Winkler coefficient of substrate or subgrade reaction coefficient, N - a parameter that depends on the thickness of the layer below the beam and soil properties.

Reaction of soil resistance as follows:

$$q(x) = kw(x) - N\frac{d^2w(x)}{dx^2} \tag{3}$$

Considering the value of the parameter *N* we distinguish three cases:

when $N = 2\sqrt{kEI}$, then k is not defined, for $N > 2\sqrt{kEI}$ is a complex number, while for $N < 2\sqrt{kEI}$ is real number.

In case $N > 2\sqrt{kEI}$ solution of differential equations is:

$$w = A_1e^{m_1x} + A_2e^{m_2x} + A_3e^{m_3x} + A_4e^{m_4x} \tag{4}$$

where

$$m_{1,2,3,4} = \pm - \sqrt{\frac{N}{2EI} \pm i\sqrt{\frac{k}{EI} - \left(\frac{N}{2EI}\right)^2}} \tag{5}$$

In case $N < 2\sqrt{kEI}$ the differential equation is:

$$w = C_1e^{\alpha x}\cos\beta x + C_2e^{\alpha x}\sin\beta x + C_3e^{-\alpha x}\cos\beta x + C_4e^{-\alpha x}\sin\beta x \tag{6}$$

where

$$\beta = \sqrt{\lambda^2 - \frac{N}{4EI}} \qquad \alpha = \sqrt{\lambda^2 + \frac{N}{4EI}} \qquad \text{where} \qquad \lambda = \sqrt[4]{\frac{k \cdot b}{4EI}}$$

The main goal of the two-parameter model of soil is by determining the parameters: k, T, N, depending on the model, obtain more realistic relationship between settlement of foundation beam (w) and soil reaction (q).

Bending moments and shear forces are also calculated using the formula $M(x)=-EI(d^2w/dx^2)$ and $Q(x)=-EI(d^3w/dx^3)$.

3 SELECTION OF PARAMETER N

As mentioned earlier, the literature states that the parameter N depends on the thickness of the layer beneath beam and the soil properties. The selection of this parameter can be established as a problem, because it can be lot of ambiguities, especially when it is unknown layer of soil beneath the beam and its characteristics. There are more ways of selecting the parameters k_s and N which can be found in the literature (e.g. from settlement curves of uniformly loaded beams). This paper presents choosing the parameter k_s and N based on the idea that the parameter N tension in the membrane or horizontally suspended chain or cable (leaning) on two supports.

According to this, tension N has maximum value at the ends.

If it is given values as follows: l – length of the beam, q - load (average load on the contact beam and soil), f – deflection (from the average continuous load), and if the calculation include the equation for deflection by the effects of external forces P_1 and P_2 for loaded continuous beam, we get that N_{max} is:

$$N_{\max} = \frac{ql^2}{8f}\sqrt{1+16\left(\frac{f}{l}\right)^2} = \frac{384EI}{40l^2}\sqrt{1+16\left(\frac{5ql^3}{384EI}\right)^2} \tag{7}$$

Furthermore, subgrade reaction coefficient k_s is calculated based on factors μ_1 i μ_0, which is read from the Bjerrum charts and modules of compressibility or elasticity. Applying the relationship of these two modules, we can derive an equation for k_s:

$$k_s = \frac{E}{\left(1-\nu^2\right)\cdot B\cdot\mu_1\cdot\mu_o} \tag{8}$$

The example of the calculation is carried out for foundation beam with dimensions as follows: length L = 10 m, width B = 1.0 m, height h = 0.8 m. The beam is loaded with forces on the edge of $P_1 = P_2$ = 1000 kN, which lies on soil modulus E_s = 9000 kN/m^2. The calculation is performed in two ways: the finite difference method presented in paper: Soldo, B., Dragojević, N., Orešković, M.: Analysis of Bending of Foundation Girders on the Ground, Journal Geotechnical Engineering, Volume 15H, 2010, Ppr10.069., and the above-mentioned method with chain or cable.

4 ANALYSIS OF RESULTS

The results of settlement and bending moments are shown in Figure 2 as follows:

a) numerical methods - based on the finite difference method [6];

b) one-parameter soil model - if the modulus of elasticity can be obtained by testing the soil by static circular plate on the ground from the equation: $E_s = 0{,}75\left(p/s\right)\cdot D$, then the subgrade reaction coefficient $k_s = E_s/0{,}75\cdot D$, then for D=0,3 m $k_s = 40000\,kN/m^3$ [6];

c) two-parameter soil model with parameters k_s i N, according to equations (7) and (8);

d) one-parameter model of soil according to the formula (8) and the two parameter model for the k_s according to equations (8) and N=0.

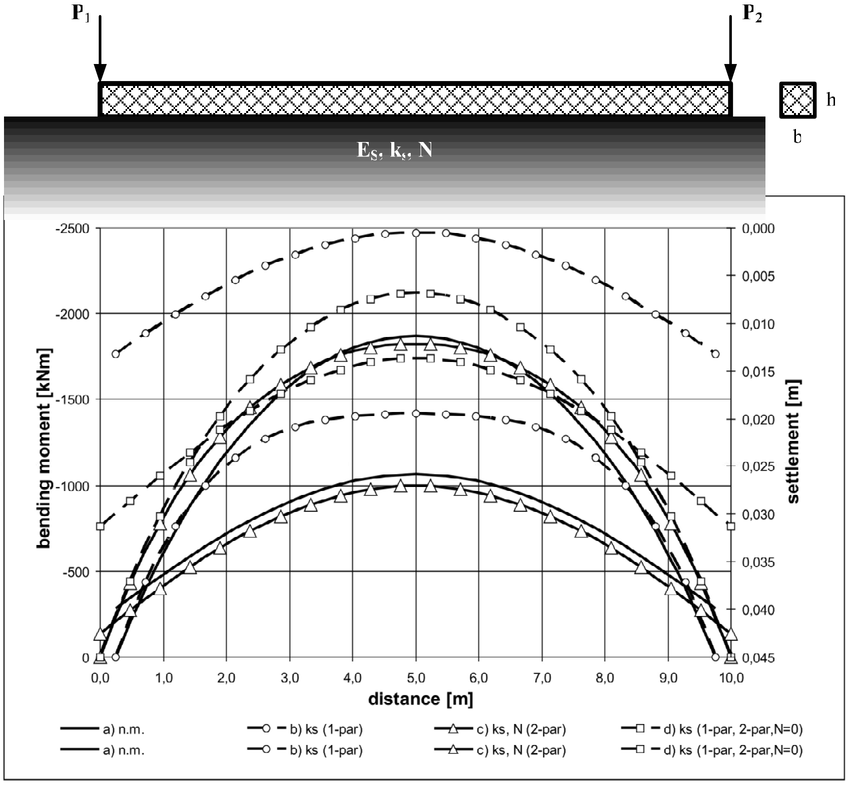

Fig. 2) The results of settlement and bending moments

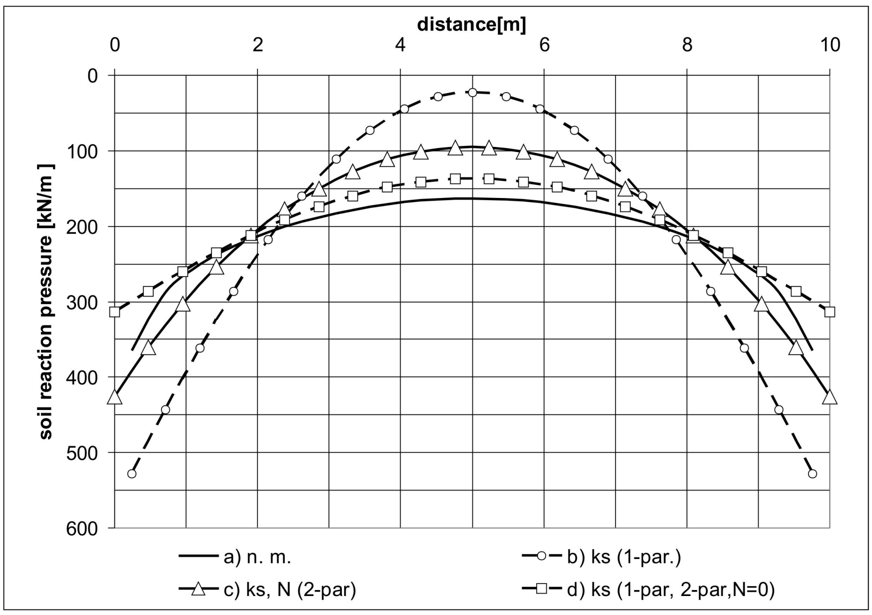

Fig. 3) The results of the reaction pressure distribution along the beam

Fig. 3. presents the results of the distribution of reaction pressure on the beam, which satisfies the condition that $\int_0^L q_i dx = (q_1 + q_2)\cdot a + (q_2 + q_3)\cdot a + ... + (q_{n-1} + q_n)\cdot a \cong$ P1+P2, where integral of soil reaction along the beam is equal to the sum of the forces acting on the foundation beam. Calculation results of two-parameter model of soil when N = 0 are the same as the one-parameter model of soil for the same parameter, the subgrade reaction coefficient.

5 CONCLUSION

By analytical methods of calculation transversely loaded foundation beams on the ground can be easily and quickly reach a solution in engineer practical application, but with attention to how to choose the input parameters. Analytical methods are often avoided because the definition of input parameters. In literature there are several ways to select parameters for the analytical methods. In this paper, that deals with calculation of transversely loaded beams on the ground, given the emphasis on the selection of parameters for the two-parameter model of soil and comparison with the results of numerical methods in the literature. As there are several ways the selection of input parameters, so the large differences in the results. This work presents a method of selecting parameters for the analytical methods one-parameter and two-parameter soil models and the results correspond well with some accurate numerical methods from the literature.

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METHODOLOGY OF REGISTRATION AND EVALUATION OF BANK VEGETATION ON EXAMPLE OF RAKOVEC

Jan Škrdla[1], Petr Kupec[2]

Abstract

The article presents methodology and example of the results of bank vegetation registration in rural landscape. Register is instrument for stand and habitat management. Methodology is applied on example of section of the river Rakovec.

Evaluated streams are fractioned into the sections delimited by significant barriers. Within the frame of sections, segments are determinate (parts with similar characteristics in general). Surveying includes site and stream assessment and streamside stand valuation. Stand assessment consists of spatial structure evaluation, species structure valuation, and age and health assessment. After surveying data processing is following (maps and database). The register serves as a summary of bank vegetation and as a base for management.

Key words:

bank vegetation, streamside stand, rural landscape, registration of bank vegetation, evaluation of bank vegetation

1 INTRODUCTION

Bank vegetation is an important constituent of landscape. Streamside stands consist of riparian and accompanying stands. Riparian stands are located on riverbed, accompanying stand are located after band edge. Bankside trees and shrubs are one of the building blocks of territorial system of ecological stability (TSES) (Šlezingr, Úradníček, 2003). Bank vegetation provides many functions. Many streamside stands aren't in good condition at present. Some stands are composited by exotic species or by species unsuitable for site. Many streamside stands are discontinuous; some banks of small streams are without woody vegetation. Reason is absence o management planning.

Bank vegetation management is solved in Law 254/2001 Sb. about water. Streamside stands are objects of other laws, for example 114/1992 about nature and landscape conservation. In

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Czech Republic isn't available unified methodology of bank vegetation assessment (Havlíčková, 2005). Bank vegetation management was deal by Šlezingr (Šlezingr, Úradníček, 2003), Havlíčková (Havlíčková, 2005) or by Novák, Iblová and Škopek (Novák, Iblová, Škopek, 1986). Streamside stands registration was deal in special management plans (exc. Mařák, 1996). Plans were projected for some rivers in administration of Povodí Moravy, s.p. Applied methodology wasn't published yet.

This article presents methodology of bank vegetation evaluation. Methodology is aimed for registration and evaluation of streamside stands in rural landscape. Result of methodology is bank vegetation database – base for management planning.

2 MATERIALS AND METHODS

Evaluation of bank vegetation consists of respective procedure steps: preliminary work, surveying and bank vegetation evaluation. In conclusion data processing and management are following. Methodology is applied on example of registration and evaluation of bank vegetation in section of the river Rakovec (hydrology order 4-15-03-069).

Evaluated rivers are fractioned to the sections, limited by natural or artificial barriers. Within the frame of sections, segments are determinate. Segments are parts of the section with similar characteristics (width, structure, species composition, etc.) in general. Segments are characterized by delimitation, alluvium and river-basin characteristics and by bank vegetation. Segments are mapped as lines. Delimitation of segment is given by beginning and end river log, length (division between end and beginning river log), middle width and area. Area is product of length and middle width.

Alluvium is characterized by natural conditions (ecosystem type group (ETG), group of forest type group (FTG)) and by land use. **River** is characterized by river-basin, stream bottom material, and bank. **Bank vegetation** (streamside stands) are characterized by width, space structure, species composition, physiological age and by health conditions.

Width of the vegetation zone is displayed in meters, and **width category** is determined. Width category depends on width, number of lines, and space dislocation. 4 width categories are distinguished. **Spatial structure** is characterized by number of vegetation layers and by bank vegetation continuity (relative density of stand). Vegetation layers are distinguished by characteristics, especially by high. Bank vegetation (storey) **continuity (canopy closure or relative density)** means coverage of area by crown projection. Continuity is displayed as decimal number from 0.0 to 1.

Species composition is significant character. Tree and shrub storeys are evaluated separately, general herbal species are noticed. Species composition (representation) is indicated in decimal number (0.1 -1). Accessory species (representation until 10%) are sign by +. Recent species composition is compared with potential composition according to Zlatník (Zlatník in Šimíček, 1999). Degree of species composition autochtonity (degree of autochtonity) depends on recent and natural representation of species. Degree of autochtonity reached values from 0 to 1 (from 0% to 100%). In **species diverzity** accessing number, immixing of the species and form of the immixing (single, group or line) are evaluated.

Physiological age is development phase of tree (stand, storey). Tree is evaluated according to Kolařík (Kolařík, 2005). In dependence on physiological age and age variability, 6 age classes are distinguished. 1st class includes homogenous young stands. 2nd class includes homogenous maturing stands. Homogenous mature stands are in 3rd class and homogenous old stands are in 4th class. Age diversified stand are classified in 5th and 6th age class. 5th class includes young stands and 6th class includes old stand.

Physiological and biomechanical vitality of trees are assessed visually. **Physiological vitality** is ability to resist harmful effects. Main symptoms of downgraded vitality are defoliation, branch malformation, crown drying-up, and secondary sprouts. **Biomechanical vitality** is grade of mechanical damage and weakening. Biomechanical vitality is affected by habitual defects (press branching, secondary sprouts and eccentric crown, etc.) and by damages (cavities, wood cracks, etc.). Physiological and biomechanical vitality are determined for species with 10% and more representation. Scale from 1 to 5 is applied (1 mean the best score, and 5 means the worst score).

Species in tree storey represented at least 10%, are objects of special measuring. Tree high and breast high diameter are measured; number of trees and number of stems per 100 meters of bank are quantified. **Stem diameter** is usually measured in breast height (130 cm) and it´s featured in centimeters (cm). Diameter is measured for trees reached or exceed breast high diameter 7 cm. Tree **height** is difference in elevation of terminal shoot and stem base. Height is featured in meters. Height is measured by sampler trees.

Result of methodology is bank vegetation database. Bank vegetation database includes maps, databases, bank vegetation evaluation and management theses.

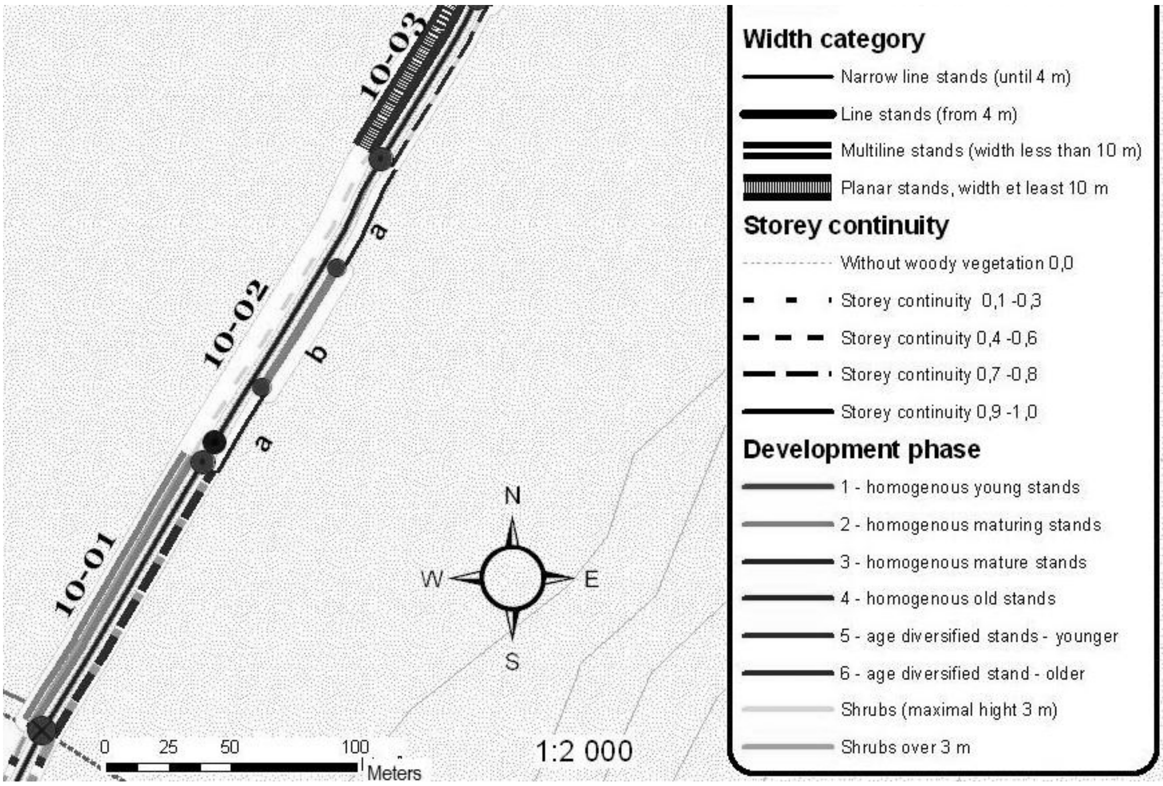


Fig. 1) *Example of detailed map of stand evaluation*

Object of map section are general and detailed maps. Maps are generated by source maps (basic map, photomap) digitalization. GIS software is applied. Content of general maps are evaluated stream display, fragmentation to sections and land use display. Detailed maps include map of stand evaluation and map of the management proposal. These maps consist to line layers of streams and bank vegetation and to point layers of segments delimitation and river log in kilometres. Detailed maps are connected to databases and shaped to display in scale 1:2000.

Databases consist of section database, segment database and specifications of tree storey. Objects of section database are section identification, including hydrological order, hydrological log of beginning and end of the sections and length.

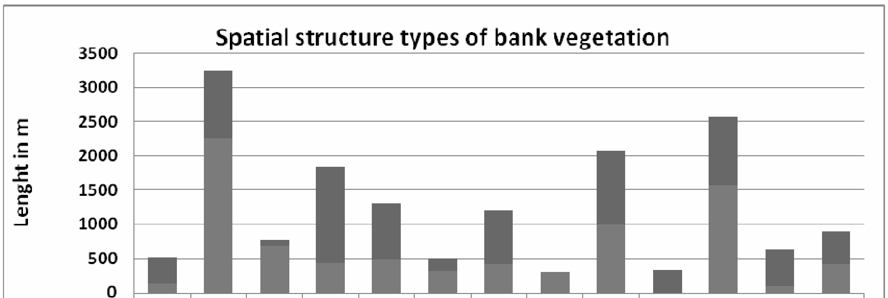
Objects of segment database are identification, delimitation, alluvium and river-basin characteristics and bank vegetation characteristics. Segments are identified according to code. Code consists of section number, segment number, bank specification (left or right). Segment delimitation data include river log of beginning and end of segment, length, middle width and area. Object of alluvium data are potential and recent conditions, landuse and river-basin depth. Stream data included bed material, information about bunding or scour erosion.

Object of bank vegetation characteristic is description of stand, tree storey and shrub storey. Database includes data about width category, continuity, qualitative rates (development phase, autochtonity, species diversity, etc.) and species composition. Objects of specification of tree storey are detailed data about tree stand. Specification is generated for tree storey with continuity at least 40% and for species with proportion at least 10%.

3 RESULTS

Alluvium in survey area is intensively utilized. Most of area (73,6%) is utilized like arable land, 11.2% of banks border on road or built up area. 15,1% of bank vegetation border on forest or perennial vegetation (forest, garden, grassland). Width of bank vegetation is limited by land use of boundary land. 95% or evaluated banks reached width between 3 and 10 meters.

Spatial structure is evaluated according to width, continuity of bank vegetation and continuity of storeys. Within the frame of evaluated sections, 13 basic types of structure are distinguished: 1. wide continuous stands, 2. continuous line tree stands with shrub storey, 3. continuous line tree stands without shrub storey, 4. continuous narrow line tree stands, 5. continuous line stand with gappy (discontinuous) tree storey and continuous shrub storey, 6. gappy (discontinuous) line tree stands, 7. continuous line shrub stands, 8. continuous narrow line shrub stands, 9. gappy (discontinuous) line shrub stands, 10. gappy (discontinuous) narrow line shrub stands, 11. single trees and shrubs, 12. unclassified (exc. stands after bank edge), 13. banks without woody vegetation.

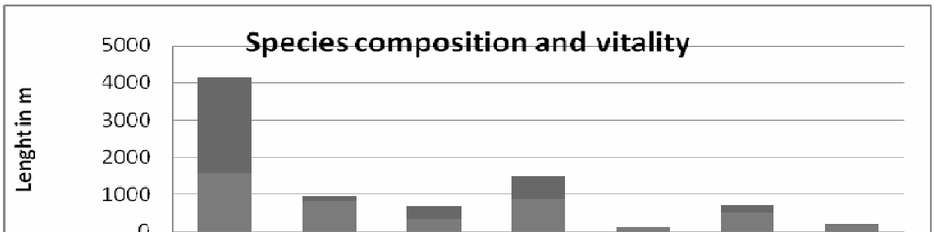


	1	2	3	4	5	6	7	8	9	10	11	12	13
Right bank	385	988	90	1420	825	185	793	0	1090	330	990	540	485
Left bank	140	2255	685	425	490	320	415	310	995	0	1580	95	410

Fig. 2) *Bank vegetation spatial structure*

By reason of space limiting, continuous line stand with shrub storey is convenient structure type. Proportional share of this type is 20%. Share of line tree stands without shrub storey and (3) a narrow line tree stand (4) is 16.1%. Stands with discontinuous tree storey and shrub stands (categories 5-10) reached to 35.4 % length of evaluated sections. Bank with solitaires, bank without woody vegetation and unclassified types (11-13) reached to 25.2% length of evaluated sections. Distribution of structure types is displayed in next diagram.

Species composition autochtonity and vitality of tree storey is evaluated in stands, reached tree storey continuity at least 0.4 (40%). Length of evaluated segments is 8283 meters. Autochtonity is evaluated on basis of degree of autochtonity (reached values from 0-1). 3 classes of species composition is determinate: 1st class- nature nearly stands (degree of autochtonity 0.7-1), 2nd class- stands witch modified composition (0.4-0.6) and 3rd class – allochthonous stands (0-0.3). In vitality evaluation, stand is classified to 3 classes. Depending on autochtonity and vitality 7 classes are determinate (1.1 vital nature nearly stands, 1.2 slightly damaged nature nearly stands, 2.1 vital stands with modified composition, 2.2 slightly damaged stands with modified composition, 3.1 vital allochthonous stands, 3.2 Slightly damaged allochthonous stands, 3.3 Damaged allochthonous stands.



	1.1	1. 2	2.1	2.2	3.1	3.2	3.3
Right bank	2580	125	340	605	0	193	50
Left bank	1560	815	340	885	115	515	160

Fig. 3) *Autochtonity and vitality of tree storey*

60 % of evaluated tree storey is 1st class of species composition (nature nearly stands), this stand compound mainly of autochthonous species: common alder *(Alnus glutinosa L),* European ash *(Fraxinus excelsior L)* a willows *(Salix sp. L)*. Main problems of species composition is alien or crossbred species representation, example crossbred poplars *(Populus x canadensis Moench)* or black locust *(Robinia pseudoacacia L)*.

Species composition diverzity is evaluated according to methodology (degrees from 0 to 6 are applied). Results of species composition accession are displayed in next diagram.

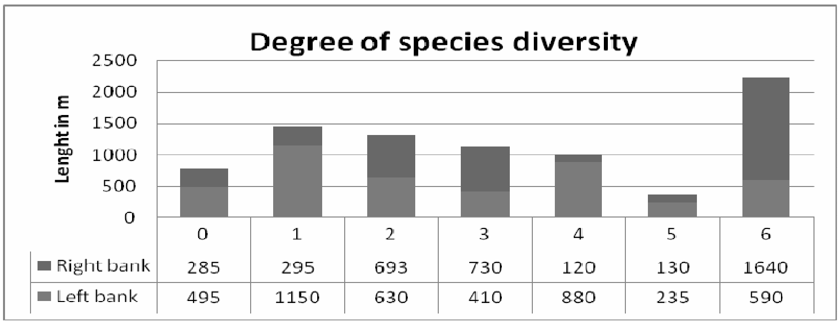


Fig. 4) *Diverzity of species composition*

4 CONCLUSION

Presented methodology is practical to bank vegetation in rural landscape evaluation. Result of methodology is bank vegetation database. Bank vegetation database includes maps, databases, bank vegetation evaluation and management theses. Object of map section are general and detailed maps. Maps are generated by source maps digitalization in GIS software. Databases consist of section database, segment database and specifications of tree storey. An object of section database is section identification. Objects of segment database are identification, delimitation, alluvium and river-basin characteristics and bank vegetation characteristics. Object of bank vegetation characteristic is description of stand, tree storey and shrub storey. Stream side database serves as base for management.

Alluvium in survey area is intensively utilized (mainly arable land), width of bank vegetation is limited by land use. Proportion of wide stands and line tree stands with shrubs is 23%. Bank with solitaires, bank without woody vegetation and unclassified types reached to 25% length of evaluated sections. 60 % of evaluated tree storey is 1st class of species composition (nature nearly stands), this stand compound mainly of autochthonous species: common alder *(Alnus glutinosa L.),* European ash *(Fraxinus excelsior L.)* a willows *(Salix sp. L.)*. Main problems of species composition is alien or crossbred species representation, example crossbred poplars *(Populus x canadensis Moench)* or black locust *(Robinia pseudoacacia L.)*.

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STABILIZATION OF BANKS WITH USING GEOSYNTETICS

Miloslav Šlezingr[1], Hana Uhmannová[2]

Abstract

Banks may also be damaged in rainstorms when runoff is concentrated into one or more main currents, or when water flows back into the riverbed after overflowing onto the flood plain. By stabilising banks by means of grassland in combination with tree species, we can prevent riverbed banks from being damaged by erosion rills that can have a very unfavourable impact on the stability of riverbed slopes.

Key words

Bankside trees, shrubs, stabilization, river, reservoir,

1 INTRODUCTION

The natural stabilizing function of vegetation accompanying watercourses is a basis for proposals of biotechnical and mainly biological stabilization measures. The paper focuses on the presentation of partial results of an ongoing experiment. The experiment is based on the accumulation of effects of a root system of a selected grass mixture and an appropriately chosen soil reinforcement method. The below described experiment is currently being carried out in a suitable area at the Žižkova site of the Brno University of Technology, Faculty of Civil Engineering.

Fig. 1) Bank stabilization – Brno damm (foto M.Šlezingr, 2008)

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2 DESCRIPTION OF THE EXPERIMENTAL PLOT

The essential part of the utilization of a reinforced soil construction for bank stabilization is its implementation in a slope. This is described in detail in [1] and [2]. There is a problem – the time from the dissemination of a suitable grass mixture to the germination of seeds and the development of a proper root system takes about 2–3 months. Therefore, the creation of a fully functional grass carpet is a matter of one vegetation period at least.

To prevent the problems with the consolidation of the slope stabilization, we can propose and pre-grow an internally stabilized grass carpet in favourable conditions and then use this for the slope stabilization.

The basis is the selection of a suitable geotextile and grass mixture. The geonet was chosen with respect to the previous long experience with similar stabilization at water structure Brno Bílovec and experimental plots in the Mendel University Arboretum. Representatives of Geosyntetika Praha also joined in the proposal of the suitable geonet and they significantly contributed to the final selection. Moreover, they provided the material for the stabilization carpet. The selected geonet is ENKAMAT 7220 and ENKAMAT 7010 [3], [4].

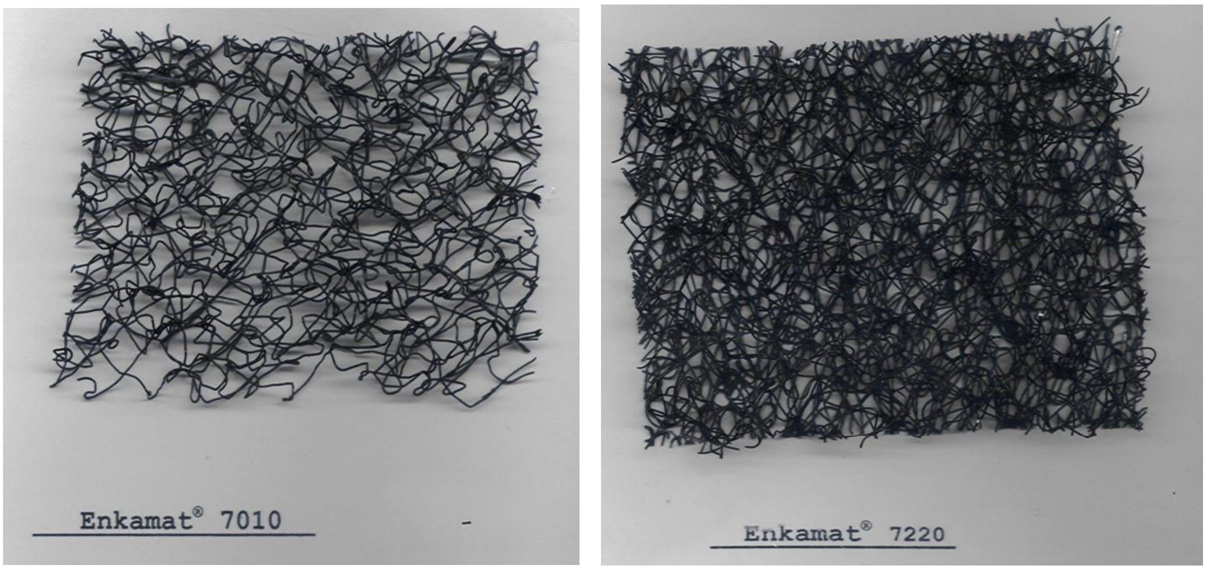

Fig. 2) Geonet Enkamat 7010 and Enkamat 7220

Another task was to choose the appropriate grass mixture. It was important to find a mixture which consists of available grass species meeting the basic criteria and which is available in a sufficient amount.

The grass mixture has to be resistant to trampling, needs to have a thick root system and small overground mass, should not be difficult to maintain and also it should endure occasional flooding. Therefore, we chose two possible grass mixtures out of the available range.

The first one is a grass mixture designed for the pitch, with high-load bearing capacity, resistant to trampling, well regenerating, with the composition:

Further, there is a meadow grass mixture, suitable for nearly all sites, with minimum maintenance requirements and well regenerating, with the composition:

In this way, we achieved a combination of four possible uses. To examine the possibilities, we established the experimental plot where the meadow and the pitch grass mixtures in combination with the ENKAMAT 7010 and 7220 geonet were seeded [4], [5].

Fig. 3) Experimental plot (8/2010)

Fig. 4) Experimental plot – detail

Currently (August 2010), there are two seeded 2 x 4 m plots, which are regularly inspected, the increments of individual growth stages are recorded and photo documentation is taken.

3 CONCLUSION

Experimental plots will remain at the Žižkova site until the end of September 2010. Then the reinforced grass carpets will be transported to the place of installation, which is a stabilized slope of a reservoir bank.

For this purpose, Brno Reservoir, the Rokle area was chosen. The parts of the bank there have already been prepared, sloped and levelled, for the laying of the stabilization carpets.

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COST ESTIMATING OF COMMON FACILITIES FOR LAND CONSOLIDATION

Alena Tichá[1] Jana Podhrázská[2] Jana Coufalová[3] Markéta Švadlenková[4]

Abstract

Land consolidation can be defined as the spatial and functional arrangement of land. Through them it is enabled to adjust the ownership of land and to create conditions for the rational management of land owners. An important part of the land consolidation plan is a proposal for common facilities. These are measures to ensure access to land (transport network) and the conditions for improving the environment (protection and land reclamation, water management, improving the ecological stability of the landscape). To build the buildings proposed in the plan of common facilities it is necessary to put forth the investment costs. The amount is determined on the basis of the cost estimating of the buildings.

Key words

Land consolidation, common facilities, cost estimating

1 INTRODUCTION

Land consolidation can be defined as the spatial and functional arrangement of land. Through them it is enabled to adjust the ownership of land and to create conditions for the rational management of land owners. An important part of the land consolidation plan is a proposal for common facilities. These are measures to ensure access to land (transport network) and the conditions for improving the environment (protection and land reclamation, water management, improving the ecological stability of the landscape). To build the buildings proposed in the plan of common facilities it is necessary to put forth the investment costs. The amount is determined on the basis of the budget of the buildings. Construction firms compete for contracts for construction of common facilities in the public competitions. Costs of land consolidation are covered by the state. According to Act No 139/2002 Coll., the funding may

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share the land consolidation participants themselves, as well as other individual and legal persons who are interested in land consolidation process. State can then provide subsidies according to special regulations. Presented article provides among others the inventories of carried out construction work, including awards, for representative objects of common facilities.

2 COMMON FACILITIES OF LAND CONSOLIDATION

2.1 Common facilities as buildings in countryside

Common facilities are part of the set of measures to ensure the development and protection of the countryside. Development of plan of common facilities goes before proposing a new arrangement of property. It is prepared on the basis of thorough field recognition, collecting all documents describing the studied area, and the expression of the organization, assessment and evaluation of environmental stability, erosion risks and hydrological conditions of the landscape. The common facilities of land consolidation are:

- measures designed to make accessible the plots, such as field and forest roads, bridges, culverts, fords, railway crossings, etc.
- erosion control measures to protect land resources as limit erosion, infiltration strips, intercepting ditches, terraces, windbreaks, erosion control grass, forestation, etc.
- water management measures designed to safely divert surface water to protect against floods as the dry polders, reservoirs, ponds, drainage, levees, etc.
- measures to improve the ecological stability of a bio-centers, bio-corridors, interactive elements,
- measures to protect and improve the environment in addition to green, landscaping, etc.
- other measures not listed above.

As regards the joint establishment of a technical nature, it is a new construction or renovation or modernization of existing buildings. For common facilities are primarily used state or municipal properties. Otherwise, it is used land owned by other owners. Land, where there are localized the common facilities should be owned by municipalities.

2.2 Assessment of effectiveness and financing of common facilities

Effectiveness of constructed common facilities can be evaluated from different perspectives - in terms of landscaping and the environment, from a technical standpoint, from an economic perspective or otherwise. From a technical point of view it is possible to assess whether the facilities meet the purpose for which it was built, namely whether the plots are well accessible, whether the erosion control measures meet the erosion function, whether increased the ecological stability by construction of bio- corridors and bio-centers and whether taken measures are appropriate to protect and improve the environment.

But the economic aspect is important, too. To assess the effectiveness of investments in common facilities, it must first be determined the cost of common facilities. In the next stage should be to compare the investment costs of the damage that has occurred in the landscape.

The next step is then needed to assess whether the possible next injury in the landscape will be reduced due to the common facilities so that their realization pay off, or that the funds used to build common facilities would be spent effectively.

Funding for land consolidation may be supported by subsidizing the source; the subsidy is understood as a direct and irreversible manner with full funding. The maximum amount is 100% of eligible expenditure, of which the grant is determined. The contribution from EU funds is 75% of public resources; the CR contribution is 25% of public resources. The expenditures eligible for co-financing include the realization of common facilities plans for land consolidation, namely:

- laying out the land under construction and building localization,
- excavating and construction works, including mass transfer,
- building materials
- the purchase, planting and providing green
- building equipment,
- other possible special work and technology according to technical requirements of an realization project,
- value added tax.

The amount of total eligible expenditure per project is 300 000 CZK to 50 000 000 CZK. The maximum amount per beneficiary in frame of the fund amounted to CZK 180 million for the period 2007-2013. [1]

3 PRICES OF COMMON FACILITIES IN LAND CONSOLIDATION

In this article we will focus on determining the cost of common facilities, of which are derived, according to certain rules, eligible costs. Their level is crucial when applying for a subsidy for the realization of common facilities.

Common facilities are in terms of building structures. The cost and purchase price set forth therein shall be budgeted based on traditional methods applied in the Czech Republic. The building object is divided into component parts in a structure that is usually given by Classification of building structures and works. In the frame of building parts is created bill of quantities of individual constructions and work. By the evaluation of individual items in the bill of quantities is created the cost account of the building. For the preliminary, tentative determination of the cost price designers use the prices of the civil works, marketed by specialized engineering organizations. The most common are printed Catalogs of description and guide prices of construction works, published by Institute of rationalization of prices in civil engineering (URS) Praha, Inc. But the budgets are normally processed by using software and electronic databases, the most commonly used are systems from URS Praha, Inc., RTS, Inc., Callida, Ltd., but many more others are available too.

Construction companies, which compete for the contracts, namely for the realization of plans of common facilities, compile the budgets partially using list prices, but significant items are calculated on its own terms of business. Proposal budgets with which they compete for contracts financed from public sources, then differ according to individual candidates.

Example budget "Stabilization of the field road in the Malhovice cadastre is given below. The budget is prepared in the price level of 2009th. Central Land Office issued instructions that the budgets of common facilities will be calculate in the RTS system.

POLOŽKOVÝ ROZPOČET

Rozpočet	**0**	**0**	JKSO	
Objekt	Název objektu		SKP	
SO 106 a	**Zpevnění polní cesty Malhovice**		Měrná jednotka	
Stavba	Název stavby		Počet jednotek	0
SO106	**Zpevnění polní cesty**		Náklady na m.j.	0
Projektant			Typ rozpočtu	
Zpracovatel projektu	0			
Objednatel				
Dodavatel			Zakázkové číslo	Z1
Rozpočtoval			Počet listů	

ROZPOČTOVÉ NÁKLADY

Základní rozpočtové náklady			Ostatní rozpočtové náklady	
	HSV celkem	1 190 945	Ztížené výrobní podmínky	0
Z	PSV celkem	0	Oborová přirážka	0
R	M práce celkem	0	Přesun stavebních kapacit	0
N	M dodávky celkem	0	Mimostaveništní doprava	0
ZRN celkem		1 190 945	Zařízení staveniště	0
			Provoz investora	0
HZS		0	Kompletační činnost (IČD)	0
ZRN+HZS		1 190 945	Ostatní náklady neuvedené	0
ZRN+ost.náklady+HZS		1 190 945	Ostatní náklady celkem	0

Vypracoval	**Za zhotovitele**	**Za objednatele**
Jméno :	Jméno :	Jméno :
Datum :	Datum :	Datum :
Podpis :	Podpis:	Podpis:

Základ pro DPH	10,0	%	1 190 945 Kč
DPH	10,0	%	119 095 Kč
Základ pro DPH	0,0	%	0 Kč
DPH	0,0	%	0 Kč
CENA ZA OBJEKT CELKEM			**1 310 040 Kč**

Stavba :	**SO106 Zpevnění polní cesty**	Rozpočet :	1
Objekt :	**SO 106 a Zpevnění polní cesty Malhovice**		

REKAPITULACE STAVEBNÍCH DÍLŮ

Stavební díl		HSV	PSV	Dodávka	Montáž	HZS
1	Zemní práce	286 348	0	0	0	0
4	Vodorovné konstrukce	78 070	0	0	0	0
5	Komunikace	748 164	0	0	0	0
8	Trubní vedení	12 505	0	0	0	0
91	Doplňující práce na komunikaci	4 223	0	0	0	0
99	Staveništní přesun hmot	61 635	0	0	0	0
	CELKEM OBJEKT	**1 190 945**	**0**	**0**	**0**	**0**

VEDLEJŠÍ ROZPOČTOVÉ NÁKLADY

Název VRN	Kč	%	Základna	Kč
Ztížené výrobní podmínky	0	0,0	1 190 945	0
Oborová přirážka	0	0,0	1 190 945	0
Přesun stavebních kapacit	0	0,0	1 190 945	0
Mimostaveništní doprava	0	0,0	1 190 945	0
Zařízení staveniště	0	0,0	1 190 945	0
Provoz investora	0	0,0	1 190 945	0
Kompletační činnost (IČD)	0	0,0	1 190 945	0
Rezerva rozpočtu	0	0,0	1 190 945	0
CELKEM VRN				**0**

Položkový rozpočet

Stavba : Objekt :	**SO106 Zpevnění polní cesty** **SO 106 a Zpevnění polní cesty Malhovice**	Rozpočet: 1

P.č.	Číslo položky	Název položky	MJ	množství	cena / MJ	celkem (Kč)
Díl:	**1**	**Zemní práce**				
1	122202202R00	Odkopávky pro silnice v hor. 3 do 1000 m3	m3	139,68	82,00	11 453,76
2	122202209R00	Příplatek za lepivost - odkop. pro silnice v hor.3	m3	41,90	28,50	1 194,15
3	122302202R00	Odkopávky pro silnice v hor. 4 do 1000 m3	m3	139,68	209,50	29 262,96
4	122302209R00	Příplatek za lepivost - odkop pro silnice v hor. 4	m3	41,90	41,30	1 730,47
5	132301101R00	Hloubení rýh šířky do 60 cm v hor.4 do 100 m3	m3	24,16	1 240,00	29 958,40
6	162701105R00	Vodorovné přemístění výkopku z hor.1-4 do 10000 m	m3	247,22	247,00	61 063,34
7	162701109R00	Příplatek k vod. přemístění hor.1-4 za další 1 km	m3	4 697,18	20,30	95 352,75
8	171101141R00	Násyp pro silnice a železnice v množství 0,75 m3/m	m3	56,29	141,00	7 936,89
9	171201101R00	Uložení sypaniny do násypů nezhutněných	m3	247,22	22,60	5 587,17
10	180401213R00	Založení trávníku lučního výsevem ve svahu do 1:1	m2	221,06	15,50	3 426,43
11	181101102R00	Úprava pláně v zářezech v hor. 1-4, se zhutněním	m2	1 296,20	10,80	13 998,96
12	182101101R00	Svahování v zářezech v hor. 1 - 4	m2	14,20	42,50	603,50
13	182201101R00	Svahování násypů	m2	206,86	36,90	7 633,13
14	183101121R00	Hloubení jamek bez výměny půdy do 1 m3, svah 1:5	kus	12,00	792,00	9 504,00
15	184102114R00	Výsadba dřevin s balem D do 50 cm, v rovině	kus	12,00	247,50	2 970,00
16	184501111R00	Zhotovení obalu kmene z juty, 1vrstva, v rovině	m2	12,00	50,60	607,20
17	184801131R00	Ošetřování vysazených dřevin ve skupině, v rovině	m2	12,00	34,30	411,60
18	184804112R00	Ochrana dřevin před okusem z drát.pletiva v rovině	kus	12,00	17,00	204,00
19	184804113R00	Ochrana dřevin před okusem chemicky v rovině	kus	12,00	0,96	11,52
20	184851111R00	Hnojení roztokem hnojiva v rovině	m3	0,60	1 975,00	1 185,00
21	184901112R00	Osazení kůlů k dřevině s uvázáním, dl. kůlů do 3 m	kus	12,00	28,70	344,40
22	00572400	Směs travní parková I. běžná zátěž PROFI	kg	6,83	96,64	660,05
23	02656045	Jeřáb obecný - Sorbus aucuparia 150-200 cm Špičák	kus	16,00	78,05	1 248,80
	Celkem za	***1 Zemní práce***				**286 348,49**
Díl:	**4**	**Vodorovné konstrukce**				
24	457971112R00	Zřízení vrstvy z geotextilie skl.do 1:5,š.do 7,5 m	m2	1 296,20	30,30	39 274,86
25	69365011	Geotextilie Bontec VNW 300 5x100 m	m2	1 296,20	29,93	38 795,27
	Celkem za	***4 Vodorovné konstrukce***				**78 070,13**
Díl:	**5**	**Komunikace**				
26	564851111R00	Podklad ze štěrkodrti po zhutnění tloušťky 15 cm	m2	1 296,20	143,00	185 356,60
27	564861111R00	Podklad ze štěrkodrti po zhutnění tloušťky 20 cm	m2	1 296,20	185,50	240 445,10
28	569831111R00	Zpevnění krajnic štěrkodrtí tloušťky 10 cm	m2	302,00	91,80	27 723,60
29	577151213R00	Beton asfalt. ACO 16+ (ABH II) , do 3 m, 6 cm	m2	894,20	329,50	294 638,90
	Celkem za	***5 Komunikace***				**748 164,20**
Díl:	**8**	**Trubní vedení**				
30	871318111R00	Kladení drenážního potrubí z plastických hmot	m	302,00	11,30	3 412,60
31	28611223	Trubka PVC-U drenážní flexibilní DN 100 mm	m	305,00	29,81	9 092,05
	Celkem za	***8 Trubní vedení***				**12 504,65**
Díl:	**91**	**Doplňující práce na komunikaci**				
32	914001111R00	Montáž svislých dopr.značek na sloupky, konzoly	kus	1,00	428,00	428,00
33	917862111R00	Osazení stojat. obrub. bet. s opěrou,lože z B 12,5	m	9,00	200,00	1 800,00
34	40445137.A	Značka dopravní info IJ 4b, 500 fólie 1, EG 7 letá	kus	1,00	654,59	654,59
35	59217460	Obrubník silniční dvouvrstvý ABO 2-15 100x15x25cm	kus	9,00	148,93	1 340,37
	Celkem za	***91 Doplňující práce na komunikaci***				**4 222,96**
Díl:	**99**	**Staveništní přesun hmot**				
36	998225111R00	Přesun hmot, pozemní komunikace, kryt živičný	t	1 147,76	53,70	61 634,71
	Celkem za	***99 Staveništní přesun hmot***				**61 634,71**

4 CONCLUSION

Assessment the acquisition costs of objects of common facilities in the form of item budget is the first step at making the economic decision. High - quality processing of the item budget before initiation the construction is important for other economic consideration. Price fixed on the basis of the budget is entering to other calculations for assessment an economic effectiveness of investment. No less important is also consideration of injury amount on possession in the country. For assessment claim amount it is possible to use various methods that are determined by insurance companies. As it turns out, problems with evaluation economic effectiveness of common facilities in land consolidation process is rather extensive and authoress will further solve it in terms of research project and university qualifying tasks.

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Zákon č. 139/2002 Sb., o pozemkových úpravách a pozemkových úřadech a o změně zákona č. 229/1991 Sb., o úpravě vlastnických vztahů k půdě a jinému zemědělskému majetku, ve znění pozdějších předpisů

[3] Regulation no.545/2002 Cl., about processing in applying the land consolidation and requirements of proposal land adjustments

Vyhláška č.545/2002 Sb., o postupu při provádění pozemkových úprav a náležitostech návrhu pozemkových úprav

[4] COMPOSITE AUTHORS: Methodical instruction to process land consolidation, issued MA CR and Central land office, force by 1.4.2010

KOLEKTIV AUTORŮ: Metodický návod k provádění pozemkových úprav, vydalo Mze ČR a Ústřední pozemkový úřad, účinnost k 1.4.2010

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POSSIBILITY OF USING SLAG FROM STEEL MILL NIKŠIĆ IN CONCRETE PRODUCTION

Radomir Zejak[1], Nataša Kopitović Vuković[2], Milun Krgović[3]

Abstract

This paper is dealing with preliminary research referred to possibility of using slag from steel mill Nikšić in concrete production. Different world experiences had been gathered, and according to them, two concrete mix designs were made, with partly usage of slag. Half of the stone aggregate in one design was replaced with slag, which had the same granulommetric composition. Crushed slag (flour d<0.125 mm) represented mineral supplement in production of self compacting concrete in the other design. By using two series of testing samples, experimental data were gathered, which helped in bringing out certain conclusions about concrete properties. Possibility of using this kind of slag was also determinate with great influence on environmental protection..

Key words

Experiment, slag, self compacting concrete, mechanical properties, consistency

1 INTRODUCTION

This Paper presents some theoretical and experimental researches about the possibility of the slag usage, from the steel mill Nikšić, in the concrete production. Steel is produced in electro-arch furnaces, where the capacity of this factory is about 300.000 tons annually. 12 - 15% slag is left on this quantity in the production process, which means that about 40.000 tons of slag is got annually. All slag which has been produced in the last 30 years is stockpiled on the dump, which is about 3 km away from the factory. Concerning the fact that the factory worked with the variable capacity of production, it is estimated that there is about 700.000 tons of slag on the dump which can be used and in that way it may contribute to the environment protection. In the theoretical part of the research, experiences from the countries are taken into account, which have already had the developed process in the slag usage in all

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spheres of building construction, with the special retrospection to the possibilities of the slag usage for the concrete production.

The slag which is transported from the steel mill Nikšić (Figure1) is used in the proper experimental researches. In the scope of testing, there was the preparation of the mix design, the preparation of the samples for the lab test, then the testing of all properties of components for the concrete production, and also the testing of properties of fresh concrete as well as stress-deformation characteristics of the hardened concrete. All process is performed according to the previous prepared programme including the adequate photo-documentations of all testing process.


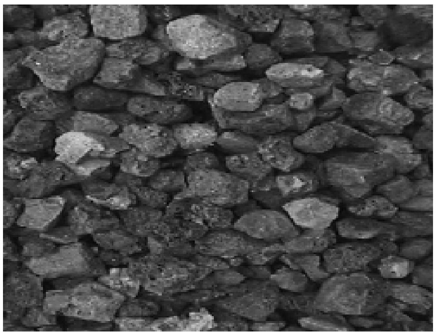

Fig. 1) Steel mill in Nikšić,Montenegro; View of the slag which is stockpiled

According to the results of experimental tests, the lab reports were made where some characteristics of fresh and hardened concrete were given, as well as their behavior during the load actions. Authors of this paper think that presentation of these preliminary test results, with the adequate conclusions connecting with the possibility of the slag usage, present modest contribution to the environment protection in Montenegro.

1.1 PROGRAMME AND METHODOLOGY OF TESTING

Slag presents the residue during the coal combustion in the process of melting raw materials in blast furnaces in the production of raw iron or steel. Additives used in the melting process as well as the manner and speed of cooling of the molten mass which remains after combustion, have influence on the appearance, structure and properties of the slag. Slow cooling influence the formation of crystalline structure, while rapid cooling may form the amorphous or glassy products. If the melt, which is poured out of the furnace, cools slowly in the air it gets a crystal structure and solid mass is formed in the form of large blocks that can be later cut by crushing and milling procedures. This type of slag is obtained in the process of steel production in the steel mill Nikšić.

The slag which cools in the air, and has the crystalline structure and the expanded slag as well, have large application as aggregates for concrete with Portland-cement binder, then in production of building elements with the less volume mass (elements of light concrete), as aggregates for production of asphalt mixtures for road structures on roads, graded bases for lower substructures of road and soil stabilization, as well as materials for different infilling. The slag which does not fit to the granulometric composition and it does not fit to the planned intention it may come to the adequate gradation by crushing and separation. The usage of slag as the mineral additive during the production of self-compacting concrete (SCC), where one part of aggregate is changed with fine ground slag, can be one of the ways for the slag usage in the concrete production. In that way, it may influence the improvement of certain properties of the concrete.

In the scope of this experiment, in the Laboratory of the Faculty of Civil Engineering in Podgorica, two mix designs are prepared with partially slag usage and they are:

Mix design 1 – Slag which is added to the stone aggregate in the form of the grain in the quantity of 50% for all four fractions, so the mix design has the favorable granulometric composition for concrete production.

Mix design 2 – Slag which is added in the quantity of 200 kg/m^3, as mineral additive for SCC concretes in the form of filer (particles are less than 0,125 mm).

Plan and programme of experimental research includes: previous tests of concrete components; testing of aggregate fractions; testing of aggregate mixture; cement testing; slag testing; preparation of mix designs; production of concrete mixture according to the adopted mix designs; testing of characteristics of fresh concrete; production of samples for testing of hardened concrete; testing of the series of the standard control concrete bodies (cubes, prism, cylinders) under the influence of short-time load for determination of relevant stress-deformation characteristics of concrete. The following characteristic properties are adopted:

- consistency of concrete
- compressive strength of concrete
- modulus of concrete elasticity
- stress–strain diagram
- Poisson's ratio

The test results are given in the form of particular lab reports with relevant data. Standard lab equipment is used for these researches, as well as modern measuring technique which are at the disposal of the Laboratory at the Faculty of Civil Engineering in Podgorica.

2 INTERPRETATION OF THE TEST RESULTS

Aggregate from the screening plant Račica from Tivat is used in the experiment, which is graded in four fractions: 0/4, 4/8, 8/16, 16/32 mm. Cement CEM II/A M(S-LL) 42,5N is used as the mineral binder, of the producer „Dalmacija cement“, Split, Republic of Croatia. In the production of self-compacting concrete (SCC) a new generation of superplastificators is used -CEMENTOL ZETA SUPER S, from the producer "TKK Srpenica", Republic of Slovenia. Crystalline slag which is got in the steel mill Nikšić, is transported to the Lab in the bags in the state as it is found on the dump. All preparations of slag for testing are performed in the lab, where the slag is firstly mechanically crushed in presses in smaller pieces, and then put into the mill where it is treated up to the moment when adequate gradation and filer are got. Granulometric curve of the slag is chosen to be adequate to the same granulometric curve of four-fraction aggregate which is used in the process of the mixture designing (Figure 2).

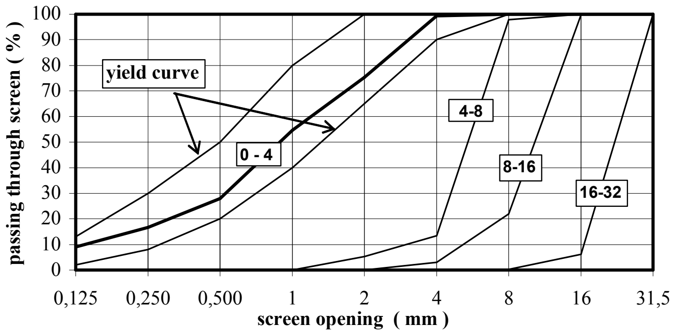

Fig. 2) Granulometric composition of the aggregate by fractions

Mix designs for preparing the classic concrete (R-1) and self-compacting concrete (R-2), where the slag is used as the aggregate additive from the Steel mill Nikšić, are presented in the following table (Table 1):

Tab. 1) Mix designs for concrete

STONE AGGREGATE	**Classic concrete (R – 1)**				**“SCC” concrete (R – 2)**	
	Aggregate		**Slag**			
Aggregate fraction - A	(%)	(kg)	(%)	(kg)	(%)	(kg)
0-4 (%, kg).	15	285	15	285	40	800
4-8 (%, kg)	10	190	10	190	17	340
8-16 (%, kg)	10	190	10	190	33	660
16-32 (%, kg)	15	285	15	285		
Mineral additive – slag (kg)	-				10	200
Cement C (kg/m3)	370				500	
Water * (lit/m3)	160				200	
Cementol Zeta Super S–“TKK-Srpenica”	(2.0 lit/m3)				(5.0 lit/m3)	
Fluidifikator Gostilec–“TKK Srpenica”	-				(0.4 lit/m3)	
W / C	0.43				0.40	
Settling (mm) / Pouring out (mm)	8.0 cm				500 – 550	

2.1 RESULTS GOT ON THE SAMPLE OF THE CLASSIC CONCRETE

On the standard lab samples experimental results of the characteristic properties of the classic fresh and hardened concrete are got, with partially presence of slag. Presentation of some tested properties is given in the continuation, as well as the behavior of the hardened concrete under the load for the classic concrete with the mixture of aggregate and slag. Concrete behavior is presented under the static load, as well as the change of Poisson's coefficient (Figure 3).

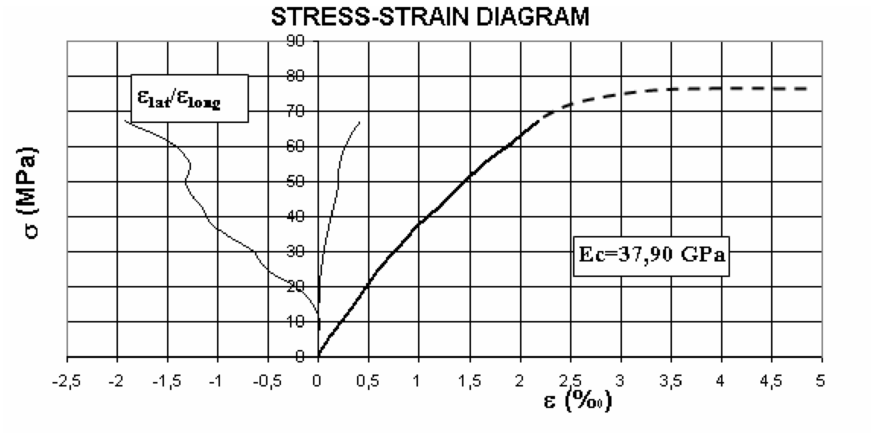

Fig. 3) Stress-strain diagram of concrete, Poison's coefficient,

2.2 RESULTS RECEIVED ON THE SAMPLE OF SCC CONCRETE

On the standard lab samples, experimental results of the characteristic properties of self-compacting SCC fresh and hardened concrete are got, with the slag presence as the mineral additive (filer d<0.125 mm). The following tables and diagrams have characteristic properties and the behavior of the hardened concrete SCC under short-time load.

Tab. 2) Average results on series of per 6 samples

No	Series of samples	Age of concrete (days)	Density (kg/m3)	Compressive strength (MPa)
1	NK-1	3	2464	51,72
2	NK-2	7	2438	50,88
3	NK-3	14	2448	54,47
4	NC-1	28	2444	60,80
5	NC-2	28	2445	63,12
6	NC-3	28	2474	58,48

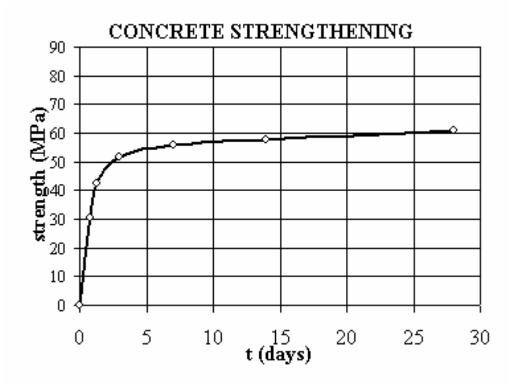

Fig. 4) Strength-age (NC-1)

3 BEHAVIOR DURING ELEMENTS TESTING

General impression which can be got during samples watching, is one mainly clear view of the visible surfaces, with the possibility of clear identification of samples of classic concrete and samples of concrete with the slag additive.

Testing of all samples was performed under the totally identical conditions by usage of standard lab equipment. During the testing of particular properties, the standard-prescribed procedures were used. The received results can be used for the estimation of structures and for structural elements, as well as for the case of casual classical concrete. Effects which could damage the possibility of usage of such concrete in building construction are not identified.

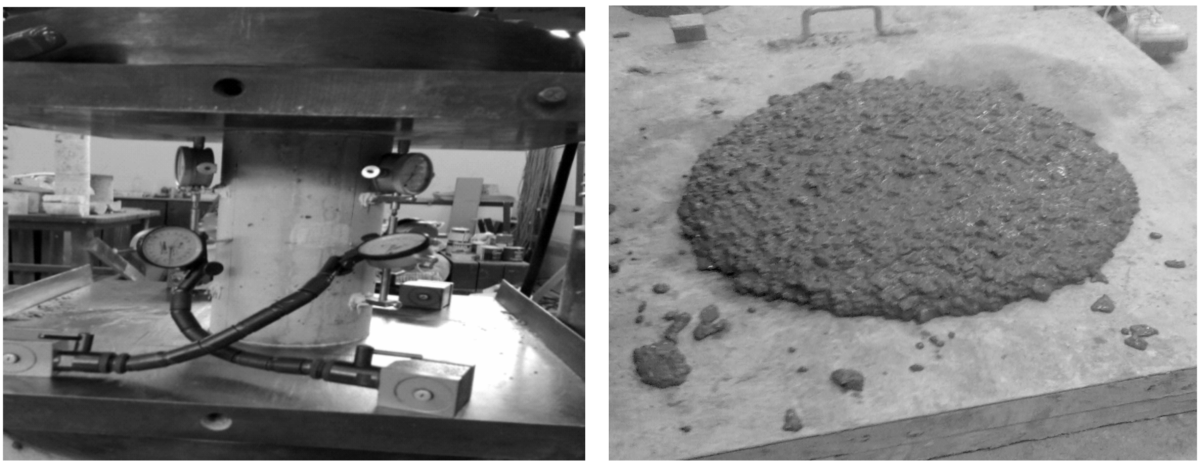

Fig. 5) a) Testing of samples of concrete b) Fresh mixture of SCC

It should mention that the gradation of the slag is got in the lab where the conditions are simulated which should be manifested in the crushing rooms. It is estimated that the received granulometric composition in the real crushing rooms would not have more important influence on such received results, which may also be confirmed by previous tests before the beginning of the production process of this type of "ecological" concrete.

4 CONCLUSIONS

This paper is consisted of one preliminary research according to which the further tests can be continued connecting with the wide possibilities of the slag usage in the building construction.

Slag from the steel mill "Nikšić" belongs to the slags with the crystalline structure which become by the natural cooling in the air and like that it has the specific mass of about 2600 kg/m^3, with the hardness 6 according to Moso scale.

Before the slag usage in the concrete preparation, it should be processed in the crushing plant as well as separation in fractions and filter.

Received results from the lab tests on concrete, which are consisted, beside stone aggregate, of the slag in the fractionized size for normal concrete or like the minerally crushed additive for SCC-concrete, have similar quantitative indicators for certain properties, as well as in the case of classical concrete with clear natural aggregate.

Directions for further investigations should be directed towards the durability testing of these concrete and their behavior in the building structures which would exist in different aggressive conditions.

The usage of accumulated slag from the dump near the steel mill in Nikšić, as concrete additive, presents very effective method for reduction of the damage effect and rehabilitation of ecological space, regarding the fact that one of the main strategic aims of Montenegro is to be recognized as ecological state.

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MIGRATION POTENTIAL OF ROAD AND MOTORWAY BRIDGES

Jaroslav Žák[1]

Abstract

Mathematical and ecological deficiencies of the currently used methodology for the quantification of the migration potential of migration profiles are described. The proposed strategy eliminates these deficiencies and provides us a reliable tool suitable for designers of road and motorway bridges and environmentalists

Key words

Migration potential, ecological potential, technical potential, motorways bridges, environmental impacts, fauna fragmentation

1 CURRENT STRATEGY

The currently used methodology [1] for the quantification of the migration potential of migration profiles defines the migration potential as the probability of the functionality of the migration profile. The strategy itself is not mathematically correct and does not fully correspond to the reality. The probability of future disturbing is not taken into account. The current strategy may bring acceptable results in some cases but generally is not objective.

2 NEW STRATEGY

The proposed methodology for the quantification of the migration potential of migration profiles defines also the migration potential as the probability of the functionality of the migration profile. The proposed strategy is mathematically correct and does correspond to the reality. The probability of future disturbing is taken into account. The proposed strategy gives reliable results in all cases and is generally objective.

Migration potential is defined as the probability of the bridge functionality for the migration and is calculated as the product of the ecological migration potential and the technical migration potential

$$P = P_e * P_t \tag{1}$$

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The ecological migration potential is calculated as the product of the significance of the migration path and the probability of the future disturbing effects

$$P_e = P_{ec} * P_{er} \tag{2}$$

The technical migration potential is calculated as the product of the probability of the bridge technical functionality and the probability of the future traffic disturbancies

$$P_t = P_{tt} * P_{tr} \tag{3}$$

P_{tt} is calculated as

$$P_{tt} = P_w * P_h * P_{whl} \tag{4}$$

where P_w, P_h and P_{whl} are so called partial probabilities for technical parameters (width, heigth and length of the bridge). The functions describing their influence on the technical migration potential were developed in the practical and the exact variants.

2.1 Practical functions

The following functions were developed based on the several years monitoring and investigation. The practical variant uses the function

$$p = 1 - e^{-\gamma(t-\delta)} \tag{5}$$

where γ and δ are constants varying for the fauna cathegory and technical parameter.

2.2 Exact functions

The exact function is in the shape of

$$p_{(x)} = \int_0^x \frac{u^{\alpha-1} e^{-u/\beta}}{\beta^\alpha \Gamma(\alpha)} du \tag{6}$$

where

$$\Gamma(\alpha) = \int_0^\infty t^{\alpha-1} e^{-t} dt \tag{7}$$

α and β are constants varying for the fauna cathegory and technical parameter.

2.3 Comparison of the current and proposed strategy

The comparison of the current and proposed strategy is clear in the fig. 1 for the width of the bridge and in the fig. 2 for the height of the bridge.

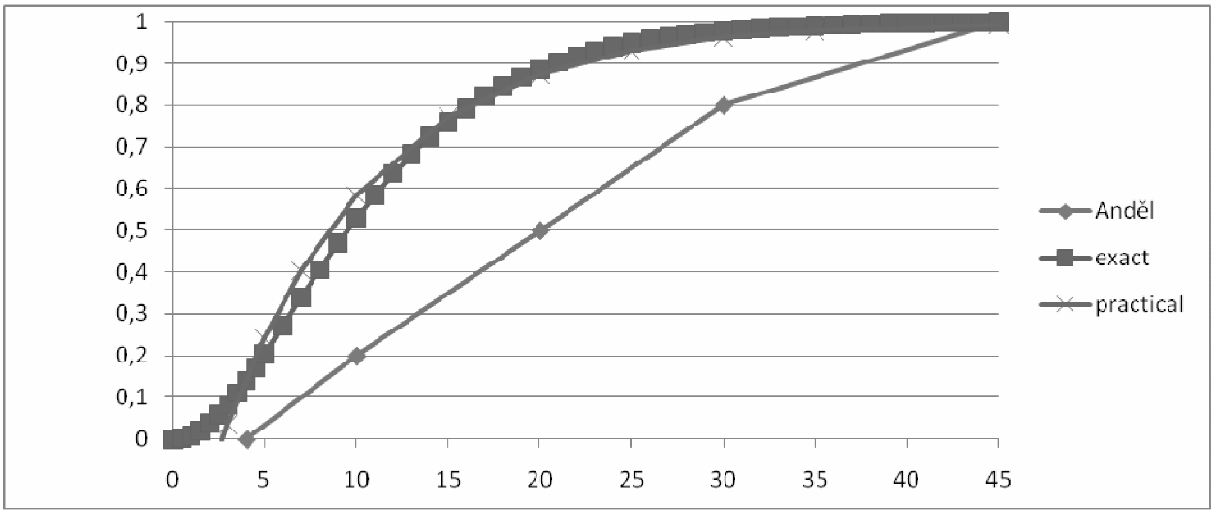

Fig. 1) The influence of the width of the bridge

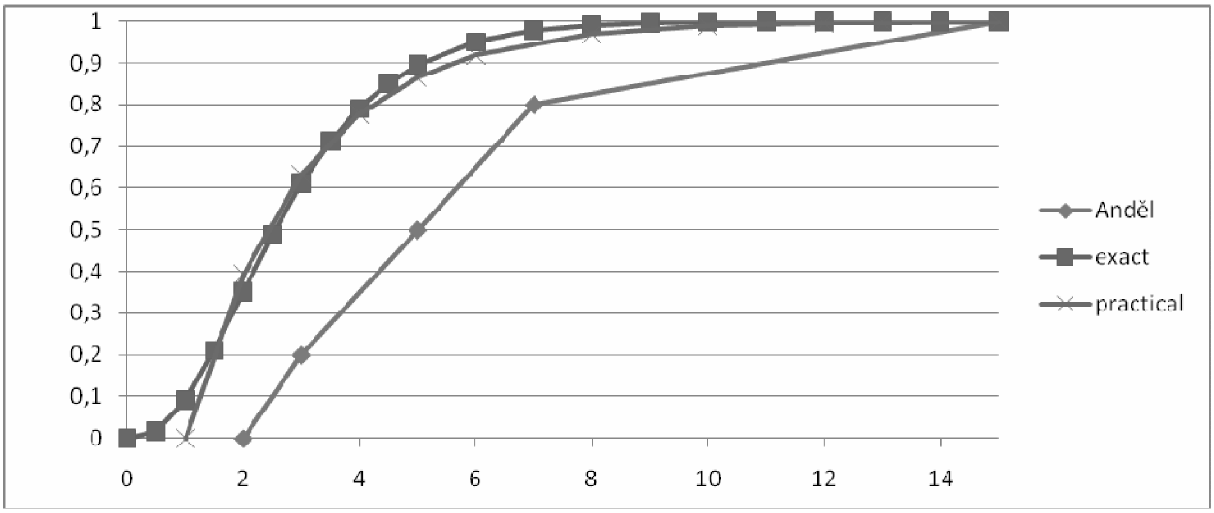

Fig. 2) The influence of the height of the bridge

3 DATA

The necessary data needed for the development of the partial probabilities functions were collected many years using camera system, photo traps and other investigation methods. The part of the camera system is displayed in the fig. 3 and the type of photo traps used is shown in the fig. 4.

4 ACKNOWLEDGEMETS

The research project was realised by the help of GACR project No 103/09/2071.

Fig. 3) Camera system used

Fig. 4) Photo traps used

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DESIGNING AS ONE OF THE KEY PARAMETERS OF THE INTERACTION BETWEEN STRUCTURE AND ENVIRONMENT, ILLUSTRATED ON THE EXAMPLE OF SEVERAL BRIDGES IN MONTENEGRO

Rade Živković[1], Radenko Pejović[2], Svetlana Jovanović[3], Mihailo Ostojić[4],

Abstract

This work indicates the significance of designing, as one of first steps in shaping future structure, on its way from the idea to its materialization.With correct attitude in this phase and with respect to all specific aspects of the subjected environment, we can significantly help resolving the problem of environmental formation and protection.This issue is a very complex one, and requires evaluation of accepted solution according to different criteria, which can often be mutually conflicting.The subjected problem is elaborated on the example of bridges in Montenegro, which are very important engineering constructions, with such influence which cannot be unnoticed, which are classified in three categories:

- Old stone bridges
- Reinforced concrete bridges
- Steel bridges

Key words

Bridge, Designing, Environment

1 INTRODUCTION

According to experience, it has been confirmed that the most successful structures, bridges are among which, have not earned that attribute only based on their grandiosity, but, mostly, because they are well fitted in the natural environment. The most successful bridges which are

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considered to be the symbols of the architectural creativity have integrated in themselves the construction, functionality, rationality and visual appearance. According to Mr. Grattesato, in order bridges to meet the above principles, they should lie on the following principles: beauty should lie in the forms of construction, simplicity and not in perplexity, functional clarity and not in overlapping, and clarity of concepts and not in accumulation of different elements.

Builing of bridges dates back more than 2000 years ago. At that time, apart from first wooden bridges, only stone bridges were built. During the last century and a half, construction of steel, concrete, reinforced concrete, previously stressed and composite bridges have been initiated. Such a progress has been characterized by the usage of new, quality materials and by improvement of the construction technology. New materials and technologies have enabled construction of very large spans and lenghts and overcoming of huge water or dry obstacles. It does not mean that the old bridges have lost their importance, especially not from an aesthetic point of view. Stone and wooden bridges have been rarely constructed today. The existing old bridges have been usually recovered, in order to preserve the construction heritage. Unfortunately, most of the bridges collapsed or have been collapsing.

In order to give an example of the successful constructon works, functionality of appearance, and well fitting into the environment, three bridges of Montenegro have been chosen, the stone one, the reinforced concrete one and the steel one.

The Emperor's bridge

The stone emperor's bridge is the oldest structure of such kind in Montenegro. It bridges the river bed of the Zeta river within the Nikšić field as well as large part the field which is flooded during the time of high water. It is located at the old major road Podgorica – Nikšić. It was completed in 1984 and built of chiselled stone. It consists of 18 arch openings of 296 m of total leght. At the bridge extension,an embankment of 600 m leght has been made, with the bridge having two arch openings. The total bridge leght is almost one kilometer. It was projected by the skilled engineer of that time Mr. Josip Slade from Zadar while the works of the bridge construction were conducted by an experienced builder, Mr. Miloš Lepetić. The bridge was built by the montenegrin ruler, prince Nikola. The construciton works lasted for less than six months. It was named after the russian emperor Aleksandar III who helped construction of the bridge. In gratitude, the prince Nikola proposed the briged to be named "The bridge of Aleksandar III the emperor", but the people named it the Emperor's bridge, to make it simplier. The apperance of the bridge is shown below, at the figure 1 and figure 2.

Figure 1.

Figure 2.

This bridge is considered to be an example of harmoniuos and well formed stone bridge of great lenght. The chiselled stone gives it the monumental appearance. It is also an example of well fitting into the space and natural environment.

The Tara bridge

It bridges one of the most beautiful canyons in Europe, The Tara river canyon, at Pljevlja-Žabljak road. It is the most valuable work of architecture in Montenegro and beyond. The bridge is made of reinforced concrete and was built in the period from 1938 to 1940. The bridge was designed by the famous yugoslav constructor, prof. Mijat Trojanović. The bridge gradient is located at the elevation of 808.61 m, the elevation of the average water level of the Tara river is 657 m, so that the bridge height over the canyon is around 150 m.

Dispositionally, the bridge was constructed as follows: The Tara river canyon was bridged by the arch construction of *l*=116.0m span, with the *f*=23.71m of arrow (compactness $l/f = 23.71/116 = 4.89$) with he road over the arch. The access construction was made as an viaduct having four arch openings of $l = 44.08m$ span each and the attached beam structure with two openings of $l = 17.00m$ span each. The bridge width is 6.5 m (road- 5.5 m plus two pedestrian paths of 0.5m). The appearance of the bridge is shown in figure 3 and figure 4.

Figure 3.

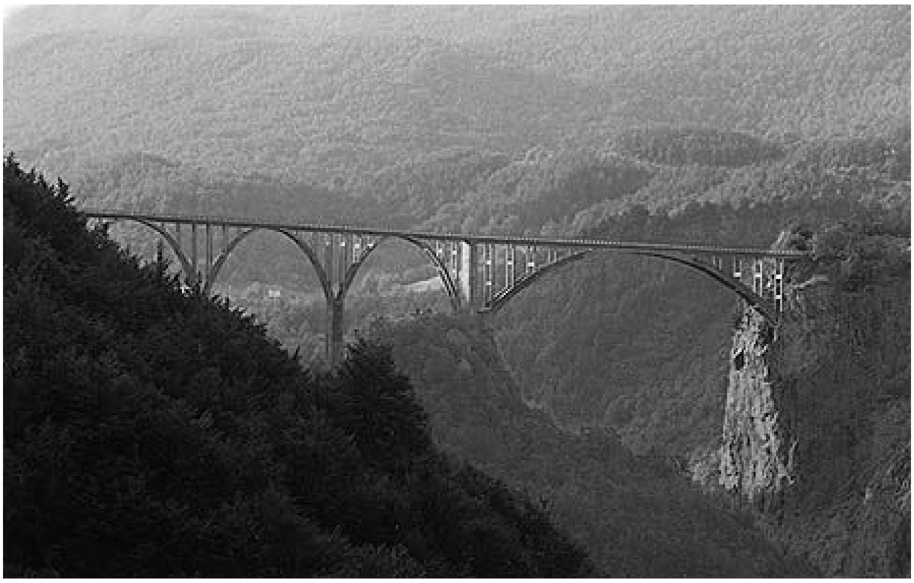

Figure 4.

The Tara bridge is a very successful designing solution, according to all parameters. First of all, it is perfectly fitted into the natural envirinment, as if it was made by nature not by the man. Altough it was made by the man, it enriches the nature and contributes to its beauty. The Tara river is widely known not only by its beauty but by this structure as well. Beside that, it has been designed according to all modern parameters in relation to bridges designing. It is one of the greatest works of design, thanks to its principles compliance and art design, making it one of the world's top achievements of that time and today.

The Little river bridge

The Little river bridge is a raiway bridge over the Little river canyon on Belgrade Bar line. It was constucted as the lattice steel constructn on high concrete pillars. It has five opennings of 81.20 + 92.80 + 150.80 + 92.80 + 81.20 span, of total lenght of 498.80m. Besides huge spans of the steel construction, this structure peculiarity is great height of the line level line over the Little river canyon amounting over 200 m. Consequently, the height of middle pillars is from 50 to 137.50 m. Slopes od the canyon are very steep with gradient of around 45 °. The pillars are designed as hollow, coffered, of variable cross section, decreasing from bottom to top, having the 40:1 gradient longitudinally and 30:1 transversally. The bridge was designed by Milivoje Kovačević, an engineer and the contractor was Mostogradnja company from Belgrade. The appearance of the bridge is shown in figure 5 and figure 6.

Figure 5.

Figure 6.

This bridge was constructed withnin very difficult and inaccessible site conditions. The designer has made a constructive solution for such conditions as regards security, rationality and appearance. Apart from the successful solution referring to the steel span construction, the designer has succeeded in forming the high front pillars of the bridge in the right way. Their, height variable cross section is a very elegant and successful solution. The bridge fits the environment by its simplicity with no special details. It deserves to be chosen as an example of well formed steel bridge and its specific purpose.

2 CONCLUSION

Besides the constructive safety and rationality, a very important aspect of this bridge referes to its visual appearance and fitting into the natural environment. Unfortunately, this aspect has not always been taken into account appropriately. Recently, designers exaggerate trying to get the "modern" solutions with the exaggerated details and complicated forms. One should, also, have in mind that the beauty lies in simple constructive forms well fitted into the environment.

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SECTION IV

UNIVERSITY TEACHING AND LEARNING OF CIVIL ENGINEERING

UTILISATION OF NEW INFORMATION AND COMMUNICATION SYSTEMS IN UNIVERSITY EDUCATION

Mária Ďurechová[1], Janka Bábelová[2]

Abstract

When optimizing the use of the teaching methods and items, generally there should be obeyed one rule – we shall implement them the way that education is effective. Direct or indirect teaching process should content all procedural aspects (motivation, exposition, fixation and evaluation). In practice more methods apply in a convenient and practical combination. This article focuses on the specific evaluation results from using the system LMS MOODLE in practical realisation of e-learning when teaching the economical subjects. Loading these communication systems enables for students at technical university better connection possibility with the real life. It leads to conclusion that the knowledge from economy and management helps them to gain professional respect in the social practice

Key words

Information technologies, teaching of economics, e-learning, education management system, distance study, LMS MOODLE, utilisation of information technologies in education, accounting software, information systems.

1 INTRODUCTION

Educational process at all levels of education is influenced by implementation of information technologies (IT). Implementation of IT is directly connected to the development of new ways and methods of education and study at a university. IT evoked fundamental changes in approach to information. Educational process as the exchange of information between a subject and object of education, it means between a teacher and a student, provides the effective utilisation of IT tools and at the same time it makes the knowledge accessible not only to a student of daily study programme but also to students of the distance form of study [2]. Studies at a technical university assume an active student's participation in the process of new knowledge gaining. As the number of students is increasing, it is necessary to search for approachable and effective alternative ways of passing the knowledge to a big number of students who are not always obliged to attend the tuition directly.

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Many traditional subjects, which were taught at universities also in the past, got a new dynamics just by the application of new IT. So utilisation of new technologies in educational process turned to very interesting also such subjects as business economics or accounting even for students of technical universities. For technically oriented students new procedures used in education have become so stimulating that they started to search for possibilities of their future use.

2 INFORMATION SOURCES

Practice calls for graduates prepared for utilisation of modern information and communication technologies able to work in a team and willing to learn further. It is inevitable to use new methods and procedures as well as new teaching tools, which allow to receive, to process and provide a wide spectrum of information.

2.1 E-learning

Very often the term e-learning covers all what is related to utilisation of computer technique in teaching process - from creation of digitalised teaching materials in electronic form (CD, ROM applications), through various multimedial and hypermedial components, interactive applications of various programs used subsequently in the teaching process, ongoing testing of knowledge, various video records of lectures accessible on the Internet etc. E-learning should not be just the way to share and spread information or to be via tests a tool for knowledge checking. The base should not be only in right time gained, but also in some context processed and understood information. Then what are advantages of conquest of modern times? These are e.g.:

- a huge amount of quality information from various sources.
- possibilities to increase the number of students without demand for new teaching spaces,
- active role of students in the teaching process,
- active, independent and creative approach to problem solving,
- individual timetable,
- independent gaining of knowledge and its categorization.

Despite of advantages and wide possibilities of IT utilisation in pedagogical process, we have to bear in mind also disadvantages we can encounter while implementing e-learning into practice. They can be e.g.

- high initial investment expenses,
- conservative thinking of people, effort to preserve the existing status,
- inevitability to create a new methodology of learning,
- a distinct methodology of teaching materials,
- problems with e-learning implementation [5].

Despite of disadvantages, of which there are less than advantages, it is clear that this way of education will be applied in the near future across the whole spectrum of our educational system. Practice says that this way of education is very creative and beneficial for university students and teachers. Teachers who still remain creators of learning materials have to keep the methodology of interactive on-line courses preparation [1].

2.2 User environment MOODLE

Some university work places have already bought various commercial systems, but in the practice in direct and indirect tuition most frequently they use LMS systems created on their own. The nature of this system is not in its technical solutions but in the fact how it integrates already known technologies and creates conditions for a new system of education. It is essential to realise that at this way of education we have to see the final goal in front of us and according to it to choose also the way how to fulfil it. Very interesting, dynamically developing and freeware system of courses management is LCMS Moodle, which is used in teaching through internet courses. This system supports the initial authorisation of system administrators, creators of courses and students, it is software compatible, it does not impose any requirements regarding computer literacy and it is also suitable for non-professionals. All imposed tasks are possible to be interpreted through in advance given point scale. Among its big positives belongs also multilanguage support with a possibility to translate text chains directly through the interface [3].

LCMS Moodle manages to simulate educational environment. It connects all tools of modern technique in a suitable way and it can be used in the same way also in teaching economics but also mathematics, because it has an inbuilt support for entering of mathematical expressions [4].

3 INTERNET PORTAL

One of the other possibilities of IT in the pedagogical process is the utilisation of an internet portal . It is a big contribution to ease and effectiveness of the educational process. The portal [6] for study of accountancy is a community web intended for students and teachers, all participants of education, in the field of accountancy and related economic subjects.

This project interlocks with Accountancy software for needs of pedagogical process, in the frame of which there was proposed and as a program realised the application intended for use of the subject Accountancy at the Institute of Management, Slovak University of Technology in Bratislava. With help of this program the procedures of computer processing of accountancy record keeping is presented to students, they can test their knowledge and an inbuilt algorithm can manage to evaluate their successfulness automatically. One of a big amount of advantages of the software utilisation is also direct interconnection to the internet which allows for the students the on-line update of laws and provisions, which is in the case of always changing legislative the another advantage of IT advance .

3.1 Description of work with the portal and its utilisation

The internet portal for accountancy study provides, besides functions of its original application, also possibility of interactions between users. There is no need for distribution; the portal is available from each point of the internet web. The centralised service is more advantageous also from the view of safety: administrators can set and change access rights and all changes of program code. They are immediately applicable for all users in the database. The system was designed so that all SUT faculties in Bratislava can use it, although initially it was developed in cooperation with students of Faculty of Electrical engineering and information technology. The system supports unified users authentication. All those who have an e-mail client in the school AIS can get through the same user name and access password into accountancy.

While working with the portal, several ways of navigation and management are used (Fig. 1):

Fig. 1) Navigation elements layout

Reference toolbar - contains links to chosen web pages. The bookmark of a just opened page or reference over which the mouse cursor is, are highlighted.

Sections menu - allows the access to whole content and all portal functions. List of available sections is widened depending on the fact if a user is logged in or if he/she has the administration rights (Fig.2):

Fig. 2) Menu of administrator's sections

1. **References in the text -** they route a user to related sections with a relevant content. They are distinguished from the normal text by blue colour, at positioning of the mouse cursor to a reference the colour changes to red. They are e.g. used in the section *users*, where the reference on the name of the administrator navigates into the section *Contact* and it is possible to send him a message.

2. **Form** - allows a user communication with the system. On the basis of data inserted into a form, a relevant function is done. After available fields filling, the navigation is

run by a click on an active button. A graphical image of form components is given by a setting of the *internet engine*. One of the main functions using a form is e.g. *Log in / Log out.*

The navigation between groups and organizations - it is a special case of navigation through a form. Users who are classified into more groups, or they have administrator rights in them, can use it. Most sections' content is adjusted to particular groups / organisations so in case of change need it is necessary to select a particular item in a drop-down list and to click to a button. Navigation panel shows only to all logged in users.

3.2 Results evaluation

Out of many practical contributions we would like to mention some possibilities which the system offers at evaluation of students' knowledge, what in the case of accountancy requires a lot of time. The portal offers to students test examples - they serve for testing of practical examples solving and repeated training. They can choose from alphabetically arranged list of available examples. Of course all examples including correct answers must be entered into the system. Correct accounting coding and sums is necessary to enter into a *day book*, also *General ledger* can help at work. After a click on *Example evaluation* the correct result appears and also successfulness of the solution. Then it is possible to continue in accounting or by the button Solve again to erase all filled values and return to the beginning.

Evaluated examples are possible to be solved just once, within the time span and successfulness they will appear also in *Evaluation*. We work with them in the same way as with *Trial examples,* but *Open* the example is possible first after the time of solving begins, to record data in *Day book* is possible only within given final term. In *Example evaluation* it is not possible to do any additional changes and final *Evaluation* is mandatory. Examples are arranged in the section chronologically. After example finishing the system precisely assesses what is the successfulness of the solution, which account coding and calculation were wrong and the student can see the correct solution. The system supports substantially more very interesting solutions on the basis of which the teacher can substantially more complexly evaluate the work and knowledge of a student during the semester. Time which the teacher loses at system setting for "a new semester" he/she gains back during the semester.

4 CONCLUSION

At present there are wide possibilities for utilisation and application of IT in the teaching of economical subjects. High attractiveness, motivation potential of such an education form and the possibility of teaching individualisation really belong to advantages of IT utilisation in the educational process. Creation of electronic educational modules and their implementation to study belong to topical tasks. To new teacher competencies belongs handling and use of available IT tools in teaching as educational systems, to which mentioned systems also belong, start to be very popular.

By a suitable combination of traditional educational methods and modern e-learning methods the teacher can stimulate realisation of creative and independent learning . While searching for new procedures we have to bear in memory that the only source which is available in unlimited number is education. The standard and quality of education is the fact which we have to bear in mind at implementation of new procedures and systems. But at work with IT we cannot forget an old Czech proverb that less is sometimes more.

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ATOMIC FORCE MICROSCOPY IN RESEARCH AND EDUCATION

Tomáš Ficker[1]

Abstract

This contribution deals with the principle of the atomic force microscope and its employment in various branches of science and technology. Due to its widespread utilization in research, and industrial applications, it is desirable to introduce this new technique also into the education of students at technical universities and colleges. This contribution shortly reports on the atomic force microscope used in the student laboratories at the Physics Department of the Faculty of Civil Engineering, Brno University of Technology.

Key words

Atomic force microscopy, cement-based materials, research, education

1 INTRODUCTION

Nanostructure of many materials has been a subject of intensive research for the last decade. Also the building materials are investigated at their nanoscales.

The nanostructure of calcium silicate hydrate (C-S-H), as the main hydration product of Portland cement materials, is one of the decisive factors affecting properties of these materials such as mechanical strength creep, shrinkage and swelling, ductility, etc. Unfortunately, the detailed knowledge of the nanostructure of C-S-H solid gel is far from a complete state. The thorough understanding of this nanostructure is a necessary prerequisite for improving cement materials, among which concrete is one of the most widespread material used in building practice. No wonder that there is a continuous interest in exploring the C-S-H gel at its nanoscale [1-7]. A variety of techniques have been employed for this purpose. In recent years it has been the atomic force microscopy (AFM) that has provided images of the C-S-H nanostructure. The AFM device can be used with a special indenter probe (usually made from diamond) for investigating nanoscale local mechanical properties as well. In this way, the atomic force microscope is capable to create not only high resolution images but also the local mechanical data in a point-like position. So the AFM technique in connection with indentation facility becomes a useful research tool in the field of material testing and research.

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However, for the successful utilization of this progressive technique in practice it is necessary to teach the students of technical universities and colleges to the basics of AFM not only within theoretical lectures but also within practical laboratory work.

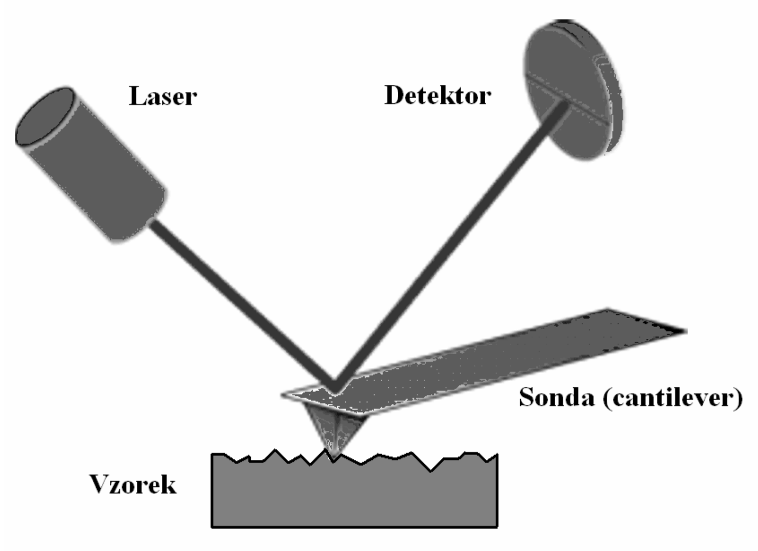

Fig. 1) Scheme of the scanning probe microscope

2 PRINCIPLE OF THE AFM TECHNIQUE

The atomic force microscopy belongs to a wider class of microscopic techniques usually termed as “Scanning Probe Microscopy” (SPM).Their principle is based on a probe, called cantilever, which is in interaction with the surface of samples (Fig. 1). Under the interaction we understand various types of force actions, e.g. van der Waals forces, electrostatic forces, Casimir forces, etc. At he end of the cantilever there is a very subtle tip whose size is ranging from a few to 10s of nm. Due to the force interactions between the tip and the surface the probe can follow the surface profiles of samples and by scanning it can image the three-dimensional surface relief (Fig. 2). There are many modifications of the atomic force microscope, e.g. the devices working in the contact mode, non-contact mode, tapping mode, etc.

- ***Contact mode*** is widely used. One end of the cantilever is hold at constant height above the sample and the other end with the tip is in the direct contact with the surface of the sample (Fig. 1). As the tip moves, it “copies” surface corrugations, i.e. the varying deflection of the cantilever is registered and used as data for imaging the surface relief (see Fig. 2).

  In another arrangement called the “contact force mode” the tip is continuously adjusted to preserve a constant deflection (not height) and the values of adjustments yield the data for imaging.

- ***Non-contact mode*** uses oscillating cantilevers and changes in resonant frequency or amplitude are registered.

- ***Tapping mode*** is based on the intermittent contact of the tip of the cantilever woth the sample and the varying forces at intermittent contacts are registered.

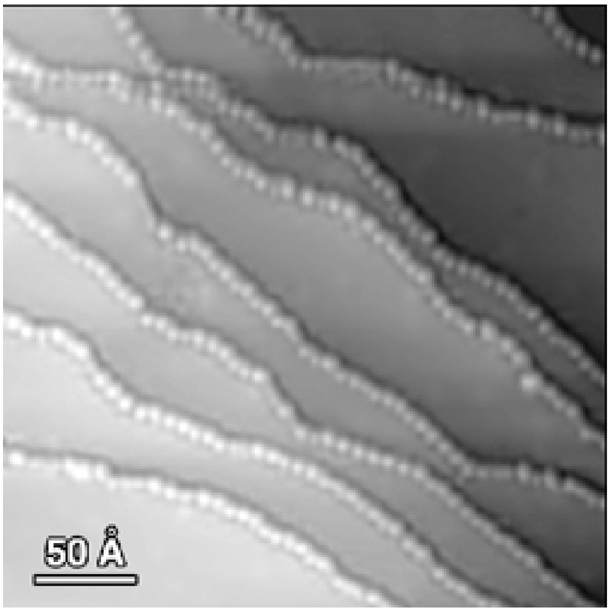

Fig. 2) Molecules of cyclopenthene on the surface of silver – source of the figure: http://hamers.chem.wisc.edu/gallery/metals/cyclopentene-color1.jpeg

There are still more modes of the atomic force microscope but the mentioned three modes belongs to the basic modes of the atomic force microscopy.

3 AFM IN STUDENT LABORATORIES

The Department of Physics, Faculty of Civil Engineering, Brno University of Technology is one of the high school departments that introduce the AFM technique into the student laboratories. The AFM device is a part of the confocal scanning microscope Olympus CLMS Lext OLS 3100 and will serve for practical teaching of students. The students will be educated in testing structures of fracture surfaces of building materials, especially cement-based materials and ceramics. Several new laboratory assignments will be designed in order students may learn basic operations necessary for controlling the atomic force microscope and measuring surface characteristics of materials. The AFM device will also serve as a support for the development of bachelor, master or Ph.D. theses. The AFM technique, given in student disposal, should become a practical tool for thorough understanding of specific structural features of building materials. The students will be provided with the know-how to use this rapidly developing and progressive discipline.

Purchasing and installation of the atomic force microscope at the student laboratory of the Physics Department of the Faculty of Civil Engineering in Brno were granted under the contract no. 573/2010 (FRVŠ) by the Ministry of the Czech Republic.

4 CONCLUSION

The scanning probe microscopy and especially the AFM represent a new type of non-optical microscopy. This microscopy is capable of imaging, measuring, and manipulating materials at the nanoscale (molecules and atoms). It is based on probing the surface of samples using cantilevers with almost microscopic tips. Since this technique is very perspective, it is desirable to introduce it into the education process at the technical universities and colleges.

ACKNOWLEDGEMENT

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THERMAL AND MOISTURE TRANSMITTANCE IN STRAWBALE STRUCTURES

Daniel Grmela[1], Petr Hamšík[2] , Danuše Čuprová[3]

Abstract

This paper represents the results of measurements made in two research projects on straw bale structures. In the first project the measurements were performed in an accredited testing laboratory using a guarded hot box. Measurements were carried out on a wall fragment. Under given conditions the heat flux "q", the thermal resistance "R", the heat transmission coefficient "U", the equivalent thermal conductivity 'λ tr " were measured and the humidity in the straw was determined at the end of the sample measurements. In the other project thermal conductivity and moisture measurments were carried out under set conditions. Measurements were compared with the results by the ČSN 73 0540 a ČSN EN ISO 13788 simulation program WUFI.

Key words

Assessment, design, holistic, straw bales, thermal, moisture, transmittance.

1 INTRODUCTION

The holistic approach to design high-quality indoor climates in residential buildings, which impeaches maximum economic, social and environmental effects, is combined by using straw bales with the clay plasters and renders in the building structure. As the one of the ways which completely fulfill defined requirements, but in spite of its strong potential, has yet to come into its own, because of absence of any relevant inland experience, experiments and design methods. That is why this paper is aiming at thermal and moisture transmittance as a base for a methodology of the thermal design and assessment of straw bale structures.

2 PROPERTIES AND THERMAL CHARACTERISTICS OF STRAW AS A BUILDING MATERIAL

Straw is a renewable natural raw material. Technically, it is a non-homogeneous fibrous material, with high air permeability, relatively high water vapor permeability and a high

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thermal and moisture capacity. The last two mentioned features are very beneficial for maintaining a high-quality indoor climate in residential buildings.

High air permeability of the straw bales is given by rough fibrous structure. Because of the high air permeability and big thickness of straw bale structures, there is a much bigger effect of heat convection and radiation in the process of heat transfer through the straw bale structure than through the other commonly used fiber insulation materials (wood, mineral and glass fibers). The thermal resistance of the straw bale structure is not lineary dependent on thickness of the insulating layer and thermal gradient. Therefore we cannot apply standard methods of thermal design and assessment. Dependencies are nonlinear and are detrimental to the heat-insulating properties of straw. The dependence of thermal conductivity of straw on the humidity also plays a significant role as well.

The values of thermal conductivity (and equivalent thermal conductivity) of straw publicized in different sources show that values are varying from 0,038 to 0,1 $W.m^{-1}.K^{-1}$ [3, 4, 5].

Thermal conductivity of straw depends on the orientation of the stalk. In the direction perpendicular to the stalks the thermal conductivity is lower than along the stalks. Different dimensions, particularly thickness of specimens and different thermal gradients along with the influence of different density and moisture contents are likely to lead to differences in the declared values of thermal conductivity of straw. Equivalent thermal conductivity includes beside the heat transfer through conduction as well the heat transfer by convection in the straw bale wall and radiation heat transfer between the stalks.

2.1 Thermal conductivity of a strawbale wall measured in a guarded hot box

In the project IGA No. 29/2009 MUAF in Brno the thermal resistance of the straw wall fragment was measured, the dimensions being 40 x 184 x 181cm. The measurements were performed by an accredited testing laboratory of the Technical and Testing Institute building in Prague (Czech Budejovice branch) according to the guarded hot box method (ISO 8990) with a temperature gradient of 41.22 °C and a mean temperature of 8.46 and 10 °C. The thermal gradient of 41.22 °C is for the CR relatively extreme, not too frequent in occurrence, on the side of safety. In a real situation this would correspond to an internal temperature of 20 °C and -21 °C outdoors [6].

Straw bales in the test wall were oriented in such a way that the stalks were mainly horizontal and perpendicular to heat flow, i.e. the "channels" in the stalk and the roots do not form a vertical "chimney" to facilitate airflow. The density of the straw bales in the construction ranged around 95 kg/m^3.

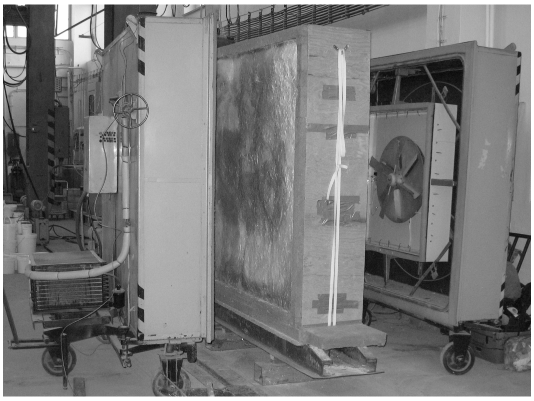

Fig. 1) Guarded hot box, TZUS Prague, Czech Budejovice branch. Measuring device before closing - part of the refrigerator (left), a fragment of straw bale wall entered into a wooden frame fitted with a thin layer of plaster (middle), heated portion of the guarded hot box (right).

The wall was on the both sides plastered with lime plaster to close the surfaces and avoid the air flow through the straw bales. It was plastered in the thinnest possible layer so to not affect the heat flow through the wall significantly. Due to the small thickness of the plaster (about 0.5 to 1.5cm) and its relatively high thermal conductivity, the influence of the thermal resistance of the plaster could be neglect without great risk of inaccuracies in the determination of the thermal conductivity of straw bales.

Equivalent thermal conductivity determined from the wall heat flux "q" in steady state, the thermal gradient of 41.22 ° C and a thickness of about 40 cm was $\lambda tr = 0.078\ W.m^{-1}.K^{-1}$. [6] After the measurement the mass wetness was: plaster - 7,1% on the cold side and 4.9% on the warm side; straw - 15.9% on the cold side and 3.5% on the warm side. [6]

2.2 Impact of moisture content on thermal conductivity of the straw

Within the scope of the research project "VVZ MSM 261 100008: Research and development of recycled raw materials and providing of greater durability of building structures" at the Brno University of Technology, Faculty of Civil Engineering was conducted the measuring of the impact of moisture on the thermal conductivity of the straw. Measurements were performed by Izomet, a microprocessor-controlled device for the direct measurement of thermal conductivity and other physical characteristics of different kinds of materials. For the measurement of straw characteristics a needle probe was used. Measurements were performed for the heat flow direction perpendicular to the stalks.

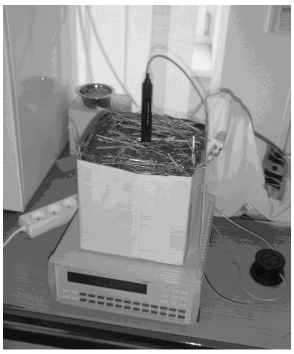

Fig. 2) Thermal conductivity measurement, device Izomet

Fig. 3) Dependence of the mean thermal conductivity of the moisture from the measurement device Izomet, wheat straw density 70kg.m^{-3}, heat flow perpendicular to the stalk.

Pre-moistened straw was compacted in a cardboard box with the dimensions of 0,2x0,26x0,365 meters. The box was sealed with a lid. The measured sample was let to get dry gradually at temperature of 21.3 °C and relative humidity of 42%. Thermal conductivity measurements were repeated in cycles of 48 hours. The samples were gradually measured from two opposite sides and were obtained by averaging the values.

2.3 Stages of moisture content in the straw bale wall

The locations of moisture content in the straw wall were measured with the Bale Master equipment, a device calibrated to measure the mass of moisture in straw bales. The Bale master was borrowed from Ing. Jakub Wihan. Measurements were taken on the house of the family Hulkovi in Nachod on the 1st of May 2009.

The external walls of the Nachod house consists of a 360mm layer of straw covered on both sides with the „peel". The interior „peel“ of straw bales on the first floor consists of plastered gas silicate bricks "stork" and on the second floor it is plastered panels of pressed straw. The straw is protected from the weather by the exterior „peel“: on the first floor it is the lime plaster and on the second floor it is a ventilated wooden facade. The supporting frame of wooden planks is integrated into the perimeter sandwich wall. " [7]

Fig. 4) View of the measured wall corner which is the most stressed by the rain.

Fig. 5) Device Bale Master for measuring the moisture in straw bales.

The moisture content was measured in the straw bale wall with the Bale Master across the wall and the results compared with values calculated according to CSN 73 0540 and ISO 13788 and then with the values obtained in the simulation program WUFI. The simulations made with WUFI include sorption, porosity and thermal conductivity dependent on the moisture content. The diffusion resistance was simulated as moisture independent, for large porosity of the straw insulation does not play an important role. The built-in moisture content was estimated to be 10%. The values for porosity and diffusion resistance were used of fibreboards from the WUFI materials catalog.

The simulation included the dynamic boundary conditions of the exterior: the annual course of temperature and relative humidity, damping the wall by the rain falling straight on the facade and its drying by the sun during the year. Climatic data was taken from the WUFI library. Data was taken from the German city of Hof, located at a similar latitude as Nachod.

2.4 Comparison of measured and calculated moisture content

Despite the inclusion of a maximum possible factor affecting the course of moisture content in the straw wall in the simulation program WUFI, it gives less accurate results then calculating according to ISO 730540 and ISO 13788. The values of the moisture in the straw insulation simulated by WUFI are higher than the values determined from measurements. The difference is probably caused by inaccurate estimates of some unknown parameters of the straw bales and the use of climatic data for simulation from a different location than where it was measured. High level of moisture content just below the exterior plaster shows the impact of driving rain or underestimation of the possibility of evaporation through the plaster in the WUFI simulation.

The course of the moisture content measured with the Bale Master and calculated according to the ISO 730540 and ISO 13788 standards correspond relatively well. On the south-east corner of the perimeter wall, where measurements were taken with the probes 1 and 3, the moisture content is increasing faster from the interior to the exterior than it was expected in the calculation. This is because of the exposure of this part of the wall to wind driven rain. Measurements of moisture content in the places of the other probes are lower than the calculated values.

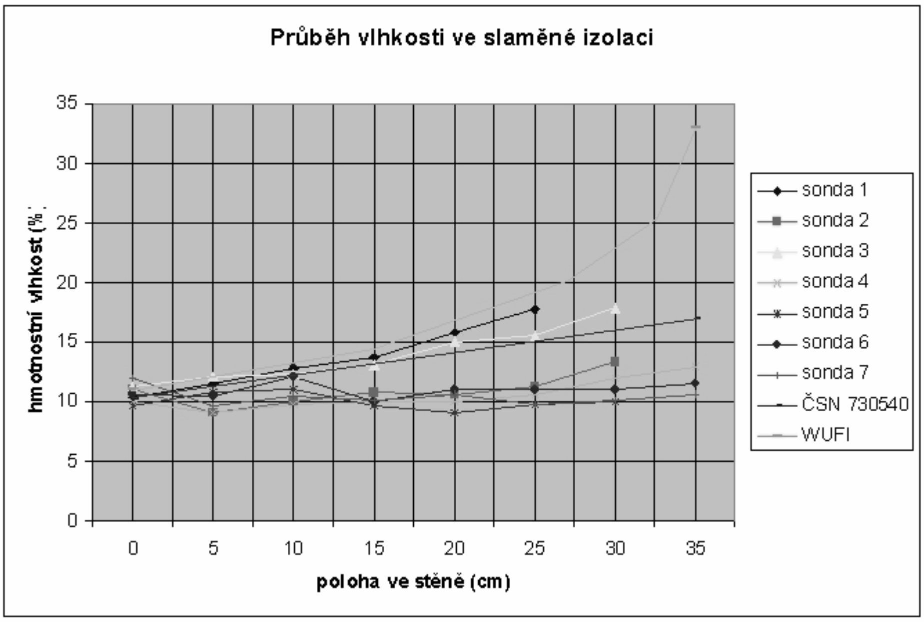

Fig. 6) Course of the moisture content in the straw bale wall - measurements, ISO 730540, WUFI.

3 CONCLUSIONS FOR PRACTICE

Straw bales allow to achieve low values of heat transfer required for passive houses. For a large wall thickness, it is difficult to meet the condition of a specific heat consumption under 15 $kWh.m^{-2}.a^{-1}$. This is due to its relative big ratio of the cooled surface of the building envelope (calculated from external dimensions) to the surface of the residential area of the house (counting from the internal dimensions). On the other hand, buildings with diffusion-open envelopes using straw and other natural materials, offers the possibility to reduce the ventilation rate which is significant for the heat loss in buildings. This is because a substantial part of the prescribed amount of air exchange is for venting out the high air humidity and noxious fumes from synthetic building materials. [8] Another advantage is the lower embodied energy in building materials.

For now, the most feasible calculation of the thermal resistance, heat transfer and moisture content in the straw bale structure appear to be to use the existing methodology CSN 73 0540-4: 2005 - "Thermal protection of buildings" with the values of thermal conductivity by the General permits issued for construction supervision of the German Institute for Construction Z-23.11-1595, 2006 (Allgemeine bauaufsichtliche Zullasung, Deutsches Institut fuer Bautechnik). In the future, the aim is to create a new methodology, which better fit straw structures. The basic task is a more accurate determination of the equivalent thermal conductivity and thermal resistance of straw structures, depending on factors such as the density of straw bales (compression rate), thickness of the layer of straw and thermal gradient (non-lineary), and moisture dependent thermal conductivity. Next step is to find and verify such methods using straw bales in building structures to ensure their superior performance throughout the life of the building, particularly with regard to the higher sensitivity of straw to high humidity in the climate of the Czech Republic.

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Research project "VVZ MSM 261 100008: Research and development of new materials from raw materials and provide greater durability of structures.

MOBILITY IN UNIVERSITY EDUCATION - BOOM OR NECESSITY?

Dana Linkeschová[1]

Abstract

When I ask the question in our Faculty of Civil Engineering who from my students has spent at least 1 month alone somewhere abroad, I can see only a few hands up. What a pity! Yes, I know: Teaching and learning process in BUT has lots of obligations, which are comparable with any Technical University. I have several reasons to believe, that international mobility shall be another necessary challenge...

Key words

Education, travelling, Erasmus, sharing and gaining experiences, living and learning in a foreign country, language and personal development

1 WHY GO ABROAD?

I have been a university teacher for nearly 30 years. I believe that a university degree means not only gaining some knowledge and information but mainly an ability to be a strong and enthusiastic person. Or at least some level of personal growth (development). A student who has spent at least one month abroad alone is usually quite recognizable. By my own experience, mobility is one of the most effective methods to get much more than only study experience. It is a personal way how to look at the world with new eyes. It is the possibility to feel and discover new emotions and learn what you cannot find in the textbooks. For example "By respecting our differences we learn how to appreciate ourselves as well as honour other people. Because we see things differently both of us can be right" [1]

2 SOME FACTS ABOUT EXCHANGE STUDENTS IN EUROPE

There exist a number of exchange programs around the Globe. One of the most popular with the students in the Czech Republic is an exchange programme called Erasmus. The existence of ECTS (European Credit Transfer System) allows us to count the modules taken at the host university towards the student's total credit score at the home university.

2.1 Erasmus

"The ERASMUS programme is targeted at higher education institutions and their students, teachers and other staff and also at enterprises and other representatives of working life. The

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ERASMUS programme encourages students and staff mobility throughout Europe and promotes multilateral cooperation between higher education institutions in Europe and between higher education institutions and enterprises.” [2]

The Erasmus programme is offered to the students since 2007 (before it was Socrates/Erasmus programme from 2000 to 2006). In the Czech Republic there are the programmes coordinated by NAEP (National Agency for European educational programmes).

2.2 Erasmus programme participants

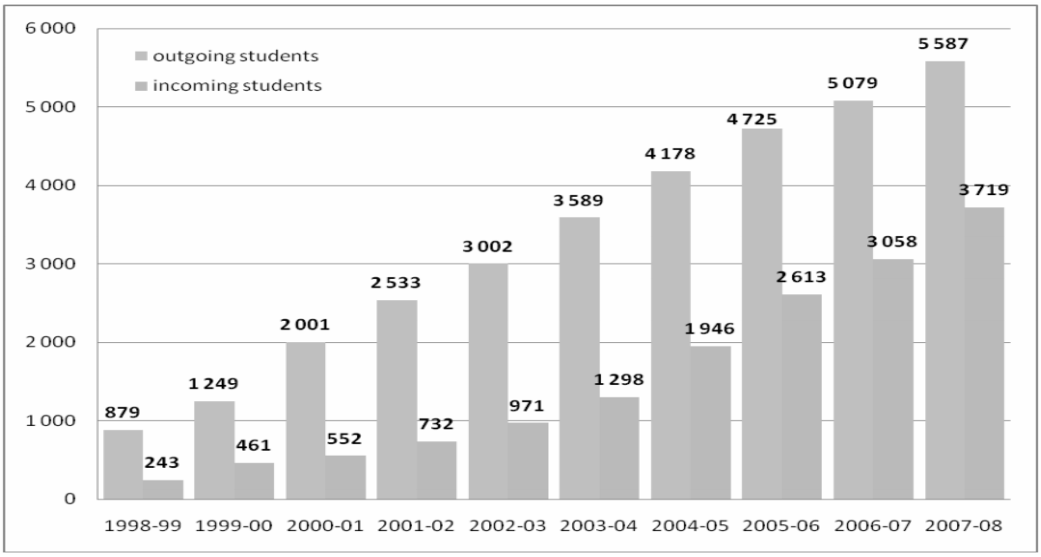
The Erasmus programme is not offered only to students. The universities across Europe are keen to host research assistants and tutors as well. In the table below we will show the number of participants of the Erasmus programme coming in or going out of the Czech Republic.

Tab. 1) Total number of students and staff mobility in Europe in 2008/2009 ([3], [4])

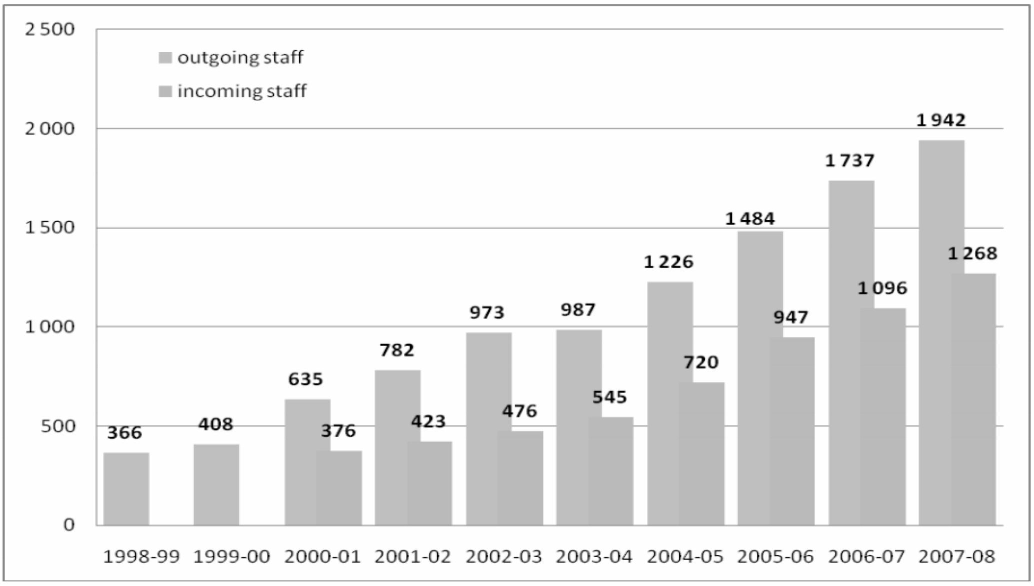
	Total number of students (studies and placements)	Percentage of Europe’s total student mobility	Total number of staff (teaching assignments and staff training)	Percentage of Europe’s total staff mobility
Czech Republic	6 045 students	3,0%	2 580 staff	7,1%
Germany	27 894 students	14,0%	3 134 staff	8,6%
Spain	27 405 students	13,8%	3 695 staff	10,2%
Hungary	5 945 students	3,0%	1 147 staff	3,2%
Belgium	4 057 students	2,0%	1 224 staff	3,4%

The previous table shows us the mobility in the past year (the data from 2009/2010 are unfortunately not yet publicly accessible). The below shown graphs are indicating the trend of mobility within Erasmus and Socrates/Erasmus between the years 1998/1999 and 2007/2008.

Graph 1) Erasmus student mobility trend in the past 10 years [5]



Graph 2) Erasmus staff mobility trend in the past 10 years [5]



As it can be seen on both of the graphs, the interest for the exchange is rising each year. However, it is not easy for a student or a staff member to actually participate on the exchange programme and there are many difficulties. Some of them are mentioned in chapter 3 with the specific students and teachers experiences.

2.3 How Czech universities mobility stands within Europe?

In the table bellow, from the European institutions that are sending out or accepting students, top 5 and some Czech are listed in the order of the number of exchange students either way.

Tab. 2: **Top institutions for incoming / outgoing students in Europe** ([6], [7])

#	**Institution hosting students**		#	**Institution sending students**	
1	U. de Granada; ES	1 858	**1**	U. Complutense de Madrid; ES	1 473
2	U. de Valencia (EG) Uveg; ES	1 667	**2**	U. de Granada; ES	1 408
3	U. Complutense de Madrid; ES	1 626	**3**	U. di Bologna; IT	1 365
4	U. Politecnica de Valencia; ES	1 547	**4**	U. Warszawski; PL	1 097
5	U. di Bologna; IT	1 526	**5**	U. Degli Studi di Roma; IT	1 090
12	UK v Praze; CZ	968	**6**	UK v Praze; CZ	1 088
101	CVUT v Praze; CZ	354	**20**	MU v Brně; CZ	699
129	MU v Brně; CZ	310	**73**	UP Olomouc; CZ	402
164	**VUT v Brně; CZ**	257	**103**	**VUT v Brně; CZ**	332

3 EXPERIENCES OF THE PEOPLE, WHO HAVE TAKEN THE CHANCE

In this chapter I want to share experiences of several people. The extracts are based on my individual empiric research in the years 2009 - 2010. All participants are or have been students in the Czech Republic across various majors. I do hope that their own words best illustrate losses and benefits of this kind of mobility.

3.1 MgA. Michaela Plachká – AMU graduate, maternity leave

"(...) These experiences had a lot of benefits for me. From the **professional point** of view: I compared my own creative work with foreign authors and I saw it in a wider context. As well I have used the archives and music libraries which are bigger than in the Czech Republic. I visited a lot of concerts with composition unknown in Czech Republic and I was inspired by the enthusiasm for contemporary music. As to the **language skills**, it was an important benefit especially in the sense of direct communication and understanding. From the **social side**: learning of different mentality; new **professional and personal contacts** which I see as a big enrichment and investment for the future; contact with non-post-communistic society and faster friendly relations without barriers.

Apart from those above, my interest for the country increased and I gained a deeper understanding of its culture. And last – my **personal growth**: mental refreshment and improvement of my memory; improvement in self-reliance; training in proactivity; revaluation of my opinions, way of thinking in different fields of life; revaluation of my own possibilities, aims and goals; betterment of searching information; **I came to realize the responsibility for my life; Inspiration**."

3.2 Bc. et MSc. Klára Marečková – Ph.D. student

Studying abroad is like a long experiential learning course. It's a decision to explore the jungle of life and let it become your big adventure. **Being open and having courage will enable you to cross boundaries** between countries as well as the boundaries in your mind: Turn a page, follow your bliss and doors will open for you that you never knew were there before.

My own study abroad started with one big loss: The loss of my horse, followed by the loss of my boyfriend and dreams. I felt terrible - angry, grumpy, and lonely. I needed to turn a page and go somewhere far. Oh, that's it - somewhere far! Travelling - wasn't that what I always wanted to do? Something I've never done though because of all our trainings? Let's study abroad! Now!

The earliest deadline for a study abroad was coming just in three days. It was an International Student Exchange Program (ISEP), a network of 300 colleges and universities from 42 countries around the world, advertised through the Centre of International Studies at Masaryk University. I wanted to improve my English and therefore the US became the country of my choice. I've spent my weekend searching through the websites of US universities till I chose and ranked 10 of them. The last step was to get a bunch of signatures on Monday morning and submit my application before 5 p.m. All went smoothly and couple of weeks later I've received a message that my classes at East Tennessee State University start on 23rd August.

My first flight ever and there I was, in the sunny and beautiful region of Great Smoky Mountains. There were plenty of parties and trips organized by the university at the beginning of the semester and everybody was very friendly and helpful .The year of my life has started. It was only a few weeks after the semester start when I got a part-time job at the Office of Career and Internship Services. Other international students became my family and several unique friendships with Americans made my time an unforgettable experience. I took overload of classes and used every opportunity to travel. **My motto was: “I’m international, I want to see everything!”**

Going abroad taught me to detach myself from the sense of ownership and to realize I’m a guest. I’ve started to explore this generosity and felt happiness – from the nature, new friends, and the little things of life. **I felt a privilege to be there and that’s why I was trying to do my best**. I’ve learned to live my life and **realized what does mean to love my home country, family and friends**. I felt like a year abroad gave me so much that I’ve decided to study abroad even the following year. I did a master program at the University of Nottingham, UK. I’m doing my PhD in Toronto, Canada now and I’m still in the flow.

This is my story. Yours is completely different. But the point is: **Got an idea? Does it seem crazy? Do it!**

3.3 BSc. et MA. Luděk Knittl – University Teacher

“**It is difficult to imagine NOT to have foreign exchanges for students and teachers alike**... I can see many positives in spending time on a foreign exchange for anyone. For my students, this is often the first time when they can experience a foreign country from the point of view of a "local" rather than a tourist. Setting the issue of the language they are going to improve completely aside, there is a variety of challenges facing anyone who has being plunged into a different cultural and social environment. From trying to find one's way to accommodation and working out how the timetable works, to negotiating with teachers, administration staff or even a bus driver. Before our students go on their "year abroad" their focus is usually primarily on the language, however, they very soon find out that they are learning much more. Extending this... They do things differently. Well, this is exactly what our focus should shift to: **doing things differently**. There are certainly things we observe at other universities abroad that will not work for us back at our workplace but there just might be something that could potentially **improve our work** and, in turn, the student experience. And even if we come to a conclusion that there is nothing new or inspiring that we can implement (and I doubt that this would ever be the case), at least we can confidently say **we have learned this first-hand**.

I would encourage everyone to give a foreign exchange a go. Having experienced life and work in a foreign country's university, I personally feel that my horizons are much broader than ever before. As for my students, when they come back from their stay abroad, they are aware of a **number of new skills** they have learned and that they then bring into their further study but also into their future careers.“

3.4 Ing. Ondřej Malovaný – BUT graduate

“Student mobility as another professional working experience abroad can enrich you in many aspects: One of the aspects of studying abroad is to gain **knowledge of foreign language**. When you study abroad you use foreign language **in every day communication** among your schoolmates, friends and you use it in the most natural way.

The majority of the biggest construction companies in the Czech Republic are likely subsidiaries of foreign companies nowadays. At **certain level of management** the foreign language is often used. In the near future the **cooperation might be more intensive**. It is possible that you will have to work with project documentation, do financial reports or deal with corporate regulations in a foreign language.

(...)It is important to **experience cultural differences**. Every country has a different culture, which is related to he way of living (historical and geographical conditions), communication, **economical effectiveness and development**. (...)You can **experience different systems and attitudes both in education or work, evaluate them and gain the best of it**. You might change some points of view on our country after living abroad."

3.5 Mgr. et Mgr. Karel Ouroda, Ph.D. – University Teacher

"Thanks to all the proclamation I have anticipated, that it will be easy... The only thing missing – the agreement between the universities... I have arranged all the necessities with the relevant people, I wrote the agreement, got it translated into English and both copies checked by the legal department. As to the formal side – everything was OK. It has been sent to the foreign university – but nothing has happened. How can you leave some ten thousand kms away, if you are responsible for an EU grant worth 7 million CZK, a number of unfinished theses and all the other work that needs to be supervised in person thanks to the student mentality? (...)**The biggest problem was to obtain the permit from the old employer for the new one** and on top of that – I was responsible for all the substitute tutors for the time being.

A few weeks of medical examinations followed. Fortunately, everything went smoothly, but none of the doctors has given me the appropriate documentation or certification. Abroad, no private doctors are accepted, everything must be from a state hospital with the result confirmed. So after the arrival – the whole jazz again – multiple screening, blood samples, etc. And what have I learned? "**Never give up. No matter what**!"; "It is necessary to **work on your own personal development**, don't always sacrifice for others."; "**The only thing you have is the one you have done yourself.**"

Recently, I have **cooperated with local professionals** and nowadays a **book is being prepared**. I am **publishing articles, visiting sights, meeting new people** – for the past few years – I didn't time for that back in Brno. On top of that I got to know, (...) **who is a friend and who was only pretending to be**... and the price paid: One yearly salary at the university – but that's not the issue. The ten-year preparation and facing the nearly-lost hope... As one wise man has said, "**Three years of hard work – ten thousand years of happiness**". I am looking forward to my return and I hope that no one else will have to improve his qualification facing the obstacles I have had. And above all I will succeed in **developing cooperation in my field of study, that didn't exist before**"

3.6 Bc. et Mgr. Darina Čejková – PhD. student

"As everything, living beyond the comfort of your homeland has its own pros and cons. When I arrived to the US I was full of fear, especially about my **language skills**. In the first four months I hardly recognized the words I had learned at school. Communication, especially through the phone was terrible. (...) The Americans never correct you, they are very professional in the business and service fields and try to understand and serve you. What about our behaviour to foreigners? I also never heard from Czech folks that **science is useful**, many Czech people think it's just wasting of money. (...) Many things are solved only through email, especially at work. After work the Americans spend their spare time among themselves, it's very difficult to improve English very fast.

The start of a "new" life brought **mind cleaning** to me. I had to think about my stuff, my life and all the **troubles** from home, work, school etc. **were so far**. Finally, I had **time only for**

myself. I think when not disturbed or surrounded by friends, family, I had to face up to all my good as well not as good qualities. I do believe I have been learning to **improve on the bad ones**, because there is nobody else to hide them. Thanks to luck (God?) I stay so far away, that there is **no easy way** to hop on a plane or a train and **get back to the home stereotype and safety**. The decision of a year-long stay means a real decision, including the price of air-tickets and a 12-month rent."

3.7 Ing. Helena Foltýnková – MU Graduate

"Having the chance to study abroad has been the only "**real life experience lesson**" that I had during my 5 years of University studies. And I bet it would be the only one **I would remember and profit from ever after**. (...)

Studying abroad is of course a challenge. But as soon as you make the decision to go the worst is over. It is the biggest "but"on the way and as soon as you have this solved out everything else should be much easier. There are many positive reasons to go - your **CV begins to be more attractive for employers**, you try to live by yourself in a different environment, you improve your language and you network. And as one of my very senior colleague at DHL said: **"Life is all about networking".** She was right."

4 CONCLUSION

I strongly agree with Luděk who said: "I would encourage everyone to give a foreign exchange a go. Having experienced life and work in a foreign country's university, I personally feel **that my horizons are much broader than ever before**. As for my students, when they come back from their stay abroad, they are aware of a **number of new skills** they have learned and that they then bring into **their further study but also into their future careers."** Helena added: "I hope that **everyone who takes the chance is already a winner**. There will be obstructions on the way but you will always remember the positive. And what's worse - **there might not be any other chance later.** You will have your careers, your families, your loans and your responsibilities. Benefit from what is now being offered to you and take the chance! **It is your investment in the future**..."

I hope that one day mobility will be a compulsory part of the university study. I do hope we can pump all the goodness from this source.

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IMPLEMENTATION OF E-LEARNING TOOLS IN TEACHING PROCESS OF FIELD WORK COURSE AT THE FACULTY OF CIVIL ENGINEERING IN RIJEKA

Ivan Marović[1], Diana Car-Pušić[2], Ivona Gudac[3]

Abstract

Recent student population represents the first generation which has been surrounded by computers in all aspects of everyday life since their childhood, therefore, teaching process had to be adjusted according to students expectations. Due to these reasons it was decided to implement hybrid (blended) teaching model into majority of undergraduate courses held at Faculty of Civil Engineering in Rijeka and to expand the teaching process with an online component. For the past three years Learning Management System (LMS) software "Moodle" has been applied. In this paper all aspects of e-learning tools implementation in teaching process of Field Work course, which is held on last year of undergraduate program at the Faculty of Civil Engineering at University of Rijeka, will be shown.

Key words

E-learning, Learning Management System (LMS), implementation, undergraduate course

1 INTRODUCTION

For the new student generations, computers are main component of everyday life. They have been surrounded by computers in all aspects of everyday life since their childhood. These are the facts which everybody should have in mind when speaking about learning and its modifications that learning process requires in today’s time. At the same time, application of the Bologna process [1] laid new demands so unification of above facts carried away number of changes into courses at the Faculty of Civil Engineering in Rijeka (FCE-Ri). For example, during last several years at the Department of Construction Management, Technology and Architecture several different software tools were used for communication and collaboration with students. All changes are adjusted according to known standards and principles for good practice in higher education [2].

Since 2006 Learning Management System (LMS) is implemented in undergraduate courses at the Faculty of Civil Engineering in Rijeka. Informatics, mandatory course on freshman year,

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was first course which implemented LMS and hybrid (blended) learning model [3]. Most academic staff at the FCE-Ri during last few years have implemented hybrid (blended) learning model, as distance learning model, into their teaching process which presents synthesis of classical education system and e-learning environment.

1.1 About Field Work Course

Field work course is defined with Faculty program [4, 5] and learning outcomes [6]. Course is taking place during last university term on the third year of undergraduate study. Field work is mandatory course which provides student to achieve 3.0 ECTS points. The aim of Field work course [5] is to introduce students with practical application of organizational and technological knowledge and competences throughout execution of construction site specific assignments. Students must participate on two different construction sites. Course layout is very broad and to achieve ECTS points students have to attend minimum 50% of all field work exercises, write concise seminar about given subject and pass the final exam. Table 1 gives an overview of students' efficacy on Field work course during last three academic years.

Tab. 1) Field work course efficacy

FIELD WORK COURSE				
Academic year	**Advisers**	**Students approached**	**Students finished**	**Efficacy**
2007/08	4	32	30	93,75 %
2008/09	5	66	64	96,97 %
2009/10	4	96	95	98,96 %

E-learning was implemented in Field work course in academic year 2009/10. Main idea for implementing was to have an efficient collaboration tool between teachers and students with possibility to include other parties (e.g. site managers) in order to bring teaching performance on higher level and generally improve teaching process.

2 NEW EDUCATION MODEL IMPLEMENTATION

Today development of communication and collaboration technologies are developing quickly, at the same time placing informations and share of informations on the top of importance list. The use of information is an inherent part of education. Internet has a vital role from this point of view. It provides a facility to support flexible delivery for teaching and learning.

Specific works are being realized to make maximum use of the developments in the field of education as in every field trying to harmonize the rapidly improving technological developments. Being effective in the world of continuous changing and development, requires earning the ability of continuous learning and development and using of modern, flexible, effective education methods. The educator must have an approach how to make personal development, teaching and improvement of the students possible. In order to reach the results conformable with the aim of the education it is important to determine the methodology which will be used. The student must earn the ability of time management together with the education. This will lighten his load and make him closer to the success [7].

Several facts influenced new learning model's implementation decision making. Questionnaire which is carried out at the beginning of first faculty year at the Faculty of Civil Engineering in Rijeka since 1999 gave few interesting outcomes [3]. Questionnaire provides possibility to track changes in students attitude regarding to computers and technology. Several directions came out from questionnaire which are important to define learning model:

- Majority of students posses personal computer (at home) with Internet connection,
- Students use computer daily (at home and/or at Faculty),
- Students are restrained towards institutional informatics education (it is important to adopt to students' needs),
- Students have high expectations of Faculty education.

2.1 Hybrid (blended) learning model

The conceptual framework for Information and Communication Technologies (ICT) in the educational setting involves ICT as a tool for campus-based teaching and communication on the one hand, and e-learning as such on the other. E-learning can be 100% virtual (via Internet) but e-learning also includes learning models in which distance learning is combined with physical meetings or seminars held at the university.

Hybrid (blended) learning is learning model that combines components of e-learning on the Internet with other learning technologies like classroom/field training and/or books. Result of hybrid (blended) learning is a product in which different disciplines and resources took part. This is the most suitable learning model for Field work course because it allows combination of group, active field work with students' independent work on personal computer.

Goal is to create a community of inquiry where students are fully engaged in collaboratively constructing meaningful and worthwhile knowledge. Collaboration is a key component of a community of inquiry and must include communication or discourse that is purposeful, threaded and reflective.

2.2 Criterion implementation analysis

Implementing Learning Management System (LMS) tool into teaching process enforced change of learning model. Beside several possible models the hybrid (blended) model has been chosen. When decision about change of learning model has to be made there are several criteria which one has to have in mind [3]:

- Will implementation of a new model improve the teaching process?
- Is a new model acceptable for targeted student population and their pre-knowledge?
- Is new model going to be well accepted by students?
- Does institution (Faculty) have proper infrastructure for the new model?
- Are teachers ready for challenges which new model brings?
- Is the new model easily applicable on several courses?
- Is it possible to maintain the new model?

Authors concluded that it is possible to give affirmative answers to all questions above and to implement the new learning model where lectures are performed directly (face-to-face method) on the construction site and through online module which enables easier collaboration and distribution of course contents. Field work course learning model is shown on Figure 1.

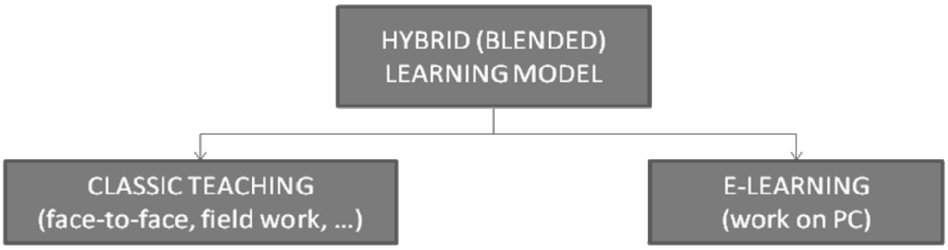

Fig. 1) Field work course learning model

3 APPLICATION OF LEARNING MANAGEMENT SYSTEM (LMS) TOOL - MOODLE

When the decision of implementing LMS was made, first step was to determine which software is the most suitable for use. There are several criteria set which software has to comply [3]:

- Software must be web oriented,
- Installation and administration must be simple,
- Software must be stable,
- Software must be low-priced (free!),
- Installation and data autonomy (Faculty server will be used with Linux and/or Windows OS).

Several different LMS tools which are present on the market were tested. On the end of testing period software Moodle was chosen to be main Faculty LMS tool. At the moment version 1.9 is installed on Linux OS. Several key characteristics of Moodle leverage decision to its favour: open source system, simple installation process, stable at work, scalable, modular and friendly-import of large number of additional modules. Implemented LMS tool Moodle v1.9 in previous years due to permanent use showed advantages and disadvantages of the system.

3.1 Advantages of Learning Management System

Advantages of using and working on LMS tool Moodle v1.9 are easy to perceive. Some main advantages of LMS tool Moodle are:

- Easy manipulation with course contents,
- Document management,
- Supervision possibility of student activities,
- Easy communication and collaboration,
- Creating schedules and deadlines with alarm notification of closing activities,
- Possibility of creating, mixing and performing questionnaires, tests and exams,
- Transparent evaluation of students during course.

3.2 Disadvantages of Learning Management System

Disadvantages of LMS tool Moodle v1.9 were negligible but still required to mention. Although installation to Faculty server went spotless, at the beginning there was little trouble with Croatian diacritical marks [3]. During students' work few problems occurred with students cheating with seminars. It is important to mention that all problems which occurred were minor and easily solved.

3.3 Organization and access to FRAK

Learning portal at the Faculty of Civil Engineering in Rijeka is called FRAK. It is an acronym of an old Faculty Computing Club (**F**akultetski **Ra**čunarski **K**lub) which was generationally the main meeting point for teachers and students interested in advanced application of computers in science and practice. To honour old Faculty Computing Club, its members and achievements, the new learning portal at the FCE-Ri was named FRAK.

Nowadays, users (teachers and students) sign into learning portal with their personal AAI@EduHr user account [8]. Local Faculty network is conceived in such way that the AAI teacher/student identity is used for access to the local network, e-mail account and FRAK.

3.4 FRAKWork – students viewpoint

At the beginning of course students took self-evaluation test. They self-evaluate their skills of using personal computers and Internet as well as different text and table processors (e.g. Work, Excel, ...) and CAD tools (e.g. AutoCAD, ArchiCAD, ...).

An important component of the quality concept is students' satisfaction which is determined through the students' reflections of the process they have been subjected to. At the end of Field work course students were inquired by online anonymous questionnaire. Questionnaire contained inquiries about Field work course on FRAK (e.g. clearness and visual sense of course information, simplicity of use, document management, ...) and its user-friendly collaboration. Authors concluded that students prefer this type of learning model because they can access all documents and information from anywhere, anytime and find collaboration with academic staff easier (Figure 2).

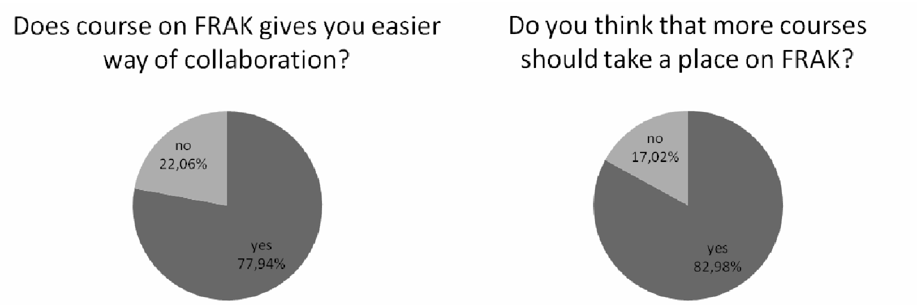

Fig. 2) Student final consideration of courses on FRAK and collaboration

3.5 FRAKWork – teachers viewpoint

LMS presents a great challenge for the teacher. It is essential for the teacher to have advanced IT skills, although work in Moodle is intuitive and user-friendly designed. Setting the course in LMS environment requires a lot of extra time. This is the fact which anyone who wants to set the course in Moodle has to have in mind.

Once the course is set and the teacher posses course documents, everything becomes much faster. Working in LMS environment is stimulating and gives many possibilities to improve teaching process. Main advantage of having set course on Moodle is to have everything in one place which is available from anywhere and anytime.

4 CONCLUSION

Authors are very enthusiastic with implementation of LMS tool Moodle in teaching process of Field work course. Hybrid (blended) learning model is easy to implement in courses which have similar program as Field work course. Working with LMS fullfills all authors expectations which were primaly collaboration and document management.

New communication technologies are means of correspondence providing and improving the mutual interaction between users and information. The application of education technology found in education literature nowadays has made mass communication and computer technology in education a vital part of the education process. That is the reason why new applications and models are put on the agenda against the classic education. Students have high expectations of university education and are open for new technologies. It is important to mention that application of LMS tools improves collaboration between teacher and students, makes course documentation mitigation easier and student evaluation becomes transparent.

All of mentioned presents great challenge for the teacher. Beside teachers IT skills, it takes lot of time to develop and create course content on Moodle. Nevertheless, LMS gives new elements in teaching process which are not able to exist in classic teaching. One has to have in mind that IT does not guarantee quality by its mere existence. Only its pedagogical use and exploitation can provide it.

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BRIDGE - CONNECTING DIFFERENT PROFESSIONS

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Abstract

The implementation of the Bologna Declaration brought substantial and fundamental alterations in the high education system in Republic of Macedonia. Its basic intention to create a compatible, comparable and attractive high education, led to chain of reforms in the educational programs, in a way that students obtained variety of optional subjects in generic branches.

The aim of this paper is to present the necessity of generic subjects in the frames of particular educational program in an explicit way. Obtaining basic knowledge in the branches that are not prime ones in their profession, the new students should foresee the necessity of collaboration among the different profess

Key words

Architecture, civil engineering, education, ECTS.

1 INTRODUCTION

The strategic aim of the Bologna Declaration [1] to establish European high education and to promote a worldwide accredited system of European education, brought to its implementation not only in the members of the European Union, but outside of its borders as well. In the process of implementation of the Bologna Declaration, the contracting states were faced with different challenges in their high education systems.

The implementation of the Bologna Declaration brought to fundamental alterations in the high educational system in Republic of Macedonia, followed by a series of changes in the legislation. Beside the implementation of three cycles of education, Bologna process

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endeavors for creation of greater mobility, flexibility and transfer of the teaching staff, as well as of the students. This mobility is planned to be effectuated, not only within one country, but out of the country as well. In that way one of the fundamental aims of Bologna process should be accomplished: quality and recognition of the qualifications obtained during the educational process.

Creation of compatible, comparable and attractive high education, in a way that students obtained variety of optional subjects in generic branches, led to chain of reforms in the educational programs at the Faculty of Architecture in Skopje, Macedonia. Introduction of the European Credit Transfer System led to creation of teaching program, which offered new subjects in relation to the basic educational subjects, connected and necessary for the designing process. The greatest alteration in the studies was the introduction of “Studio” [3], where the students meet their profession for the very first time. Under the supervision of the teaching staff, during their work in the Studio with specific problems, the students gradually implement their obtained knowledge, depending on the complexity of the problems. Namely, the concept of the educational program of the Studio is offering a possibility for collaboration between the different branches that are studied in separate subjects.

This paper, by way of the bridge example, which represents a civil structure, a symbiosis between the architecture and the civil engineering is presented. In explicit way, through the designing process of the bridge, the importance of the acquirement of basic knowledge in the branches that are not prime, but still essential for the final goal, is presented.

2 DESIGNING THE BRIDGE STRUCTURE

2.1 Bridge as an architectural form

Design of a new pedestrian bridge on the River Vardar in the centre of the city of Skopje, as a pure architectural object, is a result of an open system approach of form finding process, emerging from interaction of functional, engineering and social aspects of the urban context of this development.

The city is a system of continuous creation of meaning in space, realised through architectural structures. Such nature of the city implies its infinite upgrading, improving and changing. The interpolation of new elements in the system of the city is performed through respect and improvement of the existence and meaning of the city. The new bridge is an extension of the public space on both sides of the river which is used for pedestrian communication and as a place where novel activities and events can emerge. With its geometry, the bridge opens and closes to the surroundings, supporting the existing public space on the quay, while offering a different experience and contact with the river and the city. At the places where the bridge opens to the surrounding it becomes a platform for observing the river and the city, while on the places where it’s oriented towards the interior it’s creating a place for meetings and contacts.

Its geometry and structure is a result of formal and functional concept generated through continuous spatial manipulation of discrete formal element as an opposition to predetermined and fixed typologies. The metaphor and basic idea of this bridge is the analogy with the constant change of shape of the water and the society as a dynamic system. Its form is a frozen fragment of time in which a wave is formed and then disappears the next moment. The moment is fixed in the materialisation through which the bridge’s constantly changing geometry stands as a reflection of the continuous process of creation and disappearance of the form, fluidity of the materialisation and its reflection in the water creating unique spatial experience of the city.

The form of the bridge, or more precisely, its continuous change of shape, is obtained through a specific geometry of the basic element and its development in space. The genesis of the basic form of the element is a result of reciprocating motion by changing the position from horizontal to vertical and its change of the section (Fig. 1).

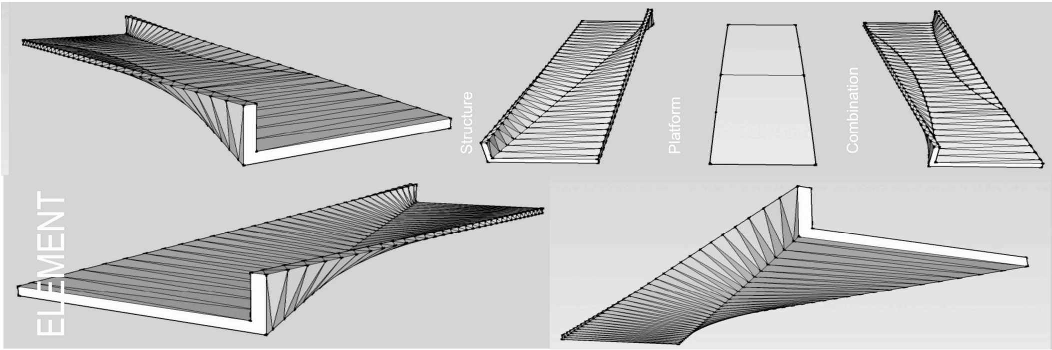

Fig. 1) Basic element of bridge geometry

This process results in a form that has a unique geometry which if observed from different angles creates a different contour. This change of shape depending on the position of observation is inherent to the process of movement. With multiplication of the basic element by two axes, x and y, we create a surface that contains wave dynamics in various stages of its formation.

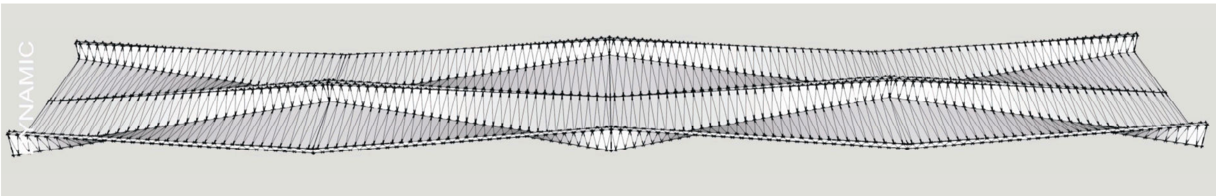

Fig. 2) Dynamic development of shape

The elements' geometry is unique, but modular, resulting in continuity and coherence of the overall shape (Fig. 2). The symmetry by two axes is obtained, which is a positive structural bearing feature of the construction. This process of dynamic generation of form creates a dynamic surface topography of the bridge which creates new connections, new vistas, and new places with different functions, and ambiences that extend and enrich the experience of the city public space.

2.2 Bridge as an civil engineering object

From statical point of view, the bridge should represent a structural system with complete validity, which totally preserves the conditions for stability and safety of the structure. The conceptual civil engineering solution originate from the clear concept and the idea itself, following the authentic development of the project, answering the fundamental requirements, related to the choice of the structural system and its materialization.

The span of l= 82,90 m, classifies this bridge structure in the group of bridges with large span, which on the other hand, narrows the opportunity for choice of the structural system and its materialization.

Based on the architectural solution, fig. 2, the structural system of this bridge structure at the very beginning was a cantilevered beam, with boxed changeful cross section along the whole length of the basic element. The structural system defined in this way and based on the proposed architectural concept, was designed to be performed of steel segments. In this manner, a stable pedestrian bridge would have been obtained, but on the other hand, it is a structure with big mass, complicated building and expensive and difficult maintenance.

Therefore, at the beginning of the bridge design, a dilemma was raised whether the bridge should be the result of the location conditions, the building process, or of the span, but without interference in the integrity of the architectural solution.

2.3 Architectural and civil engineering bridge design

Following the aesthetic and structural requirements, and aiming to an optimal solution, the dilemmas raised up during the designing of the bridge structure led to changes in the preliminary concept. Due to the collaboration of the architects and the civil engineers, the structural system of the bridge structure was redefined, and the final decision was a bridge as a continuous girder over three spans, fig. 3.

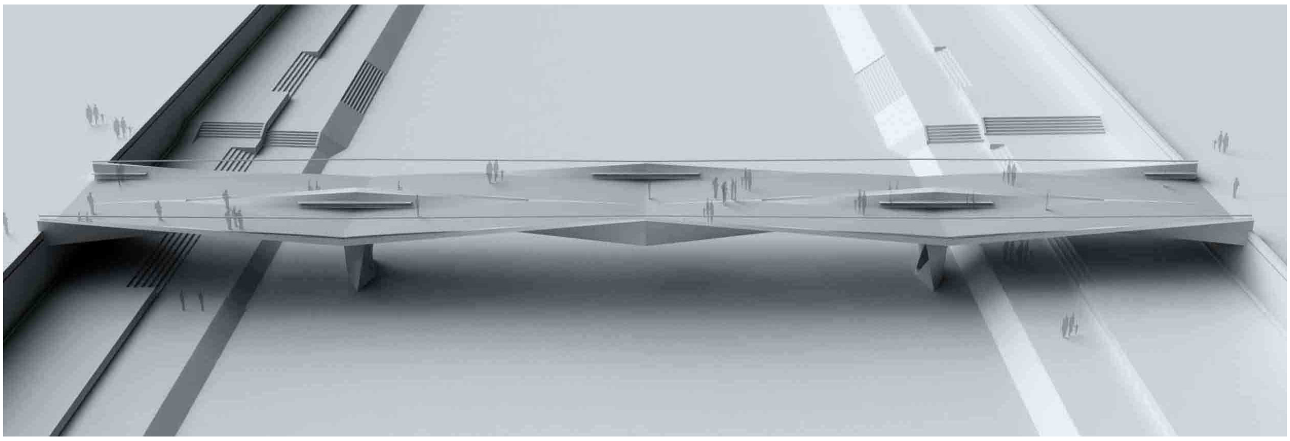

Fig. 3) View of new urban bridge in Skopje

The bridge superstructure originated from the concept of the architectural solution due to rotation of the basic element, forming a plate girder with changeful cross section. The stability of the girder from statical point of view was complemented with the monolithic reinforced concrete plate, which forms a unique boxed section with the basic bearing element. In this way, the wave shape of the superstructure, not only corresponds to the architectural and aesthetical requirements, but also satisfies the demands for stiffness.

During the phase of redefinition of the preliminary bridge design, the greatest change from architectural point of view was the introduction of two piers. The shape of the piers is a result of the same morphogenetic principles used for creation of the basic shape of the bridge. The final form is obtained by rotating the main - triangular element. It is both constructively and aesthetically appropriate and complementary to the overall form of the bridge. Rotating the basic triangular element, the massive beams along the piers convert in two independent elements, which form united beam at the supports over the foundations, fig. 4.

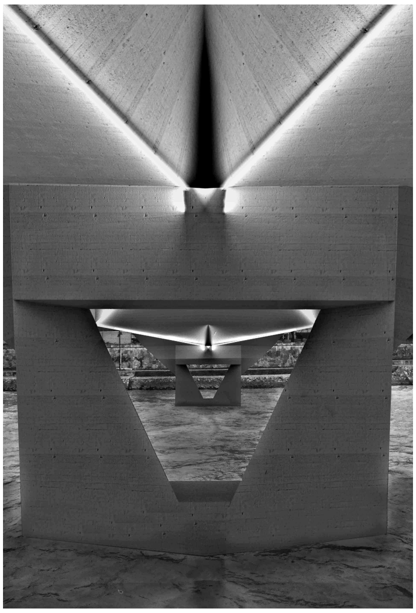

Fig. 4) View of the piers

The bridge design provides the stability of the structure and all the elements appearing are a result of its logical geometry and are proportionate to its function. The rise of the construction on the peripheral parts of the bridge is used as a barrier – fence, protecting the pedestrians crossing the bridge. This element, when rising in the middle of the bridge, becomes a logical carrier for the resting benches. The laminated glass is used for the fence to allow maximum transparency and openness of the bridge where its geometry enables it. The light is positioned in such manner that besides its basic function of lighting the walking platform actively contributes towards creation of a unique light experience of the bridge at night, with light stripes following the bridge geometry, underlining the formal analogy of waves.

The basic construction of the bridge is made out of reinforced concrete, the most suitable material for achieving the specific form and geometry of the bridge, considering the constructive system, the complexity of its realization as well the durability of the material. The walking surface is made of concrete with additives which provide the appropriate abrasiveness of the walking surface in order to ensure safe movement of pedestrians in winter conditions as well as with an additive to achieve bright, white colour of the concrete. This colour makes the walking surface distinctive from the construction of the bridge and in visual manner connects the bridge with the context on both sides of the river.

2.4 Implementation of the acquired experience

The team work among the architects and the civil engineers finalized with a design for bridge structure that satisfies not only the stability requirements, but also the aesthetical ones. The knowledge of the two different, but affined branches, contributed to a high quality final structure.

The Faculty of Architecture implemented this way of working on the architectural – civil engineering designs in the educational program. Introducing the Studio in the lecturing, the collaboration among the different professions is enabled. Through a work on separate designs, the students have an opportunity to implement the obtained knowledge from different subjects.

3 CONCLUSION

Each design is correct only if it has a clear concept. From the abovementioned, one can conclude that all separate disciplines should be involved during the design process of the structures and they should not be independent from each other, but a conversation should exist. Only in that manner one can obtain a product with exceptional final characteristics.

Exactly this way of contemplation, implemented in the educational process at the Faculty of Architecture in Skopje, contributes to the creation of architects who know how to implement their basic knowledge, obtained due to their education, in their work and communication with the colleagues of the affined branches.

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FIRST FIVE YEARS OF CONDUCTING THE POLYTECHNIC GRADUATE PROFESSIONAL STUDY PROGRAMME ON THE POLYTECHNIC OF ZAGREB

Boris Uremović[1], Davorin Tepeš[2], Gordana Ratkajec[3]

Abstract

The Civil Engineering Department of the Polytechnics of Zagreb has had over forty years of experience in the organization and development of professional study programmes. Since its foundation to the year 2004/05, the Polytechnic has been carrying out 3-year professional study programmes. In the year 2005/06, the Polytechnics of Zagreb organised two study programmes, a 3-year Professional Study Programme and a 2-year Polytechnic Graduate Professional Study Programme.

Till this time four generations of students entered the Polytechnic Graduate Professional Study Programme.

With this paper we will try to review some of the basic success indicators of that study programme, and also to point out the possibilities of future development and integration with the Lifelong Learning Programme.

Key words

Study programme, success indicators, Lifelong Learning Programme, Erasmus Programme

1 INTRODUCTION

The Civil Engineering Department of the Polytechnic of Zagreb has had over forty years of experience in the organization of professional study programmes. Its tradition runs in continuance since 1961 and the High Technical School of Construction and Civil Engineering. This school was merged in 1967 with the just formed Zagreb-based College of Civil Engineering. When the Civil Engineering Institute was established merging four Croatian Faculties of Civil Engineering with the Croatian Institute for Civil Engineering in 1977, the school also merged with the Faculty of Civil Engineering, University of Zagreb.

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After the Faculty of Civil Engineering resumed its independence from the Civil Engineering Institute in 1991, the professional study programme was continued within this faculty.

By the decision of the Government of the Republic of Croatia, the Polytechnic of Zagreb was founded in 1998. It was the opportunity to take over and independently develop the professional technical study programmes, and since then it has been the coordinator of the same and developed study programmes.

Since its foundation till the academic year 2004/05, when it was entered in the official Register of Scientific Institutions, the Polytechnic of Zagreb has been carrying out 3-year professional study programmes of Electrical Engineering, Informatics, Transport, Aeronautics and Mechanical Engineering. Members of the Civil Engineering Department joined the Polytechnic of Zagreb in 2003.

Since the Republic of Croatia has decided to adopt two-cycle study programmes, the Polytechnic of Zagreb organised two study programmes – a first cycle, 3-year Professional Study Programme, and a second cycle, 2-year Polytechnic Graduate Professional Study Programme.

2 POLYTECHNIC GRADUATE PROFESSIONAL STUDY PROGRAMME IN CIVIL ENGINEERING

The decision to establish a second cycle Professional Study Programme was made for several reasons; first, there was the intention to give our first cycle Professional Study Programme graduates an opportunity to continue their studies and to enhance their formal education; second, through contacts and constant communications with Croatian civil engineering companies, a need for civil engineering professionals with specific knowledge was articulated and it was obvious that forming a second cycle Professional Study Programme is necessary to at least partially fulfil those needs. The Polytechnic of Zagreb then established a study programme that was named Polytechnic Graduate Professional Study Programme, and among others offered a Specialization in Civil Engineering. The study programme lasts 4 semesters, awards 120 ECTS credits, and after the completion of their studies, the students acquire the title of Master of Engineering in Civil Engineering

On the first cycle Professional Study Programme, the Polytechnic of Zagreb decided to give their students an extra orientation through four different groups of courses, the two traditional groups; Building Construction; and Water and Transport Infrastructure in Civil Engineering; and two new groups; Civil and Environmental Engineering; and Management in Civil Engineering (see Table 1). These four groups of course were also given on the Polytechnic Graduate Professional Study Programme and they correspond to the courses taught on the first cycle Professional Study Programme. The rapid development of brand new technologies and the evolving economy additionally encouraged the Polytechnic of Zagreb to offer the new groups of courses. In that way it contributed to high education development in Croatia, thus creating new disciplines and covering new areas of interest. The additional confirmation, which confirms the quality of choice to offer the abovementioned groups of courses, comes in the fact that many European high education institutions now offer the same or similar programmes and groups of courses. A new confirmation came in December 2008, when the Republic of Croatia issued the Act on Architectural and Engineering Activities in Physical Planning and Building, thus forming a legal category of Building Construction Managers and recognizing the need for Management in Civil Engineering.

Tab. 1) List of courses on the Polytechnic Graduate Professional Study Programme in Civil Engineering

Course	Semester	Number of ECTS Credits	Hours of Lectures	Hours of Excercises	Hours of Individual Work
COMMON COURSES					
MATHEMATICS	I	6	30	30	120
PROBABILITY AND STATISTICS	I	3	15	15	60
PROJECT MANAGEMENT	I	5	30	15	105
QUALITY MANAGEMENT	I	5	30	15	105
ECONOMICS AND MANAGEMENT	II	5	30	15	105
ASSET MANAGEMENT	I	5	30	15	105
COMMUNICATION SKILLS	I	5	30	30	90
BUSINESS ETHIC AND LAW	II	5	30	15	105
ENGLISH/GERMAN AND CULTURE	I - II	5	30	30	90
INTRODUCTION TO ENVIRONMENTAL ENGINEERING	I	3	15	15	60
ENVIRONMENTAL MANAGEMENT	III	3	15	15	60
CONSTRUCTION PROJECT MANAGEMENT	II	6	30	30	120
ENGINEERING STRUCTURES	II	6	30	30	120
PRESERVATION OF CULTURAL-HISTORIC HERITAGE	III		15	15	60
GROUP OF COURSES - MANAGEMENT IN CIVIL ENGINEERING					
MODERN CONSTRUCTION TECHNOLOGIES	II	7	30	30	150
PROJECT PLANNING AND MONITORING	III	6	30	30	120
CONSTRUCTION REGULATIONS	III	5	30	15	105
INVESTMENT POLICIES	III	6	30	30	120
LEGAL ASPECTS OF CONSTRUCTION PROJECTS	III	5	30	15	105
BUSINESS MANAGEMENT IN CONSTRUCTION INDUSTRY	III	5	30	15	105
MANAGEMENT AND MAINTENANCE OF INFRASTRUCTURE FACILITIES AND BUILDINGS	III	6	30	30	120
GRADUATION THESIS	IV	30	15	285	600
GROUP OF COURSES - WATER AND TRANSPORT INFRASTUCTURE					
BRIDGES	II	5	30	15	105
TRAIN STATIONS	II	5	15	30	105
MODERN METHODS IN GEOTECHNICAL ENGINEERING	III	6	30	30	120
PAVEMENT STRUCTURES	III	3	15	15	60
URBAN TRANSPORT FACILITIES	III	6	30	30	120
CONSTRUCTED WETLANDS	III	5	15	30	105
SOLID WASTE DISPOSALS	III	6	30	30	120
GEOTECHNOLOGY	III	3	15	15	60
TUNNELS	III	5	30	15	105
GRADUATION THESIS	IV	30	15	285	600
GROUP OF COURSES - CIVIL AND ENVIRONMENTAL ENGINEERING					
WASTEWATER TREATMENT	II	6	30	30	120
WATER RESOURCES SYSTEMS	II	6	30	30	120
MODERN METHODS IN GEOTECHNICAL ENGINEERING	III	6	30	30	120
SOLID WASTE DISPOSALS	III	6	30	30	120
VARIETY AND PROTECTION OF LIVING WORLD	III	3	30		60
WATER TREATMENT	III	6	30	30	120
CONSTRUCTED WETLANDS	III	5	15	30	105
GRADUATION THESIS	IV	30	15	285	600
GROUP OF COURSES - BUILDING CONSTRUCTION					
PUBLIC AND INDUSTRIAL BUILDINGS	II	10	60	60	180
MODERN METHODS IN GEOTECHNICAL ENGINEERING	III	6	30	30	120
ENGINEERING BUILDINGS	III	6	30	30	120
STRUCTURAL MODELLING AND DESIGN	III	6	30	30	120
EARTHQUAKE ENGINEERING	III	6	30	30	120
FIRE PROTECTION	III	3	15	15	60
GRADUATION THESIS	IV	30	15	285	600

The main goal of the Polytechnic Graduate Professional Study Programme in Civil Engineering is to educate highly qualified civil engineering professionals that can independently offer their knowledge and expertise to Croatian civil engineering companies, and whose education profile is suited to their specific needs. The courses of this study programme have a balanced ratio of modern theoretical background and practical knowledge, so that the students can immediately get involved in all of the demanding work processes in the civil engineering area. Upon completion of their studies, students are prepared for independent realization of projects, as they have acquired highly specialized skills and knowledge needed by the present day civil engineering branch.

The primary intention of the Polytechnic of Zagreb was to organize the Polytechnic Graduate Professional Study Programme for the Bachelors of Engineering and/or Bachelors of Science who have some previous working experience. After the graduation, our students are trained and qualified for all sorts of independent work in construction practice, design offices, a variety of administrative and municipal services, and in all other branches of the civil engineering industry and areas in relation to their chosen field of expertise.

3 BASIC SUCCESS INDICATORS ON THE POLYTECHNIC GRADUATE PROFESSIONAL STUDY PROGRAMME IN CIVIL ENGINEERING

Between the years 2006 and 2009 a total number of 588 students were admitted to the Polytechnic Graduate Professional Study Programme in Civil Engineering. Figure 1 shows the number of students that were admitted to the study programme in each academic year.

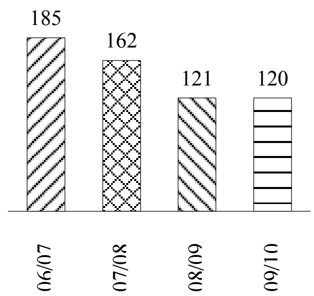

Fig. 1) The number of students that were admitted to the Polytechnic Graduate Professional Study Programme in Civil Engineering in each academic year

The Polytechnic Graduate Professional Study Programme is primarily organized for the Bachelors of Engineering and for the Bachelors of Science who have some previous working experience and many of those students are full-time employed while studying, and because of that, the classes are organized in a slowed-down manner (Thursday, Friday and Saturday only). In that way each semester actually lasts one year, and that is the reason why the number of students that were admitted to the study programme decreased in each academic year from the year 06/07 to the year 09/10. It primarily happened due to the technical issues regarding the education conduction, so that its high level of conduction could be retained. It is also expected that the number of students admitted will not increase in the near future.

In the first academic year, approximately 250 students applied for the study programme, and 185 students were admitted. In every following year, there was a slight increase in the number of students who applied for the study programme. That increase can have several explanations; first, the study programme has been recognized by students and companies as a well balanced programme which gives the students high-quality education and knowledge; second, the study programme has been recognized by the Republic of Croatia and Croatian Chamber of Architects and Civil Engineers through numerous laws and acts, which are giving the students who graduated it legal rights and obligations same or similar to those of the students that graduated the Undergraduate and Graduate University studies; third, the students and companies recognized the need for constant education, specialization and training, and the benefits that it gives on the current labour market.

For the abovementioned reasons (students are employed full-time, there is a slowed-down manner of classes conduction, and the high level of education conduction is maintained), in the period from the year 06/07 to present, only a total of 79 students graduated the study programme, and they graduated with an average grade of 3.658.

4 DEVELOPMENT OF THE POLYTECHNIC GRADUATE PROFESSIONAL STUDY PROGRAMME IN CIVIL ENGINEERING FROM 2006 TO PRESENT

During the period from 2006 to the present day, there was a constant development of the abovementioned study programme. That development was manifested through:

- changes in several courses
- changes in the structure of the study programme
- changes in the way the classes are being conducted

Through the whole period from 2006 to the present day, most of the courses on the study programme passed through certain modifications that were primarily content based. Content modification happened because the civil engineering industry is constantly evolving and changing, and by changing the course contents the students were getting the most up to date education on new and modern technologies and regulations. The changes also happened due to constant knowledge exchange between the Polytechnic of Zagreb and other similar institutions throughout Croatia and Europe. The knowledge exchange was also intensified through the student and teacher participation in the Erasmus programme.

Beside the abovementioned course changes, some courses changed their status from optional to compulsory and vice versa, and some courses were divided into several separate courses, thus changing the structure of the study programme. The status change for some courses happened because through the first years of conduction it became obvious that some knowledge obtained through those courses was necessary for good comprehension of the course matter being taught on other courses. Also during the first few years of conduction the matter taught on one of the compulsory courses became too comprehensive so the course was divided into three separate optional courses.

Because of the fact that most students are employed full-time, certain changes happened in the way the classes are being conducted. The initial plan was to conduct the classes during the whole week (Monday through Saturday) in the afternoon hours so that the students could work during the day and attend classes after work. After initial surveys conducted among the students, the decision was made to conduct the classes' only one part of the week (Thursday to Saturday). In that way the duration of the study was prolonged, but the quality of the conduction would be better, and that the students could better participate in the classes.

Also the last, but not least important changes happened in the technical aspect of the way the classes were being conducted. The Polytechnic of Zagreb is constantly investing in the most modern equipment such as computers, software, lab equipment, etc. needed for quality teaching of new technologies and procedures, which are constantly emerging in the rapid evolving civil engineering profession. To maintain the high level of expertise of her own teachers, the Polytechnic of Zagreb is constantly supporting their education and cooperation with similar institutions and importantly business companies in the civil engineering branch. During their studies, the students are often taken on professional excursions to gather new information first-hand from building sites, manufacturing plants, laboratories, etc.

5 THE POSSIBILITIES OF FUTURE DEVELOPMENT OF THE POLYTECHNIC GRADUATE PROFESSIONAL STUDY PROGRAMME IN CIVIL ENGINEERING

It is visible from past experience, and basic success indicators, in what direction should the Polytechnic Graduate Professional Study Programme in Civil Engineering be developed. The study programme must constantly adapt to the modern technologies and regulations, and it is definitely necessary to continue and enhance the current rate of investing into the education of teachers and into the modernization of all equipment necessary for quality teaching. Better transfer of knowledge and experiences between the Polytechnic of Zagreb and other similar institutions in Croatia and Europe can be achieved through further participation of students and teachers in the Erasmus Programme. Participation in the Erasmus Programme can bring knowledge and new innovative methods needed for the development of the teaching process.

The study programme must be more intensively integrated with the Lifelong Learning Programme, for example the Croatian Chamber of Architects and Civil Engineers has issued a five-year Professional Training Programme for Architects and Civil Engineers. That programme is based on the need for constant education and training of licensed engineers, which is set by the Physical Planning and Building Act. In that programme a licensed engineer must obtain 100 points through education and training during the five year period from 2006 to 2011. Students of the Polytechnic Graduate Professional Study Programme in Civil Engineering who are also licensed engineers can obtain points with the graduation of the study programme.

6 CONCLUSION

Since its start the Polytechnic Graduate Professional Study Programme in Civil Engineering has passed through some changes in course content, changes in the structure of the study programme and changes in the way the classes are being conducted. These changes happened because of the changes in new civil engineering technologies and regulations, they proved well focused, and in the end they proved necessary for the obtaining of high level class conduction.

To obtain the high level of quality, there must be a constant rate of investment in education and equipment needed. Also the teachers and students must constantly cooperate with their colleagues from other institutions from around Croatia and Europe and must exchange their knowledge and experience, either through the Erasmus Programme or through attendance on local and international conferences. The cooperation between the Polytechnic of Zagreb and civil engineering companies must also be intensified, so that the students that graduate the programme can better fulfil the companies' specific needs for knowledge and expertise.

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