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CONTENT

AUTOMATIZATION OF A CBR MACHINE

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1. Abstract

The need to introduce the new geotechnical test and its verification, in order to obtain the characteristics of the deformation that the calculations of the models based on FEM (MKP) models require, led to the automatization of the CBR machine.The objective of this project is to develop and improve a data acquisition system, so that we will be able to control the CBR machine and organize the values obtained not manually but directly from our own computer. The calculations that must be done demand a high precision. For this reason, the information that will be obtained with this new system will be more precise, and the evolution of this data will be also obtainable.

2. Introduction

Nowadays a lot of geotechnical tests are done in order to optimize the design of different constructions. These tests can be also used to raise the quality of the constructions in the sector of forestry. The most important test to describe the characteristics of the natural materials is the CBR test, which is applied for the constructive layers of the roads. The comparative characteristic obtained from the CBR standard test is not enough for the design of the pavement any more and it is necessary to use the characteristics that are taken from the cyclic tests, which describe better the nature of load that these roads suffer and represent better the character of grain materials. The cyclic CBR belongs to this type of tests.

3. Description of the problem

In order to simulate the behaviour of ground layers and design the roads, mechanical properties of components must be well known. The program that is used for this simulation is based on FEM (MKP), so it is necessary to know the strain properties of the materials. There are two different types of test that we realize in the laboratory. With one type of test we can sort the diverse granular materials that the roads ant the soil consist of, and with the other one we can calculate the mechanical properties of these materials (the module of elasticity, mechanical resistance, optimum moisture and maximum density). Tests connected with the classification of the soil: Atterberg limits, granulometric curve and aerometric test.

Tests to calculate the mechanical properties of the soil: Proctor test, CBR test

Proctor test: This test is used to calculate the optimum moisture of the material, in order to know which the best moisture to get the maximum compaction in the preparation of the road's construction. It consists of compacting the soil into a standard mould using a standardized compactive energy at different levels of moisture content. There are two types of Proctor tests: standard and modified. Depending on the type of test, some of the tools change, because the compactive energy is different. The type of test depends on the type of construction.

CBR test: The CBR is penetration test to analyze the resistance of the soil, comparing it with a material that is consisted to be 100% resistant. According to the current regulation the design of the roads is based on the CBR test, but the standard test is not enough to describe the behavior of the granular materials' deformation. Nowadays, the methods to design the pavements are modified, and these methods require the characteristics of the deformation. That is the reason why the results are verified with another test which is called cyclic CBR.

4. CBR standard: conclusions

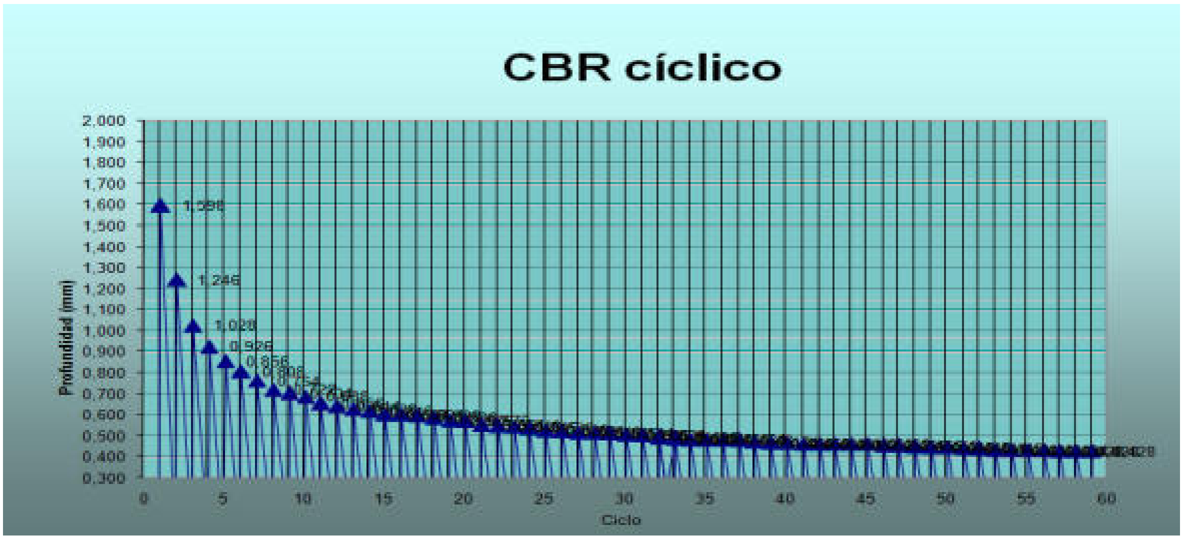
As the standard norm says, we take the values of strength in the depths of 2.5 and 5 mm, and using this formula, we calculate the CBR (%) values.

$$CBR\ (\%) = \frac{p}{p_s} \cdot 100$$

Where P is the measured strength in the test, and Ps is the strength of the comparative material. With these two values, the resistance of the material is calculated in an approximate enough way. The methods that are based on CBR standard are empiric, they are not able to describe the stress condition in the construction. The other conclusion is a graph where we can see the evolution of the strength of the plunger of the CBR machine with regard to the depth inside the tested material.

5. Cyclic CBR: conclusions

Nowadays, the methods for the design of the pavement require the real characteristics that describe the plastic and elastic deformation of the granular materials. According to the recent researches the most suitable test is the cyclic CBR, which can describe this behaviour, as it can be seen in the next graphic. Simultaneously this test is able to describe better the character of load, because the pavements suffer cyclic loads caused by the pressure of the different vehicles.



The deformation in the first cycles is both, plastic and elastic, but from the cycle number fifty more or less this deformation turns into only elastic. It can also be seen the increase of the permanent deformation in the first cycles. The objective is to calculate the module of elasticity of the material, but with the information that is obtained from the test is impossible to use this generic formula:

$$E\ (MPa) = \frac{\sigma}{\varepsilon}$$

Professor A. A. A. Molenaar, from Delft Technological University, proposes another equation to calculate the module of elasticity directly from the values we have from CBR.

$$E\ (MPa) = C_1 \cdot (1 - \mu^{C_2}) \cdot \sigma_0 \cdot \frac{a}{w^{C_3}}$$

Where: E= Elasticity module of the material.

W= calculated elastic deformation

a= load's circular radius (plunger)

σ_o= stress under the load

µ=evaluated material´s Poisson´s module

C_1= 1.797 in case there is friction between the material and the mould and 1.375 if there is no friction

C_2= 0.889 if there is friction and 1.286 without friction

C_3=1.098 if there is friction and 1.086 without friction

6. Automatization of the test

All the measurements until now have been done by hand. In order to simplify the work, the next step of the project is to measure the deformation and the strength with some transducers. If the objective is to work directly between the CBR machine and the computer, and not manually as done untill now an electronic component that is called transducer is needed. The transducers are electronic sensors that measure the deformation with a high precision, and as they are digital, they can display the value and also memorize it in the computer. Different types of transducers relating to measuring of mechanical deformation were studied, and among them the MarCator 1088 Digital Indicator was chosen for its suitability for this work. Transducers can read these values, but we need some programs to adapt these values to our necessities. In this case, these programs are SW Indusoft Web Studio and EasyBuilder 8000. These two programs are able to read the values of the transducers of the CBR machine and memorize them in the computer, in order to organize them, make the necessary calculations and extract conclusions. Another advantage of these programs is that they can draw the graphs directly, without using any other program such as Excel. So, the manual work will be less than before, and the time spent in that work will be shorter. Another application of these programs is that they give the option of controlling the machine. In case of Indusoft it is done directly from the computer, and in case of EasyBuilder 8000, from a touch screen. To control the machine, there have been made some screens similar to the controls of the machine using these programs. With this and using a properly programmed PLC, the machine can be controlled easily.

7. Conclusions

The work that has to be done manually will be very little, because it will be possible to control the machine from the computer or the touch screen. The only manual work will be to prepare the material for the test and put it in the machine. The information obtained electronically will be more precise than the one obtained manually, because it is easy to make an error when the data is being noted down by hand. As the data will be memorized directly in the computer, a lot of time will be saved.

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FLOW RATE EVALUATION OF SMALL FOREST STREAMS

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Introduction

Flow rate evaluation and measurement is touching many aspects of recent human life: from gauging the blood flow rate to measuring the velocity of a river flow or the power of the sea waves. When obtaining hydrological information in contemporary technological and engineering practice, people are bound to use the information provided by Czech hydrometeorological institute (CHMI). These information come from climatic and hydrologic yearbooks of *Atlas podnebí a hydrologických poměrů republiky* (Encyclopedia of climate and hydrology of the Czech Republic). The only source of long-term information, regarding the climate and hydrology of the land, was published in the Encyclopedia for years 1901 – 1950 (climate) and 1931 – 1960 (hydrology). Up to date information can be found directly at CHMI. (Herynek, 1996)

When it comes to small forest streams, the data is insufficient due to the lack of accuracy and concreteness. The inability to accurately and effectively measure the flow rate of small forest streams, leads to the inability to control the torrents in the right dimensions. In today's forest we can find giant dikes, meters tall. Such constructions are not only uneconomical but also senseless, as they often fail in functionality, for example because they leak underneath.

Locality

The measurements took place on two small forest streams within the area of Training Forest Enterprise Masaryk Forest Křtiny (TFE). The first stream, locality A, can be found near a forest road Rosenauerova, between the villages Kanice and Babice. This locality is in a dense forest with continuous canopy. The second stream, locality B, is situated to the north of the village Habrůvka and runs through a meadow with trees present only on the banks of the stream.

1. Area characteristics

Both localities lie in the natural forest area (NFA) 30 – Drahanská Vrchovina. The NFA 30 is situated in the catchment of river Morava. The western parts are drained by local creeks that flow into river Svratka, which no longer flows within the NFA 30. There is another river that carves its way into the NFA by the name Svitava. There is a karst area located on the left side of the river which is typical for its allochthonous streams that sink when they reach the karst and flow underground (Rudické propadání, Rasovna, pod Hřebenáčem, u Sloupu and more). The central and eastern parts of the NFA 30 are characterized by smaller creeks that run down from the plateau and flow into small rivers, for example Jevíčka and Třebůvka in the north and Blata, Šumice, Romže in the east. (Nikl J. a kol., 2000).

2. Lokality A – forest road Rosenauerova

Table - The catchment area characteristics (from SW ArcGIS)

Catchment area (m^2)	652265
Flow length (m)	1173
Altitude (m above sea level)	332
Contour characteristics	0,32 – fan-like
Catchment width (m)	453,59
Catchment slope	0,084
Flow slope	0,032
Flow density (%)	0,18

According to the forest management plan (FMP) and forester maps, the river catchment is divided into 4 forest sections: 329, 332, 333, 334. The table 2 shows the dominant tree species present on the locality. The forest density is about 90%.

Table – Main tree species distribution

329	Beech 30, Hornbeam20 , Pine 30, Spruce 10, Lime 10
333	Spruce 30, Oak 20, Pine 15, Fir 10, Larch 10, Douglas fir10, Beech 5
332	Oak 30, Hornbeam 30, Beech 25
334	Spruce 20, Oak 20, Beech 20, Pine 15, Hornbeam 10, Fir 5, Larch 5

3. *Lokality B – Habrůvka*

Table – The catchment area characteristics (from SW ArcGIS)

Catchment area (m^2)	503357
Flow length (m)	685
Altitude (m above sea level)	510
Contour characteristics	0,56 - fan-like
Catchment width (m)	529,85
Catchment slope	0,028
Flow slope	0,016
Flow density (%)	0,14

There are only two forest sections present in this area: 156, 164. Table 4 shows the tree species distribution in the relevant areas. The forest density is very low (cca. 10%).

Table – Main tree species distribution

156	Beech 55, Larch 15
164	Beech 45, Maple 20, Ash 18

Methods

Two types of water level sensors where used to measure the flow rate of the small forest streams: an ultrasound sensor and a pressure sensor. Both of these sensors where connected to a data logger M 4016.

Ultrasound sensors measure time that is needed for the ultrasound waves to pass through the liquid. Or, using the Doppler effect, they evaluate changes in the frequency of ultrasound waves in a predicted acoustic field, in which the liquid passes and thus, measuring the speed of its flow.

Pressure sensors measure the amount of pressure produced by the liquid above it. Both liquids and gases produce a certain amount of pressure that corresponds to the depth where the sensor is located.

Control unit M4016-L

Control unit M4016-L consist of a data logger and a programmable controller. There are also multiple flow-meters, when ultrasound and submersible pressure water level scanners are connected. It also contents pre-set discharge rating curves for common used spillway panels for flow rate measurement in open channels.

Ultrasound sensor – US1200 (3000)

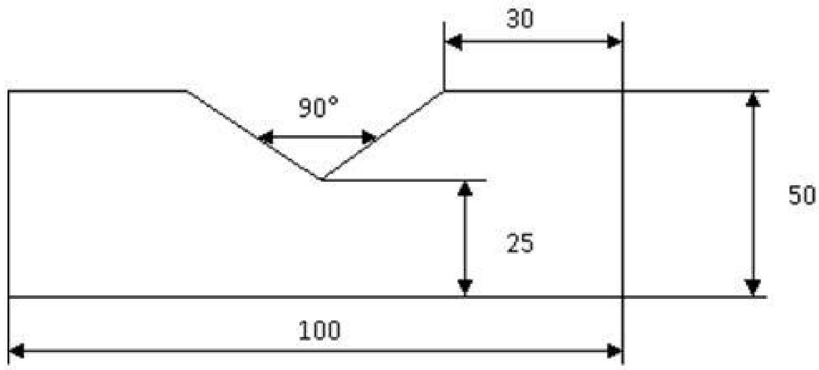
This ultrasound sensor was used for measurements on both localities A and B and is based on the principle of measurement of a time delay between emitted and received ultrasound impulse. Its specific range is 0.15 – 1.2 m (distance between the sensor and the water level). A measurement (specific) error is not higher than 1% in the long term.

Submersible pressure water level scanner (pressure sensor) LMP 307

This sensor is used for permanent water level elevation measurement. Specific measurement range is 0.6 – 2 m. A specific measurement error is not higher than 1%.

Thompson mobile spillway panel

Thompson mobile spillway panels are made from 3 mm wide stainless metal plates. The picture 1 shows a scheme of the panel that was used for measurements on both localities. A panel of this size can be used on streams that are up to 80 cm wide. If the stream is bigger, it is imperative to use a bigger panel as well.



1. Fieldwork method

The flow rate measurements started in the beginning of July 2009 and continued until the end of October, the same year. The measurements started on locality A and were carried out in weekly periods for duration of approximately 5 hours. The intervals were chosen to cover whole day time-range. Locality B was chosen later and the fieldworks started there in the beginning of September. Since that time, flow rates were measured on both localities rotating each week.

Preparation of the site

The methods used are very gentle to the measuring site. There is no need for special preparations apart from treading down the grass for better access to the spillway panel. Sometimes a little work with the pick is needed to obtain material for sealing the panel. It is most important to keep the conditions of the stream as natural as possible and not to disturb its character. Every water stream situated above the spillway must run through it. This way, the measurement is most accurate.

Securing the mobile spillway panel

The mobile spillway panel is best situated in a straight part of the stream that is of an appropriate size. The spillway is to be placed in the very center of the stream perpendicularly to the water level. When securing the panel on a new measuring locality for the first time, it is recommended to use the pick to create small fissures in the banks, so that the panel can be placed deeper into the stream-bed. This way the probability of leaking underneath the spillway panel is lowered. The spillway is then hammered lower into the stream-bed and its right position is controlled by using spirit-level. After a successful installation of the mobile spillway panel, it is important to properly seal it using local material (mud, clay).

Installation of the pressure sensor

The sensor has to be placed into the pool created by the panel right below the spillway. This way the measurement is most precise. The cable leading from the sensor has to be connected to the control unit for calibration and the data records.

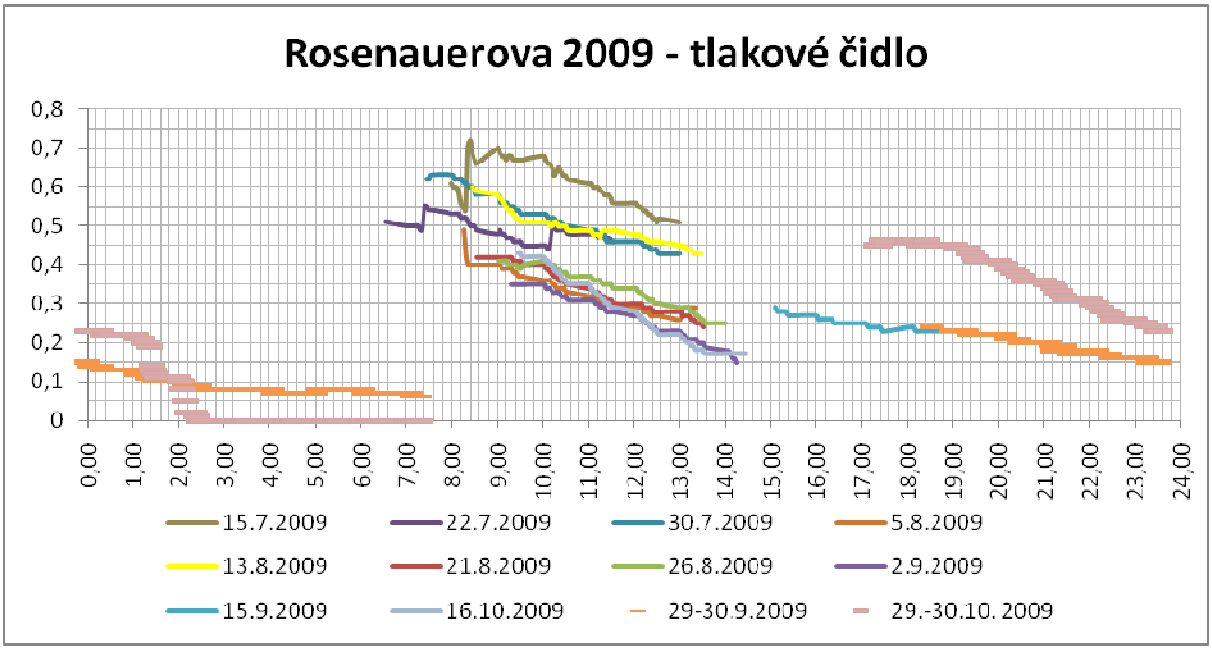
Installation of the ultrasound sensor

The ultrasound sensor has to be placed in a distance from the water level that corresponds to its specific range. It is essential to prevent the sensor from further move in any direction, since the calibration has been made. The sensor should also be placed perpendicularly to the water level.

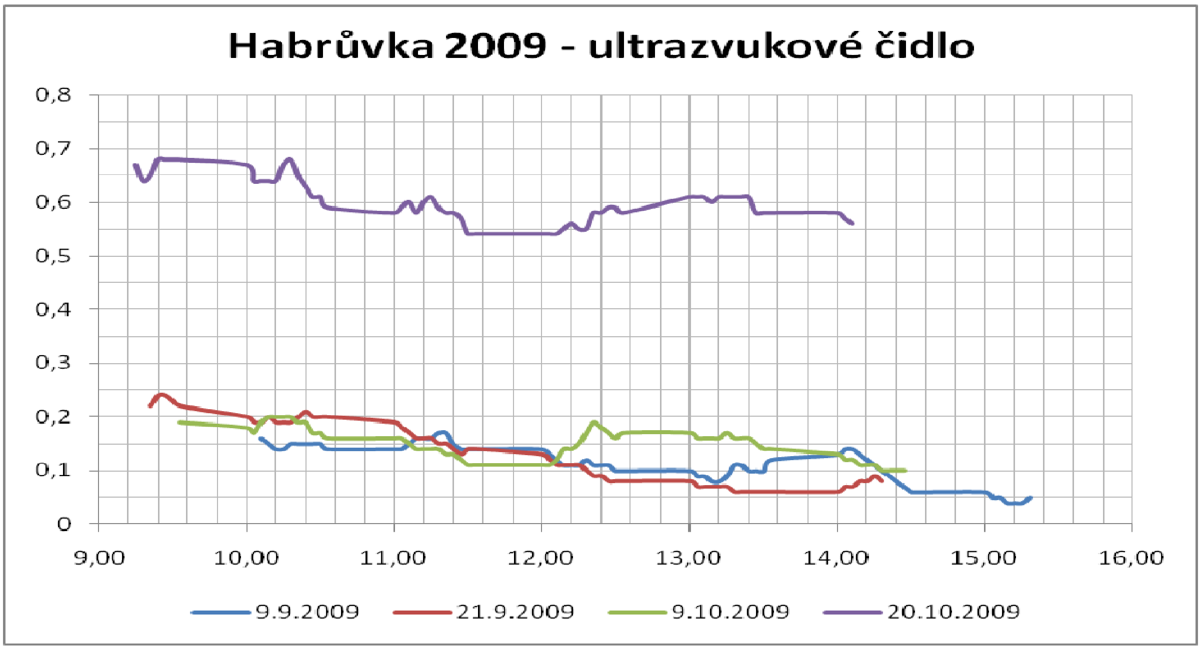
The sensor calibration

The calibration is carried out in SW MOST. The control unit is connected to a notebook via USB connector. Calibration of the sensors is made by adjusting the heights of the flow above the spillway. The information of the height of the flow above the Thompson spillway panel is used to calculate the flow rate. The calibration is to be executed every time due to the changing conditions – each time the sensor is in another height, the position of the spillway panel is always different, the atmospheric pressures varies.

Results



The final results will be published in a diploma work that is to be handed in on April 2010. As demonstration of the results, two graphs are presented below, created in SW MS EXCELL 2007.



Even though the presented results can be considered provisional, they already give an idea of some partial conclusions:

- The flow rates lower from 9 a.m. till 3 p.m.
- The trend of a decreased flow rate seems to be present on both localities
- The gradient of this decrease is lower on locality B

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BANKSIDE TREES AND SHRUBS – BASIC INFORMATIONS

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Introduction - Basic functions of bankside trees and shrubs

Bankside trees and shrubs are one of the building blocks of territorial systems of ecological stability (TSES). It is part of an ecologically balanced landscape, a form of spread green vegetation growing outside integrated forest complexes. It is created by tree species and herbs growing along streams. In relation to stream regulation, linear building along water streams etc., a lack of riparian and accompanying stands started to manifest negatively. We can say that only once it decreases, will we start to realise its indispensability in our landscape. The following paragraphs deal with the basic functions of bankside trees and shrubs. [1] [2]

Generally Valid Recommendations for a Suitable Design of Accompanying Vegetation:

1. To achieve a quality riparian or accompanying stand, it is advisable to leave part of indigenous stands, even if they are less suitable, possibly groups of fully-grown tree species, and to carry out the new planting in relation to them and under their protection.

2. Species for new planting shall be selected with a view to their future prevailing function, in particular taking into consideration whether they function as an accompanying stand (planting behind the riverbed bank line, on berm slopes as a maximum) or as a riparian stand (planting within the stabilisation of the riverbed and creating a direct relationship between the stand and the stream within the flow profile, on riverbed slopes). Or, especially in the case of smaller streams, a combination of both.

3. Monostichous, basically alley planting is not the most suitable solution either from the environmental or from the landscaping point of view and the value of such stands being part of the accompanying vegetation is low. In this case, we plant tree species on such side of the stream where they can partially shade the riverbed and we try to use, wherever possible, unexploited areas adjacent to the stream for additional planting which will increase the value of the accompanying vegetation. [3] [4]

4. Within the design of vegetation species structure, we should not forget shrubs, which have their indisputable place, and vital grassland, which is basic protection against the occurrence and development of erosion on the bank slope.

5. We propose in particular autochthonous species; other species only in special and justified cases. The planting of species unsuitable from the phytocoenological or landscaping point of view (exotic species, species more of collection importance...) may have a disturbing effect on the surrounding landscape. [1]

6. When designing in particular riparian stands, it is necessary to realise the low reinforcing effect of young stands (this mostly does not concern sprouts).

7. Over-aged plants, windthrows, dry plants, or plants intended to be disposed of for any other reason must be removed prior to starting the planting of newly designed species so as not to damage new young plants.

8. When newly establishing riparian stands of a regulated riverbed, first plant above the level of approx. Q_{150} - (eulitoral zone, soft tree species zone). [5]

9. To plant new tree species, use only healthy, vital plants of prescribed parameters (species, plant age, minimum height of saplings…) and time-tested planting processes. To ensure better growth, provide the plants with wooden poles and protection against browsing)

10. The pre-condition for good functioning of riparian and accompanying stands are regular examinations, tending cuts and the thinning of stands. In particular, care for stands in the first years after planting is very important.

11. When establishing or renewing streamside vegetation, always respect ownership relations and the minimum distance from parcel limits. In urban areas, follow green community vegetation in an appropriate manner.

12. The objective of planting is to create vertically distributed and diversified stands occupying the maximum space in the floodplain.

Riparian stand

Concerning the fulfilment of requirements of the hydrological and water function of an intervention, the design and follow-up implementation of riparian stands must respect certain principles [2] [3] [6]:

■ Plants growing inside the flow profile must be treated as stem stands (not coppice), with the crown above the bank line level.

■ To reinforce the lowest lying parts of the riverbed slope, it is optimal to place trees at a height 0.6 to 1.1 m above the level of average water flows in the growing season.

■ In order to ensure that protective riparian stands successfully fulfil their function, it is suitable to carry out continuous planting, or to plant larger groups. On a concave bank, the distance between individual plants is recommended at 1.3 to 1.7 m in extremely curved bends, 2 m in bends with small curvature. Wherever the bank is direct, the suitable distance is 2 m. In bend convexes 2 m and more, according to local conditions. If poplars are planted, the distance should be 4 m in all parts of the riverbed, also planting other species in between**.** Therefore, especially the protection of concave banks is essential. From the landscape enhancement and aesthetic point of view, it is important to keep vistas onto open water surface. (Discrepancy with respect to the continuous planting requirement)

■ If only shrub stands are designed, it is suitable to plant them in groups, alternately on both sides of the stream (not a continuous belt on both the sides). Continuous and regular maintenance and tending of stands is necessary.

■ The riverbed proposed for such adjustment should have a lined ditch bottom 4 m in width at least, a suitable width of berms being more than 10 m. Riparian stands of narrower streams and brooks shall be treated with a view to possibly higher overgrowth of the flow profile and a higher probability of interception of possible sediments on such stands. Thus, intercepted sediments may cause local closure of the flow profile and local overflow.

■ The inclination of slopes should be selected at 1 : 2, or 1 : 1.5, which best suits the shape of root systems, which mostly develop at an inclination of 1 : 1 to 1 : 1.5.

■ Riparian stands are the most suitable complements of stone or another footing ensuring the protection of the foot of slope.

■ It should be pointed out that willow (especially so-called weeping willow) is not the most suitable species to be used in the flow profile as its flowing crown unfavourably regulates the water course, which results in damage to riverbed banks.

■ Issues related to the design of vegetative bank protection must be solved in the development of stream regulation conception, and not as a complement to the technical solution.

Final Recommendations

It is extremely important to mention that all works in the recovery of bankside trees and shrubs could misfire if we fail to ensure at least basic after-planting care. First of all, it is watering and protection against forest weed, especially at an early stage of growth, further protection against browsing, against inadequate anthropogenic intervention, etc. Care for stands is always necessary, not only at the moment of planting or tending interventions. Regular checks after winter months, topping, etc. should be among the routine activities of administrators of individual streams. [1] [3]

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REGISTRATION OF SIGNIFICANT TREES ON EXAMPLE OF MUNICIPALITY STŘÍTEŽ NAD LUDINOU

Czech title: Evidence významných stromů na příkladu obce Střítež nad Ludinou

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ABSTRACT

Article presents results reached in Registration of significant trees in the village Střítež nad Ludinou project. Register was elaborated for municipality Střítež nad Ludinou. Goals of the project were to choose the most significant trees, to locate them, measure and evaluate them. The second important task of the project was elaboration of the significant trees valuation method proposal.

Article includes text, maps, database and card index. Text contents methodology and characteristics of the survey area. There are registered trees in the maps, the database includes data of trees and in the card index there are data and photos of trees in winter and in growing season. The register serves as summary of significant trees and as basis of management.

Key words: significant tree, registration of significant trees, characteristic data, Střítež nad Ludinou

INTRODUCTION

Trees located out of forestland are protected according Law 114/1992 Sb. Nature and landscape conservation (paragraphs 7 - 9) as trees and shrubs growing out of wood. Stricter conservation is applied to the trees protected according Law 114/1992 Sb., paragraphs 46 and 47. These trees are protected against to cutting and disturbing, buffer zone are delimitated, and trees are registered in Central file of nature conservation. Registration of other trees (not protected according paragraph 46) is not deal with law or unified methodology.

Article presents results reached in frame of registration of significant trees in the village Střítež nad Ludinou project. Goals of the project were to choose the most significant trees, to locate them, measure and evaluate their vitality, health and stability.

MATERIALS AND METHODS

Location

Survey area is determinate as cadastral unit Střítež nad Ludinou (CU). Area is located in east part of Olomouc region, north of the city Hranice. Locality is situated between 290 m (Ludina stream in southern part of the area) and 514 m (hill in northern part of the area). Subsoil is created mainly by shale and greywacke. Andstone, pudding stone and loess loam are located in southern part of locality (Štipl, 1995). Halpic luvisols and cambisols are main soil types. Gleysols and stagnosols are located at foot of the hills and low plains, and fluvisols are located at river-flood plains (Štipl, 1995). Northern part of the area belongs to 7th slightly warm climatic region, central part belongs to 8th slightly warm and southern part to 9th slightly warm region. Area is situated in 3rd (beech with oak) and 4th (beech) altitudinal zone.

Methodology

Methodology is based on geodesy, dendrology, tree measuring and vitality and health assessment. Registration of significant trees consists of respective procedure steps. It includes trees selection, site evaluation, taxonomy, age estimation and stage of development determination, measure of trees and health assessments. In conclusion data processing and management are following.

Site is determinate by natural conditions (group of ecosystem type) and anthropogenic impacts. Social standing means relationship between trees (solitaire, group, line of trees, stand).

Age is featured in years, and it is usually estimated. **Stage of development** means development phase. It was evaluated accordance with graduated scale from "Kolařík, J. a kol.: Péče o dřeviny rostoucí mimo les" (1. seedling - not acclimatized tree, 2. young acclimatized tree, 3. maturing tree, 4. grown-up tree, 5. old tree and 6. senescent tree). **Prospects** mean suppose tree persistence. Prospect depend on many factors (development class, tree species, physiological and biomechanical vitality, site, etc.) There are 3 groups: A. long-life trees (persistence more than 50 years), B. medium-term trees (10-50 years) and C. short-term trees (less than 10 years).

Forest (tree) mensuration includes tree height, diameter (dbh), crown base height, crown height and crown diameter measuring. Tree **height** is difference in elevation of terminal shoot and stem base. Height is usually measured by hypsometer, and it is featured in meters. **Stem diameter** (or perimeter) is usually measured in breast height (130 cm). It is measured by caliper or by diameter tape. Stems were measured 2x across by caliper (with 1 meter range) and averaged. To thick stems (diameter more than 1 meter) were measured by tape. Diameter is featured in centimeters (cm). **Crown base height** means lower branches elevation. It is featured in meters and measured by hypsometer or by estimation. **Crown height** is difference in elevation of terminal shoot and crown base. It is featured in meters. **Crown diameter** was measured as vertical projection on surface. It was measured 2x across and averaged.

After tree measurement **tree assessing** continues. In practice it is done in 3 steps: 1st visual assessment, 2nd special methods and 3rd measurement device test. Registered trees were evaluated by visual assessment, which include physiological and biomechanical assessment evaluation, stability and safety assessment. All criteria were valuated (marked) from 1 (the best stage) to 5 (the worst stage).

Physiological vitality is ability to resist harmful effects. Main symptoms of downgraded vitality are defoliation (leaves lost), branch malformation, crown drying-up, and secondary sprouts. **Biomechanical vitality** is grade of mechanical damage and weakening. Biomechanical vitality is affected by habitual defects and by damages. Habitual defects have origin in tree grow, and included unsuitable high-diameter ratio (to thin stem), press branching, secondary sprouts and eccentric crown. Harmful effect, example wind, snow, drought, insect, mushroom, man, etc evoke damages. Damages include cavities (open or close), wood cracks reaction wood and root system damages.

Tree stability is resistance to tree failure. Failure means windfall, stem or main branch breakage. Failure risk is probability of failure. **Tree safety** is level of stability applied to site and targets. Targets include people, buildings and other things, threatened by tree failure.

Results of data processing are register outputs. Outputs include texts, maps, database and card index. Text part includes survey area description, methodology and summary. Objects of **map part** are trees. Trees were mapped in software Topol and 4 maps were created. 1st map in scale 1:20 000 displays trees growing in rural area, other maps in scale 1:2 000 – 1:5 000 display trees in residential area. Registered trees are displayed like points. Tree species are distinguished by color (example limes are red, oaks are blue, etc.). **Databases** were created in software MS Excel. Database part includes 2 databases. Objects of 1st database are site data (site-database), and objects of 2nd database are registered tree data (tree-database). Site database includes data about natural conditions (type of ecosystem), anthropogenic impacts, localization, social standing and numbers of trees growing on site. Tree-database includes data about localization (plot number and position data in S-JTSK coordinate), social standing of tree, Czech and scientific nomenclature. Important parts of tree-database are measurement data, assessment, texts notice and management. **Card index** was created for all sites and trees. Card includes data about site and trees (like database) and photo of registered tree (or group of trees) from growing season and winter.

RESULTS

62 significant trees are registered in municipality Střítež nad Ludinou. 46 trees are situated in residential area and 16 in rural area. 26 trees are growing like solitaires, 28 are in groups and 5 in lines of trees. 3 registered trees are part of the stand. The most abundant are limes *(Tilia L.)*: *Tilia cordata Mill* – 29 trees and *Tilia platyphyllos Scop*. – 4 trees. Horse chestnut *(Aesculus hippocastanum L.)* includes 12 trees and oak *(Qercus robur L.)* includes 10 registered trees. The most significant trees are located mainly in rural zone and comprise old and senescent limes and oaks. Completely summary is in following table.

Czech nomenclature	Scientific nomenclature	In total	Location		Social stand			
			Intrav.	Extrav.	Solitaire	Group	Line	Stand
Lípa srdčitá	*Tilia cordata Mill.*	29	25	4	11	12	5	1
Lípa velkolistá	*Tilia platyphyllos Scop.*	4	2	2	3	1		
Dub letní	*Qercus robur L.*	10	4	6	7	1		2
Jírovec maďal	*Aesculus hippocastanum L.*	12	9	3		12		
Javor klen	*Acer pseudoplatanus L.*	3	2	1	1	2		
Jasan ztepilý	*Fraxinus excelsior L.*	2	2		2			
Topol černý	*Populus nigra L.*	1	1		1			
Smrk ztepilý	*Picea abies Karsten (L.)*	1	1		1			
In total		62	46	16	26	28	5	3

Table 1: Registered trees summary

SUMMARY

Methodology for significant trees registration was applied on example of municipality Střítež nad Ludinou. Registered trees were displayed in map, and data about sites and trees were registered in database. Important part of the tree register is card index, including data about trees and photos.

Data about trees will be archived and will serve as summary of significant trees and basis of management. Methodology can be use in registration in other municipalities.

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ASSESSMENT OF THE CURRENT CONDITION OF RIPARIAN AND ACCOMPANYING STANDS

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Introduction

Prior to deciding on the manner and methods of new planting or reconstruction of riparian and accompanying stands, it is vital to assess the current condition of the riverbed and its closest surroundings from the following points of view:

- necessary future technical interventions to the river profile (whether more extensive building intervention is expected in the particular locality, e.g. weir construction, riverbed capacitating through continuous regulation, construction of a parallel road in close proximity to the stream, construction or reconstruction of buildings in close proximity to the stream etc.)

- building modifications performed in the past (details concerning possible stream regulation, documents concerning the proposed planting of trees and shrubs within the performed stream regulation, materials concerning the original riparian stands (photo-documentation, eyewitness information), or to try to find out reasons why planting had not been performed, etc.)[1,2]

It is always suitable and very important to inspect such areas with representatives from the stream administration, Agency for Nature Conservation and Landscape Protection of the Czech Republic, representatives of the environmental department of the competent municipal authority, or other environmental organisations and to assess the condition of stands near the stream, or to compare the existing condition with the designed one.

At a meeting called in relation to the relative problem requirements of interested authorities and organisations, land and company owners, etc. with respect to future modifications, their extent, manner and time of performance, including other steps necessary to solve the task with success, must be clarified.

Method of Assessment of the Condition of Trees and Shrubs

Within stream regulation, great attention is also paid to programs in the area of landscape ecology and environmental engineering, aroused by efforts not to irreversibly disturb (through proposed construction complexes) the ecological balance of the system. (Ecological balance is a dynamic condition of the ecosystem and is the main feature of ecological stability of the system. Ecological stability is then the ability of the ecosystem to endure the effect of stressors and, after they subside, to return to the initial condition.)

Within hydraulic engineering, revitalisation and eco-biological constructions (but only here), it is vital to initially become acquainted with the current situation of the locality which will be more or less affected by proposed modifications or building interventions.

Within the evaluation of the current condition of riparian and accompanying stands, subjective opinions often prevail and, from the point of view of the technical public, due assessment of the condition of stands prior to building or another modification is often underestimated. Due inspection, including a related record, is important information for the proposal for such part of project documentation that solves the incorporation of the construction into the landscape after its completion.

This was one of the reasons why effort was aimed at facilitating initial assessment of riparian and accompanying stands by proposing a method not requiring detailed dendrological, biological or ecological knowledge. The basic principle of the proposed method is simplicity, comprehensibility and explicitness – thus wide usability. A detailed inspection of the interested location, in our case the assessed part of the bank, is necessary and inevitable. The assessment is then carried out directly within the inspection of the current condition of the territory.

The assessed sector shall be divided (if it is necessary due to its extent) into sub-sectors approx. 100 m long, which are assessed separately. Due marking of sectors in the situation is important. Each bank of the stream (reservoir) shall be assessed separately.

The assessment itself is based on scoring (marking) the fulfilment of particular criteria: 1 = the best condition, 3 = the worst condition, and consequential categorisation of the sector. The categories clearly show in what condition the stand was prior to starting building or other works in the concerned locality. Along with photo-documentation, this assessment may serve to demonstrate related facts if there are problems with incorporating the construction into the landscape within its completion.

Method of assessment of the current condition of bankside trees and shrubs

Assessment criterion		Score
A. % damaged or unsuitable* species	up to 30 %	1
	up to 60 %	2
	over 60 %	3
B. Number of vegetation layers	1 vegetation layer	3
	2 veg. layers	2
	3 veg. layers	1
C. Width of the vegetation zone (from the approximate level Q_a)	up to 7 m	3
	7 – 10 m	2
	above 10 m	1
D. Species diversity	up to 3 species	3
	4 – 6 species	2
	7 and more species	1
E. Relative density of stands:		
- a continuous vegetation stand with local vistas of the water surface		1
- medium and large groups of stands		2
- no vegetation stands, small groups, solitaires		3

* by unsuitable species, such species, exotic species etc. mean those that are unsuitable for that particular site

Conclusion

The assessed sector shall be categorised according to the score obtained:

5 – 6 points……….vegetation in good condition

7 – 8 points……….the sector needs adjustments, additional planting

9 and more points …….necessary extensive interventions, or overall recovery

After such assessment has been performed, it is possible to objectively evaluate the assessed condition of stands also after a lapse of time. Further possible specification and proposal of necessary interventions should be left to competent specialists. The assessment record completed with photo-documentation could be used as important material in the future as well.

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ACCOMPANYING VEGETATION – GRASSLAND

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Introduction

The grassland of a stream bank slope reinforces soil surface and, to a great extent, prevents the occurrence and development of erosion. When proposing suitable grass mixtures, we work on recommendations (Marhoun 1981) based on which the following criteria should be fulfilled:

1. production of a sufficient quantity of aboveground mass in the shortest possible time
2. a continuous production of aboveground mass within further development of grass carpet should not exceed 180 g/m^2
3. resistance to illnesses and pests
4. resistance to climatic variations common in the Czech Republic's geographic latitude
5. resistance to flooding
6. ability to create a thick root system concentrated in the subsurface soil zone
7. resistance to the stress caused by running water in the riverbed

Establishment of Grassland] [4]

It is necessary to realise that grassland composition, its endurance, overall involvement and consequential viability depends on the number of created and sufficiently developed individuals in the first two to three months after seeding. Although seeding is the most common method of establishing grassland, it is not the only one.

1. Establishment of Grassland by Seeding

Prior to seeding, the laying of a humus layer on disturbed planed stream bank slope is expected. The follow-up seeding is manual, or mechanisms may be used, from early April to late August. Seeds need to be fertilised in the soil by rolling. If possible, watering in the first month and top dressing are important. To prevent the undesirable development of weed, one or two weeding treatments are necessary after approx. 8 to 12 weeks of seeding. The protective function of stands starts to work within only 2 to 3 months of seeding.

2. **Establishment of Grassland by Sodding**

For fast and almost immediate effective grassing of banks, so-called sodding may be used. Sods can best be obtained from an adjacent site (meadow, pasture) that has approximately the same site conditions as the locality being reinforced. Sods shall be taken by means of special knives, cutting strips approx. 40 – 50 cm wide. Separate the strips from subsoil using a shovel to achieve optimal sod thickness. Thus removed grass strips shall be divided into squares with sides of 40 – 50 cm. The produced sod should immediately be placed on the site being reinforced.

3. **Establishment of Grassland by Hydro-seeding**

This is a hydraulic method of seeding when a mixture of seeds, water, fertiliser, organic substance and anti-erosive additives are sprayed under pressure. In this way, inaccessible slopes and other places can be re-vegetated. Within seeds, the prescribed grass mixture or seeds of tree species can be used.

4. **Other technologies**

In addition, pre-planted grass carpets, especially wherever an immediate aesthetic and stabilisation effect is requested, divided stabilisation strips, slope stabilisation by means of coconut or jute nets placed on the seeded area (prevents erosion) etc. can be used.

Examples of Composition of Grass Mixtures (Kutílek)] [2]] [3]

Grass mixtures for the eulitoral zone:	kg/ha	% share
Smooth meadow grass	31	25
Swamp meadow grass	19	10
Annual ryegrass	5	2
Reed canary grass	50	55
Meadow foxtail	17	8

Grass mixture for the supralitoral zone:	kg/ha	% share
White clover	15	11
Swamp meadow grass	12	9
Red fescue	20	15
Timothy	10	7
Annual ryegrass	5	4
Smooth meadow bluegrass	25	18

Creeping bentgrass	6	5
Meadow fescue	30	20
Perennial ryegrass	15	11

Grass mixtures with a high <u>erosion control</u> effect :	kg/ha	% share
Smooth meadow bluegrass	40	40
Red fescue, cultivar Tamara	38	25
Chewing's fescue	28	15
Perennial ryegrass	30	20

Of course, grass mixtures may be modified according to particular conditions, or specific requirements and purpose of grassing. Details can be found, for instance, in the publication Vegetace v úpravách vodních toků a nádrží, L. Novák a kol.] [2]] [4]

Final Recommendations

In addition, it should be pointed out that in the case of more extensive interventions in the accompanying vegetation, project documentation of the intervention concerned must be developed in liaison with professionals from related fields. If the recovery of stands is performed within stream regulation, this project should be part of the project documentation concerning the stream regulation itself. Again, we have to remember that the accompanying vegetation includes the herbs layer as well. Suitable grass mixtures are able to protect the slope against water erosion to a great extent.

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DETERMINATION OF BED ROUGHNESS IN SHORT SECTIONS OF THE NATURAL KŘTINSKÝ POTOK STREAM BY DIRECT MEASUREMENT OF GRAIN SIZE AND VELOCITY AND WITH THE USE OF A HYDRAULIC MODEL, AND THEIR COMPARISON FOR THE PURPOSES OF PRACTICAL USE.

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Introduction

Natural beds of small water channels are characteristic for their varied morphology both in the cross section and vertical profile. Such diversity is easy to verify and may be specified by hydraulic modelling and calculations for technical use. Bed roughness is much more complicated to determine. Moreover, in case of natural and revitalised water channels, there are insufficient table data available since they are usually provided only for individual construction materials used in stream regulation.

As explained, for example, by Matoušek (2006), hydraulic bed roughness causes uncertainty when we want to compute the water surface elevation with a specific discharge. When calculating bed roughness in practice, we mostly rely on a specialist and his experience from field measurement in suitable parts of the water channel. However, there is a lack of such experience in situations with extreme discharge and more water flowing to the channel from adjacent floodplain. Havlík & Salaj (2006) mention the fact, too. Their results clearly show the relation between the water surface elevation and bed roughness.

Sometimes, even roughness of a floodplain or a river basin is taken into consideration. Rai (2010), for example, tries to give models showing the effects of roughness on flood wave transformation and compares the calculated values with data from monitored profiles. Similarly, Warner (2005) observed how roughness of individual surfaces in the entire floodplain affects the water flow. The results imply that roughness of the bed itself is statistically most important. When the water surface elevation rises, roughness in individual parts does not necessarily have a significant impact. The total roughness may thus result lower than the calculated hydrotechnical data.

Target of the Study

The target of the study was to compare three distinct methods of bed roughness determination in a small water channel and mainly to compare their applicability in technical practice. Two of the methods (using a current meter and a mathematical model) were based on indirect determination of roughness when measuring and calculating other quantities. The third method (grain size analysis) is the standard one and was principally used for value comparison.

Methodology

The area subject to the study is located in the cadastral area of the village of Adamov and on the border of cadastral areas of the villages of Habrůvka and Březina u Křtin, district of Blansko, South Moravian Region, Czech Republic.

Total four short sections of the Křtinský potok stream were measured, namely river km 6.13-8.36 – see the map with marked profiles. It is a karst area with the geological base composed of Devonian (profile No. 1) and Jurassic (profiles no. 2-4) limestone covered with gleyed typical luvisols (profile No. 1), cambic marly (profile No. 2) and typical marly (profiles No. 3 and 4). The average annual temperature in the given area is 6°C and average annual precipitations reach 650 mm (data provided by the Czech Hydrometeorological Institute).

Velocity was measured with a current meter and grain size was analysed in specified sections of the channel. The data acquired from current measuring were further used as enter data for a hydraulic model in Hydrocheck software.

The map in Figure 4 shows distribution of individual monitored profiles. Profile No. 1 lies close to the town of Křtiny, not far from the Mariánská cave. Its borders are delimited in Fig. 5. Profiles No. 2-4 are situated near the right tributary close to the cave Jáchymka. These are delimited in Fig. 6-8.

The following three methods were used for the needs of the comparative study:

Bed roughness determined by Chézy formula. This involves data on velocities directly measured in verticals with a **current meter** and direct mapping of the channel cross section.

The velocity was measured by a current measure, type A.OTT Kempten F4 (see Fig. 1), in imaginary verticals in a cross profile. The number of verticals and individual measurements resulted from the size of the profile.

Figure 1: current measure used for measurement (photo: Hošek)

The resulting velocity measured in a given point was computed with respect to the physical qualities of the measure and the number of revolutions in a given interval. This can be expressed by a formula, $v = \alpha + \beta \times n$ where α and β are invariables characterising the qualities of the current measure and $n = a/t$ expresses the relation between the number of revolutions (*a*) and the interval of measurement (*t*).

The course of the channel bed was defined by determining distances from the terminal and water depths. Thus, the transformed Chézy formula may be used to calculate bed roughness. The final formula to determine bed roughness is formula a.

$$n = \frac{R^{1/6} * \sqrt{R * I}}{v}$$ *(form. a)*

n = surface roughness

v = mean velocity

$R = S / o$ *where R = Hydraulic Radius, S = Channel Cross-Sectional Area, and o = Wetted Perimeter*

Roughness determined by analysis of a bed sample and **representative grain size**

Analysis of grain fractions in individual profiles and determination of the representative grain size (formula b) were further used to determine roughness based on the size of the representative grain - formula c.

$$d_e = \frac{\sum d_i \times m_i}{m}$$ *(form. b)*

d_i = mean size of grain representing given grain fraction

m_i = weight of grain fraction

m = weight of sample

$$n = \frac{d_e^{1/6}}{21{,}1}$$ *(form. c)*

n = roughness

d_e = representative grain size [m]

Roughness determined based on a mathematical model of non-uniform flow (software Hydrocheck)

Programme HYDROCHECK (produced by Hydrosoft Veleslavín, version 5.2.r249 released on 23 July 2009) serves for modelling water flow through an open channel. It also allows calculations of flow through various objects, such as bridges, weirs, and culverts.

The relative coordinates of individual points in cross profiles were based on and calculated from field measurement using a current measure. The gradient was determined from the corresponding map.

The modelled flows were computed based on the water stage in the time of measurement. The channel roughness was determined by successively substituting the values until the model reached the values closest to the level of the real water stage. Hejduková (2007) used a similar method for roughness determination. The calculation was thus based on a presumption that the correct value of roughness is specified when the programme calculates, for a given geometry and flow, the course of water level corresponding the measured values. Figure 2 gives an example of such modelling and its results. Besides individual points characterising the course of the terrain (delimited by circles), we may see velocities in verticals (triangles), which show the presumed velocities in individual parts of the profile.

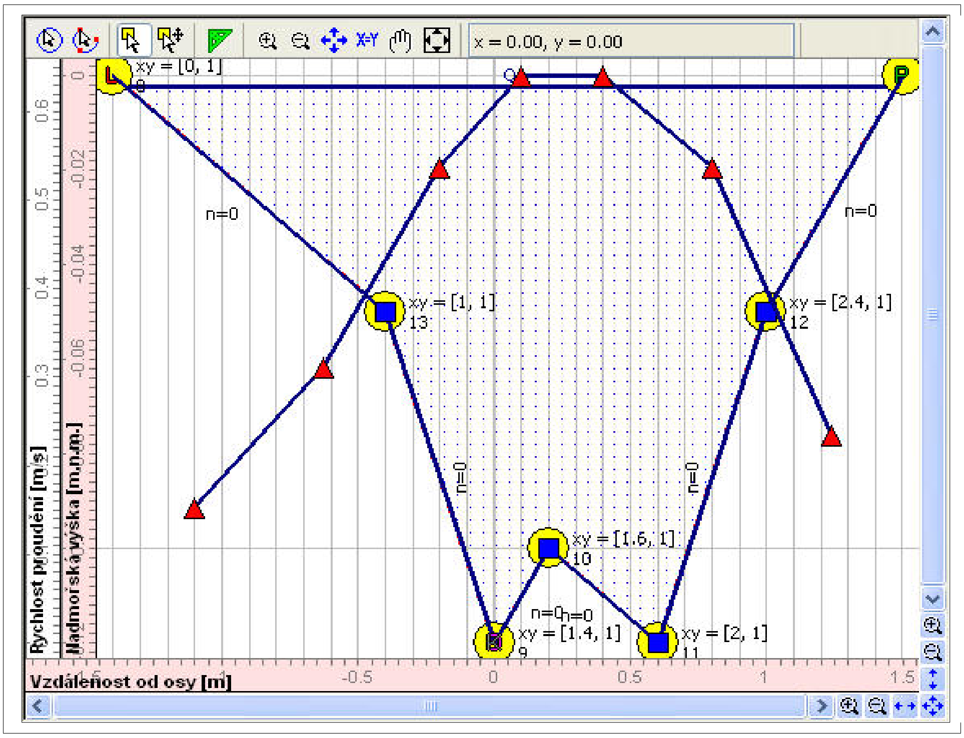

Figure 2: An example of graphical output of Hydrocheck programme.

Results

The results are organised in charts for better orientation. Chart 1 shows the analysed bed grain size in individual profiles – representative grain size. Chart 2 gives an overview of the values of roughness determined by individual methods for all profiles.

Chart 1: Representative grain size in individual profiles.

	Profile 1	Profile 2	Profile 3	Profile 4
Representative grain [mm]	14.8	41.2	19.8	30.1

Chart 2: Channel bed roughness in the given profiles determined using individual methods.

Method / Profile	Profile 1	Profile 2	Profile 3	Profile 4
Roughness calculated based on the representative grain size	0.0345	0.0409	0.0362	0.0388
Roughness calculated based on velocity/flow measured with a current measure	0.0300	0.0870	0.0490	0.0320
Roughness calculated by modelling in programme Hydrocheck	0.045	0.080	0.037	0.0550

Dsicussion and conclussions

The determined values are similar to those specified by other authors – e.g. Havlík & Salaj (2006) and correspond to the table data of the roughness coefficient according to Manning and Pavlovsky (cit. Zachar et al., 1984). However, the variance of values is too large for any further practical use. For example, Profile 2 shows a significant difference between the value based on representative grain size and the other two methods. Should these data be applied in further calculation, their distinct values would affect calculation of velocity and the total water flow through the profile in the following way: if we use the value based on the representative grain size, the velocity reaches the value of 0.535 $m.\cdot s^{-1}$ and the total flow 0.374 $m^3\cdot s^{-1}$. If we use the value measured with a current measure, the velocity is 0.251 $m\cdot s^{-1}$ and the flow 0.176 $m^3\cdot s^{-1}$. Considering that the velocity measured with a current measure reflects the real situation, as well as bed roughness determined by sample analysis, the above-mentioned difference may result from terrain morphology. The profile was located in a slight depression compared to the surrounding area and the water level was thus higher than in the other parts.

Conclusions

The most appropriate method to determine channel bed roughness is analysis of bed material, determination of the representative grain size, and subsequent calculation of the actual roughness. Nevertheless, as mentioned above, the precisely determined value of bed roughness does not necessarily correspond the reality. It has already been explained in the introduction, however, that determination of roughness represents the main problem in calculation. Determination based on grain size analysis is applicable in most situations.

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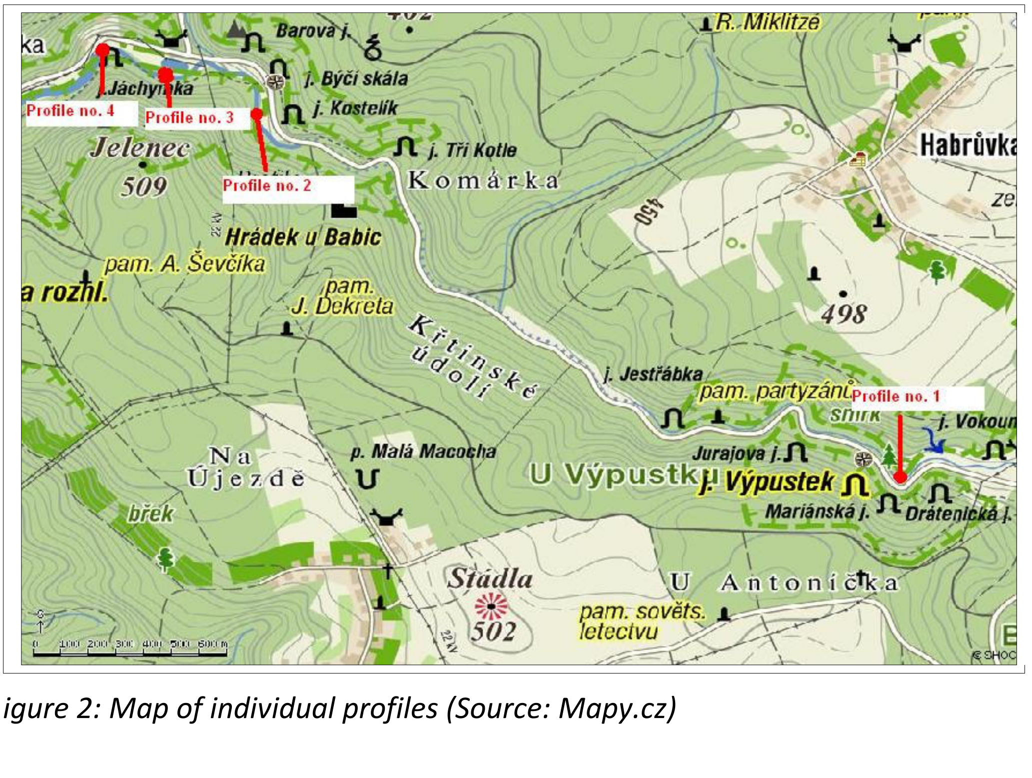
Annexes

Figure 1: Global map (Source: AMapy)



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igure 2: Map of individual profiles (Source: Mapy.cz)

Figure. 5: Profile No. 1 (Photo: Hošek)

Figure 3: Profile No. 4 (Photo: Hošek)

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igure 4: Profile No. 2 (Photo: Hošek)

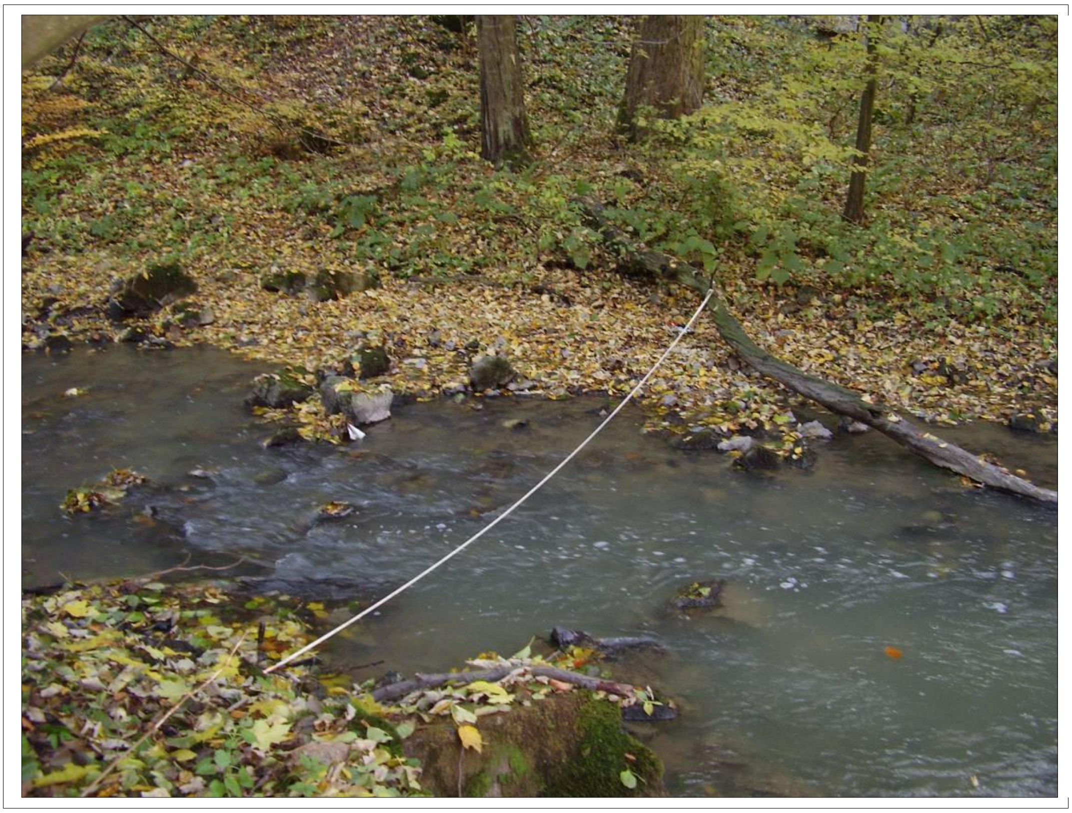

Figure 6: Profile No. 3 (Photo: Hošek)

OPTIMISING THE PROPOSED EROSION CONTROL MEASURES IN THE CADASTRAL AREA OF OTINOVES WITH RESPECT TO POTENTIAL EFFECTS AND COSTS

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Introduction

Water erosion is a natural phenomenon caused by surface and underground water runoff and mainly by the force of raindrops falling on unprotected land. As to quality, erosion may be defined as a loss of soil on a surface unit in a given period of time, as determined in similar conditions, for example, by Toman et al. (1994). It may be understood as a relation between the erosion effects of rain – rain erosivity E_r – and susceptibility of soil to erosion – erodibility of soil E_s, as stated, for example, by Holý (1978). However, the current intensive landscape management supports this phenomenon to the level of so-called potential erosion.

Silting of natural and artificial water courses, reservoirs, or other hydraulic structures is another effect of soil erosion. Sediments decrease the flow capacity of channels and increase the bottom level. This results in a risk of undesired inundations and higher level of underground water in the surrounding area. Silting can affect the functions and life of hydraulic structures. Water reservoirs face a great risk because silting decreases their storage capacity and causes problems in their utilisation. This is mainly the case in small reservoirs established in upper parts of water courses.

Nevertheless, not only extreme rainstorms cause the current erosions. We understand it when we simply compare the effects of erosion after rainstorm on a corn field and on permanent grassland – see, for example, Hůla et al (2003). Creation of large and continuous arable areas significantly contributes to erosion processes. Permanent obstacles in the landscape are being removed, the density of the hydrographic network is diminishing, and large uniform areas of some plants insufficiently protect the soil (root crops and particularly corn).

Target of the study

The target of the study is to assess the effectiveness of the three proposed options of erosion control measures in a part of a catchment area. The criteria for such effectiveness are the period of efficiency and costs required to fully adopt the measures.

Methodology

The area subject to the study is located in the cadastral area of the village of Otineves (49°25'35.369"N, 16°52'16.706"E) at the altitude of 550 m a.s.l., in Drahanská vysočina (highlands), with average annual precipitations of 650 mm and average annual temperature of 6.5°C. It is a catchment area of the Otínovský pond extending on 4.7 km^2. The study involved assessment of 81 ha of a part of the catchment area between the Otinovský and Nebeský ponds.

Figure No. 1: Part of catchment area

From the pedologic point of view, the studied area is composed of pseudogleys, acid brown soils, slightly gleyed soils, and gleysols. The slopes of the catchment area are 3 % on the right bank and 4 % on the left one. 70 % of the area is registered as arable land, 20 % as permanent grassland, and 10 % as forest vegetation.

The following maps were used: basic map 1:10000 (Czech Office for Surveying, Mapping and Cadastre, 2004) electronic historic map 1:2000 (Austrian State Archive, 1836-52).

To assess the option of a sedimentation tank we used documentation from the area management project Waldhaus & Hork7, 2001.

The potential level of erosion was determined using formula by Wischmeier-Smith (1978), which was adjusted for the conditions of the Czech Republic by Pasák et al. (1983). Thus, the universal formula to calculate long-term soil loss due to water erosion is as follows:

$$G = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

G – average long-term soil loss (t· ha^{-1}·$year^{-1}$),

R – rainfall erosivity index,

K – soil erodibility,

L – length of the slope,

S – gradient of the slope,

C – plant cover factor,

P – specific erosion control practices.

The area of the left bank is Sp_l =29.8 ha and of the right bank Sp_r =51 ha. The gradients are 4 % and 3 % for the left and right bank respectively. The individual factors of the Wischmeier-Smith formula were determined for the studied area as follows: rainfall erosivity index R=20 from the map of R factor isolines in the Czech Republic [Holý, 1978]; soil erodibility K=0.20 is derived according to the prevailing soil unit 72914 (i.e. soil quality under the Czech system of evaluation), which is a soil type under the third level of protection; length of the slope is determined from the basic map, where the left slope is Ll=3.98 and the right slope Lr=4.77; gradient of the slope on the left bank Sl=0.35 and on the right bank Sr=0.26. These values come from the formula $S = \frac{0.43 + 0.30I + 0.043I^2}{6.613}$ (Holý, 1978). The plant cover factor C=0.2 is an average value in crops cultivated in the given area, i.e. mainly cereals and root crops combined with plants of the legume family. The specific erosion control practices P=0.5 are based on the table value in contour ploughing.

Substituting the values of both banks, we get the following:

G_l= 20·0.2·3.98·0.35·0.2·0.5= 0.5572 t/ha/year

G_r= 20·0.2·4.77·0.26·0.2·0.5= 0.4961 t/ha/year

Calculating the loss related to the catchment area (Sp_l, Sp_r), we get the following values for the left slope G_{cl} and for the right slope G_{cr}:

G_{cl}= G_l·Sp_l=0.5572 · 29.8 = 16.6 t/year

G_{cr}= G_r·Sp_r=0.49608 · 51 = 25.3 t/year

The sum of the values represents the potential total annual loss of soil in the part of the catchment area:

G_{total}=Gc_l+Gc_r= 41.9 t/year

To get the volume of soil we compute the bulk density of soil = 2.02 t/m^3.

The total volume of soil thus reaches the following:

V_t=41.9/2.09 = 20.7 m^3/year

Three options were proposed for erosion control measures

Option 1: no new measures

Option 2: to establish a sedimentation tank

Option 3: to adopt biotechnical measures in the given part of the catchment area

Description of individual options

1) This option only counts with a reconstruction of the existing reservoir the Otínoveský pond and removal of silt. The works would involve a complete reconstruction of the spillway and repair of the existing outlet. The costs are estimated to about CZK 1.95 million.

Such reconstruction works will presumably be required every 120 years.

2) The sedimentation tank would be established above the end of the current storage area as a ground homogenous dike. It would be equipped with a concrete outlet and a simple stop log integrated in the spillway. The outlet should be reinforced with stones and bridged. The tank should work as a wetland. This means, that the operational water level would be 0.5 m at the outlet. The storage capacity for sedimentation is V_n = 856.6m^3.

The period of total silting of the tank (i.e. the time before the entire tank fills up with sediments) is a ratio of its original volume and the annual volume of sediments.

Maximum period of total silting T:

$$T = \frac{Vn}{Vt} = \frac{857}{20.7} = 41 years$$

The period of total silting is 41 years.

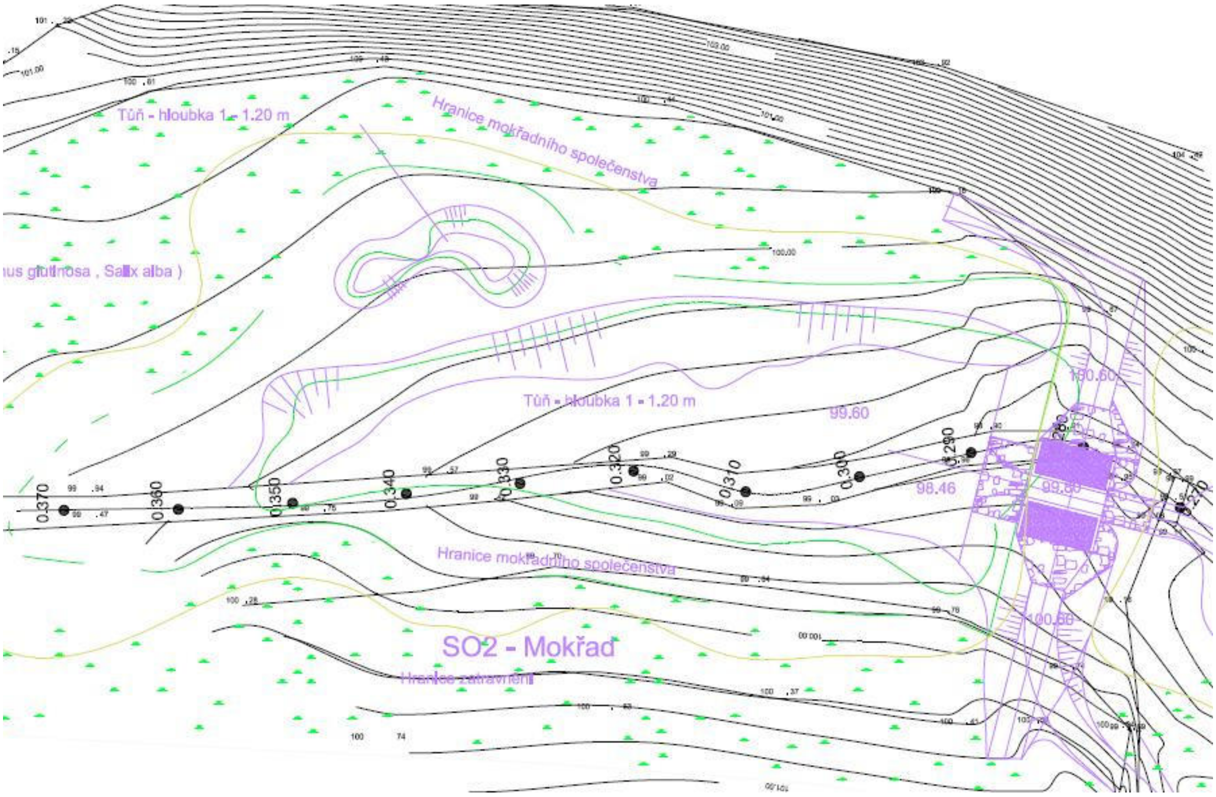

Figure No. 2: Design of the sedimentation tank

3) Biotechnical measures involve construction of soakage strips. The slopes would be divided into 25 m wide strips of arable land separated by 5 m wide shrub zones established along the contour lines. At the same time, the banks of the Otinoveský pond would be provided with 10 m wide soakage strips with vegetation. Only perennial crops or cereals would be cultivated along the watercourse. The resulting area of shrub zones would reach 7 ha, the area of soakage strips 2 ha, and arable land necessary for the measures would total 71 ha. The vegetation should be regenerated approximately every 40 years with regular management every 10 years.

Costs of individual options

Option	Acquisition costs (CZK 1000)	Life (years)	Maintenance (CZK 1000/year)	Costs of reconstruction (CZK 1000)	Compensation to land owners (CZK 1000/year)
	a	b	c	d	e
I.	0	120*)	0	1950	0
II.	1300	40	20	500	0
III.	750	40	40	500	10

Efficiency rate = acquisition costs/utility life of min. 80% * rate of impact on the entire "catchment area"

To compare the options we use the following formula:

E120 = a+((b*c)*(120/b))+(120/b)*d+120*e

Option	Costs for the period of 120 years (CZK 1000)
Removal of silt and reconstruction of the existing reservoir	1950
Sedimentation tank	5200
Biotechnical measures	5800

Discussion and conclusion

Comparing the proposed options, we can see that the construction of a sedimentation tank is not only too expensive but also unsuitable due to maintenance – silt would have to be removed every 40 years. Biotechnical measures are expensive and would probably bring difficulties when dealing with land owners. There is the Nebeský pond located above the Otinoveský pond. In such a small catchment area, the necessity of these erosion control measures is discussable. The erosion risk is not so high to cause dramatic silting of the current reservoir. Nevertheless, it would be convenient to negotiate with the forest owners in order to apply adequate rotation of crops and management that would minimise erosion risks. The vegetation strips along the watercourse should be broadened to their original and characteristic extent.

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METHODS OF THE EVALUATION OF FOREST UNITS ACCESSIBILITY THROUGH TRANSPORT TECHNOLOGY DESIGNED FOR GIS

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ABSTRACT

The presented evaluation of the accessibility of forest units by logging and hauling technology results from interactions between terrain types and edaphic categories of forest sites. The study enriches current standards and methodical procedures using new findings from the field of accessing the forest and forest harvesting. It refers above all to the enlargement of logging and hauling technologies, particularly using harvesters, clambunk skidders or forwarders. A target output serves as the determining basis of the technological accessibility of logging and hauling machinery. By the interactive use of attribute tables it is possible to obtain immediately defining information for variant technologies of logging and hauling machinery.

KEYWORDS: forest access, forest road network, wood transport

INTRODUCTION

Problems of terrain classification are dealt with in the long term in all countries with the intense tradition of forest research. Terrain classification (ROWAN 1977), which presents a classification and descriptive system of terrain for short and long term planning of harvesting and timber extraction, based on ground condition, ground roughness and slope, ranks among the first terrain classifications. A Canadian classification (MELLGREN 1980) is another example. Under European conditions, the problems were dealt with by BERG (1992), who created a "Scandinavian system" based on the same criteria and ways of evaluation as MELLGREN (1980). This classification with changes between particular categories was further applied by DAVIS and REISINGER (1992) for the use of forest machinery. Thus, they developed a technological- terrain standardization used, for example, in the USA. For Czech conditions, a terrain classification and technological standardization has been developed by Macků, Popelka and Simanov (MACKŮ et al. 1996), which is also used in Regional Plans of the Development of Forests (RPDF) .

Institute for Forest Management (formerly "Lesprojekt") standardly applied terrain classification and technological classification in relation to edaphic categories (MACKŮ et al. 1996).

Forest management planning works with attributes edaphic category, forest type and forest type group with the analogical combination of stands of the same production capacity. However, the production potential of forest sites depends also on the criteria factors of the soil bedrock. For example, a soil type shows a certain production capacity and, at the same time, it is characterized by the differentiated range of bearing capacity (slopes, waterlogged plains etc.). It follows that there is an important relationship between a terrain type and an edaphic category. Subsequent technological standardization is not the final assignment of concrete means for particular terrain types or their groups; design recommendations are general.

At present, we can find always broader use of GIS as implementation tools also in the field of forestry. In case of forest access, it is possible to prepare both the management of periodic logging measures and the operative solution of incidental and salvage felling. Just in this case, the preparation and organization of logging operations show an important role as for the rate and quality of measures under conditions of keeping procedures of sustainable forest management. Such outputs can consist in the optimized forest road location (ROGERS 2003, ABDI et al. 2009) or analyses of the forest stand interior and logging and hauling risks in inaccessible terrains (ADAMS et al. 2003). By means of GIS, it is possible to process data for the technological standardization, which brings (through map outputs) an easy instruction for accessing the stand interior by means of available and suitable means with respect to the forest environment protection.

METHODS

A new approach to the terrain classification results from presented terrain classifications mentioned above and technological standardizations.

The procedure of visualization - the creation of a map output:

- Based on digital contour lines of the fundamental base of geographic data (ZABAGED) a digital evaluation model (DEM) was constructed.
- On the DEM a raster layer is created visualizing the terrain slope. Four categories of inclination are demonstrated on the layer:

1. **1 = 0 - 10%**
2. **2 = 10 - 20%**
3. **3 = 20 - 35%**
4. **4 = >35%**

Limits of the categories result from the used terrain classification.

- Based on polygons of edaphic categories a data layer divided into four edaphic units is constructed:
  - 1 = areas with ground bearing subgrade free of obstacles – edaphic categories M, K, I, S, B, W, H, D
  - 2 = areas with ground bearing subgrade and the possible occurrence of obstacles – edaphic categories F, C, A, N
  - 3 = areas with unbearable subgrade – edaphic categories T, G, R, L, U, V, O, P, Q, J, Y
  - 4 = areas without management measures – edaphic categories X, Z

- The third data layer is obtained by the combination of two previous layers. Values of the slope raster layer correspond to slope categories 1-4.
- For the raster layer of edaphic units it was necessary to reclassify values of edaphic units 1, 2, 3, 4 to 1, 5, 6, 7 (by reason of the result expliciteness).
- Through this intersection 16 resulting categories occur. They are unambiguously documented by a numerical value.
- A corresponding technological type of logging and hauling accessibility is assigned to each of the numerical values. Identified by a code and colour.
- A resulting visualization is created, viz. a resultant map output.

AREA OF STUDY

The special-interest area is an extensive forest complex occurring in the Bohemian-Moravian Upland among villages Svratka, Křižánky, Moravské Křižánky, Milovy, Blatiny, Kadov, Fryšava and Cikháj. It concerns the area of transport segments in the vicinity of "Devět skal" mountain belonging to the natural forest region 16 – the Bohemian-Moravian Upland.

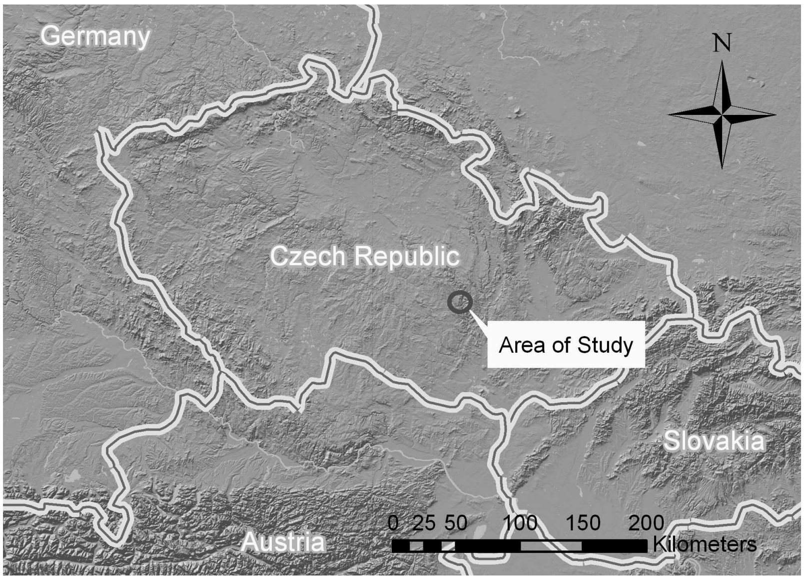

Fig. 1: A general map of the model area position

RESULTS

Technological standardizations are assigned by the determined combinations of edaphic and slope categories

Tab. I: The assignment of technological standardizations to terrain types

Combination according to Tab. 6	The code of logging and hauling accessibility	Colour marking	Technological standardization of logging and hauling accessibility
1	**1**	yellow	U, S, H (V), K, M movement possible in all directions
2	**2**	blue	U, S, H (V), K, M movement possible at right angles to the contour
3	**3**	violet	S, H, H of mountains, K, M
4	**4**	red	H of mountains, K, M, L
5	**1p**	brown	**Terrain recognition necessary**, possible occurrence of obstacles L, M – an alternative free of obstacles according to terrain type 1 (U, S, H (V), K, M movement possible in all directions)
10	**2p**	brown	**Terrain recognition necessary**, possible occurrence of obstacles L, M - an alternative free of obstacles according to terrain type 2 (U, S, H (V), K, M movement possible at right angles to the contour)
15	**3p**	brown	**Terrain recognition necessary**, possible occurrence of obstacles L, M - an alternative free of obstacles according to terrain type 3 (S, H, H of mountains, K, M)

20	**4p**	brown	**Terrain recognition necessary**, possible occurrence of obstacles L, M - an alternative free of obstacles according to terrain type 4 (H of mountains, K, M, L)
6	**1v**	green	**Terrain recognition necessary,** possible occurrence of waterlogging L, H of mountains – an alternative in the period of frosts according to terrain type 1 (U, S, H (V), K, M movement possible in all directions)
12	**2v**	green	**Terrain recognition necessary** possible occurrence of waterlogging L, H of mountains - an alternative in the period of frosts according to terrain type 2 (U, S, H (V), K, M movement possible at right angles to the contour)
18	**3v**	green	**Terrain recognition necessary,** possible occurrence of waterlogging L, H of mountains - an alternative in the period of frosts according to terrain type 3 (S, H, H of mountains, K, M)
24	**4v**	green	**Terrain recognition necessary,** possible occurrence of waterlogging L, H of mountains - an alternative in the period of frosts according to terrain type 4 (H of mountains, K, M, L)
7	**5**	black	Free of management measures
14	**5**	black	Free of management measures
21	**5**	black	Free of management measures
28	**5**	black	Free of management measures

Explanatory notes to technological standardization:
M – motor-manual technology
K – horse
U – general purpose wheel tractor equipped for skidding
S – skidder
H – harvester
V – forwarder, clambunk skidder
H of mountains – mountain harvester
L – cable hauling system

The resulting map background can be transferred again into a polygonal form and used in its attribute table.

CONCLUSION

The accessibility of forest units is an important condition for the environmentally-friendly management of forests under the conception of integration of their functions. The area determination of elements of accessibility resulted from generally classified terrain characteristics and technological standardization based on three crucial parameters, viz. terrain slope, soil properties affected by water regime and terrain obstacles. Nevertheless, using the method decreases with the complexity and demandingness of inputs. The input of GIS means new possibilities for site surveys and the selection of optimized solutions. The use of the presented method makes possible the exact support of decision making processes and determination of the optimum solution of logging and hauling processes in practice.

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SOCIAL SPACE OF GREEN STRUCTURE, SOCIOTOP IDEA

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1. Introduction

The idea of the topic for this paper came to me when I was reading article *Visualizing Urban Green Qualities in Sweden: A way of Raising the Quality of the Urban Landscape* written by Elisabet Lundgren Alm.This article is about the significance of changing the focus from green areas to green qualities. E. Lundgren Alm says in her article: „It is necessary to start categorizing urban green areas, so that qualitative aspects of greenery can be visualized in the same way as quantitative aspects today." This statement raised questions in my mind, such as 'What functions a green structure has for citizens?' ‚Who uses it and for what purpose?' ‚How can planners and landscape architects visualize green qualities in an easy way, which would be available also for citizens?' When I was searching literautre and academic papers for possible answers to these questions, I found an interesting case study: in Stockholm, the planners tried to use new approach using so called *sociotop* idea. I will explain the idea later in this paper.

The second reason for choosing this topic is particularly important for me as a student from the Czech Republic, where urban sprawl expands with what seems to be no control and hence the valuable greenery in built-up areas shrinks, I would like to learn more about the way Sweden is dealing with the problem of urban growth and green structure. Sweden has a long tradition in this field as Lundgren Alm pointed out in her article: „In a European context, Sweden has a long and internationally well-known tradition of research related to the importance and significance of urban greenery. In general, this research, besides being well reputed, helps to identify the value of urban greenery. (E.Lungred Alm, 2001)

Nowadays urban planners are faced with the challange of „promoting urban growth while at the same time sustaining the city´s attractivity". This polarisation of urban interest is solved differently on different planning levels. In this paper I would like to look deeper at the Stockholm case mentioned earlier. I intend to show how planners deal with this situation using a new sociological approach called , the „sociotop map".

In order to continue with this paper, it is necessary to first explain what exactly green structure and urban greenary is. This is then followed by a section on planning situation in Stockholm and on reasons for developing the sociotop idea. At the end I will make my own conclusions.

2. Green structure, urban greenary

2.1. green structure - origin of the idea

When I started searching for an explanation of a term green structure I came accross the following statement in the final report of COST Action C11 (Green structure and urban planning). „Green structure is not a familiar term in all countries; indeed, it is even difficult to translate properly into some languages. The underlying idea is: we need to consider the green aspects of planning as a physical structure forming an integral part of the city (e.g. green belts or green corridors), as a network of 'green' elements, as a physical infrastructure playing a role in water management, in the urban micro-climate and in biodiversity, and also as a social infrastructure for leisure, relaxation, human interaction and other social activities. Therefore, green structure is not equivalent to green areas." (Bernard Duhem: Green structure and urban planning, 2005) „Although the concept of green structure is deep-rooted in history, the term as such dates from the 1980s. In the beginning, as happens with relatively new concepts - perhaps even more so when it is intended to create a common language - there was a lot of confusion about the many possible meanings of green structure." (Sybrand Tjallingii: Green structure an urban planning 2005)

Green structure is a modern concept with at least two important roots in the history of landscape architecture and urban planning. One is the idea of the public park that developed in the eighteenth and nineteenth centuries in Germany, England and France, when many people felt an increasing need to escape from the industrialising dirty and unhealthy cities. This idea was developed by Frederick Law Olmsted[1] with his park systems and parkways for American cities. The other root is the Garden City movement that started in England and was inspired by Ebenezer Howard[2], who reacted to the terrible London urban slums of the nineteenth century. Green garden cities provided an alternative. If cities grew beyond a maximum size there should be satellite towns around the mother-city. Around each city there should be a green belt to contain urban growth.

When I think about the concept of green structure in a spatial percpective I see that green structure is more than the sum of green spaces. Green structure links town and country. In time perspective one can see that green structure links the past to the future. Green structure expresses a long history and a long-term planning policy to make the spatial structure of green spaces a basis for sustainable urban development.

2.2 urban greenary

I continued with searching for more information about green structure and I found the term ‚urban greenary', which has similar meaning to green structure. E. Lundgren Alm uses this term in her article *Visualizing Urban Green Qualities in Sweden: A way of Raising the Quality of the Urban Landscape.* She mentions that „It is an established fact that urban greenary can serve multiple functions in a sustainable urban development, e.g. spatial, ecological, social, and technical.

However, inspite of this knowledge, it has been recognized that issues regarding green landscape are often treated separately from urban development issues, and often simply in terms of areas to be protected. However, in order to make use of the multifunctional character of urban greenary, this situation calls for a change in the way it is understood and handled in urban planning practice." Then she continues „It is important to change the focus from green areas to green qualities, as this will make it more obvious that urban design and planning is not an issue of objects, such as houses, parks, and roads, but one of context, connections and qualities in local situations." (E.Lungred Alm, 2001). Lundgren Alm sees that there is a need for both new ways of viewing urban greenery in relation to urban development in general, and a change in the way green issues are expressed and used in specific urban design and planning situation. This change in the way green issues are solved is a challenge for every planning office. Now I will continue with the case study from Stockholm, which serves me as an example of how the „green issue" can be dealt with.

[1] Frederick Law Olmsted (April 26, 1822 – August 28, 1903) was a United States landscape architect, famous for designing many well-known urban parks, including Central Park and Prospect Park in New York City.

[2] Ebenezer Howard (29 January 1850 –May 1, 1928) was a prominent British urban planner

3. Stockholm study case

3.1. Introduction, basic information about Stockholm

Stockholm has a unique character as the city of green and blue – that is large preserved green areas and blue waters around the islands the city was built on. This unique character is very important as a basis for the future development. It forms a prerequisite for people to choose to live and work in the city. (Mats Pemer: Developing a sustainable compact city in Stockholm, Sweden)

Sweden´s capital Stockholm is one of the most attractive and beautiful metropolitan areas in Europe. There are 12 large parks in Stockholm, each over 200 acres. These account for 1/3 of Stockholm's total open space. "No matter where you live in Stockholm, you're no more than a half-mile from a park of at least 12 acres, designed with safe and convenient access.” - Cheryl Kollin[3]

3.2. Urban planing situation in Stockholm

Planning for human beings in nature requires knowledge of the availability of green areas, and their recreational, natural, and cultural value.

Alexander Stahle (green structure planner at Stockholm City Planning Administration) pointed out: „In the Stockholm Regional Plan (RUFS 2001) regional nodes for development are identified as well as the important regional green structure: the „green wedges“ that connect the countryside with city center.“ The City Plan aims at saving the existing green structure, but on the other hand doesn´t say anything about how a new green structure can be changed or should be developed. On the local level detailed plans for single plots are developed, but with lack of understanding of the local public. Planning policies based on public dialoque is missing in urban planning today. That´s why the Stockholm municipality is developing a Park Programme based on new concepts for public interests, the „sociotop“. The Sociotop Map is developed based on public dialoque and developed as a planning tool on city district level (scale 1:10 000). Green structure is focused on qualities and possibilities of developing qualities. In the following part I will explain the sociotop idea, which is used in the Stockholm case study.

3.3. The socitop idea

The sociotop concept was developed by Alexander Stahle and Anders Sandberg on the Strategic Department of the Planning Administration in Stockholm in 2000.[4] The sociotop concept was developed to complement the accepted concept of a „biotop“, which is the ecologically defined enviroment. Stahle and Sandberg explained a definition of sociotop as „The commonly experienced and used (life world) place of a specific culture.“ By specific culture they mean citizens of Stockholm in the Stockholm study case. A sociotop map of a city district describes the common everyday life qualities of open space, green, grey or blue, public or private. The main questions of the concept are: For whom? For what? Where?

[3] Cheryl Kollin is the Director of Urban Forestry at American Forests, a national non-profit conservation organization for trees and forests. She provides applied urban forestry research to the benefits of urban ecosystems, land and housing development, and public policy and is a co-author of Building Greener Neighborhoods: Trees As Part of the Plan.)

[4]The sociotop concept has also been used by the swedish social psychologist Lars Dencik to describe children´s social life space, networks etc. It has also been used by the german

landscape architect Werner Nohl to describe types of urban settlements and their social structure.

3.4. Mapping methodology

First open spaces (usually over 1ha) are named and defined. In this definition city landscape cathegories are used (parks, nature, squares, shores and quays). Proffesionals value the open space by observation with protocols, developed from international and national research on open space life and evaluations.Then citizens value their parks and influence the Sociotop Map through several „dialoque activities“. Citizens have an opportunity to answer questionaries[5] about favourite outdoor places. These questionaries are posted to adults and personnel at day nurseries and pre-schools, published in the newspaper, web form on the city district´s websites and interviews with different groups of people. Then different place qualities of the public are collected. This dialoque information is compiled together with the professional registrations into 20 quality-concepts or „social-cultural values.“ Then every specific place is registred with its specific composition of values into a sociotop map. The quality-concepts are made to a simple everyday language to work as a tool for communication between the „public“ and the „planner“. These were for example: play, quiet, walking, picnic, crowds, swimming, wilderness. As a result the GIS-based map is produced and now it can be used for green structure analyses in various urban planning projects.

Now we are familiar with the sociotop idea and the way it can be used. In the following chapter I would like to focus on the question why this idea could be viewed as progressive and what the difference between a traditional approach and collaborative approach to the planning process is.

4. Conclusions

In my conclusion, I have attempted to answer the main question of this paper, i.e. whether the sociotop concept and sociotop map is satisfactorily good and useful tool for planners as well as for citizens. I will use Denis Wood´s words „ Power is the ability to do work. Which is what maps do: they work.“….What do maps do when they work? They make present- they represent…„It is interest which makes the map a representation. This is to say that maps work…by serving interest.“ (Denis Wood:The power of maps) I tried to find out if the sociotop map works.

It is not yet clear what impact the sociotope map has had on planning practice or in planning and urban theory. Many planners have heard about it. Many have at least come across it in projects, and quite a few have been using it practically, for example in EIA (Environmental Impact Assessment) and SEA (Strategic Environmental Assessment). Two other municipalities in Sweden have recently started sociotope mapping; Gothenburg (2nd biggest city in Sweden) and Uppsala (4th biggest city in Sweden).

With the citizen´s opinions and perceptions as a starting point, new places can be created that are shaped from the citizens point of view – i.e. the process follows the "bottom-up" approach rather than the "top-down", which considers purely the mind of an architect or a decision maker. The bottom up apporoach involves people, i.e. the target users for which the space is designed. This helps ensure that the design is much more likely to be appreciated and successful, as the users will recognise their own contributions and are more likely to regard the place as „their". The sociotope map emphasizes the fundamental difference between life world of citizens and the system world of planners and architects.

[5] The latest questionaries and interview guides were developed by Maria Nordstrom, enviromental psychologist at Stockholm University.

On the other hand, to express the lived world is a tricky task. As Lefebvre pointed „When compared with the abstract space of the experts (architects, urbanists, planners), the space of everyday activities of users is a concrete one, which is to say subjective". (1991 p. 362) For this reason Lefebvre is very sceptic to any representation of social space. I partly agree with Lefebvre, that representation of social space is a hard task, but I believe that it is possible.

To finish this paper I would like to say that for planners certainly need useful representation of open space functional values and citizens need good quality urban greenary for good social life. The sociotop concept might be seen as the beginning of this process and time will show us whether this sociotop idea could be useful or if there is a need for another form of representation of the lived world.

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THE STUDY OF THE NATURE TRAIL EQUIPPED BY THE EXERCISE ELEMENTS FOR DISABLED PEOPLE AND SENIORS

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Abstract

For the model area of Tichá Orlice valley was the nature trail study worked out. After the comples analysis of nature conditions and wide range of relations focused on the recreational point of view was the optimum trace proposed. One of the cirqiut was designed according to the disabled people needs and for families with small children and baby-coaches. It is led on the consolidated roads and on the roads with minimum slope. The lenght of the trail was adapted too. In addition to information and orientation features were designed furniture for recreational activities, in particular, benches, picnic tables and shelters. Small "Castle Circle" offers visitors a workout features for the elderly or people with a mild form of disability. Construction of facilities and equipment should streamline traffic and to eliminate its negative impact on the natural environment. Extension of tourist supply should lead to an increase in attendance of the region, strengthening the recreational function of forests and environmentally friendly forms of tourism.

Introduction

Into the group of disabled person can we include the persons in wheelchairs, visually impaired, mentally retarded or persons with reduced mobility. Our law does not provide any comprehensive definition of disability. It is interested only about the extent to which a citizen is unable to work. Some definitions of disability include the social context: the victim is someone who as a result of persistent illness, accident or defect, or due to a deviation of a social nature, is severely limited in practice compared with the surrounding society. Seniors and families with strollers are faced with similar problems as people in wheelchairs.

Principles for access to the countryside for disabled people

Information boards and signposts

- information on the obstacles (stairs, steep slopes, impassable sections, etc.)
- directional signs readable from a height of seated and standing figures, is why the center should not be higher than 120 cm above the ground, inclination 5-10 °
- matte finish, rather than reflective materials
- for the blind Braille, audio or tactile maps
- allocated parking and access points
- the possibility of a shorter variant (abbreviation)
- optimal route length 300-1500 m

Roads and footpaths

- cross slope of 1% due to storm water runou
- in areas with moist ground 30 cm deep trenches on the outflow of rainwater
- optimal path width in the range of 1.6 to 1.8 m
- railing high 90 cm and in the height of 75 cm
- guiding elements for the blind side of the road - log, metalled lane
- setting suitable surface material into the environment without inequalities

Slopes and stals

- maximum slope in the range of 1:50 to 1:40
- staircase in the least possible extent
- railing at least 30 cm before the beginning or end of a stairway at a height of 90 cm on both sides

• in the case of a long staircase - rest platforms at least 1.3 m

Bridges

• walkway planks with gaps of 5 mm, at right angles to the direction of walking

• 1:20 maximum slope

• width of at least 1.2 m

• equipped with handrails both sides

Rest of the bench

• at a distance of 50-100 m apart in a quiet and attractive locations

• at the same level as the way, some in the sun, some in the shadow

• next to the bench instead of 1 m wide for wheelchair parking

• bench with 50 cm high, the back braces and armrests

• the bottom edge of the table should be there at least 75 cm from the top plate of the table legs with overhang 60 cm

• combination weight around 350 kg provide reliable support

• placement of benches on only two sides - the rest of the people use a wheelchair, or moms may park their stroller there

Study of the nature in the Tichá Orlice river valley

Topic and target group of the nature trail

The theme of the proposed trail is a medieval fort near the town Choceň. Their position on the hill, however, predisposes hills difficult hilly terrain, totally unsuitable for families with pushchairs or disabled people. On the other side of the valley Tichá Orlice with exposed chimneys arenaceous marl rocks, just a few minutes walk from downtown, still holds untapped potential for recreation. For this reason, longer range has been designed by leading castlesc difficult terrain and shorter PR Peliny and the park, which is its length, difficulty and terrain surfaces trips tailored to families with prams, seniors and disabled persons.

The study provides NS with different target groups. Its theme and content focuses on current city residents Choceň, offering bits of history to know their city and provide wildlife with a walk recreational furnishings and attractive playing elements. Furthermore, the NS should reach out to new groups and to attract more visitors to the region.

Guidance and information elements

The advantage of sitting, then bowed panels that easily fit into the environment, prevent vision and are easy to read to children and people tied to a wheelchair. The content of the panel can be printed on a special foil and mounted on aluminum plate. Information panels will be attached to wooden columns at a height of 80-100 cm. Posts are designed from roughly round to evoke a medieval atmosphere. The study suggests 4 options graphics panels. Every-panel contains the symbol and name of the trail, stop sign, guide map, a description of other parts of the route, part of the text, picture section, prohibition pictograms, the name of the founder, and other requirements under the rules of publicity grant programs. The content of the information panels constitute the basic information about the location, a brief description of the fort and a legend or tradition of Choceňsko.

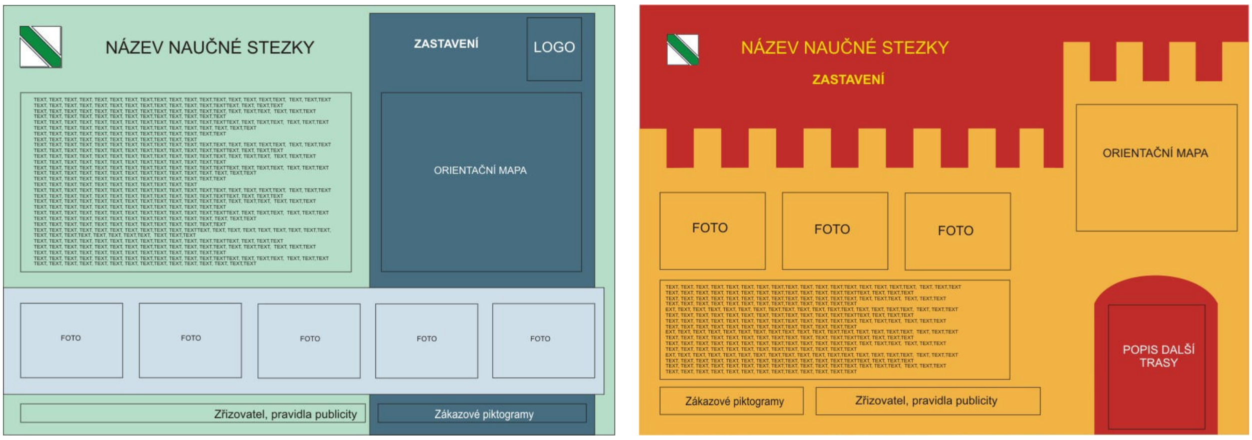

Figure 1: Information panels

Designed furniture

Important part of the NS is furniture. Proposal's elements should be adapted to the intended users, the environment, which will be located on the NS. The Chateau offers visitors a range of workout elements for the elderly or people with a mild form of disability. Furniture components are designed to exercises and game elements, such as bowling or seniors favorite playground for pétanque. The site is designed Peliny commons with the grilling table and a set of stone benches and a table. Visitors can spend a pleasant afternoon with friends at the barbecue, just bring your own materials and fuels.

For the target group of visitors is reflected in the benches, which are prescribed by the seat height of 45 cm and head under his hands. Are spaced at distances of 50-100 meters apart along the path. Thanks to the circular form of trails will ensure placement in the shade and sun. Play elements in a public place must comply with standards ČSN EN 1176 playground equipment and ČSN EN 1177 Playground shock absorbing surface. It must also be certified by authorized person. For this reason, the furniture was chosen from a menu already certified firm.

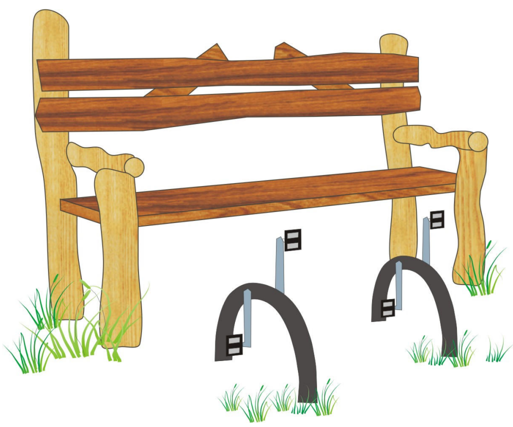

Figure 2: Excercise element - bench

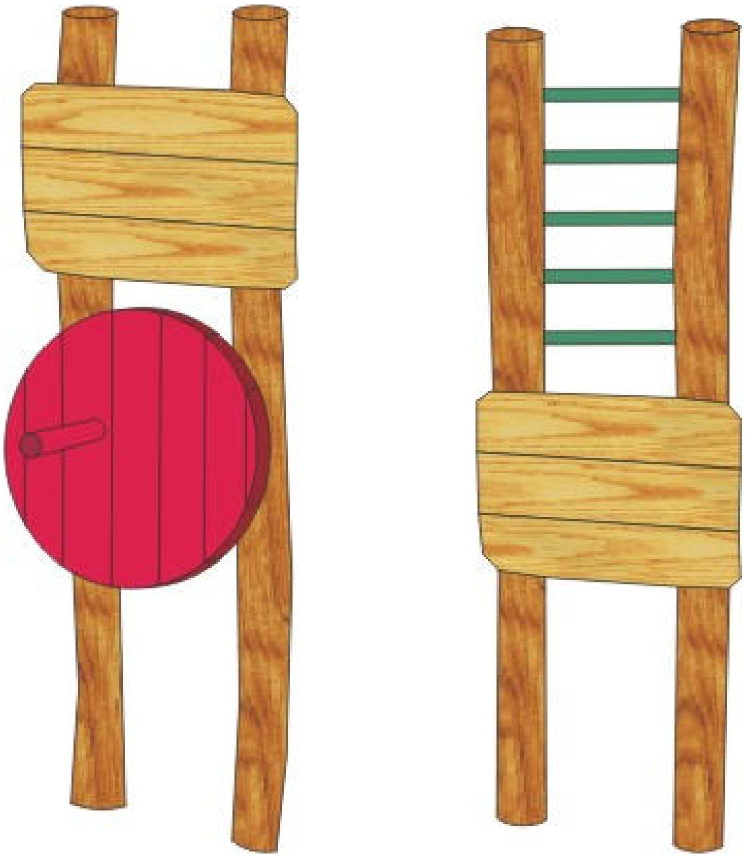

Figure 3: Excercise elements – rotary disc and hayrack

Figure 4: Excercise elements – foot bridge

Conclusion

Disabled persons, seniors and families with strollers in nature encounter similar obstacles. Sometimes just a little thing for them to trail or an attractive site became inaccessible. When planning the trail is wheelchair should be considered on its easy availability, security and sledding trails, adequate maneuvering space, how to overcome height differences and the appropriate choice of material surfaces. Must be tailored for guidance and information features. For the visually impaired can use Braille or audio recordings. Orientation in space will allow them to guide the edge of the road lanes. It is necessary to adjust the length of the circuit with the possibilities of shortening the route, and off-road performance. Carefully selected furnishings to be deployed at short distances.

The study proposes trails 3 km long circuit for disabled people, leading after 5 stops. It begins with a large range of welcome signs, but leads through the park to the castle and go up the river rocks below martile. At the end of the valley turns back to Choceň. The trail is equipped with special furniture and Training included protahovacími elements, bowling and play area for pétanque.

The content of the information panels constitute the basic information about the location, a brief description of the fort, a legend or tradition of Choceňsko annex and graphics on that stop.

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THE SOLUTION OF PROBLEMATIC POINTS OF TIMBER BUILDINGS RECONSTRUCTION

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ABSTRACT:

The problem is eliminating the risks by supplementary thermal insulation of timber buildings. It is important to observe the possibility of diffusion and condensation of water vapour in connection with danger of wood moisture increasing in construction. Service life of constructions and buildings of wood is dependent on temperature and moisture conditions in layers of the building cladding where the wood framework is built in. The aim of the paper is to carry out an analysis and assessment of the newly designed structure of the external cladding of a log cabin building from the viewpoint of heat engineering, particularly in light of possible diffusion and condensation of water vapours or temperature/moisture conditions and corresponding equilibrium water content of built-in wood.

KEYWORDS: wood, log cabin construction, heat-technical assessment, moisture, service life

1. INTRODUCTION

The Czech Republic is obliged, similarly as other EU member countries, to guarantee the implementation of 2002/91/ES direction on the energy demands of buildings into its legal order. The direction introduces requirements for the standard framework of the method of calculation of the energy demands of buildings, viz. both for newly designed and realized buildings and for existing buildings, which are the subject of reconstruction.

Generally, it refers to a very elaborated process, which should result in the increased quality of buildings and their technical equipment under simultaneous reducing the requirement for the supply of energy, higher coziness of the inner environment of buildings and, last but not least, reducing the environment load particularly by CO2 emissions as a component of the sustainable development of society.

On the basis of the direction mentioned above member countries commit them to accept measures inevitable to determine minimum requirements for the energy demands of buildings based on the standard form of evaluation. They can differentiate between new and existing buildings, various types of buildings and local conditions. The determined use of buildings and their age can be also taken into consideration. In the CR, the process is applied updating the CSN 73 05 40 standard "Thermal protection of buildings". This updating of even related standards will refer to all buildings for living, thus also those where reconstruction and modernization will be carried out.

2. MATERIAL AND METHODS

In standard designing practice, proposals of these adjustments are mainly aimed at achieving the required coefficient of heat passage, see Tab. III in the CSN 73 0540-2 standard "Thermal protection of buildings" – Part 2: Requirements. Because it refers to wooden structures, which have their specificities, thus, at the endeavour to achieve the lowest heat losses through lowering the coefficient of heat passage of cladding and through decreasing or elimination of its air permeability other basic requirements posed on constructions and buildings must not be affected (Lokaj, 2003). Particularly it is necessary to pay attention to a fact that when increasing one property ensuring basic requirements, reduction of the functional reliability of a building from the aspect of other no less important factors must not occur. Adequate service life and durability of a building have to be guaranteed.

Thus, to design and carry out reliable wooden building constructions with sufficient durability it is necessary to formulate main principles of the structural protection of wood. Primarily, the protection should ensure such moisture of wooden elements in the structure the wood not to be attacked by biotic agents, ie by wood-destroying insect or wood-decaying fungi. The main task of the protection of built-in wood is to prevent the penetration of rainwater and groundwater into the building. At the same time, however, it is necessary to prevent the water vapour condensation in the structure. It follows that without the adequate treatment of the construction from the aspect of heat engineering and verification of temperature/moisture conditions in the structure it is not possible to guarantee the mechanical strength and stability of wood-based materials or the durability of wood and wood-based materials in light of risk and damage caused by biological factors.

2.1 Methods

Under certain conditions, water vapours condensate inside wooden constructions. To assess particularly multilayer constructions it is necessary to pay attention particularly to provisions of the CSN 73 0540-2 standard "Thermal protection of buildings – Part 2: Requirements from the year 2002 and CSN 730540-2 standard, Change 1 as of March 2005, part 6. For a building construction where water vapour Gk i kg/(m2.a) was condensed and thus could endanger its desired function, condensation inside the construction must not happen: Gk = 0. The risk of a required function consists usually in shortening the anticipated lifetime of a construction, decreasing the inner surface temperature of a construction resulting in the origin of moulds (rot), volume changes and marked increasing the weight of a construction out of the framework of statistical calculations, increasing the weight moisture of a material to a level causing its degradation.

Provided the condensation of water vapours in the construction does not endanger its required function, restriction is required of the annual amount of condensed water vapours in the construction Gk in kg/(m2.a) to fulfil a condition: Gk ≤ Gk,N.

A requirement for the limited amount of condensed water vapour for other constructions, ie also for outside walls is determined as a lower value from Gk,N ≤ 0.5 kg.m-2.year-1 and Gk,N ≤ 0.5% of the area weight of a material. For building constructions where wood or wood-based materials with allowable limited condensation of water vapours occur inside the construction the standard mentions that it is necessary to carry out protection of these materials according to the CSN 49 0600-1 standard at least for hazard class 2 according to CSN EN 335-1: Durability of wood and wood-based materials. Definition of classes of threat by biological attack. Part 1: General principles and the CSN EN 335-2 standard

“Durability of wood and wood-based materials. Definition of classes of threat by biological attack. Part 2: Application for solid wood. Hazard class 2 includes wood or wood-based materials, which are indoors quite protected from weather but high humidity of the ambient environment can result in occasional but not permanent increasing its moisture.

In the building construction where the limited condensation of water vapours is admitted in the construction no condensed amount of water vapours must remain in the annual balance of condensation and evaporation of water vapours, which would permanently increase the moisture of a construction. Thus, the annual amount of condensed water vapours in the construction Gk in kg/(m2.a) has to be lower than the annual amount of evaporable water vapour in the construction Gv in kg/(m2.a).

The existing calculation procedure of evaluation of the annual balance of water vapours in constructions according to the CSN 730540 standard is rather different from a procedure given in the CSN EN ISO 13788 standard. Edge conditions in both procedures are introduced quite differently. In a methodology according to the CSN 730540 standard, evaluation of constructions is carried out gradually with increasing outer temperature from the calculation temperature -15°C to +25°C. Methodology according to the CSN EN ISO 13788 standard specifies calculations by particular months using mean month temperatures and humidity of the ambient air. The methodology also makes possible to introduce the different mean temperature and humidity of internal air into calculations for every assessed month, which was not possible in using standard procedures according to the CSN 73 0540 standard.

For the relative humidity of internal air the CSN EN ISO 13788 standard introduces the triple method of its determination according to the type of a room under evaluation. In ordinary rooms, their classification is carried out into humidity classes and the relative humidity of internal air is determined on the basis of external air humidity and an allowance corresponding to the appropriate humidity class. It is, however, unfavourable that the calculation according to the CSN EN ISO 13788 standard totally neglects temperatures, which are lower than the lowest mean month temperatures. It means that this calculation cannot determine how the situation will look in a construction at an external temperature lower than cca –5°C. A considerable advantage of this procedure consists in a possibility to introduce the initial building moisture or moisture accumulated during the present existence of a building.

A substantial difference in the possible determination of the amount of water vapour permeating through the construction stems from the method of assessing the properties of a steam-proof layer (“moisture stop”). In Czech technical literature, products for a steam-proof layer are classified according to their value of the equivalent diffuse thickness sd [m], which expresses the equivalent thickness of the air layer with the same diffuse resistance as the appropriate layer of a building construction.

The most marked increment of moisture in a cladding as against a computation model is, however, caused by heterogenous properties of materials, which bring about that in the place of material failure multidimensional diffusion of moisture occurs (Svoboda, Králíček; 2000).

Inhomogeneity of materials built-in in the group of strata of a cladding can be caused by technological undiscipline during building, most often by the imperfect connection of particular materials or by their connection to pervading elements and constructions. The CSN EN ISO 13788 standard mentions that in such damaged materials with great diffuse resistance decline of the equivalent diffuse thickness can occur even by several orders.

According to some authors it is recommended to decrease the factor of diffuse resistance up to 10% of its original value by a special estimate according to the percentage of damage. In other technical papers it is even mentioned that the value of equivalent diffuse thickness of such damaged materials can be reduced even 100 ×, ie to 1% of its original value. The amount of moisture, which penetrates to the external cladding strata thanks to the multidimensional propagation of moisture, cannot be determined by analytical calculations and, thus, it is necessary to use numerical methods or laboratory measurements of diffusion. Present laboratory measurements carried out in VUPS Zlin Co. and recently also in laboratories of FS CVUT (Faculty of Building, Czech Technical University) proved marked increase in the mass flow already at the very small disturbance of layers with great diffuse resistance. Results of measurements of moisture stops carried out in laboratories of the Faculty of Building by means of the Wet-Cup method when a perforated area amounted to 0.125% of the total sample area show decline in the equivalent diffuse thickness sd to a value of 5.3 to 4.7% of the value of undisturbed material (Slanina, 2004).

2.2 The proposal of thermal insulation of a log cabin building

A wall of solid wood fulfilling the required value of the coefficient of heat passage should be min. 37.5 cm thick. Most of timbered structures of beams is, however, 14, 16 to 24 cm thick. Thus, at reconstruction, it is necessary to deal with the thermal insulation of such a cladding. In the interest of preserving the outside appearance, internal thermal insulation of external walls is mostly designed.

Within a research project, 3 variants of thermal insulation of a timbered building were tested. In a selected building, sensors were installed on wooden elements to measure moisture and subsequently, thermal insulation was carried out of the building cladding. In each of the proposed methods of thermal insulation, temperature resistance and the coefficient of heat passage were determined by calculation according to the CSN EN ISO 6946 standard, the inner surface temperature and diffusion of water vapour under design conditions and the moisture balance (without the effect of built-in moisture and solar radiation) according to the CSN 73 0540 and CSN EN ISO 13788 standards.

Variant I – refers to additional thermal insulation from the inner side, which corresponds to the often-used proposal of a designer. For the thermal insulation a “moisture-stop” is used, which is not specified in detail. For the thermal insulation of an external wall 200 mm thick, thermal insulation ORSIL NF from mineral fibres 100 mm thick is designed. The inner surface of the wall consists of plasterboards 12.5 mm thick or floorboards. Between the inner boards and thermal insulation a moisture stop is inserted. The thermal insulation is inserted between studs of an auxiliary construction serving for the attachment of inner facing (see Fig. 1). (Kotásková, 2006)

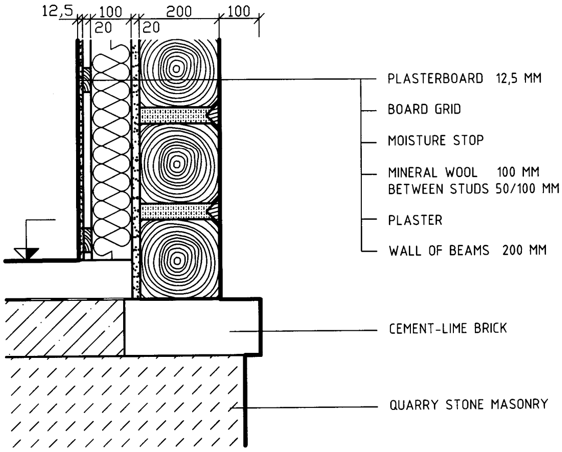

Fig. 1: A detail of the thermal insulation of the log wall from interior (Variant I and Variant II)

Variant II – corresponds the structure of the previous variant, however, the most effective moisture stop available in our market is used. It refers to a bubble polythene foil 4 mm thick coated with an aluminium foil. Between the moisture stop and inner facing, a closed air gap is carried out. Thus, the moisture stop reflection surface with lower emissivity is used to reduce the heat passage by radiation. During making the construction, it is necessary to be very particular about the quality sealing of the moisture stop joints, connection of the moisture stop to other constructions and sealing installation passages. At the design, a "diffusion rule" for multilayer constructions was observed where the value of the diffusion resistance of layers fell from the first layer in interior to the last layer in exterior. Details of the cladding structure - see Fig. 1) (Kotásková, 2006)

Variant III – In this case, it refers to the construction of the log cabin external wall with additional thermal insulation from the outside. Behind the log wall construction, a diffusion sheet with the higher value of equivalent resistance sd = 0.15 m creating convection barrier is attached. Thus, the flux of hot moist air from interior to the thermal insulation through fissures in plaster and in the puddle (filling up) of joints of beams of the timbered construction is prevented. The thermal insulation is inserted in two layers into grids made of laths perpendicular each other in order to ensure interruption of systematic heat channels. Before a ventilation gap below the external cladding of wood, a diffusion foil with equivalent diffusion thickness sd = 0.02 m is designed. A "diffusion rule" for multilayer constructions. Details of the cladding structure - see Fig. 2)(Kotásková, 2006)

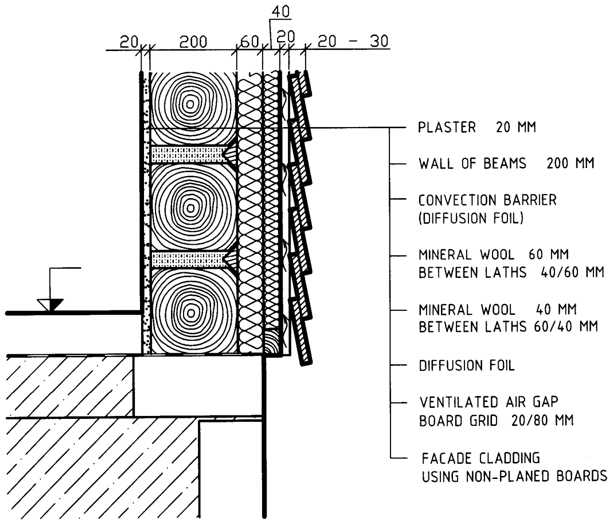

Fig. 2: A detail of the thermal insulation of a log wall from exterior (Variant III)

3. RESULTS

3.1 Variant I

A number of calculations and assessing the variant were carried out with the coefficient of heat passage either without the "moisture stop" degradation, further including degradation or correction of the coefficient due to anchors going through a heat-insulation layer or degradation is included or correction of the coefficient due to systematic heat channels, wooden studs 50/100 mm with 625 mm spacing. With respect to heat-technical assessing it is possible to classify the selected construction without degradation as a construction fulfilling requirements of correspondent harmonized standards. However, if we extend the heat-technical assessment by findings given above and aim at monitoring the temperature-moisture conditions inside the construction of an external wall, we can state (based on the analysis of calculations carried out by means of standard software) that the designed construction is rather risk from the aspect of reliability and durability. If we include in the calculation of the coefficient of heat passage degradation of the heat-insulation layer by anchors a requirement is not fulfilled for the coefficient of heat passage for lightweight constructions of external walls: U < UN, where U [W.m-2K-1] is a calculated value of the coefficient of heat passage and UN [W.m-2K-1] is a required value of the coefficient of heat passage by the CSN 73 0540 standard. Evaluation of the balance of moisture according to the CSN 730540 standard shows that condensation occurs in the place of existing plaster and roughly half of the thickness of the existing log construction of an external wall already at an outside temperature lower than + 5°C. According to edge conditions of the calculation, the period can take 180 days per year. Within the period, considerable part of the wooden construction will be subject to temperature/moisture conditions, which correspond to the equilibrium wood moisture > 28%. Based on the balance of condensed and evaporated moisture according to the CSN EN ISO 13788 standard it is evident that moistening the wooden construction will occur for the period of six months.

3.2 Variant II

In a designed construction with additional thermal insulation from the inner side, condensation of water vapours does not occur at designed edge conditions for habitable rooms. As evident from diagrams in Figs. 3 and 4, condensation zone does not originate inside the construction; lines of partial pressures do not intersect: pdx < p“dx, where pdx is the course of calculated values of the water vapour partial pressure, p“dx is the course of values of the partial pressure of saturated water vapour.

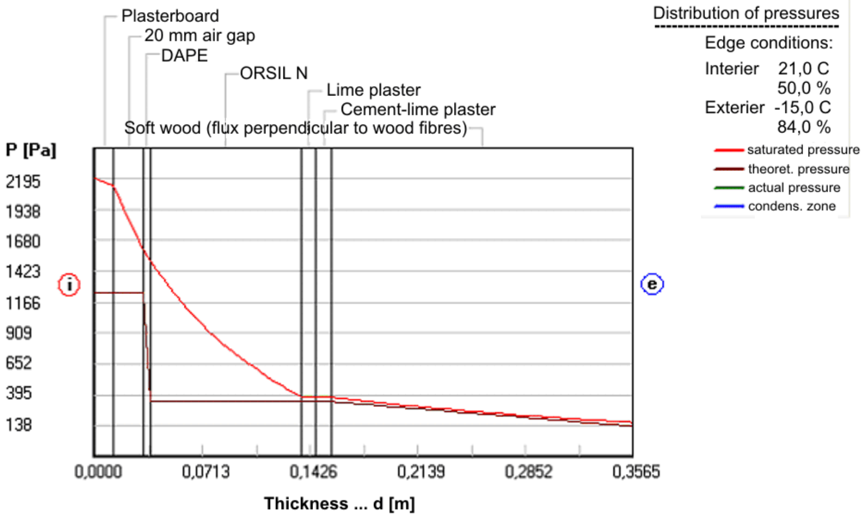

Fig. 3: Distribution of the water vapour pressures in a construction – loading by the external design temperature and moisture according to the CSN 73 05 40

At temperatures of ambient air approaching -15°C, moistening can occur of beams of the existing log wall above the value of equilibrium moisture content 20%. Under conditions corresponding to designed terms stipulated for bathrooms, the equilibrium moisture content of wood in the external wall construction would still increase. Moreover, wood in the present log cabin construction will be exposed to direct weather effects, which can impact on further moistening and durability of the construction particularly on the northern non- insolated side of a building.

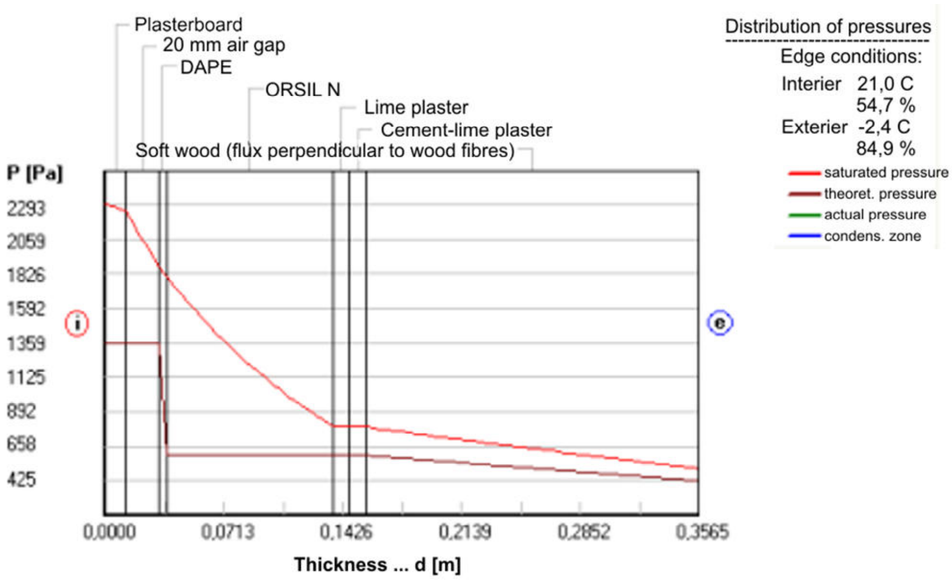

Fig. 4: Distribution of the water vapour pressure in a construction – calculation according to the CSN EN ISO 13788 standard

3.3 Variant III

The designed structure of the log cabin external wall with additional thermal insulation from the outside unambiguously fulfils principles of the structural protection of wood. Wood built-in in the construction fulfils conditions of the endanger class 1 (CSN EN 335-1 standard): wood or wood-based material is indoors, quite protected from weather being not subject to the effect of moisture. The present log cabin construction is virtually protected from the effect of moulds and wood-rotting fungi as well as wood-destroying insect.

Thanks to the low equilibrium moisture of wood and favourable temperature and moisture conditions in the construction it is possible to introduce into the heat-technical evaluation of the construction values of heat conductivity of applied materials corresponding to operation conditions. Thus, the calculated coefficient of heat passage of the construction U and heat losses of the building are substantially reduced (Havířová, Kubů, 2005).

4. SUMMARY

An overall survey of the additional thermal insulation of structures and evaluation of particular variants of the thermal insulation of a log cabin building shows that a well-designed structure and the type of a thermal insulation system are of the decisive importance for the service life and reliability of a construction. External thermal insulation of cladding is unambiguously better than inner insulation. Using a thermal insulation from exterior the existing wall is protected from weather effects (water does not penetrate through drying checks and joints into walls), problems associated with the water vapour condensation inside the construction do not occur and the absorbing capacity for heat of external walls is favourably affected. Additional thermal insulation of log cabin buildings from the interior side is almost always a risk matter. In every designed building construction of wood or in the design of its adaptation/modification a designer or contractor should also check/test the reliability of a construction in rooms with the higher design value of the relative humidity of the inner environment, eg a bathroom.

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