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CHALLENGES AND PERSPECTIVES

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ELECTRIC CARS
CHARGING STATIONS IN BOSNIA AND HERZEGOVINA

Quality of print in Offset printing

GEOSCIENCES IN SOLVING HUMANITARIAN PROBLEMS

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Content

Sadržaj

Dear reader,

Driven by the need for the area of scinetific research in the field of technical sciences to receive a publication in which the reference method to publish scientific papers will contribute to understanding, monitoring and development of Technical Sciences, we have launched the first international scientific journal Techno Science.

The Magazine was conceived as a publication intended to recognize technical sciences in international environment as a unique area in which joint action, cooperation and exchange through professional and scientific researh work is possible. In the perception of the Techno Science publication, the field of technical sciences is not limited to specific areas and branches, but is open for all contents which are in the function of technical sciences, with the aim of achieving the highest academic standards and monitoring flows of modern technology and the needs of society at the global, international level.

The magazine was published by NIA „The Association for Research, Education and Development", which aims to improve the current situation and will offer a new concept through publications of scientific - research results in the field of technical studies. NIA will place Techno Science in the center of all events and will offer networking, partnership and acquiring all requirements for entry and indexing in international reference scinetific bases as main strategic goal and task of the publication.

Techno Science is the result of team work of managerial, editorial and editorial staff board, which have, through mutual ideas, made a mutual vision in which quality is a condition for action and excellence as a prestige need to be achieved.

We would like to wish a warm welcome to all of you who are interested to achieve the vision of quality for excellence! We want to create new values that will build the future!

The second issue is dedicated to the International Symposium "GeTID&teh" which is organized and held for the fifth time by the Faculty of Technical Studies, University of Travnik. Selected authors and their work were given the honor and privilege to be part of the content that has a historical value. NIA Association is in partnership with the Faculty of Technical Studies and considering the international character and diversity of the scientific fields and branches of technical areas that were represented at the 5th International Symposium "GeTID&teh" the selected concept has fully satisfied the requirements for quality and content of the second issue of the publication Techno Science. We truly hope that you will share our opinion and that our positive energy is going to be a good motive and the initiator of your ideas to us.

The magazin will be published two times per year. On the last pages of this publication you can find the instructions for authors. These, as well as additional important information, can also be found on the web site www. technoscience.ba. We want you to feel free to contact us with all your proposals, suggestions and comments in order for the quality and progress of the publication.

We are looking forward to our future cooperation and we would like to welcome you!

Amra Tuzović, Ph. D.
Editor in chief

Dragi čitatelju,

Vođeni potrebom da naučno–stručni i istraživački prostor tehničkih nauka dobije publikaciju u kojoj će se na referentan način objavljivati naučni i stručni radovi koji će doprinijeti razumijevanju, praćenju i razvoju tehničkih nauka, pokrenut je prvi međunarodni naučno–stručni časopis Techno Science.

Časopis je zamišljen kao publikacija čija je namjera da se tehničke nauke u međunarodnom okruženju prepoznaju kao jedinstvena oblast u kojoj je moguće zajedničko djelovanje, saradnja i razmjena preko istraživačkih radova stručnog i naučnog karaktera. U percepciji publikacije Techno Science oblast tehničkih nauka nije ograničena na posebne oblasti i grane već je otvorena za sve sadržaje koji su u funkciji tehničkih nauka sa ciljem postizanja najviših akademskih standarda i praćenja tokova savremene tehnologije i potreba društva na globalnom, međunarodnom nivou.

Časopis izdaje NIA - Udruženje za istraživanje, edukaciju i razvoj koje želi kroz publikovanje rezultata naučno-istraživačkog i stručnog rada iz oblasti tehničkih nauka unaprijediti trenutno stanje i ponuditi novi oblik koji će svoju primjenu naći u praksi. NIA će kroz svoje koncepte djelovanja publikaciju Techno Science staviti u centar svih dešavanja i ponuditi umrežavanje, partnerstvo i stjecanje uslova za ulazak i indexaciju u međunarodnim referentnim naučnim bazama što je osnovni strateški cilj i zadatak publikacije.

Techno Science je rezultat timskog rada menadžerskog, uredničkog i redakcijskog odbora koji su kroz zajedničke ideje napravili putokaz zajedničke vizije u kojoj je kvalitet uslov za djelovanje, a izvrsnost prestiž koji se želi dostići.

Svi koji vide sebe na putu u ostvarenju vizije Kvalitet ZA Izvrsnost dobro su došli u NIA okruženje i publikaciju Techno Science! Želimo stvarati nove vrijednosti koje će graditi budućnost!

Drugi broj časopisa je posvećen Međunarodnom simpoziju „GeTID &teh" koji se u organizaciji Fakulteta za tehničke studije Univerziteta u Travniku održao po peti put (21.–23.10.2016.), a odabrani radovi su dobili čast i privilegiju da budu dio sadržaja koji ima historijsku vrijednost. Udruženje NIA je u partnerskom odnosu sa Fakultetom za tehničke studije Univerziteta u Travniku, a s obzirom na međunarodni karakter i raznovrsnost u naučnim poljima i granama tehničkih oblasti koje su bile zastupljene na 5. međunarodnom simpoziju „GeTID &teh", odabrani koncept je u potpunosti zadovoljio zahtjeve za kvalitet i sadržajnost drugog broja publikacije Techno Science. Nadamo se da ćete i vi dijeliti naše mišljenje i da će naša pozitivna energija biti dobar motiv i pokretač Vaših ideja prema nama.

Časopis će izlaziti dva puta godišnje. Na zadnjim stranicama ove publikacije nalaze se uputstva za autore koja će biti dostupna i na web stranici www.technoscience.ba kao i ostale značajne informacije.

Želimo da imate otvoren pristup prema nama, sa svim svojim prijedlozima, primjedbama i sugestijama koje ćemo staviti u funkciju kvaliteta i napretka publikacije.

Radujemo se zajedničkom putu na kojem vam želimo dobrodošlicu!

doc. dr. sc. Amra Tuzović
Glavna urednica časopisa

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Design of the message

HARIS JUSOVIĆ, Visual artist

FACULTY OF TECHNICAL STUDIES, UNIVERSITY OF TRAVNIK, BOSNIA AND HERZEGOVINA

Communication has the most important role in the world of graphic design. The way in which we visually define the purpose of our communication affects the overall logics of what we had designed. Inspiration is all around us. At times, it is shy and hidden. At times, it imposes itself. Anyhow, creating a story is an ongoing process that lasts even after the story was finished. With the help of visual communications, which are the essential part of graphic design, the story becomes a message. It becomes a message we share with others.

It resembles a box of chocolates. It is a message to be seen, read and interpreted. If you, as a designer, send a message to the world, you ought to be clear. You need to have a goal. A message without a goal is worthless. The goal could be a provocation, a declaration of love, a call to action, a call to the state of the society.

The message must be centered to the outcome and result-oriented. The example that illustrates the designers' reaction to the state of our society the best is the MESS Festival 2011 poster. That year, the largest theater festival in the region took place in honor of the closed museums in Sarajevo. The fact that the most important cultural institutions of a capital city were closed due to lack of money necessary to cover the overhead expenses was terrifying.

The poster showed the facades of closed cultural and historic institutions in the Capital in a form of MESS logo as a hole in a maze, shown from an unusual angle, focusing on the man as the savior, trying hard to resist and not to fall into another extreme while running away from disappearance. Here, man was a symbol of resistance and durability, by which he manages to resist catharsis. Without the communication component, graphic design is just a dead letter.

No segment can justify the absence of the punch line in visual communication. The punch line is the message, direct or indirect.

Designing the message is preceded by acquiring the general knowledge, the direction in which the message should go and its final scope. The message does not change the world, but it does change the mindset.

Without the communication component, graphic design is just a dead letter on paper.

Having realized that we had remained on the edge of the cultural catharsis, we managed to activate ourselves, which resulted in reviving the lost institutions.


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Geoscientists without borders – geosciences in solving humanitarian problems

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After heavy rainfall in the Balkan region (May 2014) that caused a lot of damage from floods in Bosnia and Serbia, the Association of Geophysicists and Environmentalists of Serbia (AGES) launched, with the support of SEG's (Society of Exploration Geophysicists) program Geologists Without Borders and the local community, a two-years long humanitarian project called The Assessment of infrastructure caused by floods in Bosnia and Herzegovina and Serbia. Geoscientists without Borders is a new program by the SEG Foundation sponsoring the application of geophysics and geosciences in solving humanitarian problems worldwide. This program aims to connect universities and experts from the local community, which were hit by a natural disaster.
The aim of the project is to combine several geophysical methods in order to establish the most efficient methodology which can define and remediate the existing landslides and prevent the emergence of new ones. Combining several geophysical methods, such as seismic (reflective, refractive, MASW), electric, EM and satellite methods, the obtained results will be presented to the relevant local authorities. Based on these results, mitigation measures of the investigated landslides will be proposed. Through multidisciplinary partnership and cooperation of AGES and the local community with experts from the world famous institutions dealing with engineering and geosciences, global geophysical community will be significantly strengthened. Also, training students in the application of geophysical methods is another aspect of the project. Students of undergraduate and graduate studies involved in the field work, as well as data processing and interpretation, will learn the practical aspects and the importance of geophysics. These students will be the next generation of geophysicists who will deal with predicting and preventing similar disasters in locations prone to landslides across the region.

Keywords: Landslides, Geoscientists without Borders, Serbia, BiH.

Introduction

In May 2014, a heavy rainfall caused an extensive disaster in the Balkan region (Figure 1). The damage was particularly severe in the catchment area of the River Sava. According to the European Bank for Reconstruction and Development (EBRD), the damage was estimated at around 1.5 to 2 billion euros in Serbia, and about 1.3 billion Euros in Bosnia and

Figure 1. Satellite image of the rain cloud covering Europe on 13 May 2014.

Herzegovina (BiH), (SBS, 2015). More than 1 50.000 people were evacuated and the total number of affected people reached 1.6 million. Houses were destroyed or partially damaged by floods due to the overflowing rivers and failed river banks in the plain areas, and by landslides in the hillsides. The number of landslides counted over 2000. This highlighted the danger of living in landslide prone areas, and the need for assessing the landslide potential.

Among the wide range of aids from all over the world, The Society of Exploration Geophysicists (SEG) sponsored a Geoscientists without Borders (GwB) project initiated by The Association of Geoscientists and Environmentalists of Serbia (AGES) titled Assessment of flood-damaged infrastructures in Bosnia and Herzegovina and Serbia.

This project connects 15 geophysical specialists from nine countries, 32 students and graduates of six universities in four countries (Japan, Serbia, BiH and Montenegro), local geophysical contractors, engineers and politicians of local governments, as well as residents of the local areas in geophysical surveys.

Geoscientists without Borders is an initiative of SEG launched through its Foundation to support humanitarian applications of geoscience around the world. Projects are often selected in the areas in need of assistance where geophysics can be a tool. The topics include archaeology, water management, pollution mitigation and disaster management due to earthquakes, landslides, tsunami and volcanoes.

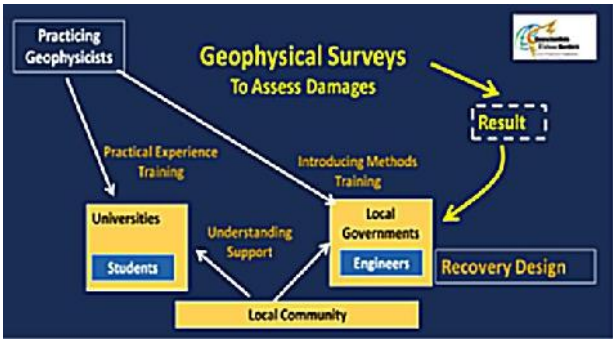

Figure 2. A Schematic diagram of the relationship between stakeholders of the GwB project.

The application of geophysics to landslide areas had been a previous GwB project in Brazil and Sweden in 2010-201 1 (SEG website). The current project was selected only a few months after the disastrous rain in response to the application by AGES. It started with a discussion with the local community and site scouting in March 2015, followed by field data

collection in June and September 2015. Twelve geophysical experts, twenty-two students and graduates from Serbia, BiH, Australia, Sweden, Italy and Japan participated in the fieldwork. It was supported by six local governments and many residents of the local community. The outcome will be delivered to the local engineers for designing their recovery plan (Figure 2).

Six locations in Serbia and BiH have been surveyed so far in the project in 201 5 (Figure 3). They are evenly spread between Serbia and BiH, and even in BiH, evenly spread between regions within it, considering the sensitivity of both the political and religious background.

Figure 3. Project areas

Methods used and review of results

Ground methods (seismic and electric) were used in order to compute a full set of elastic parameters and map layer boundaries.
Time lapse methodology (6 or more months difference) was also used, to investigate if any reactivation or slide advancement is happening. The base line survey was in the dry period, while the repeated survey was made after the rainy period. Multichannel Analysis of Surface Waves - MASW is a seismic technique used to investigate the underground condition by S-wave velocity distribution. It has been used in many engineering applications in recent years.

Seismic refraction was used to infer layer velocities and invert for layer boundaries. P-wave tomography was computed and combined with refraction interpretation. P-velocity profile was combined with shear velocity profile inferred from MASW measurements to produce profiles of elastic properties (Young modulus, Poisson's ratio, Lame's constant Lambda, Bulk modulus). These moduli or typical engineering parameters are related directly to the soil properties, rock strength and quality. Reflection imaging is used to help interpret layer boundaries and their morphologies as well as fine structures such as faults and fractured zones. Electrical resistivity tomography (ERT).

When studying landslides, electrical resistivity tomography (ERT) is a useful method because of the strong contrast in the resistivity between the coarse landslide material and the undisturbed bed-rock, despite some ambiguities that could be introduced during the inversion procedure and the limited resolution at depth. This method also helps by revealing the resistivity characteristics of the subsurface, thereby providing valuable information on groundwater distribution and on the geological structure of the subsurface. By conducting ERT in two phases, firstly in a dry period and secondly after a rainy period, we estimated water-table level by using the relationship between resistivity and water saturation.

Slope stability investigation. In this Project, a geotechnical engineer specialised in landslides will use the data and suggest direction of further investigation and remedial actions. The results will be presented to the local authorities so that they can plan the reconstruction of the damaged infrastructure. The proposed landslide investigation and analysis procedures consist of (1) preliminary investigation, (2) detailed investigation, (3) analyses of landslide mechanism and slope stability, and (4) selection of mitigation measures. In the step (1), collection and review of existing data, detailed site walkover and the topographic study was undertaken. Based on the results of these studies, a detailed geotechnical investigation including the all core borehole drilling, the geologic structure study, surface deformation study, the groundwater monitoring and the slip surface investigation will be carried out.

Geotechnical laboratory testing such as shear box tests and triaxial tests were also undertaken in step 2, in order to determine the residual strength of geomaterials in the slip surface. Based on these geotechnical studies, the identified slip surface will, then, be compared and refined with outcomes of the geophysics investigation.

The data obtained from preliminary and detailed investigations in the steps (1) and (2) will, then,

be used in the following analyses of landslide mechanism and slope stability in the step (3). Based on the results of all the steps, an appropriate landslide mitigation measure will be selected in the step (4). To extend the areas directly covered by the MASW survey and characterize it further, satellite imagery will be used to delineate the landslides boundaries, based on the soil properties and possibly thermal response. Clustering techniques will be used to integrate different geophysical measurements, as seismic, satellite, electro-magnetic and geological surveys.

In 2015, the following localities were investigated:

- Phase I: Valjevo, Zovik and Vrazici (3D)
- Phase II: Lopare, Bajina Basta (2) and Krupanj and in 2016:
- Phase I: Lopare (repeat S+R + new 3D), Novi Seher, Donji Bradic
- Phase II: Valjevo (repeat S+R + new profile, extend 5) (Figure 4).

Results of the complex geophysical investigations performed in Valjevo are presented in Figure 5.

Educating the future generations of geophysicists/ geoscientists/ environmentalists in BiH and Serbia

Project Assignment Goal was rigorous, theoretical and practical training of 32 students of undergraduate to postgraduate studies (particularly from BiH and Serbia) in application of geophysical methods (e.g., seismic, electric, etc.) in landslide analysis and research on landslide risk management, so to enable them in the future to join the teams of the landslide restoration planners and to conduct their own research and procedures, applying the basic principles of environmental protection and of sustainable development.
Project Assignment Reasons: The endeavour to educate new generations of experts in each scientific and professional field is the essential long-term goal of any serious scientific and professional organisation. Therefore, one of the relevant aspects of the Project to be realised by AGES, together with their partner organisations and supported by the SEG' Geoscientists without Borders and the local governments where the landslides were investigated, is actually the education of future generations of geophysical experts.

Figure 4. Lines of geophysical measurements in Valjevo

This particularly refers to the students of the universities involved in the Project - who, at the time of initiation of this Project, have the status of active students of undergraduate to postgraduate studies and who are interested in professional development in the fields of applied geophysics, geosciences and environmental sciences, the doctrines without which it is impossible nowadays to get the idea of a high-quality analysis of the areas affected by landslides, conducting landslide risk procedure assessment - particularly in the landslide prone areas, establishing the geological requirements to perform (geo) engineering works of restoration and/or mitigation of the landslide consequences and the like.

The landslide phenomenon, in any local self-government, especially in urban areas, causes multiple adverse effects on people's lives, health and work, as well as on socio¬economic development of the community because, in a very short period of time, it leads to extensive degradation of urban infrastructure (e.g., roads, bridges, water supply, sewers, telecommunications, etc.), inflicting significant material damages to the affected local self-governments.

It is not a rare case that massive and/ or frequent landslides make the everyday living completely impossible in the affected areas. Because of the need to have the landslide consequences remedied

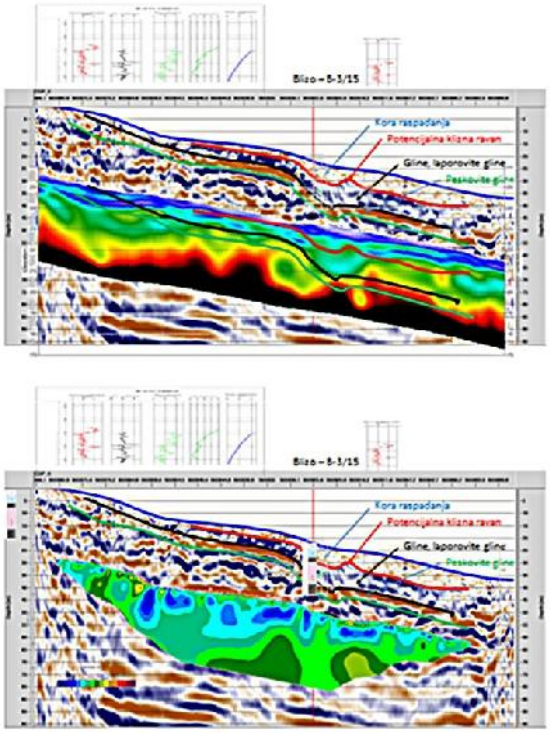

Figure 5. Results of the complex geophysical investigations performed in Valjevo

as soon as possible, the destroyed infrastructure in first place, and to have the normal course of everyday life and work restored in the communities that are located on, or gravitating toward the affected areas, when studying the negative effects of landslides, unfortunately, there are very often omitted the assessments of the negative effects of landslides on the wildlife and environment in the area of a direct or indirect landslide impact.

It was for this reason that, when outlining the plan of education intended for the students who participate in the project, a particular emphasis was put on gaining a sound knowledge in the field of landslide ecology, in addition, of course, to the carefully planned education necessary to master the methodology of geophysical investigation of landslides and acquire the general knowledge of landslides (e.g. types of landslides, terminology, specific features of landslides on local, regional and global scale and the like).

The above said type of integrated education, within which all the methods and doctrines are studied for the purpose of the contribution thereof to the protection and continual improvement of the environment, is increasingly practised nowadays, since it has become absolutely clear that a healthy environment is the basis of health of every person and of prosperity of the modern civilisation, as constantly pointed out by numerous international organisations dealing with the protection of biodiversity and the implementation of the concept of sustainable development (e.g. UNEP, OECD, WHO, etc.).

Such a type of integrated education involves, among others, the fact-finding and acquiring the skills in project management, developing the skills of outlining the public advocacy of certain ideas, e.g. regarding the importance of providing for the material resources and political will to establish a long-term monitoring over landslides and/or a timely and more complete informing of the citizens about the risk of landslides, and the like.

It is worth noting that the universities involved in the Project have not been chosen at random, but because they provide for education of the students of geology, geophysics, geodesy, architecture, civil, mechanical and electrical engineering, ecology, environmental protection and the like, potentially interested to participate in the Project offering them the acquisition of the theoretical and practical knowledge necessary for the geophysical investigation of landslides and the implementation of the engineering geology techniques intended for restoration thereof.

Project Assignment Sustainability:

1. Making students of undergraduate and postgraduate studies qualified to analyse the landslides by applying the geophysical methods would provide, to BiH and to Serbia as wed, a significant number of young geophysics experts who will, in the future, be able to independently work in this field of research for the purpose of the restoration of landslides;
2. The publishing of the monograph, with the emphasis on presentation of the basic elements of the so-called landslide ecology, would fulfil the evident void in the literature in this field in Bosnian, Serbian and Croatian languages, and thus, provide the basic information and support to the education in this significant professional activity.

Conclusions

As a part of the 2015-2016 GwB project of Assessment of flood-damaged infrastructures in Bosnia and Herzegovina and Serbia, a complex geophysical survey has been carried out. The data collected for reflection analysis were analysed by using the MASW method and compared with the results of the geoelectric method.

In the next few months, the reflection and refraction analyses of the same data will be completed, and the electric resistivity profile will be available. A few drilling sites have already been proposed. These data will be integrated into a comprehensive interpretation to contribute to landslide risk analysis. Among several Project Assignment Results related to education, the following ones are very important:

1. To make the students of undergraduate to postgraduate studies qualified to use, on their own, the up-to-date geophysical methods when analysing the landslides and, on the basis of the application thereof, to assess the risk for repeated landslides, to provide the advice to the geology engineering team within the procedure of landslide restoration planning, taking into account the observance of the fundamental principles of environmental protection and its continuous improvement, as well as the implementation of the sustainable development concept;
2. To make the students qualified to perform, on their own, the scientific-research work in the field, to make use of professional literature, process the results of their measurements, prepare the presentations of such results and the basic draft of the manuscript, as well to publish their scientific results;
3. The Monograph containing the presentation of the basic elements of the landslide ecology, from anthropogenesis and biological consequences of landslides, to presentation of the ecological tools that can be used to restore the biodiversity in the areas devastated by landslides, including the implementation the concept of sustainability and sustainable cities.

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Geolozi bez granica – geonauke u rešavanju humanitarnih problema

SAŽETAK

Nakon obilnih padavina u regionu Balkana (maj 2014. godine) koje su izazvale veliku štetu od poplava u BiH i Srbiji, Asocijacija geofizičara i ekologa Srbije (AGES) pokrenula je, uz podršku SEG (Society of Exploration Geophysicists) programa Geolozi bez granica i lokalne zajednice, humanitarni projekat Procena oštećenja infrastrukture u poplavama u Bosni i Hercegovini i Srbiji. Geolozi bez granica (Geoscientists without Borders) je nov program Fondacije SEG koji sponzoriše primenu geofizike i geonauka u rešavanju humanitarnih problema širom sveta. Ovaj program ima za cilj povezivanje univerziteta i eksperata sa lokalnom zajednicom koju je pogodila neka prirodna katastrofa. Cilj projekta je da se kombinuje nekoliko geofizičkih metoda u cilju uspostavljanja najefikasnije metodologije kojom se mogu definisati i sanirati postojeća klizišta i sprečiti nastanak novih. Kombinacijom nekoliko geofizičkih metoda, kao što su: seizmičke (reflektivna, refraktivna, MASW), električne, EM i satelitske metode, dobijeni su rezultati koji će biti predstavljeni relevantnim lokalnim vlastima i na osnovu kojih će se predložiti mere sanacije ispitanih klizišta. Kroz multidisciplinarno partnerstvo i saradnju AGES i lokalne zajednice sa stručnjacima iz poznatih svetskih institucija koje se bave inženjeringom i geonaukama, globalna geofizička zajednica će se značajno ojačati. Takođe, obuka studenata u primeni geofizičkih metoda je još jedan aspekt projekta. Studenti osnovnih i poslediplomskih studija koji su uključeni u rad na terenu, kao i obradu i interpretaciju podataka, sagledaće praktične aspekte i značaj geofizike. Ovi studenti će biti sledeća generacija geofizičara koji će se baviti predviđanjem i sprečavanjem sličnih katastrofa na lokacijama sklonim pojavi klizišta širom regiona.

Ključne riječi: Klizišta, Geolozi bez granica, Srbija, BiH.

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Geological structure and radon concentration in the territory of Serbia

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Lately, a hot topic in Serbia is the concentration of radon in the territory of the country and its impact on the health of the population. According to the statements of the National Agency for Protection against Ionizing Radiation and Nuclear Safety, above all, it is impossible to discover when the measurements of the concentration of this gas have been performed and which part of the country is covered by investigations, but the conclusion is that the results are in the highest percentage within the expected range. However, according to the available data performed by the competent geological institutions and the Vinča Institute, risk areas have been defined, where appropriate measures should be implemented. The data are analyzed in the paper and their correlation with the geological structure of the terrain is presented. Keywords: Radon, public health, Serbia.

Introduction

Environmental contamination by radioactive elements is certainly at the top of all the problems that have ever existed, and there is concern for the need to protect the nature and the man. Among all, radon in gaseous state is characterized by the ability to migrate through groundwater to large distances and to concentrate indoors, showing unwanted effects. The critical organ is the lungs, where it is fixed, causing malignant disease. Epidemiological studies have shown that this gas is the second leading cause of lung cancer (after smoking) (Komatina-Petrović S., 2011). Just like in most European countries, the problem of deaths caused by radon needs a more serious approach, and the first step is to use the existing geological and other appropriate data and to carry out radon risk mapping. It is logical that the research work should start from the most risky areas, marked by uraniferous formations and phenomena of uranium (Komatina M., et al., 2012).

In Serbia, systematic studies of nuclear mineral resources started at the end of the first half of the last century. Namely, in the period from 1948 to 1990, about 50% of the potential uranous territory of Serbia was covered by Geoinstitute - Belgrade and hundreds of anomalous zones of high radioactivity were discovered (Komatina M., 2016). The data collected are particularly valuable when it comes to preventive medical operation and organization of health care, because they indicate the risky areas, where human population is suffering the most, and which require urgent protection measures (areas of Stara Planina, Bukulja and Cer Mts. with uranium deposits, ore bodies in the Kukavica Mt. near Vranje and Muhova at Golija Mt., areas with uranonous phenomena at Lepenski vir, Brnjica, Plavna, Kosmaj - Babe, Stuble near Gnjilane, etc., Vranje-Bujanovac, Poljanica, Pčinjski, Sokobanjski, Zaplanjski, Koritničko-babušnički sedimentary basins, etc.) (Komatina S., 2004).

Particular attention should be also directed to the results of the measurements of the radioactive gas radon concentration, performed during the last two decades by Vinča Institute at several localities over the country (Žunić S.Z. et al., 2014). It has been shown, for example, that the measurements of the radon content in the

houses of the villages Stara Kalna, Gabrovnica, Belevica on Stara planina Mt. are, to say the least, warning. Thus, for example, in March and July 1997, the radon concentration in the two houses of Stara Kalna reached even 1736 and 2218 Bq/m3, in Balta Berilovac 1739 and 2012 Bq/m3, in Belevica 934 and 1500 Bq/m3 (Bossew P., et al., 2014). Note that, according to the Agency, the warning level is 400 Bq/m3.

In the Southern Serbia, the measurements of radon content covered 300 primary schools, and high (anomalous) concentrations were registered in every tenth school. Furthermore, exactly the half of the registered anomalies refer to the areas of Surdulica, Vranje and Bujanovac (Uševce, Dobrejance, Kruševo, Surdulica, Misurica, Krševica, Košarno, etc.).
In the mentioned areas, the primary carriers of ore occurrences are granitoids of Surdulica, Bujanovac and Kukavica, but also volcanites of the Lece massif, while secondary uranium deposits are related to the Paleogene sandstones of Poljanica basin, Vrla, etc. (Bossew P., et al., 2013).

Geological composition and structural fabric of Southern Serbia

The territory of Serbia is characterized by different petrographic content and complex structural relations (Fig.1). Within the territory, the following geotectonic units are defined (Fig.2):

- Carpatho-Balkanides, with the part of Dakian basin;
- Serbo-Macedonian mass;
- Vardar zone;
- Dinarides and
- Pannonian basin.

Investigations related to radon concentration in primary schools have been performed in the area of the Serbo-Macedonian mass, southern from Jastrebac Mt., as well as Sokobanja (spa), within Carpatho-Balkanides. The boundary between the two units extends from Golubac, to Despotovac, Aleksinac, Niš and Ruj Mt., while, between the Serbo-Macedonian mass and Vardar zone, it extends from Belgrade, to

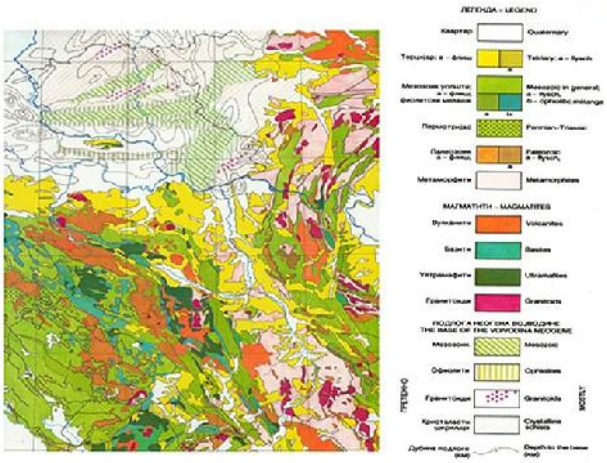

Figure 1. Geological map of Serbia

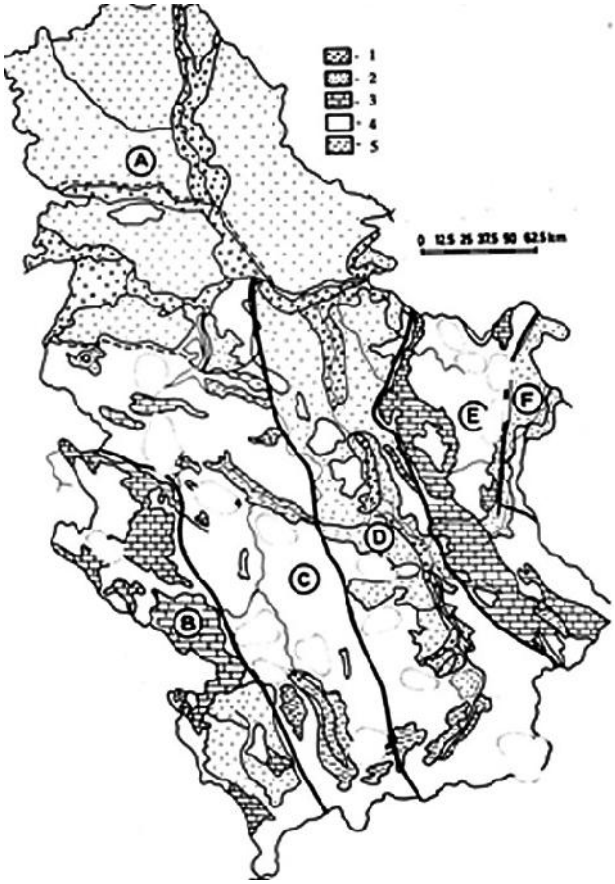

Figure 2. Geotectonic units of the territory of Serbia.
A. Pannonian basin, B. Dinarides of Western Serbia; C. 22 Vardar zone; D. The Serbo-Macedonian mass; E. Carpatho-Balkanides; F. Dakian basin;
1. Alluvial formations;
2. Neogene lacustrine sediments;
3. Limestones;
4. Fractured formations;
5. Neogene clay sediments

Aranđelovac, Kragujevac, Trstenik, Podujevo and Gnjilane, towards the National boundary with FYRM (Fig.2).

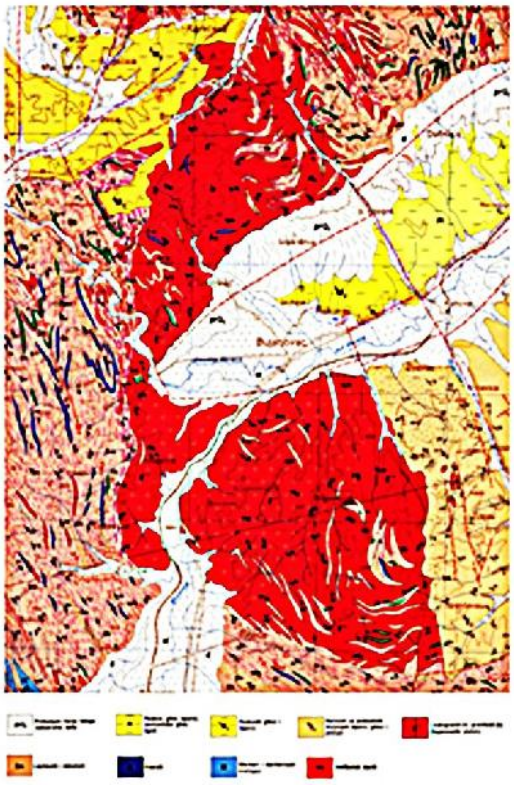

Figure 3. Geological map of Bujanovac pluton (Žunić S.Z. et al., 2014)

The study area from the Serbo-Macedonian mass is characterized by complex geological structure - numerous geological formations of different origin and age. In other words, Precambria to Quaternary magmatic, metamorphic and sedimentary formations are present (Komatina M., 2001).

Precambrian and Paleozoic schist rocks are predominant, defined as upper and lower crystalline complex. Bottom crystalline complex is made of gneiss, mica schist and leptynolite, with lenses of marble and quartzite (Fig.1). Marble formations are predominant along the edge zone to Vardar geotectonic unit, extending from Propaslica, to Kmetovac, Preševo and Staro Nagoričane (Fig.3). The top complex (known as Vlasina) is made of low-level crystallinity shale (green shale facies) - mica-chlorite schists, amphibolites, mica schist and quartzite. This complex extends from Golubac (Danube river), to the Pek river, Babićka gora and Seličevica to Osogovo and along the National boundary with Bulgaria. Granite layers of Mt. Kukavica and the Slatinska river, but also granitoide layers of Božica are intruded into the top complex shale. Furthermore, within schist formation, intruded magmatic rocks (granite, diorite, granitoide formations of Vlajna), as well as granitoide of Bujanovac pluton and SE from Gnjilane (intruded 234 million years ago) (Fig.3) are significant.

Uranium-bearing formations of the Southern Serbia

During the last six decades, systematic investigations related to uranium content were performed in Serbia. That is why in 1949, several uranium-bearing minerals were discovered by geologists from The Geoinstitute, Belgrade, and in 1955-1959, a conclusion that the terrains made of old schist and granite layers are the most perspective geological environment for uranium minerals was announced. In the period 1960-1971, beside Žirovski vrh in Slovenia, deposits in Permian red sandstones of Stara planina Mt. (Gabrovica, Srneći do, Dojkince), granites of Bukulja Mt. (Paun Stena, Cigankulja) and numerous other mineralizations (Zaplanje, Barbes, Slatinska river, Stublovača near Gnjilane, Muhov on Golija Mt., etc.) and radioactive anomalies, were discovered.

Systematic regional and detailed investigations were performed over one half of the potential uranium-bearing territory of Serbia, when several hundreds of high- radioactivity zones were defined. Besides uranium, radium and potassium, radon was subject of investigations not only in the prospecting stage, but also during discovering nuclear raw materials deposits. Because of the high migration ability and appearance in various geological formations, which is characteristic in comparison to almost all other metals, uranium is of very unique metalogenesis. Besides, once deposited, uranium can be easily moved into another formation and concentrated depending on geological and hydrogeological conditions existing after forming the deposit. However, in different

areas all over the world, uranium production is carried out from deposits in appropriate petrographic formations, as: quartz sandstone (USA, Nigeria, etc.), conglomerates (Canada is at the second place in the world in reserves from conglomerates; S. Africa and Brazil), uranium-bearing phosphates in Morocco, uranium-bearing schist rocks (N.Australia, Sweden, Spain, etc.) and granites (Spain, France, Czech Republic, Germany, etc.).

In Serbia, the following uranium-bearing units are recognized:

- crystalline massifs with alkaline type granitoide outcrops. It has been already mentioned that these rocks are particularly present in SE part of Serbia, within the Serbo-Macedonian mass. Significant appearances are: Nekudovo, Resavica, Trepetljak, Klokočevac, etc. Shales of Mt. Kitka in FYRM, from the same geotectonic unit, with radon-gas concentration of 15,000 Bq/l, as well as gneiss in Selecka Mt., characterized by the series of radioactive anomalies, should be mentioned.
  The granitoide formations are defined as an environment consisting of the greatest number of uranium appearances and deposits (Janja granite with deposits, Mezdreja, Gabrovnica, Srneći Do; granites of Bukulja Mt. with Paun Stena and Cigankulja deposits; granites of Kukavica and Cer, etc.). It is worth mentioning that granitoides were uranium sources, contributing to forming deposits in adjacent younger sediments;
- Old terrigenous sediments (sandstones and similar) are the most important formations for uranium mineralization in former Yugoslavia. The best known are: Permian Greden sandstones (Žirovski Vrh deposit in Slovenia) and Permian red sandstones in Stara planina Mt. (Dojkinci deposit), etc.
- Terrigenous sedimentary basins, particularly basins with Lower Tertiary sediments, formed within or along the edge of crystalline/granitoide massifs. The Uranium mineralization of this type has been discovered in Vranje basin (Fig.3), but the environment suitable for depositing is also present in Toplica, Leskovac, Sokobanja and Babušnica basin.
- Uranium deposits can be formed in crushed zones of volcanic rocks. Uranium mineralization in the Zletovo river (FYRM) is related to the crushed zones of andesite and pyroclastite in Zletovo-Krapovo volcanogenic area. Southern from Gnjilane, lava flows and pyroclastites of alkaline volcanism (Fig.4). Stublovača hill, southward from the town, is made of trachyte, containing uranium veins, visible near Stuble village. Trachytes are characterized by very high content of thorium and uranium.

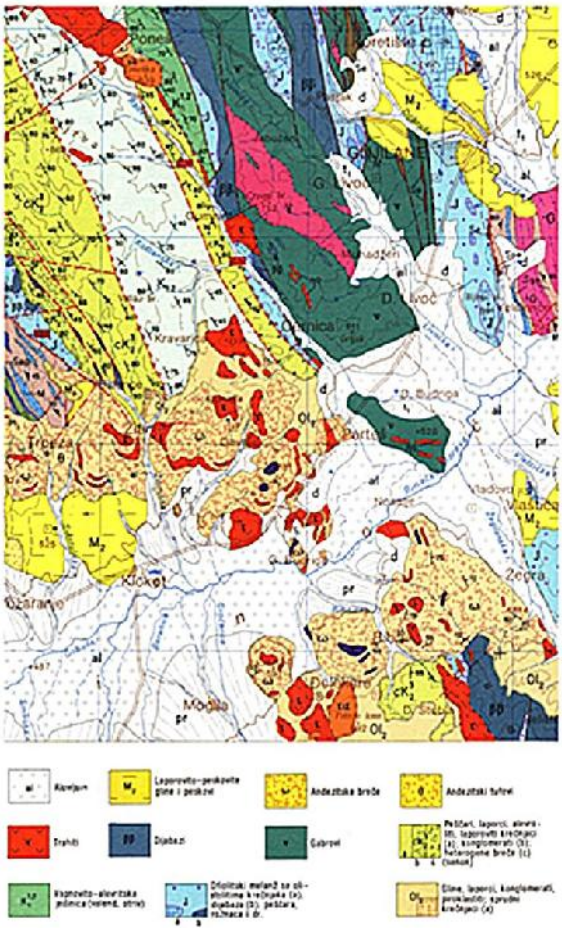

Figure 4. Geological map of Gnjilane and its vicinity (Žunić S.Z. et al., 2014)

Besides partly investigated ore zones of Stara planina, Bukulja and Cer Mts., the following areas of S. Serbia have not been studied enough:

1. Surdulica granodiorite massif (Fig.5), particularly the Slatina river, containing granites with high uranium content (it is expected to be a uranium deposit). Because of the present mineralization, the locality of the Slatina river has been the subject of exploratory drilling and lab investigations. Furthermore, within volcanic rocks (dacites,

quartz latites), formed as breakthroughs in granodiorites, quartz latites are formations with high uranium content (granite: 7.14 ppm; quartz latite: 7.15 ppm), but also of thorium (granite: 17.07 ppm; quartz latite: 22.33 ppm).

2. The complex of Lece massif volcanic rocks (predominantly andesite), SE from Kuršumlija (Fig.6), is characterized by high uranium content. The average uranium content is 3.35 ppm and of thorium: 14.50 ppm.
3. Within the investigations of the Tertiary basins in Serbia, radiometric measurements have been carried out in the area of the upper part of the Pcinja river, as a perspective regarding the discovery of the uranium deposits. Here, large amounts of uranium have been brought by volcanic activity. It was determined that the majority of the discovered uranium occurrences are distributed along the appropriate stratigraphic horizons in Paleogene sediments, particularly in facies where sandstones are predominant. Uranium outcrops are visible in Saince- Mezdraja zone. Neogene sediments are, also, carriers of uranium mineralization, but only in Žbevac-Klinovac zone. In the southern part of Surlica tufaceous series, narrow-localized uranium occurrences are present in breccias close to the main fault, along which dacite-rhyolites are outcropping.
4. Pegmatite containing beryl and radioactive minerals are located in Pasjača and Vidovača Mts., southern from Prokuplje, at the area of approx. 200 km^2 (Fig.7).

Radioactive minerals are discovered in pegmatite bodies near Dobrotić village and in Vukašinov potok (Fig.8). The high content of uranium soluble component, particularly in the areas of granitoid rocks, is important for uranium migration during the weathering process. The released uranium is mobile, and at suitable geochemical barriers, it can be accumulated in high concentrations. For example, sandstones and conglomerates from Paleogene lacustrine basins could be suitable for uranium accumulation. It is also known that uranium can be transported to distances of several tens of kilometres, making the investigators more complicated. The highest values of hydrochemical uranium anomalies in the territory of Serbia are defined in Barbes Neogene basin (uranium content in water: 2.14 mg/l), granitoides of Bukulja near Garasi village (1.30 mg/l), volcanic rocks (trachyte) of Klokot Tertiary basin near Balance village (eastern from Uroševac) (up to 0.65 mg/l) (Fig.4), granitoides of Janja (Eastern Serbia) (up to 0.40 mg/l). High radon content in groundwater directs to the relationship with some uranium mineralization – uranium degradation in contact with water. Migration of this radioactive gas is carried out along fault zones and fracture systems, and it is more expressed than for uranium and radium (Komatina M., 2004).

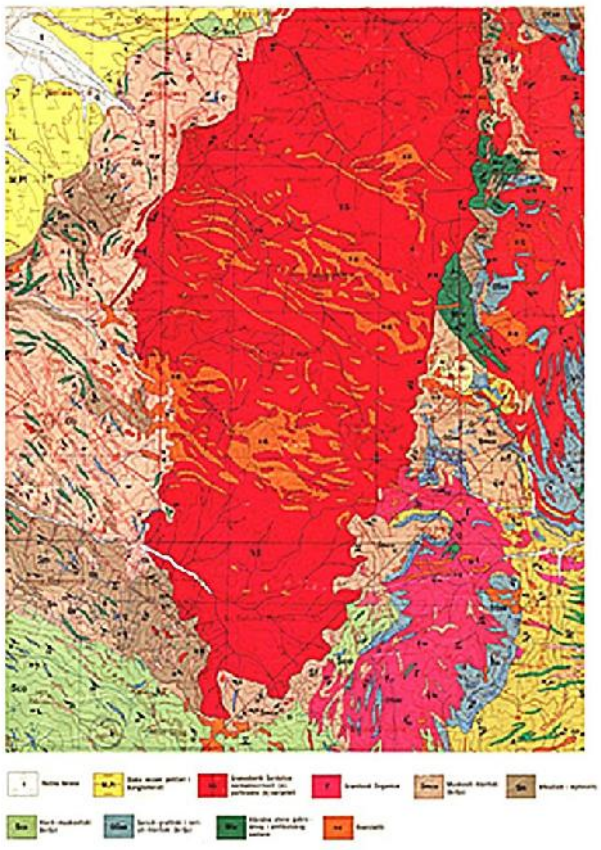

Figure 5. Geological map of Surdulica granodiorite massif (Bossew P., et al., 2013)

The highest distinguished values of hydrochemical radon anomalies in Serbia are: Grban – in Proterozoic metamorphites of Stalac gorge (radon content: 5,020 Bq/l) and Majur-Slatina spring in granitoides of Bukulja Mt. (1,000 Bq/l), etc. The anomaly in the area of Kitka Mt. is also interesting – approx. 20 km southern from Skopje (FYRM), where peak value of radon content in groundwater of Crvena voda spring of 19,640 Bq/l was determined. It is possible that the main aquifer is made of Paleozoic marble,

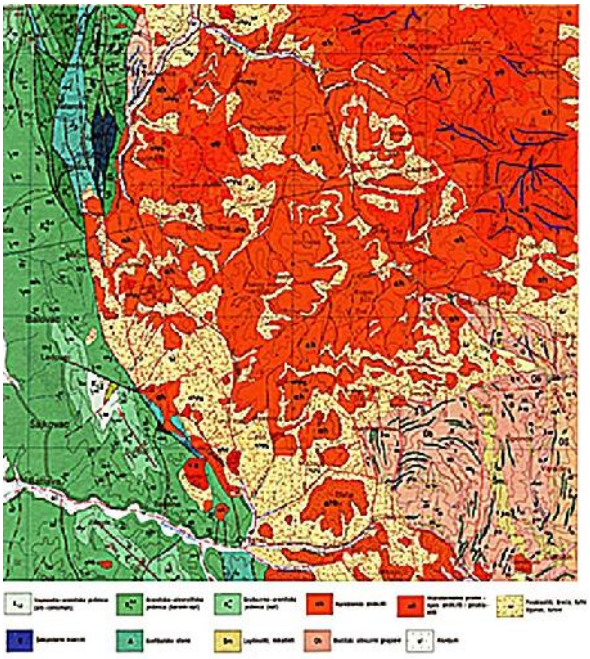

Figure 6. Geological map of Lece andesite massif (Bossew P., et al., 2013)

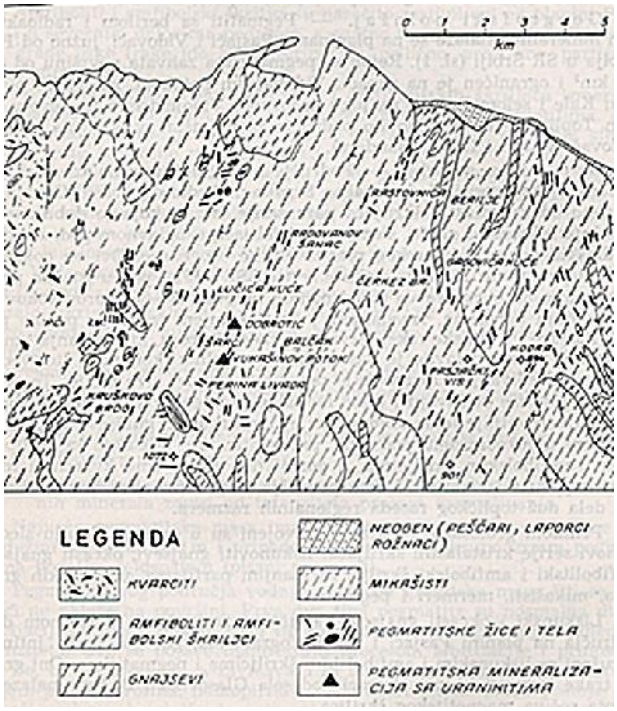

Figure 7. Geological map of the area southern from Prokuplje (Komatina M., 2016).

confined by impermeable metamorphites and intrusions (Fig.8). From marble, groundwater flows along the fault zone, being in contact with uranium deposits and becoming rich in radon and radium. The deposit has been probably formed by accumulating uranium and other mineralization at the contact of magmatic intrusion and marble.

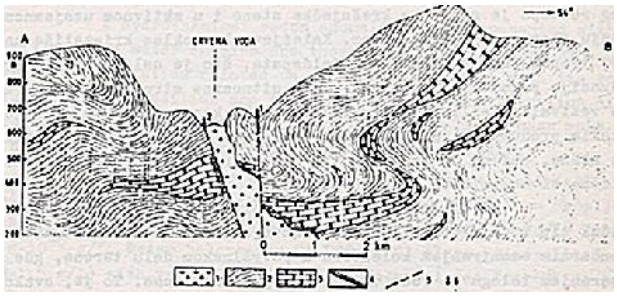

Figure 8. Prognosed geological cross-section (Komatina M., 2016)
1. granite;
2. gneiss and myca schist;
3. marble;
4. mineralization;
5. fault;
6. radioactive spring

Conclusions

Environmental contamination by radioactive elements is certainly at the top of all the problems that have ever existed, and there is concern for the need to protect the nature and the man. Among all, radon in gaseous state is characterized by the ability to migrate through groundwater to large distances and to concentrate indoors, showing unwanted effects. The critical organ is the lungs, where it is fixed, causing malignant disease. Epidemiological studies have shown that this gas is the second leading cause of lung cancer (after smoking). According to the statements of the National Agency for Protection against Ionizing Radiation and Nuclear Safety, above all, it is impossible to discover when the measurements of the concentration of this gas have been performed in Serbia and which part of the country is covered by investigations, but the conclusion is that the results are in the highest percentage within the expected range. However, according to the available data collected by the competent geological institutions and the Vinča Institute, risk areas have been defined, where appropriate measures should be implemented. In the paper, the relationship between high radon concentration and geological structure of the area is discussed.

On the basis of this analysis, further investigations should be performed and measures for public health protection cccarried out. The data collected are particularly valuable when it comes to preventive medical operation and organization of health care, because they indicate the risky areas, where human population is suffering the most, and which require urgent protection measures (areas of Stara Planina, Bukulja and Cer Mts., with uranium deposits; ore bodies in the Kukavica Mt. near Vranje and Muhova at Golija Mt.; areas with uranonous phenomena at Lepenski vir, Brnjica, Plavna, Kosmaj - Babe, Stuble near Gnjilane, etc.; Vranje-Bujanovac, Poljanica, Pčinjski, Sokobanjski, Zaplanjski, Koritničko-babušnički sedimentary basins, etc.). Investigations related to radon concentration in primary schools have been performed in the area of the Serbo-Macedonian mass, southern from Jastrebac Mt., as well as Sokobanja (spa), within Carpatho-balkanides.

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Geološka građa i koncentracija radona na teritoriji Srbije

SAŽETAK

U poslednje vreme se u Srbiji sve više govori o koncentraciji radona na teritoriji države i njenom uticaju na zdravlje stanovništva. Prema saopštenjima Agencije za zaštitu od jonizujućeg zračenja i nuklearnu sigurnost Srbije se, pre svega, ne vidi kada su vršena merenja koncentracije ovog gasa i koji deo zemlje je obuhvaćen, ali se zaključuje da su rezultati u najvećem procentu u očekivanom opsegu. Na osnovu raspoloživih podataka vršenih od strane nadležnih geoloških institucija i Instituta Vinča, mogu se definisati rizična područja, gde bi trebalo sprovesti odgovarajuće mere zaštite. U radu se analiziraju ovi podaci i daje njihova korelacija sa geološkom građom terena.

Ključne riječi: Radon, zdravlje stanovništva, Srbija.

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Quality webpages

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According to Poddar, Donthu and Wei (2008) , the quality of a website is defined as the overall perceived quality from the viewpoint of consumers. The main source of information about products and services needs to be, precisely, the website, which will allow users to quickly find the information through search engines on it. Search engines are a very desirable "tool " for all the parties; both the buyers and sellers. They allow us to quickly find information without searching the entire site, and therefore must be well designed to be effective. Keywords: quality, web, website, web design, informations.

The quality of the website

When designing a website, we must pay attention to designing visually appealing and interesting pages. It is imperative to increase customer satisfaction by meeting the exact quality of graphic design and visual appearance. Although it does not seem so important things like colour, text, entertainment and other forms of multimedia play an important role, and have a growing influence on the end user, and companies need to invest, groom and pay more attention to these features of the website. (Mithas, et al., 2007).

To attract the end-user a site should be fun, informative, challenging and unique. It must be clearly formulated and simple to avoid wasting time and customer or user dissatisfaction. Web pages must constantly be updated with the latest information, because customers want to see changes in the website. These products/services that are available should be placed on key words or pictures. Advanced websites support programs to help resellers learn what types of customers are interested in specific types of products / services and which can attract and retain them. A large number of companies that do business over the Internet use icons on their web for showing a page where customers can see the products they offer. Icons are usually small images of products, displayed on the website hyperlinks, that link to other sites of the company. The icons are accompanied by a short description of the products including the brand price, and they are used to attract customers to the website virtual store. The pictures are an important element of effective web design, and their popularity reflects it. The success indicator is reflected in the fact that they require far less effort than reading a text, and are therefore more attractive to the user.

Once the root website contains interesting elements, they cause consumer satisfaction or arouse their curiosity, and so it becomes more detailed than by providing more information about the product. Furthermore, although the icons are small, they are easily noticeable by users. This is their compact nature, which provides a simple homepage with a clear design. This factor is particularly valuable because it helps to make the first impression of web visitors more favorable, thereby encouraging them to investigate the site further. However, one should take into account that a lot of pictures on the page can significantly slow down its loading speed, and thus discourage users from using this website. The schedule icon also affects the efficiency of navigation display in a quality website. (Lam, et al., 2007)

A very important factor for the end user is the quality of information on the website. For consumers, the information quality is seen in accurate, relevant, complete information on the characteristics and prices of products or services. The accurate and comprehensive information offer the possibility of comparison with competing products or services. If it turns out that the information on the offered product/ service are of high quality, they impact customer

satisfaction, who in turn, purchase products or further research the sites.

According Ltifi Gharbi (2012), the quality of the information is reflected in three aspects:

- Semantics (user-friendliness of a website)
- Syntax (logical sequence scale information)
- Graphics (pleasant reading experience due to the graphical interface).

The safety of the user, during the use of the website, is also important: users need to share personal information with an organization they are not familiar with. Studies have shown that at least 50% of Internet users are concerned about their safety on the Internet: the abuse of credit cards you purchase with, sharing personal information, and web owners cookies follow the customer's online activity. The same survey shows that two-thirds of active users of the site leave it because it solicits personal information, while one in five users give false information to access the site. (Iwaardeen, et al., 2004)

According to Iwaarden Wiele in (2004), less than 10% of users leave the page if the page load time is under 7 seconds. However, when the page load time increased to over 8 seconds, 30% of respondents had to leave it and when the delay exceeded the load time of 12 seconds, 70% of respondents left the website. Users expect the website to load faster because all websites technologically advanced. So, it is very important that companies have a web page that is faster, but on the other hand, visually appealing.

As the number and size of the animation, images and sounds make the website more attractive, the time it takes to load a web page is likely to increase. Therefore, it can be assessed as negative by the user. The quality of services websites provide relates to the level of customer satisfaction, in regard to the services received, after they visited a certain website. Since Internet shopping does not include physical contact, the quality of services a website provides is very important for companies. The Quality of Service websites provide includes on-line or off-line elements. On-line elements include the simple way of getting feedback on product orders in case of complaints. Off-line elements include a fast delivery of products or services enabling the return of the goods with a refund if customers are not satisfied with them. The quality of service implies a willingness to respond rapidly to customer needs, including changes in the order, cancellation of the purchase, return of goods or money.

Off-line elements are a fundamental feature of the success the quality of services accomplished, since they impact the customer's perception of the value of all purchases. Their satisfaction results in an intention to repeat the purchase, or just visit the website. E.g. the fast delivery of products or ease of product returns in the event of dissatisfaction greatly impact the formation of the customer's positive experience, creating confidence and trust, which ultimately leads to more frequent visits to the website and customer retention. (Kim, Galliers Shin, 2010)

The perceived quality of websites

The perceived website quality can be defined as the consumer's opinion about the work and the appearance of a specific company's website in comparison with the websites of other companies. There is a positive connection between the quality web sites and consumer confidence. The positive initial impressions on the website have a great impact on customer confidence, as well as to the salesperson or the company.

A quality website serves as a signal to customers to increase confidence in it, and range according to the confidence intervals towards the dealer. Therefore, if the consumer's initial experience with our website is negative (e.g. Due to incorrect or defective display data), the first impression reinforced the negative ones and caused an overall negative conclusion about the website.

Similarly, if the consumer has an initial positive experience, based on professional, neat quality sites, it is likely that they will have a positive impact on the perception of the quality of website. (Lowry, et al., 2007)

According to a study conducted by Chen, Hsu Lin (2010) the effects that different levels of website quality have on the consumer's intention to purchase on-line, suggest that website quality affects the perception of the product quality which will be discussed in the chapters below.

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Kvalitetne web stranice

SAŽETAK

Prema Poddar, Donthu i Wei (2008), kvaliteta web stranica se definira kao ukupna percipirana kvaliteta s gledišta potrošača. Glavni izvor informacija o proizvodima i uslugama treba da bude upravo web stranica, koja će omogućiti korisnicima brz pronalazak informacija putem pretraživača na web stranici. Pretraživači su veoma poželjan „alat" obadvijema stranama, kako kupcu tako i prodavaču. Pretraživači omogućuju brz pronalazak informacija bez pretraživanja cijele stranice, te stoga pretraživači moraju biti dobro osmišljeni da bi bili učinkoviti.

Ključne riječi: kvalitet, web, web stranica, web dizajn, informacije.

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Basic Technical Requirements for the Use of Subliminal Messages in Marketing

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The term subliminal perception is used to indicate the effects that stimuli, exposed for a short period of time so that they cannot be perceived consciously, have on people's behaviour. The use of subliminal messages for marketing purposes is well-known. The data on the effectiveness of subliminal messages originate from laboratories where special equipment was used. Having analysed technical characteristics of contemporary television sets and computer monitors of the world's leading manufacturers, we checked whether they can be used to subliminally display text messages and images. A subject cannot perceive a text message exposed for 50 ms (Kouider & Dupoux, 2001).

However, the length of exposing images depends on their content and ranges from 1-4 ms (Murphy, 1990), up to 20 ms. The refresh rate limits the shortest exposure of stimulus on contemporary monitors. On CRT monitors, it relates to the maximal number of images which can appear on the screen within one second and is expressed in Hz. With most monitors it amounts to 60 Hz, thus the shortest exposure of a picture on the screen is 1000ms/60≈16.67ms. LCD monitors have a different way of creating images and a different refresh rate in comparison to CRT monitors, but devices with nominal 60Hz, 120 Hz≈8.33 ms and 240 Hz≈4.16 ms are available on the market. These monitors usually have a response time of 5 ms. Therefore, contemporary computer monitors and television sets have technical preconditions for subliminal exposure of text messages and images.
Keywords: subliminal message, marketing, television monitor, computer monitor.

Introduction: Definition of Subliminal Perception and Marketing

It seems that everything in connection with the term subliminal perception is disputable : its name, the theoretical basis, the existence of effects and practical use. Subliminal perception is usually used to indicate the effects that stimuli, exposed for a short period of time so that they cannot be perceived consciously, have on people's behaviour. The term unconscious perception and suboptimal perception are somewhat better for explaining the phenomenon we have just defined, since there are various causes that make people unaware that the stimulus is exposed (the stimulus may be exposed only for a short period of time, it may be masked by other stimuli, or it may be out of focus with the subject's attention).

It is appropriate to use the term subliminal when we talk about studies conducted in the psychology of marketing, given that this definition was created for the needs of those studies, along with numerous prejudices. In this paper, we will deal with the effects of short exposure to visual stimuli for marketing

purposes. The term subliminal perception will be used besides its controversy since it is well-known to general public. A study by Zanot et al. (1983) showed that 81% of respondents knew what subliminal advertising was, while a study by Rogers & Smith (1993) showed that 74% of respondents were acquainted with subliminal advertising and that 61.5% of respondents believed that advertisers used subliminal messages in their advertisements.

Furthermore, people usually consider this type of advertising as manipulative and unacceptable, which has led to the legal prohibition of subliminal advertising in the USA, United Kingdom and Australia (Karremans et al., 2006).

In its broadest sense, the term marketing implies the communication between the one who sells and the one who buys. Within such a communication it is necessary to attract the buyer's attention, inform them on the product and finally persuade them to buy it. At the beginning of the twentieth century, marketers used newspapers, leaflets and the radio, but the situation changed drastically with the appearance of films.

It turned out that it was not irrelevant how the marketing message would be formed, what its target would be, how long it would be, etc. Therefore, marketers turned to psychologists, who, between the two world wars, became more open for practical application of the results of their studies. Inspired by the marketers' needs, psychologists checked which colours used in commercials attracted the buyers'attention the most, how long should commercials last, how often should they be broadcast to be effective, which personal characteristics should be targeted, how to formulate a slogan to be catchy and easy to remember, etc.

Studies which were carried out intensively for a quarter of a century pointed to some of the most important principles, but marketers thought it was not enough given the fact that even the best commercials could not sell some products in quantities that would satisfy manufacturers.

Politicians and military strategists were looking for more reliable methods to spread propaganda and undermine the morale of the enemy. A great number of influential people, including the founder of behaviourism John Watson, went into marketing. Nevertheless, the results were still not impressive enough for marketers (Watson, 1922; Buckley, 1982; Petty, Cacioppo & Schumann, 1983). Meanwhile, the idea of the possible use of subliminal stimuli for advertising purposes emerged as one of the ways to increase the effectiveness of advertising messages. When the studies of subliminal perception started, they were actually the continuation of earlier studies and their results had almost been forgotten.

The first studies of subliminal perception emerged at the beginning of the twentieth century and were supported by Scripture's assertions presented in his book "The New Psychology", published in 1987, in which he described the basic principles of the effect stimuli has on respondents who were not aware of it (Scripture, 1897). A study carried out by Dunlap (Dunlap, 1900) is also worth mentioning. In one of his experiments, Dunlap cast "an invisible shadow" on the eyes of the subjects who were looking at the Müller-Lyer illusion, which consists of two lines of the same length with arrows on both ends pointing to opposite directions, creating the illusion of different line lengths. Dunlap concluded that casting this shadow affected the way his subjects perceived the line lengths. Even though these results were not confirmed by other scientific research, Hollingworth (1913) suggested that such subliminally presented material could be used in advertisements. Further research in this field was accelerated by the emergence of the tachistoscope during the World War II, which enabled a very short exposure time to images and messages.

The Use of Subliminal Messages in Marketing

Given that the term subliminal is defined as below threshold, it is crucial to define what is meant by the threshold. Depending on the way research and measuring are conducted, psychology makes a difference between subjective and objective thresholds. The objective threshold is measured using a forced choice when a subject has to choose between offered alternatives. Subjects are exposed to an image or a word for a very short period of time. Then, they are given a few alternative images

or words, including the one which was shown. They are, afterwards, asked to say which one they were exposed to. The objective threshold is reached when subjects are able to say what they saw only on the basis of a mere guess. The stimulus exposure time which was so short that subjects recognize it only based on a guess, in a situation of a forced choice, is later used to subliminally expose the stimulus (Chessman & Merikle, 1984).

The subjective threshold is determined by the exposure time during which subjects are not able to say whether they consciously observed the exposed stimulus, but they were not forced to choose between alternatives. They only have to say whether they noticed something and what that was. One should bear in mind that the subjective threshold is higher (i.e. slower), for on average 40 ms, than the objective one (Merikle, Smilek & Eastwood, 2001). In subliminal perception, there is a disagreement between a subject's awareness of the stimulus and their behaviour under the influence of that stimulus. In other words, the subject is not aware of the subliminal stimulus.

However, the stimulus still has influence on their behaviour, and that is the reason why this paradigm is named the dissociation paradigm (Snodgrass, Bernat & Shevrin, 2004; Merikle, Smilek & Eastwood, 2001). McConnell et al. (1958) pointed out that it can be claimed, with a degree of certainty, that the closer the stimulus is to the threshold of consciousness, the more effective it will be.

However, the main difficulty is in determining the threshold, given that it is variable, both among subjects and in only one subject, from one day to another. In professional literature, subliminal advertising is usually related to the alleged experiment carried out by James Vicary (Merikle, 2000). This experiment could have been considered the first test of the influence subliminally exposed material has on advertising purposes, if it had really been carried out. In 1957, Vicary said that he had designed a special machine capable of displaying messages for a short period of time while the spectators, not being aware, watched a film.

The term subliminal advertising was created by Vicary, who also founded the "Subliminal Projection Company". In the alleged study which lasted for six weeks, Vicary exposed the audience to messages such as "Drink Coca-Cola" and "Hungry? Eat Popcorn". The messages were being repeated every five seconds and the message duration time was 1/3000 seconds. After processing the results, Vicary concluded that the sales of Coca-Cola increased for 18.1%, while the sales of popcorn increased for 57.5% (Merikle, 2000; Karremans, Stroebe & Claus, 2006).This discovery had a great impact on the public, and journalists also paid a lot of attention to it. Companies competed to get his services and, as a consequence, Vicary became popular and rich. Cinemas, television and radio stations started to use this technique.

However, at the peak of the frenzy for his technique, it was discovered that Vicary falsified both the entire experiment and the results in order to raise the rating of his marketing company. Although Vicary himself admitted what he had done, his false results are quoted and published even today. Vicary's assertions served as an inspiration for a large number of studies, which consequently led to the use of subliminal messages with the aim of persuading potential buyers to choose new products.

Since the exposure time of subliminal messages is very short, a few words or a single image may unconsciously internalize with a possible effect on behaviour,therefore the message needs to be simplified as much as possible. This is illustrated by the following experiment carried out by Byrne (1959). In his experiment, he exposed the word "beef"for 5 ms, several times, during the film. The experiment had the control group, which was watching the same film, without exposing the subliminal material. In the final stage of the experiment, the subjects were offered to choose one out of 5 different types of food on the list.

The results showed that subjects from the study group did not, statistically, significantly choose beef sandwiches more often, in comparison to subjects from the control group. Still, based on a questionnaire given to estimate the degree of hunger among the subjects, it turned out the subjects from the study group were hungrier that the subjects from the control group. Giving a TV presentation on thirst-related subliminal messages, Cooper & Cooper (2002) showed that subjects exposed to such a program were thirstier after the presentation, compared to the estimations before the exposure to subliminal messages, and compared to the control group which had watched the same program, but without subliminal messages.

Karremans et al. (2006) modified some details of Vicary's study, conducted it, and, based on the results, concluded that subliminal advertising of a brand affects the choice of that brand and the intention to drink that brand, but only in case people who this brand is advertised to are thirsty. Similar results, though in another context, were obtained by Strahan et al. (2002).Based on her own study, Bermeitinger et al. (2009) concluded that subliminally exposed material affects subjects only if it is related to their current need, or if subjects are in an appropriate motivational state. Contrary to the aforementioned studies, a great number of studies show that subliminal advertising is not that efficient after all.

In 1959, Champion and Turner conducted a study including two groups of students which did not show the significant effect of the images presented for 1ms on participant's decisions. Having meta-analysed 23 works which tested the efficiency of subliminal advertising, Trappey (1996) concluded that subliminal messages did not have a strong impact on behaviour. The same was confirmed by Saegert (1987). What is frequently criticized about studies on subliminal perception, carried out in the first half of the twentieth century, are methodological mistakes and exaggerated claims.

These studies were not only criticized for their shortcomings, but the very idea that the stimulus can be observed and processed unconsciously was rejected. Certainly the most influential and the most powerful criticism of subliminal perception can be found in the works of Eriksen (1956; 1960) and Goldiamond (1958). According to Moore (1988), the biggest issue was that studies which examined the effects of subliminal perception did not pay enough attention to the fact that stimuli should actually be below the threshold. In some studies, stimuli were far below the objective threshold; therefore, they were practically non-existent for subjects and without any effects on their behaviour.

The main criticism of subliminal perception research in the psychology of marketing was related to the studies which asserted that there were significant and long-lasting changes in the behaviour of subjects under the influence of subliminally exposed stimuli. However, during the seventies and the eighties, numerous studies were conducted by imposing stricter control of experimental situations with the aim to check whether subliminally exposed stimuli can be seen on an unconscious level and whether that way of collecting information affects decision making and the behaviour of subjects, without an intention to show big and permanent changes in the behaviour of subjects. A group of researchers used visual presentation of words and images the under conditions which prevented the possibility of their conscious perception. This is primarily related to the use of the stimulus exposure for a very short period of time, with the use of masks in order to neutralize afterimages.

The era of modern research in the field of subliminal perception started with experiments carried out by Marcel (1978; 1980) which tested the impact of subliminally exposed words on different types of cognitive judgement. In his experiments, Marcel exposed words (primes) for an exceptionally short time (at or below the level of detection, between 20-110 ms), after which masks were exposed to neutralize subsequent effects, followed by words to be recognized or classified in different ways.

The results of the experiments showed that subjects made lexical decisions faster when primes were semantically related with targets, which can be explained as the effect of semantic priming. The results of Marcel's experiments are important since they imply that cognitive processing of primes and the target achieve significant depth, even though their conscious recognition is blocked by short exposure and the use of masks.

Nevertheless, these set effects of subliminally exposed stimuli are not the only ones. In fact, it turned out that it is possible to use such stimuli to influence both the affective and aesthetic experience of targets exposed after them (Zajonc, 1980; 1984). Namely, subjects may develop an emotional reaction to a stimulus, which follows a stimulus exposed for a short period of time, and which they cannot recognize. It was believed that this was a consequence of the possibility that the affective reaction can be developed not only independently but also prior to the cognitive response (Moreland & Topolinski, 2010). Zajonc named this phenomenon "affective priming".

Studies which were aimed to test the effects of primes based on semantic content or physical attributes did not show effects when the exposure time was below a certain limit (usually below 20 ms). However, studies that used primes with affective content confirmed the existence of positive effects with the exposure of 1-4 ms (Silverman & Weinberger, 1985; Murphy, 1990). These differences

should be considered a consequence of the nature of the stimuli themselves (emotional vs. non-emotional), and not a consequence of the methodological differences in the performed experiments. Since stimuli were presented with such a short exposure time, numerous methodological remarks against studies in this field were avoided in studies by Zajonc and Murphy (Hollender, 1986). The problem with all studies of this kind is that many of them do not provide any data on whether subjects are aware of their exposure to prime, that is, we usually don't have data on whether the prime was visible or not. Kouider & Dupoux (2011) examined precisely this awareness of primes in subjects using several different prime exposure times, and their data suggest that primes below 50 ms can be considered invisible for subjects. Also, it should be noted that these data relate to priming with words only.

The existing data on the characteristics and effectiveness of subliminal messages originate mainly from laboratories in which special equipment was used. The aim of this paper was to verify whether text messages or images can be displayed subliminally on contemporary television sets and monitors of the world's leading manufacturers and what the shortest exposure time is. In particular, we compared the stimulus exposure time required so that stimuli could be considered subliminal, which we have discussed earlier in the paper, with technical characteristics of contemporary monitors available on the Internet, with the aim to determine whether it is possible to display such shortly exposed messages on them. Widely used monitors that create an image in three different ways currently available on the market are: CRT, LCD, and LED monitors (Sixto, 2003)

Here, we will not deal in detail with the way the image is formed on these screens. Instead we will mention only the most necessary information needed to understand the factors that determine the shortest period of time in which a picture is kept on the screen. Within the cathode-ray-tube (CRT), the display image is formed when an electron beam from one or more electron guns travels throughout the vacuum tube causing the pixels at the phosphorescent screen to glow. CRT televisions and computer monitors are based on analogue technology (Van Gorkom, 1997).

An LCD monitor is an improvement over the older cathode ray tube (CRT) monitors; it uses fluorescent panel and cold cathode technology (Menozzi et al. 2001).

Liquid crystal diode (LCD) technology Liquid crystal diode (LCD) technology is a form of lighting used in computer monitors and televisions. Cold-cathode fluorescent lights known as CFL lights are used to illuminate the screen for viewing graphics and video. The image is created by blocking light which passes through a layer of liquid crystal molecules (pixels) sandwiched between two layers of polarized glass. The naturally twisted liquid crystal molecules are forced to unwind or coil tighter by an electrical current; thereby the amount of light that passes through the glass is changed. In comparison to CRT, LCD needs almost half the power usage, is mercury-free, and has low electromagnetic interference (EMI) (Sluyterman, 2006).

The Properties of the Monitor Which Determine the Shortest Time of Image Exposure

The process of image formation in plasma screens is similar to LCD technology, but instead a layer of liquid crystal molecules there is a layer of cells coated on one side with red, green, or blue phosphor and containing inert gases. The gases are charged, they heat and emit a visible colour that forms the image with a progressive scan. The viewing angle of the plasma screens is wider, and it can generate more colours and darker blacks than LCD screens, also, it is not prone to latency problems (blurred motion). On the other side, plasma displays generally don't create image as crisp as LCD because plasma-screen pixels cannot be made as small as LCD pixels (Opara et al. 2012).

Light-emitting diode (LED) computer monitors use neither cold-cathode technology nor fluorescent technology. The screen is illuminated by light diodes in one of the two different ways, or a combination of both. There is edge lighting in which the white LED lights are clustered around the rim of the screen and diffuse evenly. LED lights are also spaced evenly behind the screen, and they are either not controlled or are controlled with a "local dimming" option.

The advantage of LED backlighting is in an even better energy savings, better colour quality, clarity, and faster refresh rates. The shortest time for and image to be displayed on the computer screen is dependent upon refresh rate and pixel response time. The refresh rate is the number of times per

second a complete image is drawn on the screen and is expressed in Hz. It should be distinguished from frame rate. The refresh rate is an attribute of the monitor, while frame rate is an attribute of the information which is sent to it from graphics processing unit. The frame rate signifies how often the image being displayed is repeated per fraction of a second before it is changed. In this paper we will assume that the frame rate is as high as the refresh rate of the monitor or even higher. The refresh rate of the CRT screens depended on the frequency of the electricity.

In the U.S., electricity runs at 60Hz, and elsewhere, 50Hz is common. Later, 60 Hz refresh rate became standard. This refresh rate causes the display's image to flicker which leads to eye fatigue and headaches in users, but this is individual. After all, nearly all the TV and movies we see are rendered at somewhere between 24 and 30 frames per second (Didyk, 2009). The newest LCDs are using greater refresh rates, having improved from 60Hz to 120Hz and faster panels rated at 144Hz are also now available along with 240Hz.
In the early days of LCDs this was predominantly a consequence of the "response time". Response time is the time the pixels need for changing from light to dark. The response times on modern LCDs are quite short, and this is the big issue anymore.

High-end televisions now have up to 600Hz refresh rate (60" Full HD Plasma TV with 600Hz, 2016), additional interpolated frames are inserted between the real images to smooth the image motion via advanced digital processing. It should be noted that this number is not the amount of frames per second it can display, but the inverse of the duration of a small pulse. For example, 600Hz plasma means its pulse length is 1/600 second, even though it only draws 60 frames per second. Plasma TV manufacturers wanted their products to appear as good as LCD TVs and started advertising higher refresh rates meant to reduce motion blur. It should be noted that the refresh rate has input lag impact. Input lag is the amount of time that passes from one refresh to the next, and at the same time, this is the shortest period of time in which the image is presented on the monitor.

The shortest period of time in milliseconds, in which the image could be presented, is calculated by dividing the 1000ms with the number of Hz in the refresh rate. Table 1 shows the common refresh rates and the shortest time the image is held on the screen.

Table 1: The refresh rate and the shortest time the image is held on the screen

REFRESH RATE	TIME IN MS
60HZ	16.67
75HZ	13.33
80HZ	12.5
100HZ	10
120HZ	8.33
144HZ	6.94
240HZ	4.16

Conclusion

The shortest exposure time of the stimuli on modern monitors is limited by the refresh cycle (refresh rate). A higher refresh rate enables a shorter exposition time of the image. The refresh rate in CRT monitors is usually 60 Hz. Consequently the image on the screen can be exposed as briefly as 1000ms/60≈16.67ms. LCD monitors create images in a different way and have a different refresh rate from CRT monitors, but there are devices in the market with the nominal 60 Hz, and between 120Hz and 240 Hz. As we see from Table 1, for monitors which have 120Hz, the shortest exposure time is 8.33ms and for those of 240 Hz it is 4.16ms. These monitors typically have a response time of 5ms. The experiments that we mentioned in the first part of the paper showed that the text primes exposed for 50ms are below the conscious perception, image primes should be exposed below 20ms, and emotionally charged image primes should be exposed 1-4 ms. So, we can conclude that the modern computer monitors and TV sets have technical prerequisites for the subliminal presentation of text and images. We should bear in mind that contemporary monitors can be used for subliminal exposition of images and texts if graphics processing unit has the frame rate as high as the monitor, which is usually the case. Computer and TV monitors are made with such high refresh rates in order to cope with motion blur and make the illusory movement look as natural as possible. In this paper we tried to examine whether these technical improvements may be used for other purposes. The use of subliminal messages in marketing is forbidden, but there are examples that it is still used. The ethical and legal concerns are possibly a constraint for using subliminal messages in marketing, technical prerequisites, as we tried to show in this paper, are no more.

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Osnovni tehnički preduslovi za upotrebu subliminalnih poruka u marketinške svrhe

SAŽETAK

Subliminalnom percepcijom označavaju se efekti koje na ponašanje ljudi imaju draži koje se izlažu veoma kratko tako da se ne mogu opaziti svesno. Javnosti je poznata upotreba subliminalnih poruka u marketinške svrhe. U istraživanju Rogers & Smith (1993) o subliminalnom reklamiranju znalo je 74% ispitanika, a 61.5% veruje da reklame sadrže subliminalne poruke, mada je ovaj manipulativni vid reklamiranja zakonski zabranjen. Podaci o učinkovitosti subliminalnih poruka potiču iz laboratorija gde je korišćena specijalna oprema. Analizirajući tehničke karakteristike savremenih televizijskih prijemnika i kompjuterskih monitora vodećih svetskih proizvođača proverili smo da li se na njima subliminalno mogu prikazivati tekstualne poruke ili slike. Tekstualna poruka izložena u trajanju od 50 ms nevidljiva je za ispitanika (Kouider & Dupoux, 2001), dužina izlaganja slika, pak, zavisi od njihove sadržine i kreće se između od 1-4 ms (Murphy, 1990), pa do 20 ms. Najkraće izlaganje stimulusa na savremenim monitorima ograničeno je ciklusom osvežavanja (refresh rate). Ciklus osvežavanja kod CRT minitora odnosi se na maksimalan broj slika koje se mogu pojaviti na ekranu u okviru jedne sekunde i izražava se u Hz, kod većine monitora on iznosi 60 Hz, dakle slika se na ekranu može najkraće izložiti 1000ms/60≈11.67ms. LCD monitori imaju drugačiji način stvaranja slike i ciklus osvežavanja od CRT monitora, ali su na tržištu prisutni uređaji od nominalno 60 Hz, 120 Hz≈8.33 ms i 240 Hz≈4.16 ms. Ovi monitori obično imaju i vreme odziva od 5 ms. Na savremenim kompjuterskim monitorima i Televizijskim aparatima, dakle, postoje tehnički preduslovi za subliminalno izlaganje tekstualnih poruka i slika.

Ključne riječi: subliminalna poruka, marketing, televizijski monitor, kompjuterski monitor, ciklus osvežavanja.

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Theory of Hydrocarbons

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The presence of hydrocarbons in the Earth's crust is a recognizable fact and an idea that they are the remains of life on the Earth's surface that have been buried a long time ago and now appear as oil and natural gas. However, pioneering work and ideas have even sprung up in another direction... Recently, there is a growing number of supporters who believe that deep in the Earth (deep hot biosphere), underground sources of chemical energy exist. Here, we will try to give a transparent reflection theory of deep natural gas.
Keywords: hydrocarbons, the theory of the origin of oil and gas.

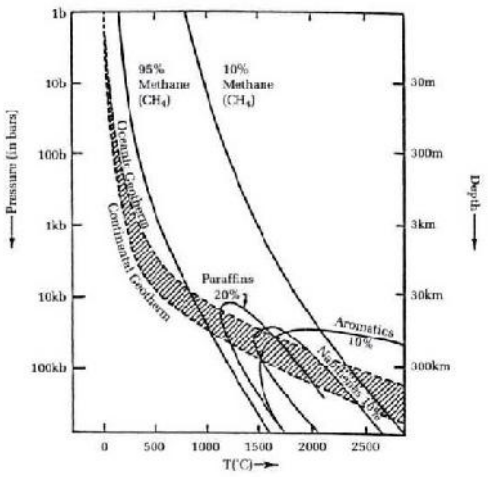

Figure 1. Stability of hydrocarbons at temperatures and pressures in the earth (from Chekaliuk, 1976).

Historical views of the theories of oil occurrence

An abiogenic hypothesis was first proposed by Georgius Agricola in the 16th century and various additional abiogenic hypotheses were proposed in the 19th century, most notably by the Prussian geographer Alexander von Humboldt, the Russian chemist Dmitri Mendeleev and the French chemist Marcellin Berthelot. Abiogenic hypotheses were revived in the last half of the 20th century by Soviet scientists, who had little influence outside the Soviet Union because most of their research was published in Russian. The hypothesis was re-defined and made popular in the West by Thomas Gold who developed his theories from 1979 to 1998, and published his research in English.

Some of the evidence used to support abiogenic theories includes:

Proponents	Item
Gold	The presence of methane on other planets, meteors, moons and comets
Gold, Kenney	Proposed mechanisms of abiotically chemically synthesizing hydrocarbons within the mantle
Kudryavtsev, Gold	Hydrocarbon-rich areas tend to be hydrocarbon-rich at many different levels]
Kudryavtsev, Gold	Petroleum and methane deposits are found in large patterns related to deep-seated large-scale structural features of the crust rather than to the patchwork of sedimentary deposits
Gold	Interpretations of the chemical and isotopic composition of natural petroleum
Kudryavtsev, Gold	The presence of oil and methane within non-sedimentary rocks upon the Earth

Gold	The existence of methane hydrate deposits[2]
Gold	Perceived ambiguity in some assumptions and key evidence used in the conventional understanding of petroleum origin
Gold	Bituminous coal creation is based upon deep hydrocarbon seeps
Gold	Surface carbon budget and oxygen levels stable over geologic time scales
Kudryavtsev, Gold	The biogenic explanation does not explain some hydrocarbon deposit characteristics[2]
Szatmari	The distribution of metals in crude oils fits better with upper serpentinized mantle, primitive mantle and chondrite patterns than oceanic and continental crust, and show no correlation with sea water
Gold	The association of hydrocarbons with helium, a noble gas

A world-famous scientist Thomas Gold contends that there is a false thesis of the oil crisis. Namely, the Gold hydrocarbons that make up the oil reservoirs are constantly supplemented.

Thomas Gold, a prominent astronomer and professor emeritus at Cornell University in Ithaca, N.Y., considered for years that oil is actually a renewable energy source that is constantly created on earth under hot conditions and extremely high pressures.

Most scientists hold that oil, which can be reached by drilling, is a result of the decomposition of the prehistoric plants. But Gold believes that the oil was there from the moment of the Earth's formation, and that life there preceded life on the Earth's surface. The existence of [deephot biosphere] could prove to be one of the monumental discoveries of our time. Maybe, life is an inevitable consequence of physical laws and can arise spontaneously in millions of places.

At depth, it will, given sufficient time, perform this feat of alchemy, transforming the remains of surface life buried within sediments-or so we are told. Petroleum is therefore regarded as "fossil fuel." Yet the assemblage of widely accepted facts on petroleum chemistries and their geographical and geological occurrences, considered as a whole, does not support a preference for this standard solution. Pushed aside or not even reported because it does not fit, that particular science is in deep trouble. This has happened quite often in several fields. In geology, for example, a person who thought that continents or parts of continents might have moved in the past was ridiculed before 1960, despite the existence of good evidence from magnetic rock measurements. After 1965 anyone who did not believe in such movement was again a subject of ridicule. In petroleum geology, the massive and persuasive evidence of a deep origin of the fluids is still treated with disdain and cannot be published in certain journals.

The Deep-Earth Gas Theory

New ideas in science are not right just because they are new. Nor are old ideas wrong just because they are old. A critical attitude is clearly required of every seeker of the truth. But one must be equally critical of both the old ideas as of the new. When the established ideas are accepted uncritically the conflicting new evidence is brushed aside.

Carbon and hydrogen can form a great variety of molecules that have different ratios of carbon to hydrogen and different molecular geometries, and all are called hydrocarbons. At the temperatures and pressures on or near the earth's surface, some hydrocarbons are solid (coal), some are liquid (crude oil), and some are in the vapour state (natural gas, which is predominantly methane).

Liquid and gaseous hydrocarbons are commonly called petroleum, which exhibits a great variation in the proportions of the various hydrocarbon molecules. Petroleum also has unifying features that suggest a similar mode of generation. Nowadays, most petroleum geologists outside the former Soviet Union would say that the question has been completely answered - deposits of biological debris, reworked by geological processes, account for all natural petroleum.

Elevated temperatures (but not elevated to volcanic levels) and elevated pressures prevailing at depth will, given sufficient time, perform this feat of alchemy, transforming the remains of surface life buried within sediments-or so we are told.

The Origin of Petroleum: Two Conflicting Theories

Even though the biogenic origin theory leads to many inconsistencies (which will be addressed in Chapters 4 and 5), it is, nevertheless, virtually impossible, in the Western world, to conduct any research in petroleum geology, that implies a questioning of this accepted position, now.

A young person- however brilliant-with no scientific standing, who attempted to do so would have no hope of passing the peer review, either for obtaining funds or for publishing adverse results.

Fortunately for me, by the time I began nosing around in the field of petroleum geology, I had established a favourable standing for myself in the fields of physics, including geophysics, and in astronomy. I had, by then, been elected to memberships in several prestigious learned societies, and this standing made it possible for me to air my heretical views on the origin and ubiquity of oil and natural gas. Beginning in 1977, I wrote a number of papers on the subject of "deep-earth gas," in which I explained my reasons for thinking that natural gas and other hydrocarbons had originated at great depth-perhaps 100 to 300 kilometres beneath the earth's surface.

This depth is nearly 100 to 300 kilometres deeper than the depth that the proponents of the biogenic view would place the origin of petroleum in, as a consequence of their central presumption that petroleum forms from the remains of surface life, buried within the sediments. I presented the deep-earth gas theory during the time of the so-called energy crisis, which, to my mind, had arisen not because there was a physical shortage of oil and gas but because a cartel of major oil producers had gained much strength when several senior petroleum geologists forecast that within fifteen years all the reservoirs of crude oil in the world would be exhausted.

It was in the interest of the oil producers to cut back on production and exact the most revenue possible from the remaining reserves. Now, twenty-five years later, the world is awash in oil and has more than it requires, even by conservative estimates and even projecting significantly increased rates of consumption. My proposal (and that of many Russian colleagues) that petroleum is abiogenic and ubiquitous deep in the earth, though far from the mainstream opinion, did receive attention, particularly from petroleum entrepreneurs because of its practical importance well beyond the boundaries of pure science.

In 1982 I supplemented the deep-earth gas theory in my own mind with the concept that a "deep hot biosphere" was thriving on these deep resources. A full decade passed before I was able to publish this hypothesis. In taking this next step, however, I finally managed to put together all the pieces of evidence, including some that had initially been supportive of the biogenic theory of origin, in a way that I felt provided a satisfactory resolution of all the paradoxical information.

The origin of petroleum has been the subject of many intense and heated debates since the 1860s, when crude oil was first discovered to be present in large quantities in the pore spaces of many rocks. Was it present when the earth was first formed, or is it a fluid concentrated from huge amounts of vegetation and animal remains, that may have been buried in the sediments over hundreds of millions of years? Arguments have been advanced for each of these two viewpoints, and although they seem to conflict, each line of argument has its strong points.

The biogenic theory holds that biological debris buried in sediments decays into oil and natural gas in the long course of time, and that this petroleum then becomes concentrated in the pore spaces of sedimentary rocks in the uppermost layers of the crust. The search for oil was conducted with this theory of biological origin in mind, so the presence of biological material in the sediments was regarded as a key indicator of strata worth prospecting.

Where petroleum reservoirs were found in rocks possessing no materials that could have given rise to the oils, it was simply accepted that crude oil and natural gases often migrate through vast distances and that source rocks may, therefore, sometimes be indeterminable.

The biogenic theory of the origin of petroleum was widely adopted around the 1870s, when the earth was thought to have formed as a very hot body, perhaps a body of molten rock. If this had been correct, then no hydrocarbons supplied with the hot rocky material could have survived; they would all have been oxidized to CO2 and H2O. So long as this mode of origin of the earth was the dominant view, an

abiogenic origin of petroleum, formed from materials accumulated in the formation of the earth, was not a tenable viewpoint. At that time, the formation of petroleum from vegetation, after the surface had cooled sufficiently, seemed to be the only possible explanation. The subsequent discovery of molecules of clearly biological origin in all natural oils greatly strengthened the biogenic theory.

The present theory of the formation of the earth is that it formed by the assembly of cold solid pieces, condensed from a nebula surrounding the sun. Much of the material acquired in that way would have escaped excessive heating, and an abiogenic solution now seemed possible, but the biogenic theory was, by then, so firmly entrenched that the opposing evidence was brushed aside. Even when, in the 1940s, the presence of many hydrocarbons on other planetary bodies of the solar system was discovered (bodies that could not have acquired them from vegetation), it continued to be maintained that just our earth acquired hydrocarbons from a source that could be supplied only here: vegetation.

Now, whenever crude oil or natural gas is encountered in igneous rocks (rocks formed by the solidification of magma), the hydrocarbons are deemed to have migrated from a sedimentary "source" rock. In this view, igneous rocks underlying the deepest sedimentary rocks offer no prospect whatsoever for containing hydrocarbons, and so very few holes have been drilled into these "basement" rocks. Nearly all wells were drilled in sedimentary rocks, so nearly all oil was produced from sedimentary rocks.

Before long, this fact was then taken to show that sediments were essential for producing oil. Sedimentary strata were indeed essential for the production of much of the oil we now have, not because there is necessarily more oil in the sediments, but because that is where oil companies chose to drill. The belief in the biogenic origin of petroleum thus led to a self-fulfilling prophecy.

The theory of the biological origin of hydrocarbons was so favoured in the United States and in much of Europe that it effectively prevented work on the opposing viewpoint. This was not the case in the countries of the Former Soviet Union. Much work has continued there, on both sides of the debate, since the middle of the nineteenth century. In attempting to resolve this issue, the Soviet Union seems to have been more lenient toward scientific dissent than were the Western countries, probably because Mendeleyev, the revered Russian chemist, had supported the abiogenic view. The arguments he presented are even stronger today, given the greatly expanded information pool we now have. The abiogenic theory holds that hydrocarbons were a component of the material that formed the earth, through accretion of solids, some 4.5 billion years ago.

Due to the increasing internal heat, liquids and gases were liberated, and because they were less dense than the rocks, buoyancy forces drove them upward. In favourable conditions, the upward journey from the regions of origin would be temporarily dammed in porous rocks at depths that our drills can reach, and from which we then derive commercial petroleum. In volcanic regions we have a different situation.

There, channels of liquid can extend to great depths without interruptions, as pressure differentials between the solid rock and the nearly equally dense magma will be small. If methane from deeper levels enters such a channel, it will ascend as a mass of bubbles, and each bubble will have contact with the fresh magma surface many times over in the ascent. Whatever loosely bound oxygen may be available there will be captured by the bubbles and at the high temperature will oxidize the methane to CO2 and water. So, it is not surprising that the emission from volcanoes, at quiet times, produces mostly CO2 and water, and only a small percentage of methane (reported in most volcanoes as 2-5 percent, but much higher in some; in the Azores the figure quoted is 17 percent).

But, in major eruptions of the same volcanoes, a large amount of flammable gas is often involved, and flames have been seen on many such occasions. The most clearly identifiable case was in the course of eruptions under the sea surface of one of the Krakatau volcanoes in the Sunda Straits; eruptions that did not break through the surface of the water but resulted in flames dancing on the surface over large areas.

In this case, there can be no confusion between flames and volcanic spray of red-hot ash, as has been suggested for many events where the presence of flames had been reported. The seemingly reliable reports of flames have also come from Central American volcanoes, from Santorini in the Mediterranean, North of Crete, and from the great African Rift. (The chance of seeing the flames in an eruption depends on the wind driving the dense smoke aside from the more vertical flame.) In a violent eruption, the small bubbles that come up at

quiet times will not be present; instead large plumes of gas will appear, racing upwards through the molten rock. The contact area between gas and rock will be much smaller, and the time of such contact much shorter, thus reducing the amount of oxidation that can take place. All in all, a variety of evidence indicates that hydrocarbons or hydrogen are major components of the volcanic gases. The CO2 that is commonly seen in volcanoes at quiet times gives no proof that CO2 is the primary carbon gas supplied to the surface of the earth.

Where the emission of gases into the atmosphere can be measured directly, methane is almost always the dominant carbon gas, except when the measuring zone approaches an area of active volcanism, where CO2 often dominates. (I will return to this point in the discussion of mud volcanoes in Chapter 8.) Plumes of hydrocarbons that find their way to the earth's surface without encountering magma may or may not be oxidized en route. They will, in any case, be oxidized soon after the exposure to the oxygen- rich atmosphere. This means that the ultimate fate of primordial hydrocarbons is to be oxidized into carbon dioxide and water.

The abiogenic theory of petroleum formation depends on the verity of five underlying assumptions. Firstly, hydrocarbons, or compounds that could have been converted into hydrocarbons at the intense pressures of the earth's depths, must have been a common constituent of the primordial materials out of which the earth was formed.

Secondly, in the four and a half billion years since the earth accreted, the primordial hydrocarbons must not subsequently have become dissociated and fully oxidized to carbon dioxide and water by exposure to the significant amounts of oxygen bound in the rocks of the earth's crust. Thirdly, hydrocarbons must be chemically stable at the combination of high temperature and pressure that prevail deep within the earth.

Fourthly, hydrocarbon fluids must have found or created suitable pores in which to exist at depth, and through which to travel in their journey upward, driven by buoyancy forces due to their low density compared with that of the rocks. Finally, a source of hydrocarbons must still exist at great depth. Can these five assumptions all be valid?

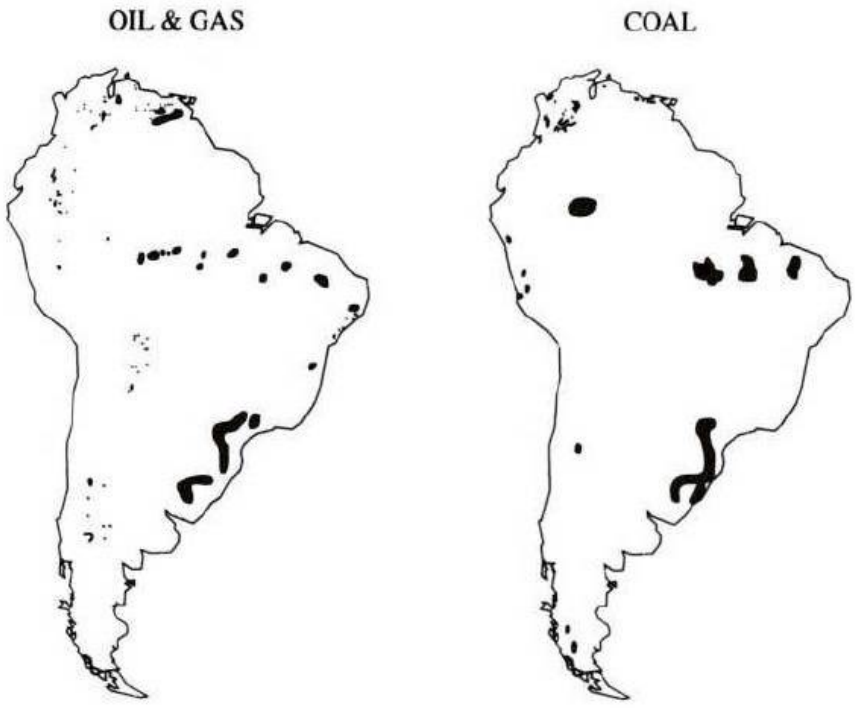

Figure 5.3 Overlap in the distribution of coal and oil in eastern Brazil. Many other such areas of overlap exist, which presents problems for the biogenic theories of coal and oil formation but is readily explained by the abiogenic theory. SOURCE: oil map adapted from International Petroleum Encyclopedia, 1994, p. 85; coal map adapted from a commercial atlas by H. M. Goushu Company, San Jose, Calif.

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Teorija ugljikovodika

SAŽETAK

Prepoznatljivo je prisustvo ugljikovodika u Zemljinoj kori. Ideja da su ugljikovodici ostatci života na Zmljinoj površini koji su već davno sahranjeni i pojavljuju se kao nafta i prirodni gas. No, pionirski radovi i ideje nikle su i u drugom smjeru...U posljednje vrijeme raste broj pobornika da duboko u Zemljinoj (deep hot biosphere) kori postoje podzemni izvori hemijske energije. Ovdje ćemo pokušaati dati pregledno razmišljanje teorija dubokog zemnog gasa.

Ključne riječi: ugljikovodici, teorije o porijeklu nafte i plina.

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Change in ISO 9001:2015

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In this article we give basic guidelines regarding the implementation of the change process in the company and their relationship to the QMS defined by ISO 9001:2015 standard.
Keywords: Change, ISO 9001:2015, Change process, implementation, steps to Implement changes.

Introduction

ISO 9001:2015 focuses on change management at many places. Any change, whether in the process, manpower, machinery, instruments, technology, raw materials, suppliers, customer requirements, legal requirements etc. shall go through a defined change management process.

One of the goals of the ISO 9001:2015 is to enhance the requirements for addressing changes at system and operational levels.

The ISO 9001:2015 requirements provide a strong basis for a management system of a business that supports the strategic direction of the organization.

Once the organization has identified its context and interested parties, and then identified the processes that support this linkage, addressing changes becomes an increasingly important component of a continued success.

Once processes are determined, an organization will need to identify the risks and opportunities associated with them. Changes may be necessary to achieve the benefits associated with the determination of risks and opportunities.

They can be related to any element of the process, such as inputs, resources, personnel, activities, controls, measurements, outputs, etc.

The change process in ISO 9001:2015

The change process would include:

- the change to be implemented
- changes initiated by the reason for change
- changes reviewed by the evaluation of change for consequences / effects on an overall performance of quality system and further actions to be taken to resolve such effects
- resources required to make the change
- skills required to make the change
- the final decision for change approval; the change in the documentation as per change to be implemented.

Changes are intended to be beneficial for the organization, and need to be carried out as determined. In addition, the consideration of new, introduced, risks and opportunities need to be taken into account.

To achieve the benefits associated with changes, the organization should consider all types of changes that may need to occur. These changes may be generated, for example, in:

- The processes
- The documented information
- The Tools
- The equipment
- The employee training
- The supplier selection
- The supplier management
- and many others

The successful management and control of these changes has become a core requirement within the organizations QMS.

Things to consider when implementing the new requirements for Change

There are many triggers that can cause a change to the Quality Management System:

- Customer feedback
- Customer complaint
- Product failure
- Employee feedback
- Innovation
- Determined risk
- Determined opportunity
- Internal audit results
- Management review results
- Identified nonconformity
- Many others

These recommendations are not necessarily applicable for every type of organization. Some changes need to be carefully managed, while others can be safely ignored. In order to sort through this, the organization should consider a method to prioritize. To determine the priority, the organization should consider a methodology that allows them to take into account:

- The consequences of the change
- The likelihood of the consequence
- The impact on customers
- The impact on interested parties
- The impact on quality objectives
- The effectiveness of processes that are a part of the QMS
- others

Typical steps to Implement changes

- Define the specifics of what is to be changed
- Have a plan (tasks, timeline, responsibilities, authorities, budget, resources, the necessary information, others)
- Engage other people, as appropriate, in the change process
- Develop a communication plan (appropriate people within the organization, customers, suppliers, interested parties, etc. may need to be informed)
- Use a cross functional team to review the plan and provide feedback related to it and the associated risks
- Train people
- Measure the effectiveness

What changes need to be made?

- The change in the process (inputs, activities, outputs, controls, etc.)
- Communication with customers
- Communication with the supply chain
- Additional controls for processes
- Inspection
- Employee training
- Implement a new process
- Provide documented information
- Change existing documented information
- Improve employee competence
- Outsource a process
- Many others
- Other considerations.

Prior to making a change, the organization should consider unintended consequences. After making a change, the organization should monitor it to determine its effectiveness and identify any additional problems that might occur. The records of some changes may be needed as a part of the Quality Management System.
Here are some tips and techniques to help plan and implement changes in an effective, efficient and timely manner:

- The change must be realistic, achievable and measurable
- Start at the top but involve every layer
- Risk thinking through change management
- Risk management will be included in the change management!
- Make change management integrated

Conclusion

There are different internal and external sources initiating the change throughout the organization. The Change management tool, as a platform, enables you to plan, control and manage every change needed in the organization.

Implementing The Change Management tool will help you with every single change suggested in ISO 9001:2015 and will be a good practice for any other change such as business needs and daily decisions. An effective change management will support a smooth transition from the old Quality Management system to the new one and will be a good practice to manage all the other changes of your organization in the future.

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Promjene u ISO 9001:2015

SAŽETAK
U ovom članku ćemo dati osnovne smjernice o provedbi procesa promjene u društvu i njihov odnos prema QMS definiranog normom ISO 9001: 2015

Ključne riječi: Promjena, ISO 9001: 2015, proces promjene, implementacija, korake za provedbu promjena.

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Productivity model depending on security environment

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It is generally known that investments in Health and Safety at work represent an economic cost effectiveness in a company's business. As determined, investments in safety at work, although they represent a cost, contribute to increase the productivity which finally increases profit. A decrease in the number of injuries at work is directly connected with the main economical indexes of efficacy like productivity, cost- effectiveness and profitability. An interest of every employer is to gain maximum profit with minimal costs (costs due to injuries and professional occupational diseases). Better productivity = Better health and safety at work.
Keywords: cost – effectiveness of health and safety at work, productivity, profitability, efficiency.

Introduction

In this paper, we will show the extent of the workers optimum safety during the work process (with the application of certain standards of safety at work), that can affect the productivity of labour itself, or increase the profitability of the company. A safe work environment and a high-quality training for workers reduce the risk of accidents at work. The application of the basic rules of safety at work is actually the application of preventive safety measures.

The realization of a large income with an optimal utilization of the system man-machine-environment, with minimum investments and a tendency for maximum security is the mode of production. Any injury represents direct and indirect costs which depend on the branch of activity and severity of physical disability. Operating losses and increased tax debt are just some of the consequence's generated damage (occupational injury).

A capable worker represents a common interest of the employers and the state. Business success is based on the application of the principle of maximum rationality. From the point of view of safety at work, the essence of this principle is that with a certain amount of investment in occupational health and safety, a company can achieve the maximum business results.

In that regard, the success of the business depends on the number of work-related injuries and sick days (absence from work) as a consequence of the injury at work.

The interest of employers is that with minimal investment (the Occupational Safety and Health) they achieve maximum business results, regardless of the possible consequences of such work (injuries and occupational diseases), if the consequences are not charged to the business. On the other hand, the interest of society is that with minimal consequences (injuries and occupational diseases) employers achieve maximum business results.

Increasing productivity and company's business performance is the mutual interest to both employers and workers. The creation of a safe working environment ultimately leads to a more competitive economy. Economies with lower standards of safety at work are not competitive, but investment in occupational health and safety was never at the expense of competitiveness.

The role of safety at work

The goal of occupational safety and its measure is an attempt to avoid possible accidents and injuries to workers. To achieve this goal, it is necessary to know certain rules and regulations that affect it. The basic safety rules are applied before all other safety rules. These rules completely eliminate or reduce hazards that could damage the work. The problems in the application of basic safety rules are related to the maintenance of capital, investing in the equipment, and implementation of regulations as the basic safety rules.

Today, injuries continue to take lives, inflict physical, mental and material damage to the individual, the family and the entire society. Statistics show that each year in the EU industry around 50 million workers are injured, around 100,000 die, and this also forms a new 1.5 million invalids who work.

Countries with a less developed system of occupational safety spend a higher percentage of GDP on diseases and injuries incurred at work, allocating resources from productive activities. Governments, their regulatory bodies and agencies seek to improve safety at work in order to reduce the costs that the company would pay as a result of injuries and disease, and to simultaneously improve competitiveness and national efficiency.

The productivity may be increased through safety at work so as to:

- Reduce the number of people who retire early or who are unable to work due to injury or illness,
- Reduce the cost of social and health care benefits for injuries and illnesses,
- Increase the work capacity of people by improving their health and
- Maximize productivity by encouraging more efficient working methods and technologies.

We conclude that healthy individuals and a healthy society are, as a whole, more productive. A German study on the labour market has found that poor health reduces the likelihood of a person to remain employed permanently by 6% and doubles the chances that he or she will no longer be a part of the labor force.

There are a lot of research and business studies which have shown that safety at work can stimulate productivity :

- By reducing the damage caused by negligence, through the elimination of unproductive work machines, improving the production process and so on,
- Through the production of quality products,
- By encouraging companies to disclose more productive methods due to the need to put an end to the old practices and,
- Committing to replace older and less productive technologies and equipment.

Businesses act rationally when considering security and safety at work as a "career move". There is little evidence to require a numerical analysis as the primary evidence for the consideration of the safety and protection.

Consequently, a number of initiatives is designed to highlight business success factors related to safety and protection, such as reputation, supply chain requirements, cost control (e.g. insurance costs) and staff motivation.

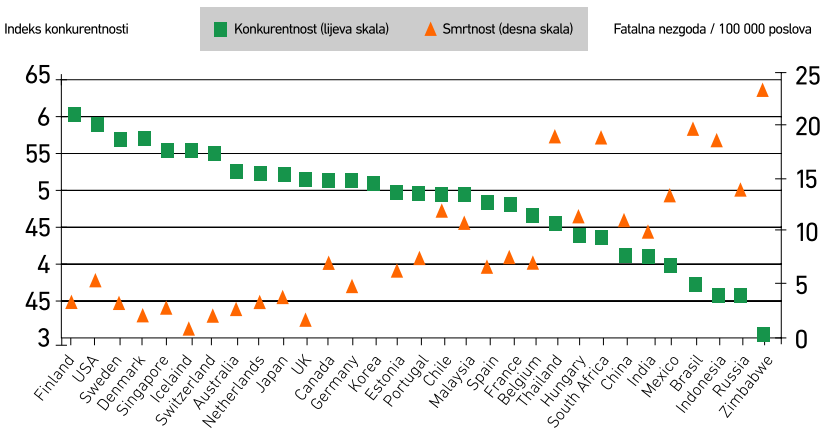

Chart 1: Competitiveness and Security (World Economic Forum)

The concept of occupational safety appears in parallel with the development of tools and attitude towards work. The task of occupational safety and health is reducing the number of accidents, occupational diseases and material losses due to downtime at work. An accident at work is an undesirable, unforeseen event that could result in a minor or a major injury (a stab, cut, break, etc.), health damage to workers or material loss due to delays in production.

Occupational diseases, unlike accidents, occur as a result of a health hazard by a repeated and long-lasting effect of abnormal working conditions, harmful substances and adverse hygienic conditions. The non-physiological conditions of work are too long working hours, gruelling posture (kneeling, bending) or overloading of certain organs of the body (lifting and transporting cargo).

Until the injury comes, one is responsible for three important factors:

- When a person does not know how to work
- (lack of work)
- When a person can not work safely (influenced by disease, alcohol, drugs and the like.)
- When a person does not want to work safely (ignoring the regulations and safety protection) The purpose of the occupational safety and health is to ensure working conditions without endangering the worker's life and health.

The duty of the company:

- The company is obliged to provide all protective devices and equipment for work.
- It must put a warning on performing dangerous jobs.
- It must indicate:
- The duties and rights of workers regarding safety at work
- The content and method of education and care, first aid, fire protection
- Exercising the right regarding control and inspection

The duty of workers:

- The employee has the right and an obligation to use protective devices in certain jobs.
- All workers who perform their tasks must be trained to work in a safe manner.
- Each employee is obliged to implement measures to protect the company in their scope of work.
- The employee must report to the immediate superior any faults or defects that threaten him and the environment.
- The employee must report their personal disease such as poor vision, poor hearing, dizziness, heart problems, epilepsy and the like.
- Accidents and injuries must be reported to the immediate superior.
- The employee has the right to refuse to work on a job where his life is in immediate danger
- An employee may be fined by the supervisory body or magistrate for non-compliance with the safety rules
- The employee must comply with the job provisions with special conditions on which specific requirements, such as the qualifications of medical fitness, age, sex, mode etc. are prescribed.

The Company shall not put to use working tools if they are not made in accordance with the rules of safety at work, or if they are defective.

The impact of protection at work on productivity

Productivity is defined as the quantitative expression between the volume of production, services or transport and quantity of the labour force, which we could show with the general formula:

$$P=Q/L=q$$

Where:
P is the labour productivity
Q is the volume of production
L is the number of employees
q is the lead to the fulfilment output per unit of labour
In addition, productivity can be written inversely, i.e. calculating how much is spent on labour to produce one product:
P = L / Q =t
(T = time spent per unit of product)

This definition of productivity is derived from basic economic principles: to achieve maximum results with minimal investment that can be achieved in two ways:

- Increasing the total weight of the product

or

- Increasing performance.

Factors of productivity

Factors of productivity are all the facts that affect the performance, and as such they can be grouped into:

- Objective and
- Subjective factors.

Objective factors of productivity

Objective factors of productivity can be technical and social. Technical factors of productivity are all the material and technical means of production as well as scientific and technical achievements that are not applied, but there is an economic possibility. The most important factors are:

- Technical characteristics of the product on the basis of which normative work of making products is made.
- Characteristics of technological processes that require a lower or higher utilization of the workforce in its execution.
- The characteristics of the funds required for the work, their modernity and technological sophistication, the condition and the amount of labour productivity.
- Technical characteristics of the materials used in production.
- Work environment and conditions of work in such an environment, regardless of whether they are natural or artificial ones.
- The volume of changes in production can affect productivity.
- The type of work organization, in its level, directly increases or decreases productivity.
- The level of organization, which deals with technical equipment
- Social factors of productivity can only be indirectly changed, and they include a cultural level, the market, the level of the development of transport networks, population and many other social elements.

Subjective factors of productivity

Organizational, subjective factors of productivity include all the elements associated with the human figure in the production and the organization of production. In line with the ways they manifest themselves, they can act through:

- The selection and decision-making on technical and social conditions of production. This selection can be found and appropriate replacement materials to some technical or technological processes
- Qualifications of manufacturers, where optimal qualifications for the work collective as a whole can be found.
- The intensity of labour through which ways to achieve optimal intensity of work can be invented, and during which workers will spend the minimum amount of the manufacturer's bio-energy per unit of product.
- Organizational measures through which the management, after analysing the entire process of technological production, tries to find ways to shorten or simplify some stages of work.
- To calculate the impact of occupational safety and health on the realized productivity, one can use methods like:
- Calculating the declining production work due to a decrease in production volume and increasing the human labour.
- Estimates of loss in production due to workers failing to work and
- The accounts decreased productivity due to lost working days.
- Regardless of the method of calculation used, it will be seen that the increase in the number and severity of accidents at work reduces productivity, and lost work results in a reduction of revenues and an increase in the operating expenses.

The impact of protection at work on the operating costs

The degree of savings in the realization of the effect falls under the cost-effectiveness. The aim of the economics is to make as much products of standard quality with as little investment as possible. When workers fall ill and become injured due to the lack of protection, material losses, which contribute to the reduction in the profitability, appear. In reality, it is difficult to implement protection measures that would exclude the the injuries that happen to workers (i.e. down to the same level).

Injuries occurred while travelling to work by a regular route are considered costs, and this cannot even be avoided by investing in the protection measures. It is necessary to monitor the dynamics of work-related injuries to determine the cost-effectiveness achieved. The occurrence of work-related injuries will depend on investments in safety at work.

The mere investment will increase the total cost of operations, but it will also increase productivity, which, in turn, will be revealed through the reduction of injuries at work. Knowing the impact the investments in occupational safety and health have on the results of operations will allow making the right decisions.

The calculation of the profitability of the company is as follows:

Ep = Pp/Tp or
Ep=(Pp/Tp-1)*100

Where:

Ep is business efficiency
Pp is total operating income
Tp is Operating costs

For example:

Business efficiency in 2010:

Ep = 12,600,000 / 7,529,255
Ep = 1.6735 or 67.35%

Economy of operation in 2011:

Ep = 12,745,000 / 7,623,250
Ep = 1.6719 or 67.19%

The results show that there has been a reduction in the profitability of the company, despite the increased investments in safety at work, which tells us that we have reached the maximum limit in which the economic population was a profitable investment in occupational health and safety.

The cost-effectiveness of protection on the basis of efficiency of operations in the reporting period can be expressed as a percentage of the difference between 2010 and 2011:

Business efficiency

Iz=(Eps/Epp-1)*100
Iz=(1,67919/1,6735-1)*100
Iz=0.09%

From this, the unprofitability of an even greater investment in safety at work with the same number of employees is apparent.

Where, from the cost effectiveness of protection: Eps is the economy of operations of the period (2011), and Epp is the last year's business efficiency (the year 2010).

The previous considerations were based on the impact the occupational safety and health has on business productivity, depending on the investment in the health care quality. A prerequisite of any production is owning assets.

The ratio of capital invested in the means of production and the realized profit is called profitability. From this, it follows that the economic viability is the measure of success. The Company generates income if its income is greater than the expenses. If the income is less than the expenses, the company operates at a loss.

The profitability depends on many elements. One of these elements is the protection and safety. In that regard, the funds invested in occupational safety and health will ensure more efficiency but will also increase the amount of capital invested.

The lack of work due to work-related injuries affects the results of operations and, therefore, affects the unprofitable business. Investing in occupational safety apparently affects the increase in cost, but, in the end, due to the reduced number of accidents at work, it actually affects the increase in revenue.

Applied to safety at work, incomes realized, with some or no protection at all, as the cost of protection, are an indicator of its economic viability. There are two types of costs as seen from the viewpoint of protection.

The first group of costs (basic protection) covers the costs related to basic safety rules and their maintenance (work insurance funds and the work environment conditions, and their regular and periodic tests, service checks, etc.).

The second group includes the cost of fees (as a result of injuries at work and occupational diseases) that are caused by an inappropriate or partial protection. The resulting costs are added to the total cost of operations.

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Model produktivnosti u zavisnosti od zaštite na radu

SAŽETAK
Opća je spoznaja da ulaganja u zaštitu na radu predstavlja ekonomski isplative troškove poslovanja preduzeća. Utvrđeno je da ulaganja u zaštitu na radu, iako su trošak, doprinose povećanju produktivnosti što u konačnici utječe na povećanje dobiti poslodavaca. Smanjenje broja ozljeda na radu u direktnoj je vezi sa glavnim ekonomskim pokazateljima uspješnosti poslovanja kao što su produktivnost, ekonomičnost i rentabilnost. Interest svakog poslodavca je da uz minimalne troškove (troškove koji su posljedica ozljeda na radu i profesionalnih oboljenja) ostvare maksimalne poslovne rezultate. Bolja produktivnost = Bolja zaštita na radu.

Ključne riječi: Ekonomska isplativost zaštite na radu, produktivnost, rentabilnost, ekonomičnost poslovanja.

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Softwares as powerful tools in modern biophillic and human-friendly architectural design: visual and tactile aspects

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In the modern era of increased stress levels in all aspects of human lives, the built environment plays a significant role, both negatively and positively. Cities and buildings account for a major portion of CO2 emissions, waste production , noise, traffic jams and energy consumption. On the other hand, besides the well-known and necessary eco-friendly measures, a smart built environment can be among the top positive stimuli for humans in regard to the connection of the environment and human psychology . Numerous design techniques that use nature and nature-like forms in its core, commonly known as biophilic design, are proven to have positive effects on the human brain, namely the relaxation and stress-relief centres. This paper aims to research and present the possibilities in creating a human-friendly and biophilic visual and tactile built environment that is made possible through use and development of softwares and technology. A special focus is given to application of fractal geometry in 2D and 3D architectural features and ergonomic urban furniture based on parametric modelling. Keywords: architectural design, biophilic design, software, fractal geometry, ergonomics.

Introduction

Centuries ago, the greatest theoretician of architecture, Vitruvius, said the never forgotten sentence: "Firmitas, Utilitatas, Venustas". Architects have always struggled not only to obtain, but also to define the Venustas, i.e. delight.

People are aware of the immense power of Venustas on the mind's well- being. The Golden Ratio was, for centuries, the key to obtaining Venustas. Ancient Greek art and architecture relied on this proportion. The proportion itself relied on nature.

This magical number, 1.61, is deeply carved in snail shells, pineapples, human face and body, the Great Pyramid of Giza, the Parthenon, Vitruvian man, Mondrian's paintings, etc. People always strove to create delightful objects for a single reason: its beneficial effect on humans and the environment. Architects have tried to create a measure that would combine form and function in architecture.

Le Corbusier succeeded by creating the Modulor as a measure of mathematical proportions in the human body that could be universally applied to everything a human creates, including architecture. It is based on achievements of the Ancient civilizations and the Renaissance that put a man into the center of the Universe, declaring him a measure of all things.

More importantly, it puts the man's needs into the focus of attention, with one sole purpose: creating a better place to live in.

This paper presents the possibilities of using developed technologies, mainly softwares, in producing architectural works with biophilic, and the effects that relieve stress on humans, through visual and tactile examples.

Use of softwares in creating and analysis of visual biophillic patterns

Stress relief is one of the burning issues in psychology, medicine and wellness today. The exact pathways of the environment's subconscious influence as stimuli on processes in human brain are still somewhat unknown. However, the influence of the built environment and art on human behaviour is certain and its specific forms do help relieve stress. Many studies have, as expected, shown that natural or natural- like environment is highly more preferable than standard, built environment [Kaplan and Kaplan 1989], since they help reduce physiological stress [Ulrich 1993] and increase concentration levels and focus [Kaplan 1995].

A very interesting recent study on human EEG response to viewing fractal patterns showed that certain fractals generate responses in the frontal brain region which makes them adequate for relaxation [Hagerhall et al. 2008]. The amazing capability of the human brain to associate one thing with another, even before the conscious levels of our minds become aware of it is the key to using nature-like forms in any kinds of design. This was proven by a study where patients in a hospital were surrounded by nature-like images. The levels of stress and anxiety were significantly lower than in patients surrounded by a typical hospital environment [Ulrich 1993]. This miraculous characteristic is the catch that is somewhat neglected in contemporary art, architecture and urban design, au contraire to the fact that it used to be one of the strongest design pillars of the ancient world. Fractal geometry, that became known under that name relatively late in science (by Mandelbrot in the 1970s), is today proven to be the core of the design in many structures that have mesmerized masses with their beauty and delight for centuries, starting with the Mesoamerican pyramids, through ancient mosaics, Islamic ornaments and remarkable Hindu temples, Gothic architecture elements, to Le Corbusier and Wright (present in different fractal dimensions).

Use of softwares in analyzing and creating fractal geometry patterns in design

The role of ornaments in architecture has many aspects; aesthetic, symbolic, cultural, psychological. A mathematician Benoit Mandelbrot said that "Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line" (Mandelbrot in Bovill, 1996, 4). This sentence picturesquely encompasses different areas where fractal geometry can be found: "visual qualities as art, their (fractal) relationship to explain natural processes, music, medicine, and in mathematics" (Pickover 1996). Despite the fact that Mandelbrot (1977) coined the term in the 1970s, from "the Latin adjective fractus, which has the same root affixation as fragment and means 'irregular or fragmented'; it is related to frangere, which means 'to break.", mathematicians have introduced functions and constructed patterns based on fractal geometry even before.

Another explanation of the fractal dimension is that "it is a statistical quantity that gives an indication of how completely a fractal appears to fill space, as one zooms down to finer scales." (Xiaoshu Lu, 2012). In mathematical language, "fractal dimension shows the relationship between the scaling factor and the number of smaller pieces that the original construction is divided into" (Batty and Longley, 1994), or:

$$D = \frac{\log(a)}{\log(\frac{1}{s})}$$

where a is the number of pieces and s is the reduction factor. (Sala, n.d.)

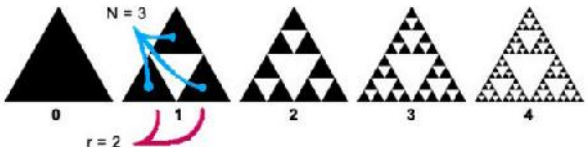

Figure 1: Creation of Sierpinski's triangle, source: Fractal Foundation (n.d.) http://fractalfoundation.org/OFC/OFC-10-3.html, retrieved on 04.11.2016

The above figure represents the N, number of parts and r, scaling factor. N equals to 3 and r equals to 2. From a simple equation we get the fractal dimension of the Sierpinski's triangle:

$$D - \frac{\log(N)}{\log(r)} - \frac{\log(3)}{\log(2)} - 1.585$$

The presence of fractal geometry in architecture is widespread, not only in terms of its fields, but also with respect to civilizations.

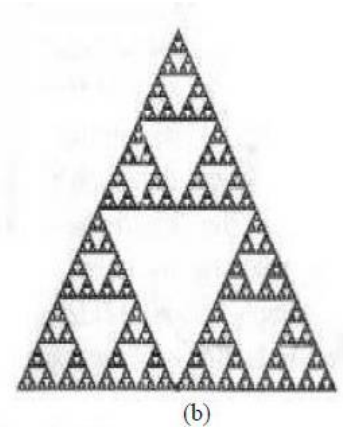

Figure 2.: a) Fractal geometry-based mosaic from the floor of the cathedral of Anagni (1104) b) Sierpinski gasket; Source: N. Sala, Some News About The Fractals, 1997, resource available online from: http:// www. arch. unisi.ch/fractals/fract1e.htm

Figure 2. shows cathedral of Anagni's "floor mosaic showing the fractal at its fourth stage of iteration" (Sala, 1997) and Sierpinski gasket fractal.

Figure 3.: The Sacred Stupa Pha That Luang in Vientane, Laos, source: Marefa (n.d.). Retrieved 17.11. 2016, from http://www.marefa.org/index.php/

Figure 3. is an example of fractal – based temple architecture, where the fractal principle is evident in the repetition of the same element in different scales. In his work, Fractals and the Birth of Gothic: reflections on the biologic basis of creativity, Goldberger (1966) discusses the relationship between fractals and Gothic art and architecture and their common features.

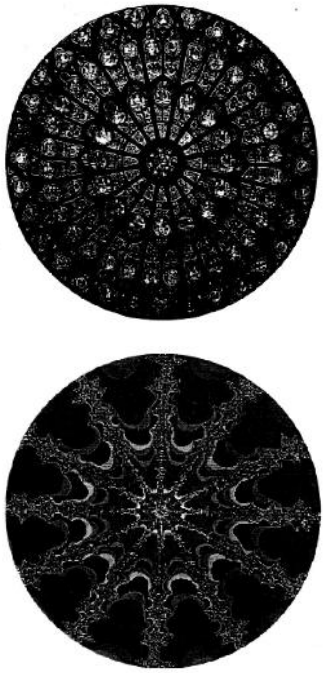

Figure 4.: a) North transept rose window, Notre-Dame de Paris, b) 12-fold symmetry in portion of Mandelbrot set magnified by a factor of 37 trillion, source: source: Goldberger, A. (1966). Fractals and the Birth of Gothic: reflections on the biologic basis of creativity. Stockholm Press 1359-4184

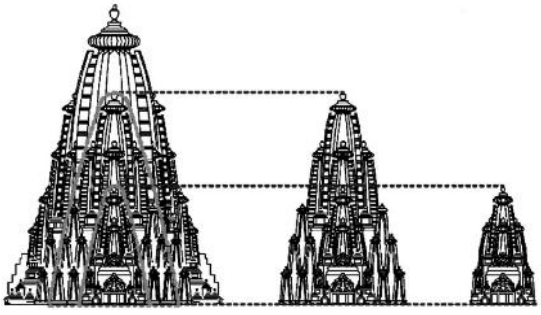

Figure 5.: Hindu temple fractal geometry characteristic, source: Joye, Y. (2011). A Review of the Presence and Use of Fractal Geometry in Architectural Design. Environment and Planning B: Planning and Design Environ Plann B Plann Des, 38(5), 814-828. doi:10.1068/b36032 (credits to Iasef Md Rian)

Xiaoshu Lu (2012) describes the application of fractals in Persian art: "In the Middle East, fractal patterns have been adopted widely in designing stucco, a typically Persian art form for the decoration of dome interiors."

Figure 6.: Stucco dome interior in a private house in Kashan. Four attractors around the main one in the center, source: Xiaoshu Lu, D.C.C. (2012). Fractal Geometry and Architecture Design: Case Study Review. Chaotic Modeling and Simulation (CMSIM), 311-322.

Figure 7.: Jami Masjid Champanar, source: 10 Famous Stone and Rock Indian Sculptures. (n.d.). Retrieved 17.11.2016, from http://hubpages.com/art/Famous-Stone-and-Rock-Carvings-in-India

Kumar (2001) discusses the position of a man in a mosque: "While praying in a traditional mosque, the Muslim in a sense returns to the bosom of nature, not externally but through the inner nexus which relates the mosque to the principles and rhythms of nature."

The role of ornaments in mosque interior is multiple, but mostly symbolic, as Nasr (1990) describes Shah mosque in Isfahan, Iran, as if "an echo from Heaven [were] to remind earthly man of his heavenly origin." Both practice and theory have shown that fractal geometry has beneficial effects on human brain and behaviour.

The application of different softwares for the generation of fractal geometry – based design, and the analysis of fractal dimensions of the existing ornaments enables the creation of patterns and design elements on the principles of fractal geometry, as well as analysis of their effects on humans in a significantly shorter period of time when compared to managing this process manually. The example below shows a software-generated ornament based on fractal geometry:

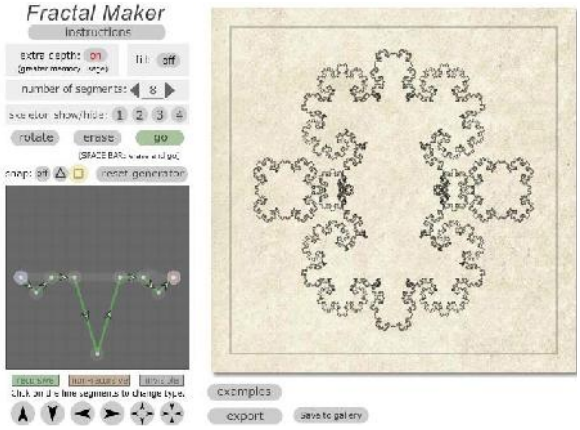

Figure 8: Applying basic fractal geometry principles to create a simple ornament in Fractal maker software (Author)

Another example of the practical use of fractal geometry analysis softwares is the analysis of the existing ornaments visual values. First, one sample, a drawing of an ornament on a dome of Sheikh Loft Allah Mosque in Isfahan, Iran, was analysed in ImageJ, image processor software, using FracLac, fractal analysis plug-in.

Box Counting analysis was conducted in order to obtain the fractal dimension of this ornament, with the aim of proving its fractal nature.

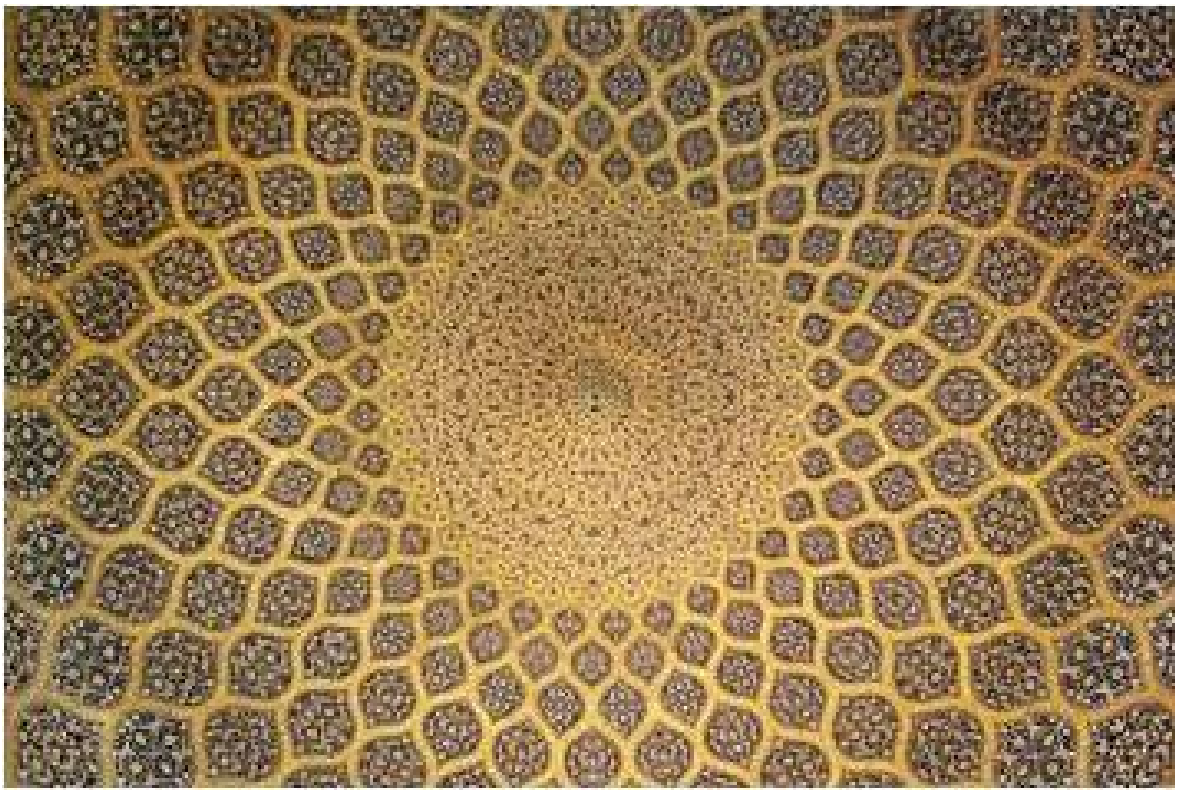

Figure 9: Ornament of the dome of Sheikh Lotf Allah Mosque, Isfahan, Iran (Kuppel der Moschee, orientalische Ornamente aus Isfahan, Iran (Depositphotos). Available from: http://de.depositphotos.com/17420297/stock-photo-dome-of-the-mosque-oriental.html [accessed on 08.10.2016.]

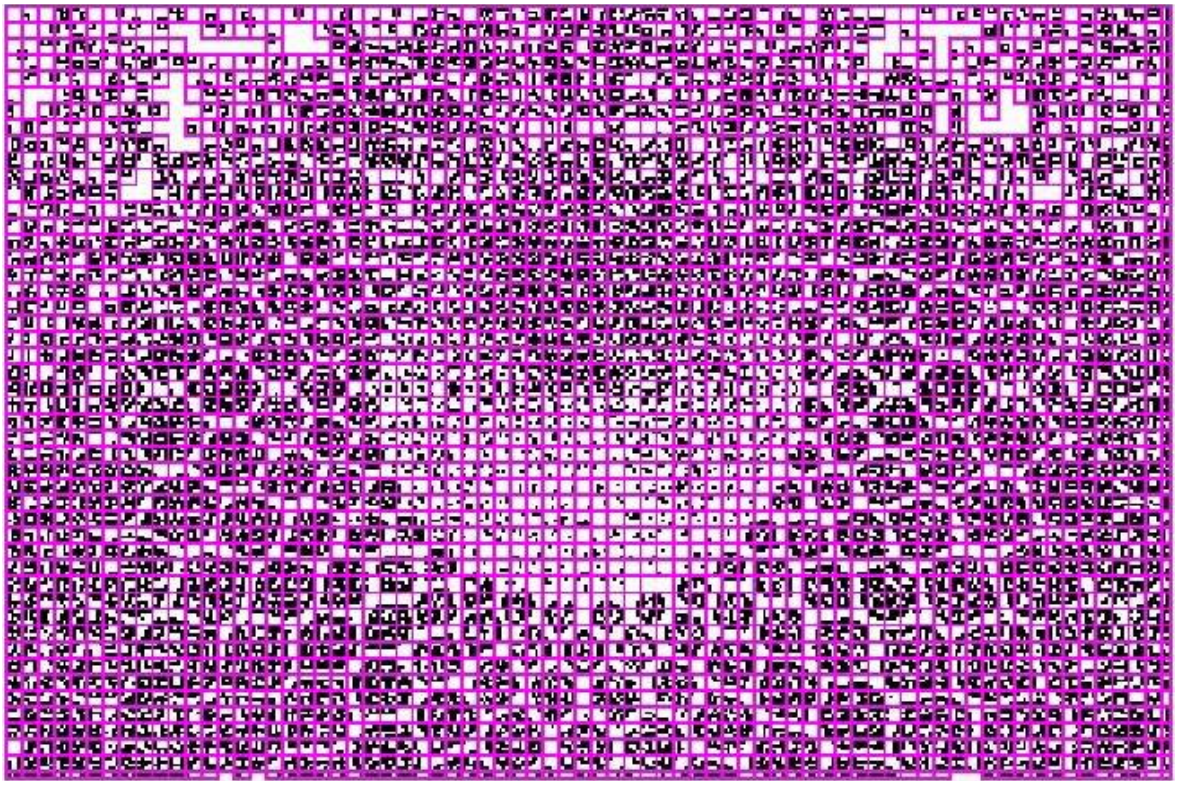

Figure 10: Box counting analysis in ImageJ software (Author)

The fractal dimension of this ornament obtained through box counting analysis performed in ImageJ software is 1.8823. Afterwards, the obtained value can be compared with different ornaments' values and analysed in terms of visual complexity, which is of crucial importance in architectural aesthetics.

The importance for humans is reflected through the relation between fractal geometry and the brain. According to the previously cited research by Joye, such visual patterns have beneficial effects on human brain and behaviour.

The use of softwares in designing the tactile aspect of human environment – parametric and ergonomic furniture design

Ergonomics represents a personalized answer for human comfort in different situations and parametric design, i.e. today, the use of different softwares that ease this process is widespread in different branches of architecture, interior design, urban furniture etc.

The term "parametricism" implies that all architectural elements are becoming parametrically malleable, adaptive to each other and to the context, and thus capable of relating and interacting with each other (Schumacher).

Just like natural systems, parametric compositions are highly integrated so that they cannot be easily decomposed into independent subsystems – a major point of difference in comparison with the modern design paradigm of the clear separation of functional subsystems.

(Schumacher, The Autopoiesis of Architecture. 2012). One of the most successful examples where parametric modelling was applied in architectural features is the Ricchezze Pavilion, where the parametric design was used to create both intimate and ergonomic furniture and space.

Figure 11.: Parametric design; Pabellón Ricchezze image courtesy of BarriosEscudero

Another good example from the urban furniture design that best explains the purpose and benefits of this method is the Hong Kong "Urban Adapter" project, where parametric modelling, softwares and creative architects' ideas were merged to produce a functional answer to changeable site conditions. Variable site conditions are entered into the software and act as input data. This is why designs created in such ways are flexible, adaptable and sustainable.

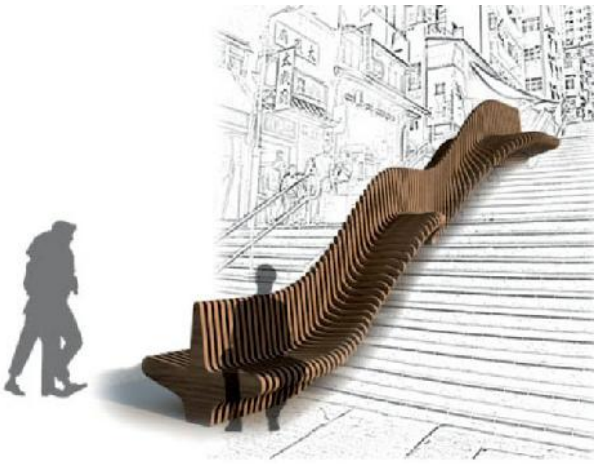

Figure 12.: 3D visual representation of the part of the Urban Adapter project

Conclusion

In today's architecture, interior, furniture and urban furniture design, urban planning, spatial planning, restoration and conservation of monuments, softwares are inevitable and very helpful tools. They save time and energy, and enable the creation of realistic renders and animations of designed solutions, but also provide a deeper insight into long-term effects on humans and the environment. Some of those aspects are certainly visual and tactile ones, such as nature-like forms in design, the application of fractal geometry principles and analysis of visual values of fractal and fractal-like forms, as well as increasingly popular ergonomic urban furniture design. Advanced use of numerous softwares of this kind can help solve problems designers face in a fast, reliable, functional and creative manner.

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Softveri kao moćan alat u modernoj biofiličnoj arhitekturi i dizajnu prilagođenom čovjeku: vizualni i taktilni aspekti

SAŽETAK

U modernom dobu u kojem stres vlada u svim aspektima života, izgrađeni okoliš igra bitnu ulogu, kako negativnu, tako i pozitivnu. Gradovi i zgrade su glavni emitenti CO2, proizvođači otpada, buke, saobraćajnih gužvi, te najveći potrošači energije. S druge strane, pored dobro poznatih i neophodnih mjera za smanjenje zagađenja, pametni izgrađeni okoliš može biti među najznačajnijim pozitivnim stimulansima za čovjeka, što se tiče povezanosti životne sredine i psihologije čovjeka. Dokazano je da brojne tehnike u dizajniranju koje se oslanjaju na principe prirode, poznate kao biofilični dizajn, imaju pozitivne efekte na centre u ljudskom mozgu odgovorne za relaksaciju. Cilj ovog rada je istražiti i predstaviti mogućnosti u oblikovanju izgrađenog okoliša prilagođenog čovjeku, sa biofiličnim elementima, sa vizualnog i taktilnog aspekta, korištenjem visoke tehnologije i softvera. Poseban fokus je na primjeni fraktalne geometrije u dvodimenzionalnim i trodimenzionalnim arhitektonskim elementima i dizajnu ergonomskog urbanog mobilijara pomoću parametarskog modeliranja.

Ključne riječi: arhitektonsko projektovanje, biofilični dizajn, softver, fraktalna geometrija, ergonomija.

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3D printing – challenges and perspectives

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This paper presents the systematic classification of the existing 3D printing processes, their operating principle, scope of application, materials that can be used, as well as some economic aspects. This is a review article, based on information available from public sources. The paper proposes a few examples of the practical application of some of these 3D printing processes.
Keywords: 3D printing, additive manufacturing, desktop manufacturing, manufacturing-on-demand.

Introduction

The main technologies used for manufacturing machine parts and other 3D items until the 1980s were:

- Subtractive manufacturing (cutting, drilling, grinding, polishing...);
- Moulding;
- Forging;
- Die cutting etc.

During the 1980s a new way of manufacturing emerged. Instead of successive cutting from a solid block of material (subtractive manufacturing)[1], the material is added layer by layer onto an appropriate platform. The new layer adheres to the previous one and, if it is in a form of powder or a liquid, solidifies. This new way of manufacturing is called "additive manufacturing"[2], but there are other names in use: DeskTop Manufacturing, Rapid Manufacturing, Manufacturing-on-Demand or 3D Printing. The additive manufacturing process is partially digital, it is controlled by a computer system, and the object is mathematically defined. However, some parts of the processes could be analogue because they depend on temperature or the intensity of radiation. Additively manufactured objects could have a complex shape, which cannot be easily (or at all) achieved by subtractive manufacturing. Information about the shape, dimensions as well as its composition are recorded as AMF Additive Manufacturing File or STL file[3].

Some futurologists, for instance Jeremy Rifkin, classify 3D printing into discoveries that will allow the start of the third industrial revolution[4], which is supposed to be the successor of the old mode of production, the dominant approach to the production of the late 19th century, based on the production line and intended for the production of a large number of identical pieces.

This paper will review the existing 3D printing technologies, working principles, materials and a possible filed of application of those processes.

Historical overview and standardization

The beginning of the development of 3D printing processes is connected to the article "A Scheme for three-dimensional display by automatic fabrication of three- dimensional model" that was published in 1981 by Hideo Kodama. He created two methods used for the formation of a three-dimensional object from liquid photosensitive polymer composition by controlled UV radiation.

In 1984, a group of French inventors, Alain Le Méhauté, Olivier de Witte and Jean Claude André, filed a patent for the stereolithography processes, that their company rejected on the grounds that innovation lacks business prospects.[5]

Only three weeks after the French group, Chuck Hull also filed his patent application for stereolithography (SLA).

The development of the now widely accepted STL file format (STereoLithography) is also one of Hull's great contributions.[6]

In 1986, the Company Helisys patented a method of forming a 3D object by laminating layers, called Laminated Object Manufacturing – LOM. This procedure has entered into commercial use in 1991.[7] In 1986, the DTM company patented a process Selective Laser Sintering – SLS, which was conceived by Carl Deckard, who was an undergraduate student at the time.[8]

Three years later, in 1989, MIT patented a process based on the application of the binder sprayed onto the powder surface (3D Printing Process - 3DP).[9]

In that year, Scott Crump patented the technology of 3D printing called Fused deposition modelling – FDM. It was based on modelling by applying molten material. With his wife Lisa, Crump also founded a company called Stratasys.[10]

Since 2005, when some patent rights for FDM expired, an open-source community has launched a RepRap project[11], which is a real democratization of 3D printing. One of the goals of this project is, for example, a 3D printer that can make the most of its parts. Modern methods of additive manufacturing, categorized into seven categories, according to ISO/ASTM52900-15 (Standard Terminology for Additive Manufacturing – General Principles – Terminology, 2015), and defined by ISO (TC 261), subcommittee F42.91 are: [12]

1. Binder Jetting
2. Directed Energy Deposition
3. Material Extrusion
4. Material Jetting
5. Powder bed fusion
6. Sheet Lamination
7. Vat Photopolymerization

3D workflow

There are a lot of similarities between manufacturing based on digital 2D and 3D printing processes. Manufacturing based on 2D processes could be divided into three main stages: prepress, press and post press. Similarly, 3D workflow could be divided into three stages: modelling, printing and Post processing. Each of those stages could be further divided.

Table 1 Main stages of 2D and 3D printing processes

2D printing stages:		
Prepress	**Press**	**Post Press**
Design Software; Scanner; Digital camera; Imposition software.	RIP; Digital printing.	Folding; Collating; Cutting; Sewing; Gluing.
3D printing stages:		
Modeling	**3D Printing**	**Post processing**
CAD software; Photogrammetry; Digital camera; 3D scanner; Manual modeling.	Slicing (similarly as RIP creating file for printing on digital press); Creating of additional structures. Main manufacturing process.	Thermal; Chemical; By light; Mechanical.

Binder Jetting - 3DP

Another name for this type of process describes it more precisely: powder bed and ink jet head 3D binder printing process. This process is based on depositing the appropriate bonding fluid onto a thin layer of powder (fig. 1). The powder impregnated with the bonding fluid becomes solid and connected with an underlying solid layer. After the bonding fluid is printed, another layer of powder is applied and the process continues. Non bonded powder remains as a support, surrounding solid parts. When the manufacturing is finished, the remaining powder is removed, and can be re-used.

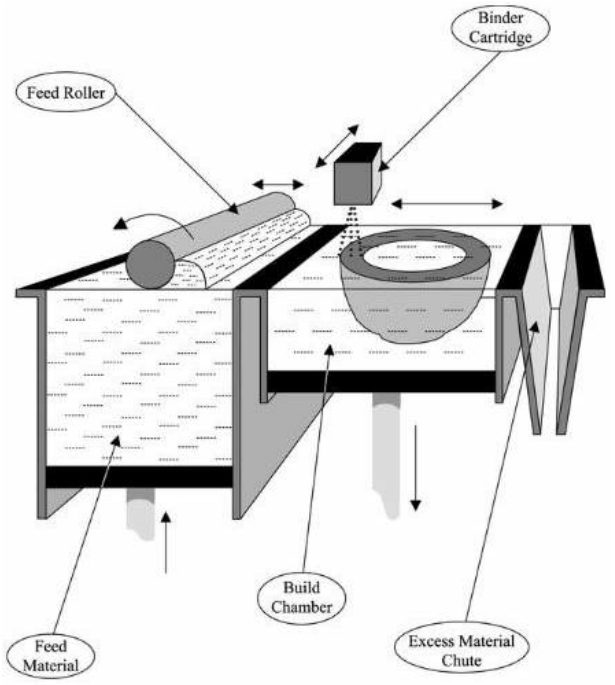

Figure 1. Schematic representation of the 3DP[13]

3DP enables manufacturing coloured objects by combining powders and binders of different colours. By choosing the appropriate powder (alloys, polymers, ceramics, composites), it is possible to achieve the desired mechanical and other properties of the manufactured object.

The process is relatively quick, and could create relatively large objects (fig. 2). It is possible to manufacture large objects of a complex geometry, because there is a supporting material surrounding it. If a powder of a different colour is combined, it is possible to obtain coloured objects. However, post processing is often necessary for enhancing mechanical properties.

Figure 2. Example of large object printed in 3DP[14]

Directed energy deposition (DED)

This process is also called: Laser Engineered Net Shaping (LENS), Direct Light Fabrication, Direct Metal Deposition, and 3D Lase Cladding. A high energy laser or an electron beam melts the metal powder or wire, delivered precisely in the focus of the beam (Fig. 3).

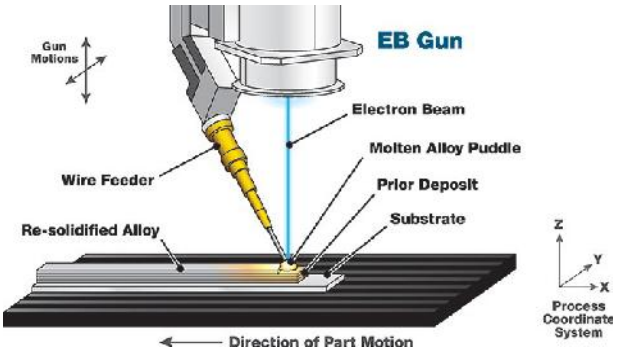

Figure 3. Schematic representation of DED[15]

The object is positioned on the supporting platform which moves in a horizontal direction (x-y). The deposition head moves vertically (z-direction) after every printed layer. There are systems with a chamber filled with inert gas, for processing oxygen sensitive materials. DED processes can manufacture new objects as well as repair damaged objects, by adding new material. Objects could be manufactured out of a broad range of metals, including titanium, steel, aluminium, tantalum, niobium, molybdenum, tungsten, Inconel and other alloys. It is possible to combine different materials for manufacturing one object.

Material extrusion

This type of process could be further divided into:

- Fused deposition modeling (FDM), and
- Robocasting, or direct ink writing (DIW).

FDM is trade mark of Stratasys company, and open source community coined a new term for the same type of process: Fused filament fabrication (FFF). FDM (or FFF) is appropriate to process thermoplastics (Acrylonitrile Butadiene Styrene – ABS, Polylactic acid – PLA, Polycarbonate – PC, Polyamide – PA, Polystyrene – PS, high impact polystyrene – HIPS, high density polyethylene – HDPE, polyphenylsulfone

– PPSU) and metals with low melting point. The fig.4 depicts how FDM works. A filament passing through the hot tube is melting and it is precisely deposited through the nozzle onto previously deposited material. Melted material quickly solidifies and bonds to previously deposited material.

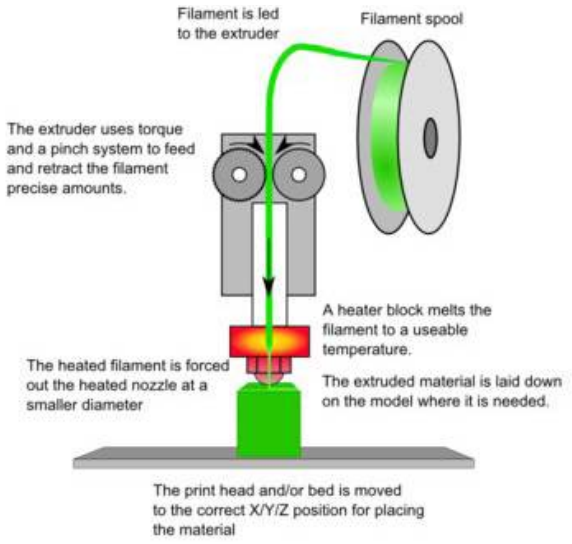

Figure 4. Schematic representation of FDM[16]

FDM is one of the 3D printing processes which is the most affordable for a wide range of user. Since the patent rights expired, the price of 3D printers (fig. 5) has constantly decreased (under 500 $ for a desktop model, in the year 2016) and it is supported by a powerful open-source community DIY (Do-It-Yourself).

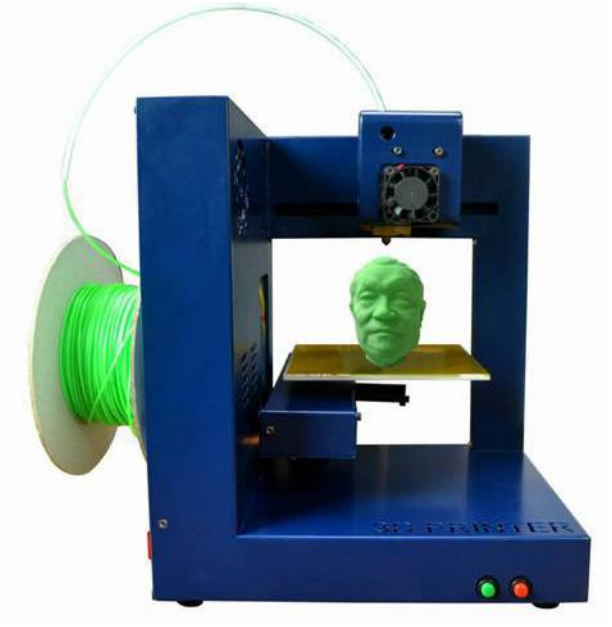

Figure 5. Cheap desktop FDM printer[17]

FDM processes can be used for quick making of models or prototypes for different purposes, or for manufacturing small series of products. DIW process applies "ink" directly onto a platform or a previously deposited material. In fact, the "ink" is a ceramic slurry with complex rheological properties, which, placed under pressure, when the velocity gradient is high, flows relatively easy (shear thinning), but when it is deposited and there is no velocity gradient, viscosity increases and the "ink" remains in place. The created object is not completely solid, and it must be dried or sintered. It is possible to combine ceramics with metal and to create objects of composite materials. DIW is especially appropriate for creating labware, lattices for filtration or catalysis, and artificial parts of the human body (bones).

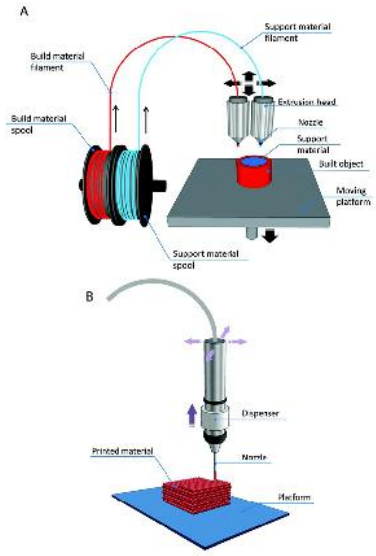

Fig. 6 Schematic representation of DIW[18]

Material Jetting

This process is similar to 2D ink jet printing. However, the ink layer is thicker and the platform carrying the objects can move in a vertical direction, so the 3D objects could be formed by a direct deposition of liquid material (ink). After depositing, material must be solidified by UV curing or by spontaneous drying. Material jetting can be divided into three subcategories:

- Liquid metal jet printing;
- Plastic jet printing;
- Multijet modelling (Fig. 7).

For a complex geometrical object, it is important to use support material, which is also applied by jetting.

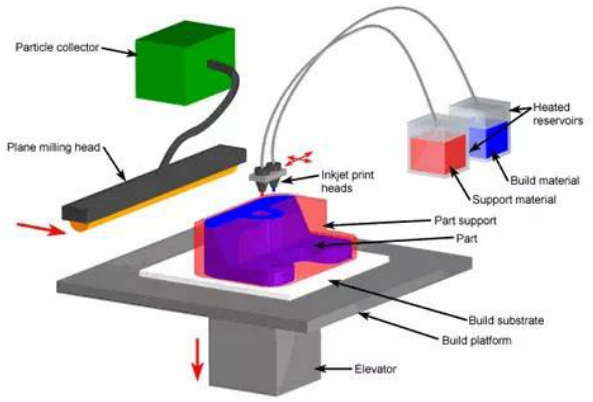

Fig.ure 7. Schematic representation of multi jet modelling[19]

Material jetting technology is an excellent tool for a fast making of realistic and functional prototypes with fine details and precision. It is the most precise 3D printing technology today, up to 16-micron layers, which is thinner than a human hair. It is possible to use the following plastic materials: rigid opaque plastic, transparent plastic, rubber-like plastic, simulated polypropylene, heat resistant, simulated ABS.

Powder Bed Fusion

The term powder bed fusion refers to processes based on selective heating of the powder layer.

Heating can cause melting or sintering, which makes the powder, exposed to heat, solid. There are many subcategories:

- Electron beam melting (EBM), for alloys including Titanium;
- Selective laser melting (SLM), for steel, Aluminum, Ti-alloys and Co-Cr alloys;
- Selective heat sintering (SHS), for thermoplastic powder;
- Selective Laser sintering (SLS), for thermoplastic or ceramic powder;
- Direct laser metal sintering (DMLS), for most of alloys.
- After heating one layer, the printing devices apply a new layer of powder. When the object is finished, the remaining powder is reused.

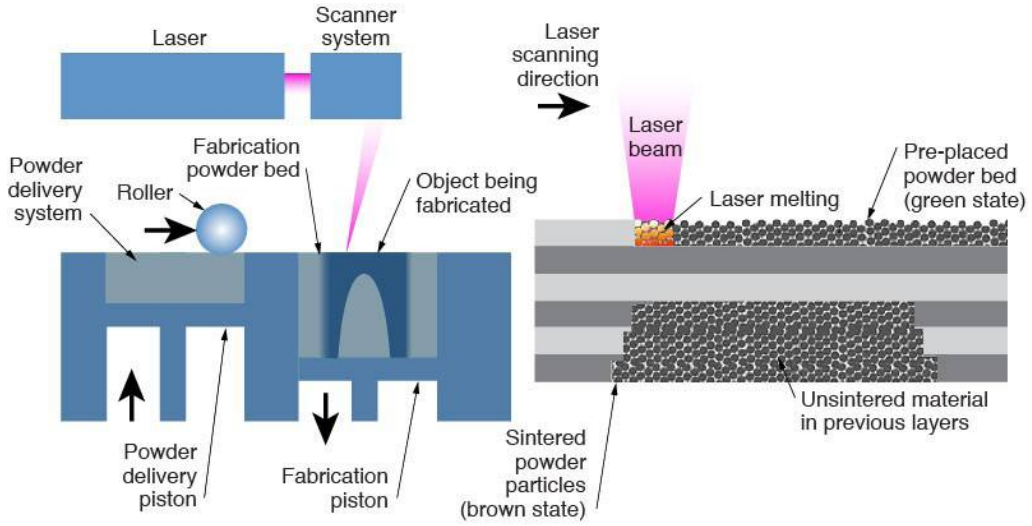

Figure 8. Schematic representation of SLM[20]

Powder bed fusion technology is appropriate for producing functional prototypes and spare parts of complex geometry. The surrounding powder that is not melted or sintered provides an excellent support.

Sheet Lamination

It is also called "laminated object manufacturing" (LOM) or "selective deposition lamination" (SDL).

The process is based on successive lamination of the layers of the material and selective cutting of each layer.

After laminating and cutting the last layer, excess material, which is also cut, is removed and final 3D objects remain. Objects could be created out of preprinted foils of paper, metal or plastic, so it is possible to obtain coloured ones.

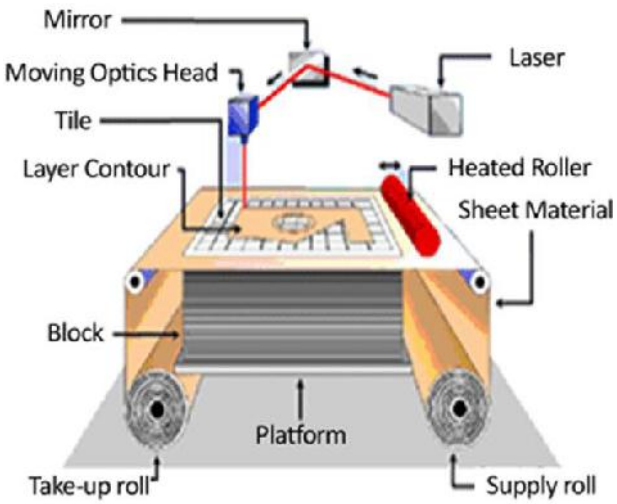

Figure 9. Schematic representation of LOM[21]

LOM processes are mostly used by artists, architects, and designers for making relatively large and cheap models and objects (fig. 10). Models have mechanical properties similar to wood. A disadvantage of this process is a relatively poor dimensional precision, in comparison to other 3D printing techniques.

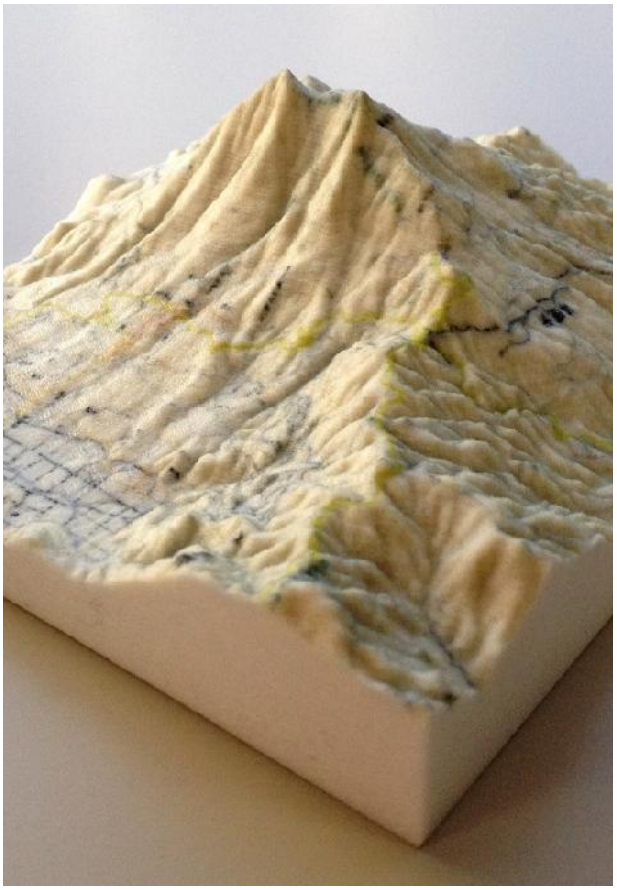

Figure 10. Typical models created by LOM

VAT Photopolymerization

Vat photopolymerization refers to a few similar technologies:

- Stereolithography (SLA); this is the first 3D printing process; it utilizes a moving laser beam for curing the photopolymer;
- Digital light processing (DLP); it utilizes a micro mirror projector for curing the photopolymer;
- Continuous digital light processing (CDLP); polymer is cured by LED and oxygen;
- Continuous liquid interface production (CLIP).

Stereolithography works with liquid photopolymers. An object grows, layer by layer, in the container. A thin layer of photopolimer is cured by UV radiation and photoplymer becomes solid. Then a new amount of liquid photopolymer is added, to form a new layer to be selectively cured.

If UV radiation comes from above, the dimensions of the object are limited by the size of the container (fig. 11). However, if UV radiation comes from below, then it is possible to produce significantly larger objects (fig.12).

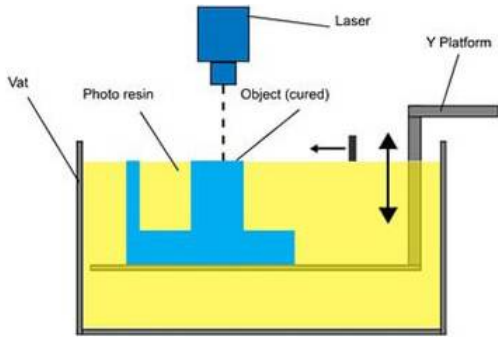

Figure 11. Schematic representation of VAT with approach from above[22]

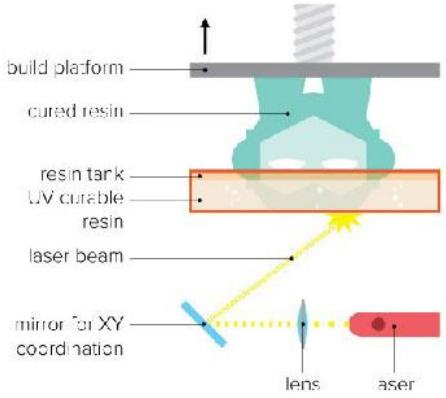

Figure 12. Schematic representation of SLA with approach from below[23]

SLA is relatively fast technology for making larger objects that could have good mechanical properties. Accuracy and precision could be very high, comparing to other 3D printing technologies. SLA is appropriate for manufacturing models, highly detailed sculptures (fig. 13), spare parts and jewellery. The surface finish could be very smooth. However, the price of printers and polymers is still relatively high.

Figure 13. Highly detailed sculpture manufactured by SLA

Perspectives of 3D printing

The development of 3D printing technologies is somehow similar to developing desktop publishing technologies. It will enable a wide range of users with a different level of education to create 3D objects at home. On the other hand, industrial 3D printers are getting cheaper and more advanced, so the greater portion of machine parts industrial manufacturing will be 3D printed. Advancing 3D printing technology will open new fields of application in:

- Medicine (making prosthetics, artificial parts of the human and animal bodies, models for practising surgery);
- Designing machine parts (creating models and prototypes);
- Design and arts (making models, maquettes, decorative items);
- The analysis of problems (making maquettes and models).

There are authors that believe advancing 3D printing technology will:

- Help maintain a sustainable development in the world;
- Change the world economy because of new ways of production – production on demand;
- Making great developments in other fields possible;
- Even become the basis of a new industrial revolution.[24]

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3D štampa – mogućnosti i perspektive

SAŽETAK

U ovom radu sistematizovana je klasifikacija postojećih postupaka 3D štampe, prikazan je princip rada svakog od postupaka, oblast primene, materijali koji se mogu koristititi, kao i neki ekonomski aspekti primene. Rad je preglednog tipa, zasnovan na informacijama dostupnim iz javnih izvora. U radu je predloženo i nekoliko primera praktične primene nekih od pomenutih postupaka.

Ključne riječi: 3D štampa, aditivna proizvodnja, desktop proizvodnja, proizvodnja na zahtev.

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The foundation, methods and infrastructure proposal for electric vehicle charging stations in Bosnia and Herzegovina

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By focusing on the environmental resources and the exploitation of renewable energy sources, an analysis and description have been made concerning the basis and model for the construction of electrical cars, including the proposed infrastructure for electrical vehicle charging stations in Bosnia and Herzegovina. Keywords: ecology, electric vehicles, renewable energy sources, infrastructure, "green energy".

Introduction

An electric car is an automobile that is propelled by an electric motor, using electrical energy stored in the accumulator or another energy storage device.

They were popular at the end of the 19th, and the beginning of the 20th century. In the middle of the year 2000, the interest in electric car manufacturing renewed, mainly due to a concern about rapidly increasing oil prices. So, since September 2011, the models of serial production, available in some countries are: Tesla Roadster, REVAi, Buddy, Mitsubishi i-MiEV, Nissan Leaf, Smart ED and Wheego Whip LiFe.

Although they are more expensive in relation to conventional ones, the advantages of electric cars include a considerably lower level of air pollution in the cities, a lower greenhouse gas emissions, and they require considerably smaller investments and efforts in the development of the charging infrastructure.

Electric cars charging stations

In this chapter, the main features necessary for the existence of an electric car charging station are described.

Electric cars charging station models

There are four different ways of charging electric cars for which it is necessary to provide an appropriate infrastructure:

Model 1: A socket with an extension cord An electric car is connected to an electrical network (AC voltage, single-phase or three-phase 16A rated current) by a standardized connector and live lead, neutral wire and grounding.

Model 2: A socket and cable with a protection device. An electric car is connected to an electrical network (AC voltage, single-phase or three-phase 32A rated current) by a standardized connector and live lead, neutral wire and grounding, together with a signal line between the electric car and the socket.

Model 3: A specific socket on a dedicated circuit A direct connection between the electric car and the electrical network (AC voltage, single-phase or three-phase), established by using special equipment for the electric car power supply.

Model 4: Direct current (DC) connection for fast recharging An indirect connection of an electric car to an electrical network (AC voltage) established by

using an electric car charger where the signal line comes to the equipment permanently connected to the alternating network.

Modes 1 and 2 represent slow ways of charging and they serve for household sockets. Mode 3 supports both slow and fast ways of charging (depending on the rated current) and we need special equipment for it. Mode 4 represents a fast way of charging.

Electric vehicle charging time

A fully charged electric vehicle battery, produced by electric vehicle automakers (such as Nissan), has the capacity of about 20 kWh, providing it with an electrical autonomy of about 100 miles. Since February 2016, there are two models; a 70 KWh and a 90 KWh battery. Manufacturers have chosen two solutions f or faster charging (a 22 kW, and even 43 kW and higher):

- Use the vehicle's built-in charger, designed to charge from 3 to 43 kW at a 230 V single-phase or a 400 V three-phase.
- Use an external charger, which converts AC current into DC current and charges the vehicle at 50 kW (e.g. Nissan Leaf) or higher (e.g. 120-135 kW Tesla Model S).

Table 1. Charging

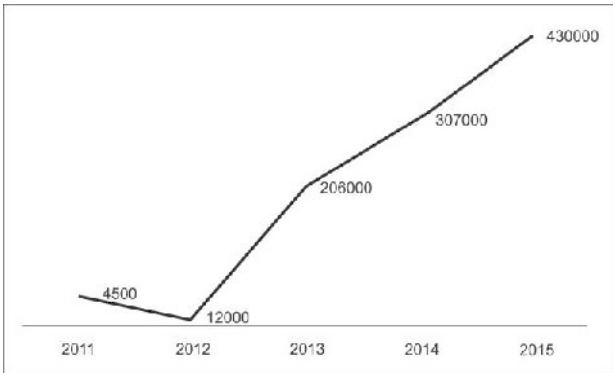
Charging time for 100 km	Power supply	Power	Voltage	Max. current
6–8 hours	Single phase	3.3 kW	230 V AC	16 A
3–4 hours	Single phase	7.4 kW	230 V AC	32 A
2–3 hours	Three phase	10 kW	400 V AC	16 A
1–2 hours	Three phase	22 kW	400 V AC	32 A
20–30 hours	Three phase	43 kW	400 V AC	63 A
20–30 minutes	Direct current	50 kW	400–500 V DC	100–125 A
10 minutes	Direct current	120 kW	300–500 V DC	300–350 A

Charging station types

As the charging station types we can classify stations for fast charging within 30 minutes, stations with a medium charging speed that lasts 3 hours and household charging stations that enable car charging within 6 to 8 hours. Apart from the listed, we will mention:
- stations for battery swapping and
- solar stations

Electric cars charging stations in the world

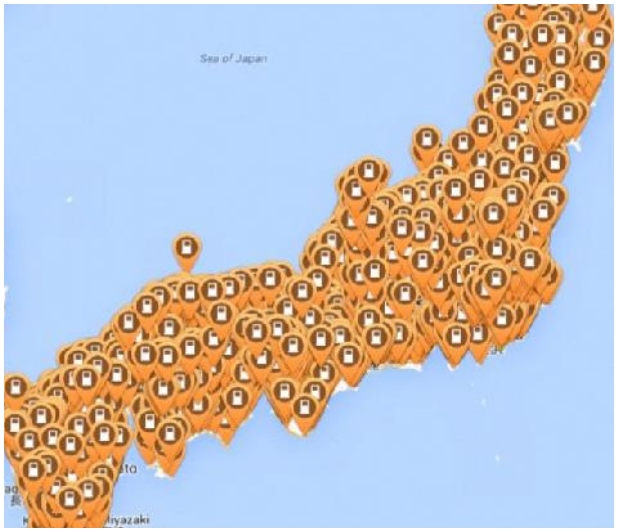
In comparison with conventional cars, the number of electric cars in the world is very small. Less than 1% of the total car number belongs to the group of electric ones, but it is important to emphasize that a growth trend is recorded in that field. According to the data acquired by statistical agencies in September 2015, the number of electric cars, found in the world streets, exceeded one million. Also, a larger growth trend in the number of electric cars is expected in the future. According to the predictions, in 2030, the number of electric cars in the world should be 10.5% of the total car number. Based on this, we can conclude that there should be over 210 million electric cars found on the roads all around the world in 2035.



Picture 1. Number of new sold electric cars by years (total 1 million-December 2015)

In terms of electric cars, as a characteristic country in the world, among others, we can say that China possesses the biggest complex for electric cars charging points, built in Beijing. It is spread over 26500 square meters and has 30 places in total which provide a possibility of fast charging. Besides China, we will emphasize Estonia as the first European country which had the entire country area

covered with car charging stations, and Japan, as the first country with more electric than petrol car charging stations. It is needless to say anything about the network and connection of the charging stations. Only fast charging stations are shown in the picture below.



Picture 2. Electric car charging stations in Japan

In Europe, an improvement in this field is reflected in the plan that the number of cars, using conventional fuels, will be halved by 2030 in the cities, and that, by 2050, these cars will be completely replaced by electric ones.

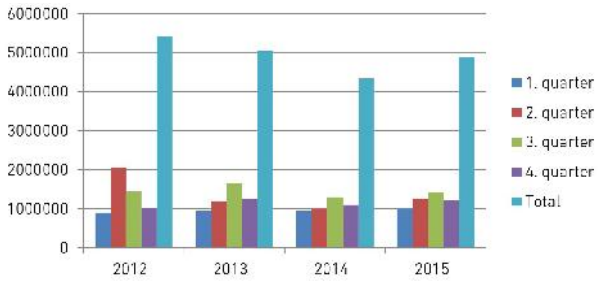
The problem occurred during the creation of universal rules, mostly for connectors that will be used. However, the standard according to which, until December 2015, all European stations for electric car charging must use the so called Type 2 connector, is adopted.

Picture 3. Type 2 connector

Electric cars and charging stations in Bosnia and Herzegovina

Although the concept of electric cars, and therefore charging stations of the same, is unknown in our region, taking into consideration the given and the data of the world statistical agencies, we can conclude that by 2035 we will have over 100 000 electrically operated cars on the roads.

Beside this, it should be emphasized that, due to its geographical location, Bosnia and Herzegovina is a transit country. Even if the concept of electric cars does not take hold, we must be aware of the fact that people who use Bosnia and Herzegovina as a transit country or those who come to Bosnia and Herzegovina as tourists have a need for electric car charging stations.



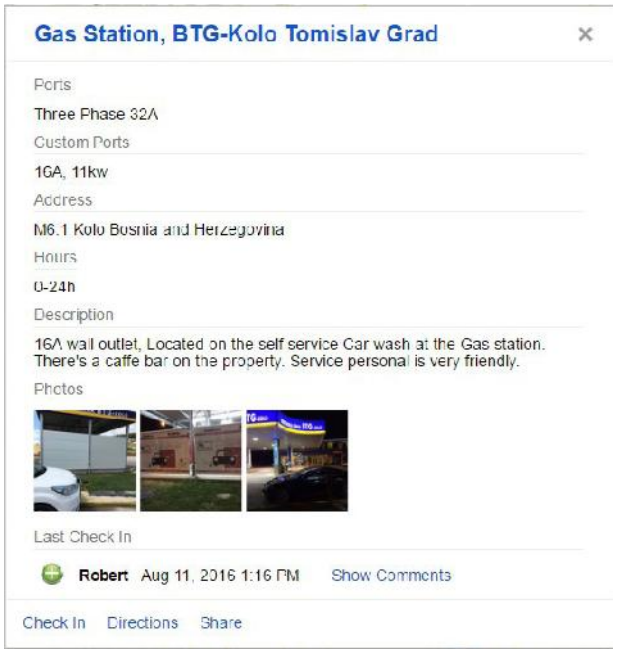
Graph 1. Number of foreign cars in Bosnia and Herzegovina (transit and tourists)

On the graph we can see that, according to the statistical agency, about 5 million foreign cars annually go through Bosnia.

According to all predictions, this number will grow since tourism just begins to take hold in Bosnia, but if we view it as constant, we still see that from the 5 million cars, in 2035, 500000 should be electric ones.

A very small number of electric cars can be seen in Bosnia today. One of the main reasons for this is the lack of charging stations. The information that proves it is that in Bosnia there is just one electric car charging station. It is placed in Tomislavgrad.

Based on the prediction about the development and a potential number of electric cars in the world, and therefore in Bosnia (stated in the previous text), a much higher number of charging stations is necessary.



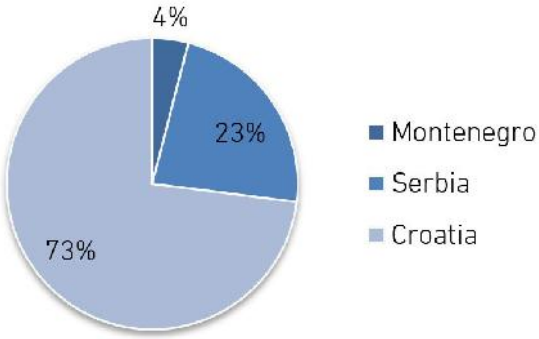
Picture 4. Electric car charging station in Bosnia and Herzegovina- Tomislavgrad

Infrastructure proposal for electric car charging stations in Bosnia

In this work, we decided to make a proposal for allocating electric car charging stations on the territory of Bosnia and Herzegovina. We will primarily focus on the stations the population, for whom Bosnia is a transit country, will use. In the second part, we will give the proposal for allocating particular charging station infrastructure that might be useful to all Bosnian residents. We will also propose to introduce a system of owning electric car charging stations with a three-phase connector, as well as building private solar stations for electric car charging by which we would get 100% "green" effect with 0% pollution in our country.

The transit network

Based on the charging stations in the region and alignment through Bosnia as well as planned alignments in development, we made a proposal of allocating electric car charging stations for cars that go through Bosnia, i.e. cars that use Bosnia and Herzegovina as a transit network. Therefore, our infrastructure would cover the whole area of Bosnia and Herzegovina. We took into consideration the geographical position, as well as tourist locations and resorts so that people who pass by have a more pleasant stay and can spend quality time that is necessary for charging the car. The next chart shows, in percentages, the direction cars will take when travelling from Bosnia.



Graph 2. Travel directions of the cars from Bosnia and Herzegovina

Picture 5. Infrastructure proposal for electric car charging stations in Bosnia

Picture 5 shows a plan for building 16 new electric car charging stations. The stations are allocated so that they cover transit places, but also the whole territory of Bosnia and Herzegovina near town locations or border crossing, so that users can make the most of the time needed for charging car batteries to visit certain tourist attractions or simply use the time to rest in a town. The stations can be built within the already existing petrol stations, or

they can be individual stations with resorts. These stations would be listed in applications which show the locations and charging stations accessibility, and users could access them through different devices (computer, phone...) In the table, red colour shows the distance between two closest stations.

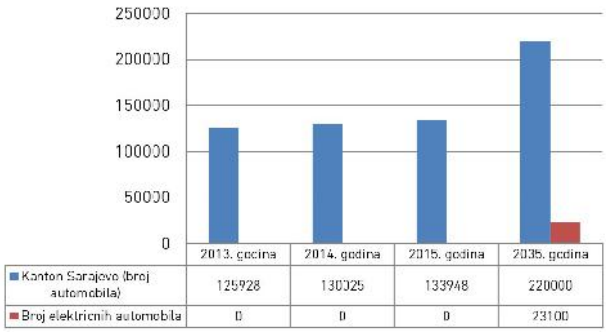
Keeping in mind that the electric car movement radius is in average 130 kilometres, it is taken into account, so in the table we see that the distance between the nearest stations does not go over 130 km, no matter the direction you take.

Table 2. Distance display in km between planned stations for electric car charging

	Banja Luka	Bihać	Bijeljina	Bos. Grahovo	Bugojno	Doboj	Gacko	Konjic	Mostar	Neum	Sanski Most	Sarajevo	Tomislavgrad	Tuzla	Višegrad	Zenica	Zvornik
Banja Luka		153	221	164	116	98	316	207	232	308	63	188	161	158	301	128	207
Bihać	153		362	112	196	239	390	288	303	363	120	307	224	299	419	246	348
Bijeljina	221	362		382	262	131	275	236	304	387	294	178	324	70	180	191	54
Bos. Grahovo	164	112	382		141	261	280	200	192	253	123	262	113	321	375	202	392
Bugojno	116	196	262	141		162	203	91	116	220	138	121	60	196	234	61	251
Doboj	98	239	131	261	162		287	202	270	353	171	159	222	71	272	91	120
Gacko	316	390	275	280	203	287		114	88	127	341	132	173	248	133	196	222
Konjic	207	288	236	200	91	202	114		69	152	230	60	84	165	174	111	195
Mostar	232	303	304	192	116	270	88	69		84	261	129	85	234	221	180	264
Neum	308	363	387	253	220	353	127	152	84		322	212	146	317	256	263	346
Sanski Most	63	120	294	123	138	171	341	230	261	322		249	175	231	361	188	280
Sarajevo	188	307	178	262	121	159	132	60	129	212	249		145	121	113	69	124
Tomislavgrad	161	224	324	113	60	222	173	84	85	146	175	145		256	258	121	279
Tuzla	158	299	70	321	196	71	248	165	234	317	231	121	256		171	140	47
Višegrad	301	419	180	375	234	272	133	174	221	256	361	113	258	171		182	126
Zenica	128	246	191	202	61	91	196	111	180	263	188	69	121	140	182		161
Zvornik	207	348	54	392	251	120	222	195	264	346	280	124	279	47	126	161	

Detailed network

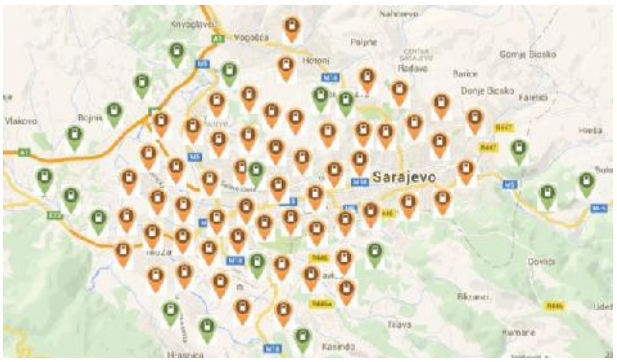
By the time a lot of the residents of Bosnia and Herzegovina start using electric cars, a network should become more complex and every town should have public charging stations. Ultimately, the network, or electric car charging station infrastructure in Bosnia and Herzegovina should look at least as close to those in the European countries. On the basis of BIHAMK data about the number of registered cars in the area of Sarajevo Canton, an annual growth trend of about 3% is noticed, so we can assume the number of cars in Sarajevo Canton in 2035 will be around 220000. In comparison with the growth trend at world level, i.e. an increase in the number of cars by 2035, we conclude that there should be over 23000 electric cars in Sarajevo Canton. By this, we mean the ownership of private electric cars.



Graph 3. Growth trend of car number in Canton Sarajevo

In order to run smoothly, a much larger number of charging stations is necessary. In the next picture, the picture of Sarajevo city is represented together with a potential placement of electric car charging stations. They are necessary in order to satisfy the

needs of the population that primarily come from other cites, or the population that passes through, but also the needs of the local residents.



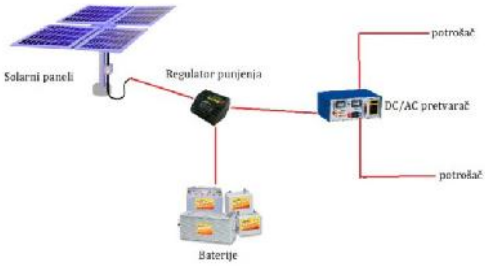
Picture 6. Proposed infrastructure of electric car charging stations in city of Sarajevo

A proposal of a private electric car charging system

Although it is considered that electric cars do not pollute the environmental, that claim is not established in general.

The term known as "Well to Wheel" shows us that electric cars, indirectly, pollute the environment. An indirect way of polluting is reflected in the fact that they use electrical energy produced in objects that pollute the environment such as thermal and nuclear power plants.

In order to make our cars 100% "green", cars with 0% pollution, we propose building private solar charging stations.



Picture 7. An overview of solar system for charging

By a simple calculation, on the basis of the installed equipment technical data in the solar system, we can acquire information that an average user in our area needs an approximate surface of 55 square meters of solar panels to charge a battery of an average electric car.

Conclusion

In accordance with these conclusions, it is necessary to awaken citizen consciousness as well as the authorities in Bosnia and Herzegovina, so that electric cars find their place in our area. A European project "Transport 2050" shows us that, in the next 15 years, the whole of Europe is going to reduce the number of cars that use fossil fuels by 50%, and that electric cars are going to take their place. If we want to keep up with Europe, we must seriously dedicate ourselves to solving this problem. Taking into consideration our advantageous geographical position, electric car charging stations will decide if we will still be a transit European country, or a country that everyone will give a wide berth.

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Osnova, metode i prijedlog infrastrukture punionica električnih automobila u Bosni i Hercegovini

SAŽETAK
Fokusirajući se na ekološke resurse i iskorištavanje obnovljivih izvora energije zbog smanjenja emisije štetnih gasova, analizirani su i opisani osnova električnih automobila, modeli izgradnje, te prijedlog infrastrukture stanica za punjenje električnih automobila na području BiH.

Ključne riječi: ekologija, električni automobili, obnovljivi izvori energije, infrastuktura, “zelena energija”.

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On the effect of pre-stressing using micro-pile injection

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When damages occur on structures due to their base giving in, strengthening of that base, i.e. of the foundation soil, is performed. One possible method of strengthening is through the use of pipe micro-piles and pressure injection, which is the subject this paper deals with. The effect of pipe micro-pile injection, the process and successful repair are described below.
Keywords: micro-piles, pressure, injection.

Introduction

Small diameter piles (micro-piles) have low rigidity and bearing capacity, but carry a very specific and important role, and can be repaired using supplementary injection.

Injecting the injection mixture leads to pre-stressed surrounding soil, and after the mixture hardens, to compression pre-stressing of the hardened mixture next to the micro-pile pipe.

This type of pre-stressing results in favourable features in low-permeation high-deformity soil. A considerably lower air pollution in the cities, and a lower greenhouse gas emissions require considerably smaller investments and efforts in developing the charging infrastructure.

There are also more modern methods of strengthening the soil below structures, such as expansion resin (also used for soil pre-stressing). Injecting this resin into the area below the foundation has numerous advantages: no digging/excavation is necessary, there is a safe laser-based movement control, the operation is quick, efficient, and simple, it does not pollute the environment, there is a direct contact between the soil and the construct, there are no dynamic effects, etc.

About micro-pilots and injecting

About the micro-pilot and injection process

The steel pipe is outfitted with a sharp point at the top and lateral perforations approximately 1.0 m (depending on the length of the micro-pilot) from the top of the pipe, in order to allow seepage of the injection mixture (Figs. 1 and 3).

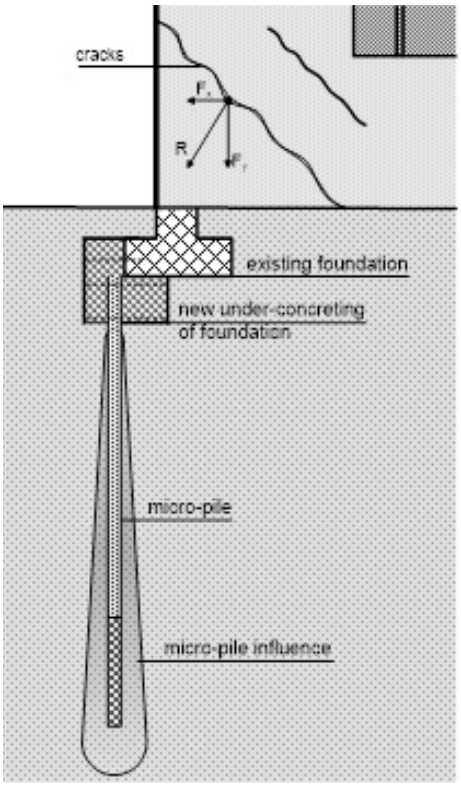

Figure 1. Some of possible micro-pile applications: - prevention of the soil creeping under load, - decrease of settling, - prevention of differential settling

Spiking the sharpened micro-pile pipe or its placement into a drilled bore-hole 4-5″ in diameter, when faced with a low-permeation high-deformity soil is quite simple. When the steel pipe reaches the planned depth, spiking is ceased, and the operation of sealing the ring-shaped area between the pipe and the surrounding soil on a segment approximately 1 m below the surface of the soil now begins. The most important operation before injection is setting the appropriate packer (Fig. 2) in the upper portion of the pipe so that the seepage of the injection mixture to the surface during the injection is prevented. Next, injection is used to facilitate injection pre-stressing of the contact zone between the pile and the surrounding soil.

Under pressure, the injection mixture exits the pipe through the perforations, but due to high density (and thereby high viscosity), the injection mixture, being a pressed-in fluid, cannot propagate through filtration into the surrounding soil (because the soil is not permeable enough). Instead, there is an effect of compaction grouting, i.e. injected surface being created in the soil.

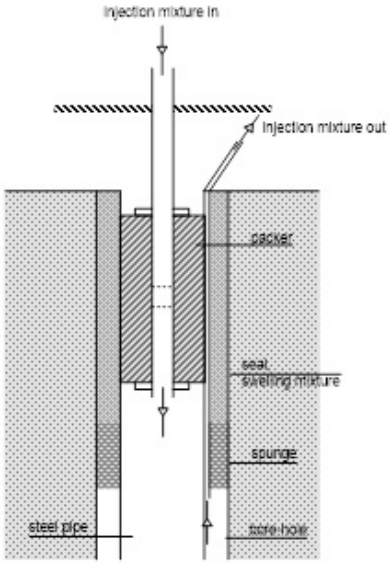

Figure 2. Detail at the outlet of the bore-hole injection

Pipe micro-pile injection characteristics

This type of soil pre-stressing appears due to the inability of filtration seepage of the injection mass into the surrounding soil (due to low soil permeability and high density, i.e. very high viscosity of the injection mixture). Soil pre-stressing in this case also appears due to high level of deformity of the surrounding soil and due to forces speared by high

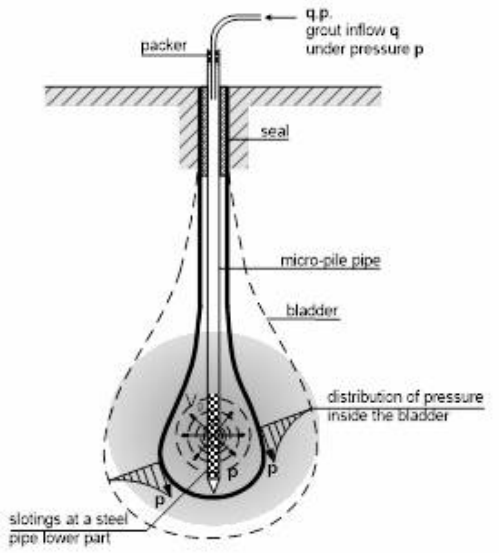

Figure 3. Effect of pressure pre-straining of hardened contents (ideal case diagram)

working pressures (prad) during the injection into the pipe and the underground space surrounding the pipe, especially around the top of the pipe, where perforations were made in order to facilitate injection mixture seepage. An estimate of the successful creation of pre-stressed soil around the pipe micro-pile is determined by measuring return pressures (ppov), and the volume can be ascertained according to the quantity of the injection mixture used. The total volume of the mixture used (Vu) for the pile in question contains two components: Vo = volume of the mixture contained within the steel pipe and Vg = volume of the mixture outside the pipe, with the ratio being:

$$V_u = V_o + V_g \qquad (1)$$

Coefficient of realized injection volume K may be formulated as follows:

$$\kappa = \frac{V_g}{V_o} = \frac{V_u - V_o}{V_o} = \frac{V_u}{V_o} - 1 \qquad (2)$$

In theory, the coefficient may have values between: 0 ≤ K ≤ ∞ (most often 2 to 10).

If the return pressure is very low and the coefficient K is close to zero, that means the soil features low deformability (semi-hard or hard clay). If the return pressure is low and K is high, the soil is very deformable, which may mean:

- The soil contains cracks or other paths (for example, holes along dead roots, groundhog holes, etc.)

- The soil contains intercalations (or thicker layers) of high permeability

- The injection mixture entered the holes (in some underground areas, etc.)

- Due to overly high pressure, the ground fractured (fracturing hydro-fracture grouting), and the injection mixture filled the cracks

- In very soft, non-consolidated and water-saturated dusty/muddy layers there exists a high probability for the injection mixture, heterogeneously mixing with the muddy materials (creating round, bubbly accumulations).

The effect of stress in the soil is partially transformed and weakened, although the coefficient K may carry a high value. The quality of the above process is shown through increased density and total stiffness of the injected zone, decreasing the total soil deformability along the micro-pile pipe. The average strain effect surrounding the pipe micro-pile is estimated using two parameters: ppovr >1 bar (better: Ppov > 5 bar) K >1 (better: K>3)

The effect of soil strain due to injection

When the injection mixture is allowed to solidify, i.e. become properly dense (a minimum of 30 minutes, usually around 60 minutes), packers are taken down from the micro-pile pipe.

In order to prevent the rising seepage of the mixture due to return pressure, it is necessary to hold initial pressures in the soil (especially those in contact with the surrounding soil) to levels as high as possible.

After a few days the injection mixture hardens, and fluid pressure fills the stress area. However, the area of the contact with the surrounding soil will keep the pre-stress effect, manifesting in the surrounding soil increasingly pressuring the hardened contents within the pre-strained area. The said phenomenon has a positive effect on the pile bearing capacity from two aspects:

- The hardened injection mixture is exposed to increased spatial pressure stress (pre-stressing), increasing its resistance to rifts in the pipe

- Soil around the stress contour is in a high-compression state, resulting in decreased porosity and deformability, and increased bearing capacity.

An example of salt silo foundation repair

A large number of silos have been constructed lately, only by installing them on standard foundations and only with a visual examination of the foundation soil, without any pre-construction geotechnical examinations (Fig. 4). After filling the silos up with 100 tons, or 80% of their capacity, settling and leaning of the silos was noticed, both phenomena increasing significantly in a short time period. Counter-measures were introduced right away: surveying of settling and geotechnical investigations. The silo foundations at the depth of 1.3 m were set on hard clay, but from the depth of 2 m (where the water level is), there was soft clay. After geotechnical investigations, a means of repair/improvement (i.e. preventing further settling) was suggested – driving a micro-pile into the foundation soil to below the present foundations, then injecting and thereby improving the soil, as will be shown below.

Figure 4. Salt silo: a) Silo photograph
b) Silo foundations at the depth of 1.3 m, diagram of the foundations and driven-in micro-piles

Figure 5. Foundation, bore-hole, steel pipe

The chosen repair method using micro-piles is the simplest, fastest and the most economical means of improvement for the presented situation.

The following was performed on 4 foundation footings (4 micro-piles per foundation): pre-drilling and driving in the pre-perforated steel pipes 6.00 m long, 101 mm in diameter, with a wall thickness of 3.60 mm, installation of rubber packers and injection of a certain quantity of cement suspension under pressure, thereby forming return pressure (Fig. 5).

The entry pressure (pre-injection) was 12 bar. Through the measurement of return pressure, it was ascertained that injection was successful and yielded the pressure of 3 bar, while the volume of used mixture was approximately 2.5 times larger than the volume of the drill-hole.

The contents and the characteristics of the injection mixture per 100 kg of dry cement: water (42 kg), bubbling additive -''Interplast – A'' (0.5 kg or 0.17 l). The average mixture density, based on the formed injection mixture, was 1.9 t/m3.

The operation also called for filling in the area between the pipe and the footing wall using an appropriate adhesive with a bubbling additive in order to ensure a long-lasting bond.

Settling is coupled with surveying equipment monitoring. The diagram of the time-based settling of the silo (i.e. the 4 foundations) was drawn according to the collected data.

The diagram shows that the repair of the soil was successful, i.e. further settling was stopped (Fig. 6).

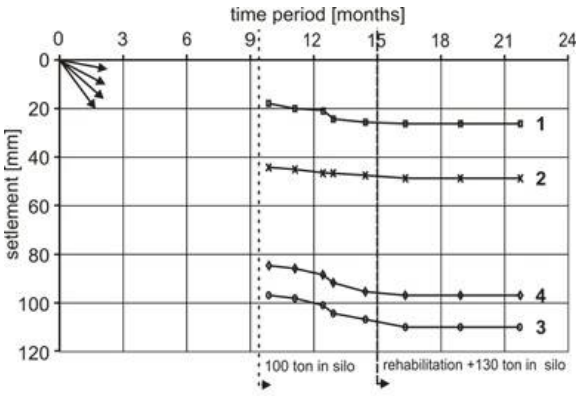

Figure 6. Time-based diagram of silo settling

An estimated calculation (not taking in consideration the pre-stress) of the pile at the depth of 6 m and estimated diameter of 0.2 m, using the alpha method with non-drained stiffness, gave us the total bearing capacity of one pile of Qt>230 kN, which is a significant increase per foundation.

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O efektima prednaprezanja metodom injektiranja mikrošipovima

SAŽETAK
U slučaju oštećenja konstrukcije zbog slabljenja podloge, izvodi se ojačavanje te podloge, tj. temeljnog tla. Jedna od mogućih metoda ojačavanja tla i tema ovog rada je upotreba cjevastih mikrošipova i ubrizgavanjem pod pritiskom. Opisani su efekti ubrizgavanja mikrošipovima, postupak i uspješno ojačavanje tla.

Ključne riječi: mikrošipovi, pritisak, ubrizgavanje.

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Experimental testing of beam girder on generally layered soil

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The paper describes model testing of girders and results of using the transversely loaded flexible beam girder on appropriately prepared layered soil. The settlement and bending moment (relative girder deformities) are measured along the girder in order to produce necessary results. The procedures and results of testing are then compared and final results commented on. Keywords: Foundation girder, generally layered soil, experiment, settlement, bending moment, comparisons.

Introduction

Some unknown reaction pressure is found to be loading girders laying on the ground, as a reaction to the known external load and the weight of the girder itself. Finding the distribution of reaction pressures is the primary task aimed at discovering the solution to the so-called contact problem of girders on a continual base. Distribution of reaction pressures must fulfil the conditions of balance and those of compatibility of settlement of girders and the ground below them. Those programmes which are presently accessible and most used adopt certain limitations concerning the possibility of system deformations (plane deformations or axially-symmetrical problems), meaning the realistic width of the girder is not being used. For that reason, it is beneficial to have as many test results as possible, especially when the ground is layered (with variable thickness of layers and variable thickness of compressible layers below the loaded girder).

Model testing

Model testing was performed using the prepared primary basin of the test model with various thickness of "artificial soil" forming the base for monitoring loaded beam girders. The primary basin of the test model as a construction for laying artificial soil of various thickness was constructed from concrete in three different heights shown on Figs. 1 a, b, c. The artificial soil contained the mixture of sand, bentonite, concrete and water.

Several prepared samples with various component ratios were tested in the laboratory, and the one, for which we believed would suit the test run the best, was chosen: a mixture containing 87% sand, 10% bentonite, 3% cement and water amounting to 400% of the bentonite mass.

The mixture was chosen based on the assessment of accomplishing certain strength levels when tested. The chosen mixture was kept 20 days after mixing, i.e. after having been poured in a liquid state. Fig. 1c shows the test basin filled with artificial soil and steel construction (which will be used as support for the counter-weight).

Samples were taken from the test basin and its characteristics tested right before the testing/ observation of the loaded girder, i.e. 20 days after laying the floor in the basin. Compressibility characteristics were determined using the oedometer test and through measurements using the testing round plate 15 and 30 cm in diameter, as shown on Fig. 1d. The average compressibility module from oedometer and testing performed using the round plate was estimated to be Ms=6500 kN/m2.

Strength parameters were also tested on the artificial soil and bore the same results as the average ones: cohesion c=20 kN/m2 and the friction angle of =33o. Undrained strength was tested as well, using the vane, and amounted to approximately cu=140 kN/ m2. In the end, as will be shown later in the text, it was shown that this type of artificial soil with these components and basin laying is quite suitable for these and similar model experiments.

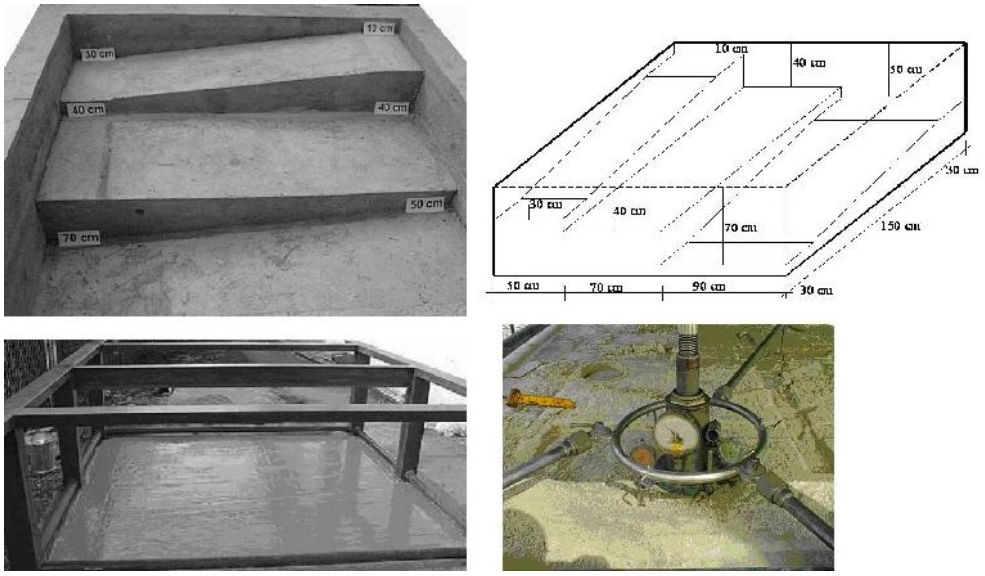

Figure 1. Model testing: a) Testing model basin, b) Test basin dimensions, c) Test basin filled with artificial soil and the steel support construction (for load support), d) Testing the soil using the testing plate

A steel girder of length L=1.5 m and cross-section b=0.085 m and h=0.050 m was chosen. The value of the elasticity module was tested according to Fig. 2 a and the calculation from the expression for the deflection of the girder on two supports when the force is acting on the centre:

$$w_{max} = \frac{Q \cdot L^3}{48 \cdot EI} \text{ [m]} \quad (1)$$

where: Q - force [kN], L - girder length [m], E - girder elasticity module [kN/m^2], I - inertia moment $I = \left(b \cdot h^3\right)/12$ for the rectangular section. Calculated value of the steel girder elasticity module used in the calculation of the bending moment is E = 1.85×10^8 kN/m^2.

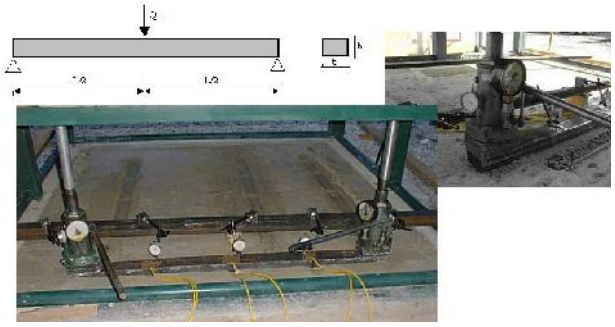

Figure 2. Primary girder: a) testing the girder on two supports with concentrated force, b) girder load detail, c) detail of girder being tested

Concrete blocks were used as counter-support for presses. Forces were applied to edges of girders (see 2b and 2c). Hydraulic presses with measurement area up to 60 kN and exactness of 5 kN were used. Force was applied in increments of 5 kN up to 35 kN.

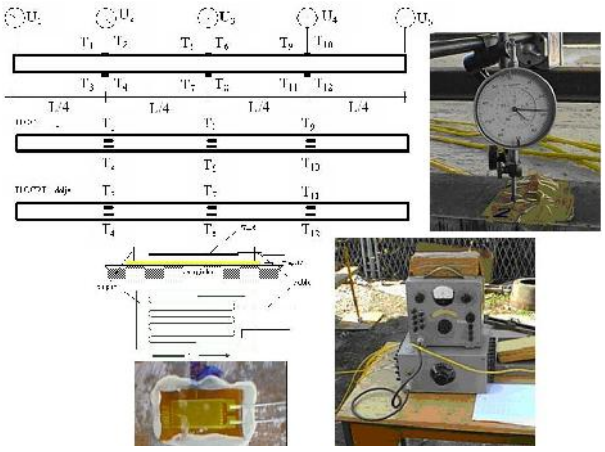

Fig . 3. Monitoring girder settlement and distortions: a) diagram of setting up the micro-gauge and tensometer along the girder, b) micro-gauges on the girder, c) attached (glued) electrically resistant tensometer on the girder, d) The Wheatston bridge

Micro-gauges for measuring settling were set-up on five points along the girder, as shown on Fig. 3a. Electrically resistant tensometers for measuring longitudinal deformities on the girder (manufacturer's code: 1-LY13-10/120), having a measuring base of 10 mm and resistance 120 Ω

(HBM, 1999, 1), were glued in three profiles x four tensometers (more tensometers = more reliable measurement of deformity in that point) along the girder (L/4, L/2 and 3/4L). The Wheatstone bridge was used for measuring the change in resistance of the measuring tensometer (Fig. 3d)

Measuring electrically resistant tensometers, we achieved elastic relative distortion ε_{el}, and knowing the elasticity module of the steel girder E allows us to calculate the strain of fibers at the edges of the girder σ, and knowing the resistance of the cross-section of the girder W allows the calculation of the bending moment M.
Since the elasticity module of the steel girder is known (E = 1.85×10^8 kN/m^2), we can also calculate loaded girder stress using the following expression:

$$\sigma = E \cdot \varepsilon_{el} \qquad (2)$$

After girder stress is calculated, and knowing the dimensions of the girder cross-section, we can calculate the bending moments. According to the theory of elasticity, the bending moment can be expressed as:

$$M = \sigma \cdot W \qquad (3)$$

where W is the resistance moment of the girder cross-section $W = b \cdot h^2/6$, while σ is the stress on the edge strands of the girder.

Analysis of experimental test results

Soil profiles in model testing

Several girder tests with various soil profiles were performed on prepared bases; we will show you 3 characteristic variations - on Fig. 4a (Profiles A, B and C). The following is the overview of settling results and bending moments reached through experimental testing. The following experimental soil profiles were tested, see Fig. 4a: - Profile A is the linear change in thickness (10-30 cm) of the artificial soil layer - Profile B is the even thickness (40 cm) of the artificial soil layer - Profile C is the incremental change in thickness (20, 40, 60 cm) of the artificial soil

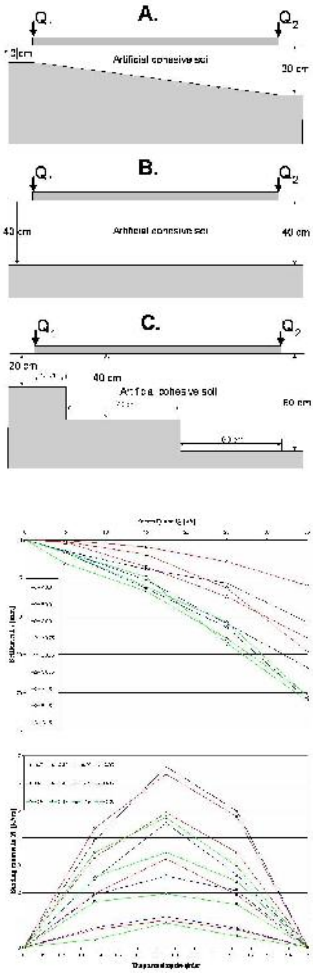

Figure 4. Measurement results: a) profiles A, B, C, profiles of bases beneath the girders, b) dependence of the forces on the girder and the settlement of the girder on soil profiles A, B and C, c) dependence of bending moments along the girder with various forces being applied on the girder using soil profiles A, B and C beneath the girder

Conclusion

When testing the soil of various thickness, the trend of increased settling with increased layer thickness was noticeable. Maximum bending moments with the same forces on the girder depend on the position of the layer beneath it, probably because certain breaks in the soil occurred. The differences in girder bending at higher loads on layer A with respect to layers B and C are possible due to various bearing capacities, which is tied to the relation of girder width and thickness of the layer along the girder. Results may be beneficial when calculating primary girders, specifically long primary girders, where the change in soil composition along the girder is common.

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Eksperimentalno testiranje grednih nosača na opće uslojenom tlu

SAŽETAK

Rad predstavlja model testiranja nosača i rezultate korištenja transverzalno opterećenog fleksibilnog grednog nosača na adekvatno pripremljenom slojevitom tlu. Slijeganje i moment savijanja (relativna deformacija nosača) mjereni su duž nosača da bi se dobili rezultati. Postupak i rezultati testiranja su uspoređivani i diskutovani.

Ključne riječi: temeljni nosač, opće uslojeno tlo, eksperiment, slijeganje, moment savijanja, komparacija.

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The analysis of the found girder on the soil of general stratification

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The work shows the results of the investigation of contact problems in the system of transverse loaded flexible foundation girder and compressible soil with general stratification. The results of the accomplished theoretical analysis and those of the model research conform. The developed program can be explicitly useful in designing long foundation girders, for which the varying composition of soil along the girder is a common occurrence.
Keywords: Found girder, soil of general stratification, analysis, experiment.

Introduction

On the girders that lie on the soil, an activeness of unknown reactive load occurs, as a reaction to the activeness of a known outer load, whose total amount is known, but its distribution along the girder is not. At the moment, the available commercial programs on the market, for girders on soil design, have some limitations in the behaviour of the girder and soil. These programs solve only the plane (plane deformations) or axial-symmetrical problems (for a unit angle expressed by arch measure), which have a significant influence on the total distribution of reactive pressures and, ultimately affect the movement and inner forces in the girder.

The shown compute procedure includes the development of algorithms for girder-soil contact problem analysis. As a base for the development of the procedure, the differential equation of transverse loaded girders may be used, in which the bend angle equals the soil settlement, for an undetermined distribution of outer force along the girder. For the numerical solution, a compatible program for computer designing has been made. The proposed procedure was submitted to a model check, which consisted of observing the behaviour of a girder on stratified soil, in different cases of load and soil stratification (linear and leap variation of deformable soil layer thickness.

The foundation girder design

The contact problems were a subject of investigation for many investigators, till today. As the oldest example of solving the contact problems, the investigation of a stiff circled disk behaviour on a homogeneous, elastic and isotropic half space can be stated (Boussinesq 1885). Hertz (Hertz 1882) has solved the contact problem of two elastic bowls with different diameters. The investigation of contact problems of two bodies with complex geometry started in the beginning of the 20th Century. Winkler (Winkler 1867) solved the problem of girders on soil underneath building columns, or the problem of longitudinal tracks for level luffing crane, and the procedure was further developed by Zimmermann (Zimmermann 1888) (so called one-parameter model or Winkler soil model). The basic assumption of this model is very unrealistic (soil modelled as a system of undependable springs), but due to the simple mathematical interpretation of the problem, the model is used even today in engineer practice.

The two-parameter model (Vlasov & Leontiev 1966) is performed from the basic Winkler model. This model enables a connection of Winkler springs with the stretched elastic membrane, wherewith it is possible to model the attribute of soil as a connected

continuum. At the one-parameter and two-parameter soil models, the basic problem is their selection (the parameters are not physical and they depend on the amount of load and the shape of the loaded area).

Finally, due to the development of computers and numerical procedures (a method of finite elements, a method of finite differentials and so on), today, it is possible to model complex relations of construction and soil interaction.

The proposed procedure of foundation girder design

The method of finite differentials by which the mathematical discretization of the differential equation of the problem is used. The solution leads to seeking unknown values in discrete points.

Figure 1 shows a discretization of the beam girder with unknown values of movement vector{w} and reactive pressures {q} with a known vector of outer load {p}, and the known weight of a girder segment g.

Differential equation of the girder for point i is:

$$\frac{EI}{a^4}(w_{i-2} - 4w_{i-1} + 6w_i - 4w_{i+2} + w_{i+2}) + q_i = p_i + g \qquad (1)$$

In the matrix form 1:

$$[D]\{w\} + [\lambda]\{q\} = \{f\} \qquad (2)$$

where:

[D] - matrix of deferential operator,
[λ] - diagonal matrix,
{w} unknown vector of movement,
{q} unknown vector of soil reactive pressure,
{f} - outer acting vector.

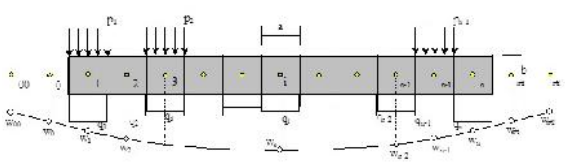


Figure 1. Discretization of the beam girder on n equal elements

The amounts of unknown fictive movements (w_{00}, w_0, w_{n+1} and w_{n+2}) are determined from the edge conditions (known bending moments M_1 and M_n and transverse forces Q_1 and Q_n in points $_1$ and $_n$) using the deferential relations of the bending moment and transverse forces with unknown movements.

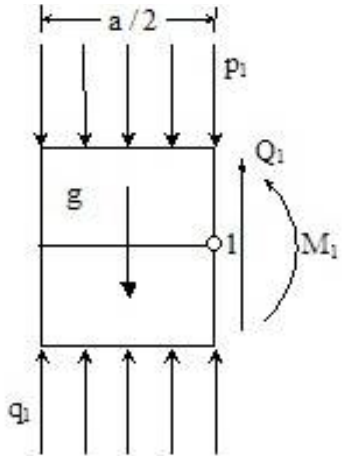


Figure 2. Edge conditions in point 1

$$M_1 = \frac{a^2}{8}(q_1 - g - p_1) \approx -\frac{EI}{a^2}(w_0 - 2w_1 + w_2) \qquad (3)$$

$$Q_1 = \frac{a}{2}(q_1 - g - p_1) \approx -\frac{EI}{2a^3}(-w_{00} + 2w_0 - 2w_2 + w_3) \qquad (4)$$

A differential equation for point 1 can be computed inserting w_0 and w_{00} according to the terms 3. and 4; :

$$\frac{EI}{a^4}(w_1 - 2w_2 + w_3) + \frac{9}{8}q_1 = \frac{9}{8}(g + p_1) \qquad (5)$$

Analogy for point 2:

$$\frac{EI}{a^4}(-2w_1 + 5w_2 - 4w_3 + w_4) - \frac{1}{8}q_1 + q_2 = \frac{7}{8}g - \frac{1}{8}p_1 + p_2 \qquad (6)$$

The deferential matrix operator:

$$|D| = \frac{EI}{a^3} \begin{vmatrix} 1 & -2 & 1 & & & & & & \\ -2 & 5 & -4 & 1 & & & & & \\ 1 & -4 & 6 & -4 & 1 & & & & \\ & 1 & -4 & 6 & -4 & 1 & & & \\ & & \cdot & \cdot & \cdot & \cdot & \cdot & & \\ & & & 1 & -4 & 6 & -4 & 1 & \\ & & & & 1 & 4 & 6 & 4 & 1 \\ & & & & & 1 & -4 & 6 & -4 & 1 \\ & & & & & & 1 & -4 & 5 & -2 \\ & & & & & & & 1 & -2 & 1 \end{vmatrix}$$

The diagonal matrix [λ] has a form:

$$[\lambda] = \begin{vmatrix} \frac{9}{8} & & & & & & & & \\ & \frac{1}{8} & & & & & & & \\ & & 1 & & & & & & \\ & & & 1 & & & & & \\ & & & & 1 & & & & \\ & & & & & \cdot & & & \\ & & & & & & 1 & & \\ & & & & & & & 1 & \\ & & & & & & & & 1 \\ & & & & & & & & & -\frac{1}{8} \\ & & & & & & & & & \frac{9}{8} \end{vmatrix}$$

The soil reactive vector pressures (q) and loads (f):

$$\{q\} = \begin{Bmatrix} q_1 \\ q_2 \\ q_3 \\ \cdot \\ \cdot \\ q_i \\ \cdot \\ \cdot \\ q_{n-2} \\ q_{n-1} \\ q_n \end{Bmatrix} \qquad \{f\} = \begin{Bmatrix} \frac{9}{8}g + \frac{9}{8}p_1 \\ \frac{7}{8}g + \frac{1}{8}p_1 + p_2 \\ g + p_3 \\ \cdot \\ \cdot \\ g + p_i \\ \cdot \\ \cdot \\ g + p_{n-2} \\ \frac{7}{8}g + p_{n-1} - \frac{1}{8}p_n \\ \frac{9}{8}g + \frac{9}{8}p_n \end{Bmatrix}$$

The algebra equation linear system form (2) of n×n order is undefined because there are two vectors {w} and {q} with 2×n unknown components. In order to solve the system, it is necessary to define the additional relation of two unknown vectors (soil modulus) by defining the settlement matrix.

Defining the influence settlements

The value of settlement in the observed point is defined by knowing the distribution of additional stresses and deformable characteristics of the soil under the point.

$$w \quad \sum \Delta w \quad \sum \frac{\sigma_v \cdot \Delta z}{M_v} \qquad (7)$$

where:

Δw - the increment of settlement,
σ_v - additional vertical stress,
Δz - soil layer thickness,
M_v - layer modulus of incompressibility Δz .

The additional values of vertical stresses σ_v underneath the observer point on the depth z are determined using Steinbrenners solution (Steinbrenner 1934) for the uniform contact pressure q acting on a rectangular with sides a and b.

$$\sigma_z = \frac{q}{2\pi}\left[\operatorname{arctg}\frac{a \cdot b}{z \cdot \sqrt{a^2 + b^2 + z^2}} + \frac{a \cdot b \cdot z}{\sqrt{a^2 + b^2 + z^2}}\left(\frac{1}{a^2 + z^2} + \frac{1}{b^2 + z^2}\right)\right] \qquad (8)$$

Figure 3 shows a quality review of vertical stresses on the depth along the perpendicular under the central point of j element due to the uniformly spread load on the a×b area of i element obtained by super positioning the term proper rectangular area (8).

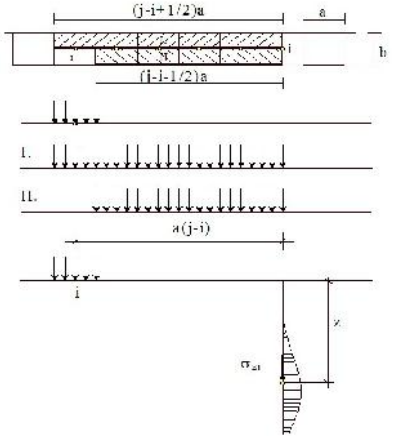


Figure 3. Vertical loads under the central point of j element due to the load on point i

$$\frac{q}{\pi}\left[\operatorname{arctg}\frac{\left(j-i+\frac{1}{2}\right)a \cdot \frac{b}{2}}{z \cdot \sqrt{\left(\left(j-i+\frac{1}{2}\right)a\right)^2 + \left(\frac{b}{2}\right)^2 + z^2}} + \frac{\left(j-i+\frac{1}{2}\right)a \cdot \frac{b}{2} \cdot z}{\sqrt{\left(\left(j-i+\frac{1}{2}\right)a\right)^2 + \left(\frac{b}{2}\right)^2 + z^2}}\left(\frac{1}{\left(\left(j-i+\frac{1}{2}\right)a\right)^2 + z^2} + \frac{1}{\left(\frac{b}{2}\right)^2 + z^2}\right)\right] -$$
$$-\frac{q}{\pi}\left[\operatorname{arctg}\frac{\left(j-i-\frac{1}{2}\right)a \cdot \frac{b}{2}}{z \cdot \sqrt{\left(\left(j-i-\frac{1}{2}\right)a\right)^2 + \left(\frac{b}{2}\right)^2 + z^2}} + \frac{\left(j-i-\frac{1}{2}\right)a \cdot \frac{b}{2} \cdot z}{\sqrt{\left(\left(j-i-\frac{1}{2}\right)a\right)^2 + \left(\frac{b}{2}\right)^2 + z^2}}\left(\frac{1}{\left(\left(j-i-\frac{1}{2}\right)a\right)^2 + z^2} + \frac{1}{\left(\frac{b}{2}\right)^2 + z^2}\right)\right] \qquad (9)$$

After determining the values of vertical stresses along the vertical, through every knot i (i=1, 2, 3,... n), it is possible to, knowing the deformable characteristics of every layer, determine the values of influence settlements. The elements of the influence settlements matrix [U] are computed from the following terms:

$$\alpha_{ij} = \int_0^{h_i} \frac{\sigma_z dz}{M_{vz}} = \frac{1}{M_{v1}} \sum_{z=0}^{zi1} \sigma_{zi} \Delta z + \frac{1}{M_{v2}} \sum_{zi1}^{zi2} \sigma_{zi} \Delta z + \ldots + \frac{1}{M_{vm}} \sum_{zi,m-1}^{zim} \sigma_{zi} \Delta z \qquad (10)$$

$$\alpha_{ji} = \int_0^{h_j} \frac{\sigma_z dz}{M_{vz}} = \frac{1}{M_{v1}} \sum_{z=0}^{zj1} \sigma_{zj} \Delta z + \frac{1}{M_{v2}} \sum_{zj1}^{zj2} \sigma_{zj} \Delta z + ... + \frac{1}{M_{vm}} \sum_{zj,m-1}^{zjm} \sigma_{zj} \Delta z \quad (11)$$

Finally, the girder settlement equation for a known reactive pressure distribution is:

$$\{w\} - [U]\{q\} \quad (12)$$

The course of found girder design

By inserting the equation (3) in the differential equation (2), a following term can be obtained:

$$([D][U] + [\lambda])\{q\} = \{f\} \quad (13)$$

The term (13) presents a system of equations in which only the soil reactive movements on the girders are unknown. The final term for solving the pressure reactive vectors {q} is:

$$\underbrace{([D][U] + [\lambda])}_{[A]}\{q\} = \{f\}$$
$$[A]\{q\} = \{f\} \quad (14)$$
$$\{q\} = [A]^{-1}\{f\}$$

After solving the equation system (14), the settlement of the knot point can be computed using the term (12). When the movement vector is determined, the vectors of the bending moment and transverse forces can be determined using the terms (3) and (4). Based on the presented procedure a program, named "NOSAČ99" (GIRDER99), for designing the foundation girder on a generally stratified soil is made. The solutions gained using the program are related with the results of model testing, which will be shown later in the text.

As it can be seen from the presented procedure, the calculation of the influence settlement matrix is gained using the hybrid method. The Steinbrenner solution for homogeneous isotropic linear elastic half space is used for determining the distribution of additional stresses in the centre of discrete areas (Steinbrenner 1934). The assumption that the distribution of additional stresses does not depend on the soil stratification is accepted (figure 4). In that case, the additional stresses under the point i, due to the load q on the area above point i, is equal to the additional stresses under the point j, due to the load q above the point i. It is also a fact that the additional stresses under the point j, due to the load activeness in point i, is equal to the additional stresses under the point i, due to the load activeness in point i. It can be said that the assumption of additional stress reciprocity is valid.

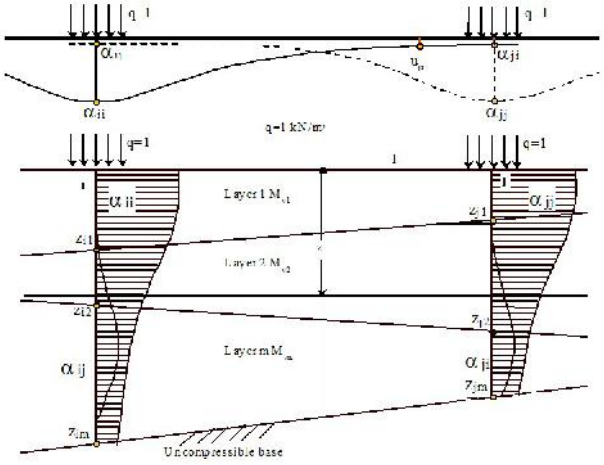


Figure 4. The vertical stresses under the centre element point

In order to determine the deformations and movements underneath the observed points, the real soil stratification, modelled with a suitable modulus of incompressibility of a single layer (linear oedometer soil model), is accepted.

If the additional stresses till any horizontal plane on the depth z are observed, the movements under points i and j due to the activeness of equal load q above the observed points will not be mutually equal $(\alpha_{ii} \neq \alpha_{jj})$ which applies for the movements in point j due to the load in point i and in point i due to the load in point j $(\alpha_{ji} \neq \alpha_{ij})$. Due to the uninformed soil stratification, the theorem of mutual movements is not valid. The same is valid only for homogenous isotropic linear elastic half space. A stratificated half space in general is not homogenous. The influence settlement matrix is unsymmetrical and it is necessary to separately compute its members for every discrete element loaded with single contact pressure.

Model research

Experimental research is composed of observing the loaded girders on different soil thickness. Girders with determined stiffness are placed on engaged layers, which are loaded with different amounts of force. The equipment used in the test is:

a hydraulic press for load application, a micrometer for measuring the vertical deformations, i.e. soil settlements under the girder, an electrically resistant tensometre for measuring the horizontal deformations of the girder due to its bending (HBM 1999). A steel rectangular section has been chosen for the girder and the base has been made from an artificial coherent soil (sand, bentonite, cement and water), which has been placed in a plastic state. The mixture has enabled a high homogeneous degree , with an accomplished extra final hardness after 20 days (cement bonding). The model research has been carried out by using an arranged test model pool with various thickness of "artificial soil" which made a base for beam girders.

The test model construction

The basic test model pool, as a construction for engaging the artificial soil with various thickness, is built in three levels. The reinforced concrete construction is shown on figures 5 and 6.

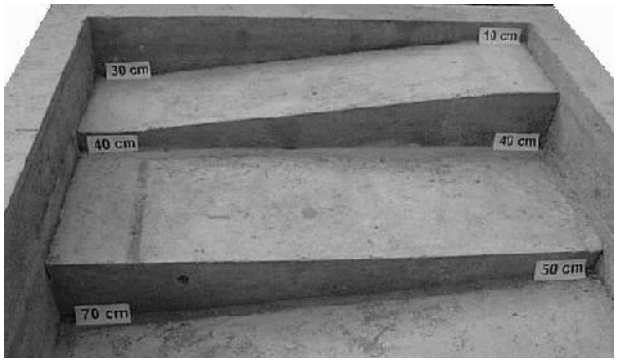


Figure 5. The basic test model pool

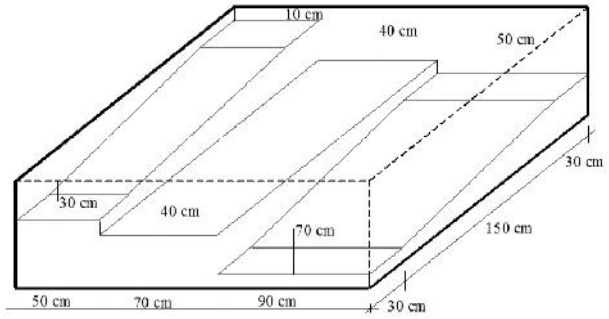


Figure 6. The basic test model pool dimensions

Artificial soil

A mixture made out of prepared patterns with various proportions of the mentioned components is: 87 % of sand; 10 % of bentonite; 3 % of cement and water in an amount of 400 % of bentonite mass. The mixture of satisfying strength, at which a soil failure for the assumed values of load on girder does not take place. It obtained the requested characteristics 20 days after mixing and placing it, in liquid form, in a test mould.

The pool is completely filled with the mixture, which is smoothly graded and covered with wet linen and PVC foil to preserve moisture. Figure 7 shows a test pool filled with artificial soil and made out of a steel construction (HBM 1999).

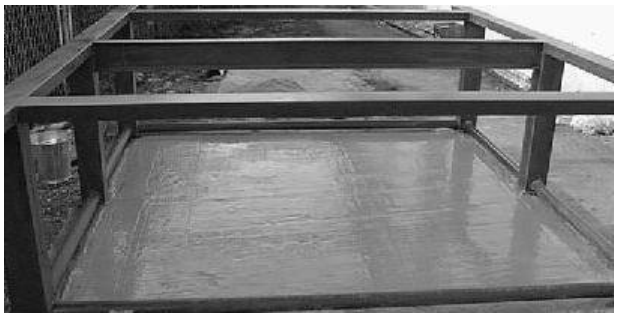


Figure 7. A test pool fill with artificial soil and a steel construction for load

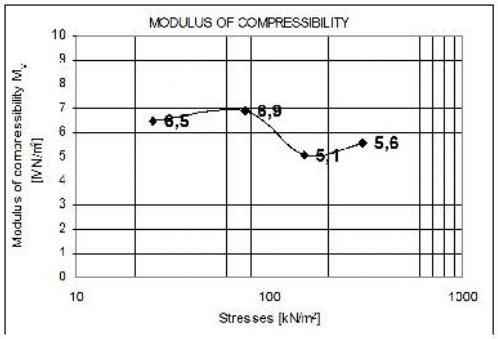
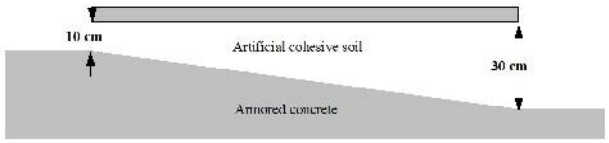


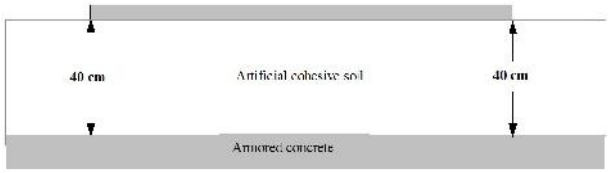
Figure 8. The compressibility diagrams (the stress-modulus of compressibility relation)

The characteristics of artificial soil are also tested by taking the samples from the pool, directly before the research took place, which means 20 days after putting the soil in the pool. The amounts of the modulus of compressibility are shown on the diagram in figure 8. The characteristics are determined by the oedometer test and from the measures made with a test plate of 15 and 30 cm in diameter. Figure 8 shows that the modulus of compressibility values are not uniform, neither in the observed point, nor through the depth of the deformable layer. The soil profiles in model testing There were 3 load girder tests with different soil profiles that took place on prepared bases (figure 9).

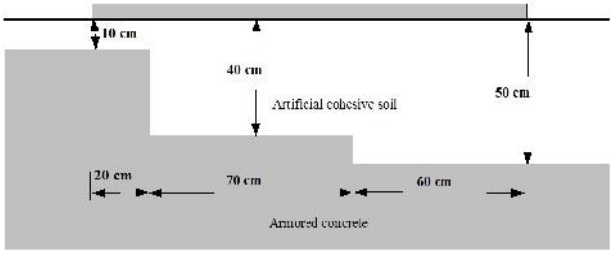
The model testing profiles



Profile I.



Profile II.



Profile III.

Figure 9. The model testing profiles

Girder load

The concrete blocks are used as counter support for presses.

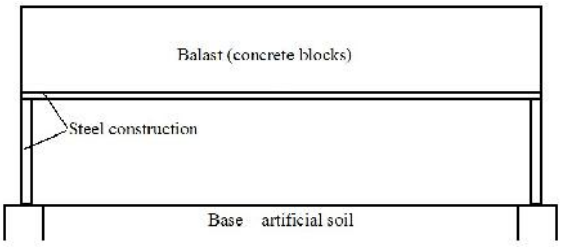


Figure 10. Balast for counter support

The steel girder for model testing

After checking the conditions for satisfying the values of the bend angle for the anticipated amount of forces, a girder with a length L=1,5 m and a cross section b=0,085 m and h=0,050 m is used.

The assumed value of the elastic module of steel was 185 000 MN/ m2. Micrometer. The micrometers are set in 5 points along the girder during the measuring (figure 11). T

he electrically resistant tensometer. During this observation of the steel girder, the electrically resistant tensometers (manufacturer mark: 1-LY13-10/120) measure a base of 10 mm and the resistance of 120 Ω (HBM, 1999).

During the testing, the electrically resistant tensometers are pasted in three profiles, every profile with 4 tensometers (due to the accuracy in deformation measuring in that point) along the girder (L/4, L/2 an 3/4L) which can be seen on figure 11.

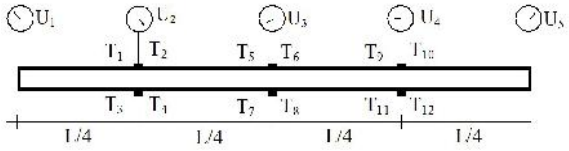


Figure 11. The scheme of placing the micrometer and tensometer along the girder

The forces are applicated on the edges of the girder (figures 12. and 13.).

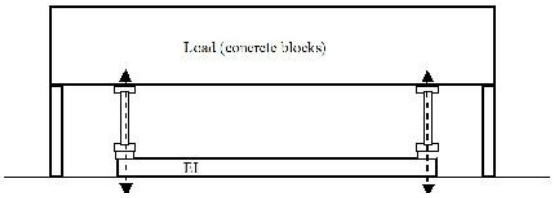


Figure 12. Girder loaded by presses supported on the load

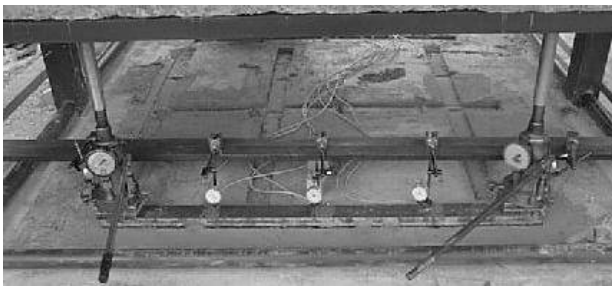


Figure 13. Girder loaded by presses supported on the load

The hydraulic presses had a measure value up to 60 kN and accuracy of 5 kN. The forces were applied in increments of 5 kN up to the force of 40 kN.

The analysis of experimental and theoretical research results

The results of the experimental research and theoretical analysis, gained using the proposed program and their mutual comparison, will be shown.

The profile I is characteristic to the linear change of the soil layer thickness.

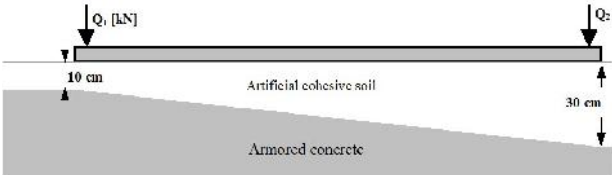


Figure 14. The girder on the deformable soil with linear variation

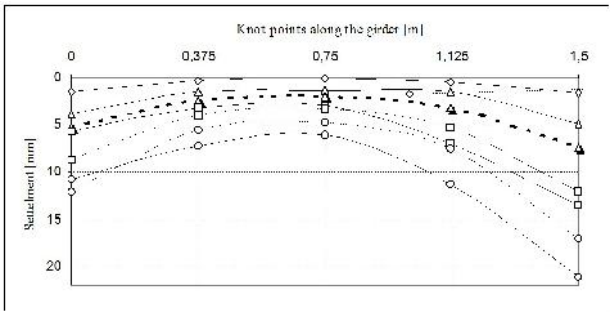


Figure 15. The relation of settlement along the girder and acting forces on girder

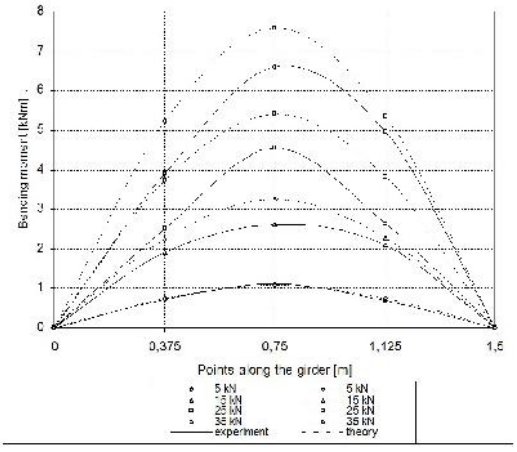


Figure 16. The relation of bending moments along the girder and acting forces on girder

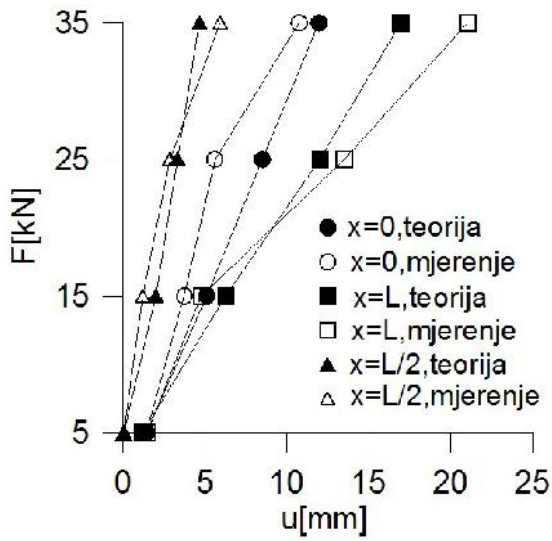


Figure 17. The force-movement diagram o the edges and the middle of the girder.

The calculated movements on the left side, where the soil thickness is relatively small (approximately as the width of the girder), receive greater amounts than the observed, due to the fact that it's not possible to activate the total failure of the base.

The layer becomes stiffer by a gradual increase of load, and a little deformation, compared to the calculated one, computed only using the start modulus of compressibility, takes place.

The situation on the other end (the thickness of the deformable layer is greater) is inverse; the observed movements receive greater amounts. This kind of behaviour is a consequence of soil relief under the girder and the decrease of the competent amounts of modulus of compressibility.

Figure 16 shows the amounts of bending moments along the girder, where it can be seen that the increase of retreat takes place while gradually increasing the outer force.

The profile II with uniform thickness of artificial soil.

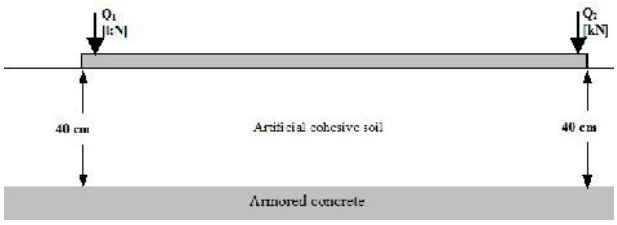


Figure 18. The girder on soil with the same thickness 40 cm

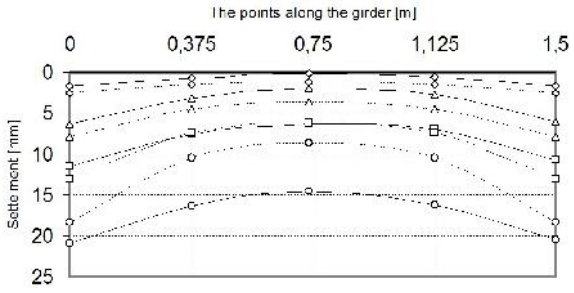


Figure 19. The dependency of settlement along the girder and the acting forces along the girder

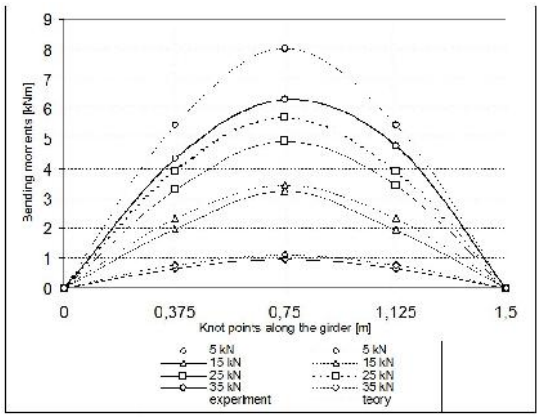


Figure 20. The dependency of the bending moment along the girder and the acting forces on the girder

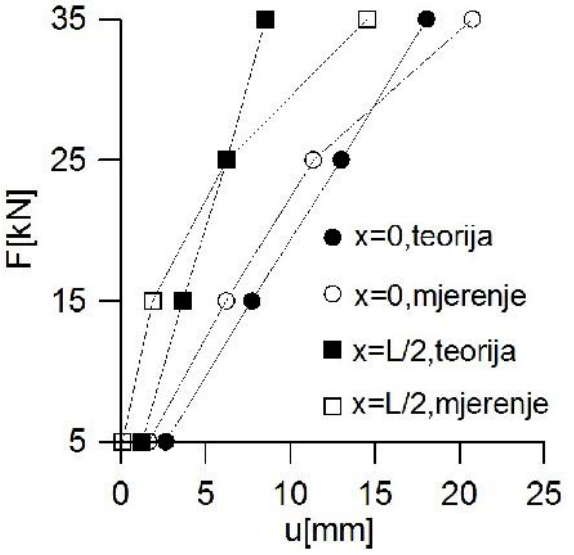


Figure 21. The force-movement diagrams on the edges and in the middle of the girder

The behaviour of the girder is consistent because of the increase in the mutual departure of observed amounts due to the base relief. The calculated bending moments are generally greater than measured, in consequence to the greater relative difference of the movement in the middle and the end of the girder because of the relief made on the points under the total girder length.

The profile III with a leap variation of compressible base thickness

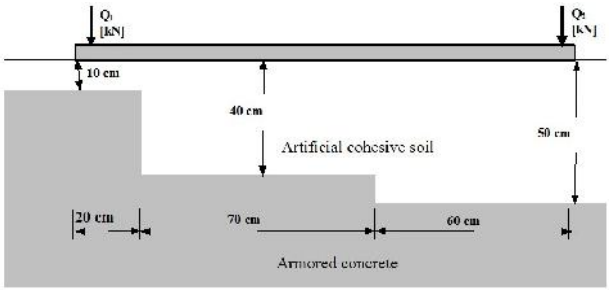


Figure 22. The girder on soil with 10 cm, 40 cm and 50 cm thicknesses

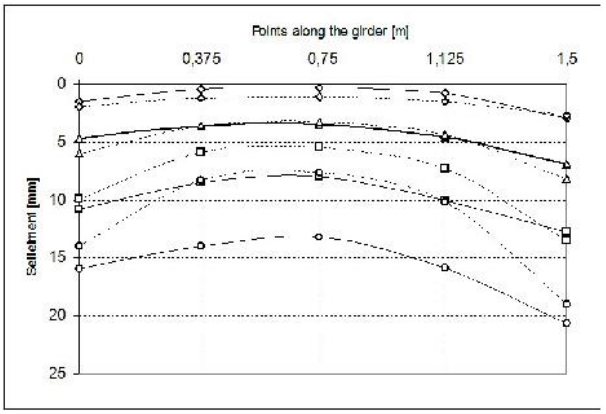


Figure 23. The dependence of settlement along the girder and the forces of acting on the girder (Forces on the end of girder 5 kN - 15 kN - 25 kN - 35 kN)

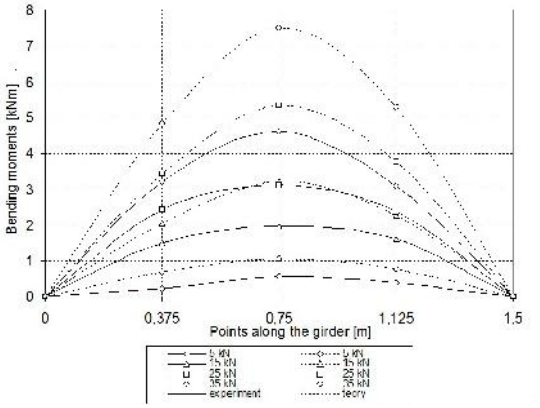


Figure 24. The dependence of settlement along the girder and the forces of acting on the girder (Forces on the end of girder 5 kN - 15 kN - 25 kN - 35 kN)

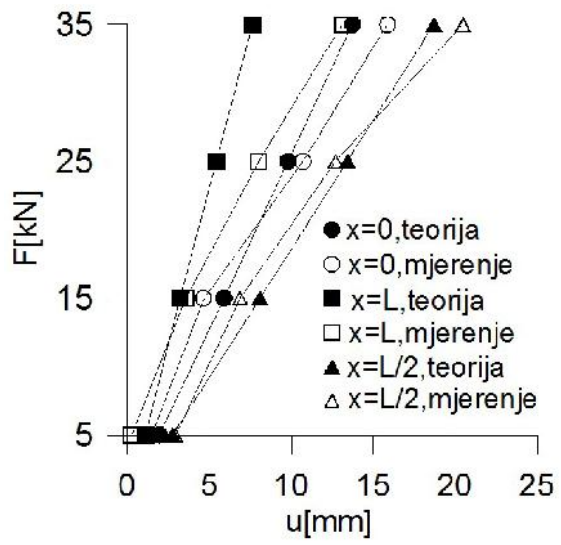


Figure 25. The force-movement diagram on the edges and middle of girder

In the case presented, and on the part of a thick deformable base layer, a creation of plastic deformation takes place, and the measured movements are greater than the ones calculated for greater amounts of force. The mentioned layer is on a relatively short part of the girder (20/150=0.13L), where a sudden leap of the deformable base thickness takes place.

Conclusion

The proposed numerical procedure enables the beam girder design of realistic width on irregular stratified soil. The model test results indicate good conformity with results of the calculated analysis for the amounts of working forces (the break force divided with a corresponding safety factor), which are in the limits of linear elastic soil behaviour.

The perceived departure of the observed occurrences and calculated occurrences take place in the plastic, and particularly in the plastic area of soil deformation. In the elastic deformation area, on the part of the girder, placed on a thick deformable base layer, the calculated movements are greater than the observed ones.

These results are a consequence of the fact that in the thick layer under the girder no soil failure takes place, due to the fact that it's not possible to form a break plane. The layer becomes stiffer and more compact by a progressive increase of outer load amounts, with the amounts modulus of compression greater than at the initial amount.

On the other hand, on the part of the girder that is placed above a deeper deformable layer, movements greater than calculated are observed at the greater amounts of the outer load.

That is a consequence of deformable layer parameters decrease due to the progressive soil relief and the creation of a non-recoverable deformation.

The created program may be useful, explicitly in long beam girder design, where the possibility of occurrence of irregular soil stratification is very great. It is possible to obtain more reliable and economic solutions in comparison with the custom design procedures by considering the true deformable layer geometry.

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Analiza temeljnih nosača na tlu opće uslojenosti

SAŽETAK
Rad prikazuje rezultate istraživanja problema kontakta u sistemu transverzalno opterećenog fleksibilnog grednog nosača i stišljivog, opće uslojenog tla. Rezultati postignute teoretske analize i rezultati modela istraživanja se podudaraju. Razvijeni program može biti iznimno koristan u dizajniranju grednih nosača koji se obično koriste u slučaju nepostojanog sastava tla duž grednog nosača.

Ključne riječi: temeljni nosač, opće uslojeno tlo, eksperiment, slijeganje, moment savijanja, komparacija.

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Sciences

Print quality in Offset printing

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A large number of factors impact the print quality in modern printing technology. Therefore, they should be controlled on the basis of standard values in order to obtain predictable and repeatable results. In order to achieve the uniform high quality prints, the reproductive process has to incorporate colour management with good calibration and ICC profiles of the printing machines. This paper analyses the reproductive process based on ISO specifications.

Introduction

The goal of each printing process is obtaining the highest possible quality reproduction of the original and the minimum deviation of colours within the process.

The standardization of printing processes in offset printing is defined by international standard ISO 12647-2:1998. Two procedures of standardization are employed in order to correctly transfer the colour information from one medium to another and to ensure that the performance of the media remains stable.

These procedures are calibration and characterization. A difference between the definitions of these terms is given in 1996 by Johnson: Calibration is setting (tuning) of the medium, device or process so that it gives replicable values.

In order to achieve high accuracy in colour reproduction process, the first step is to ensure that the media can consistently reproduce the identical colours from identical input data (colour information).

Characterization defines the relationship between the space of colours of the media, devices or processes and a uniform colour space of the CIE system which the colorimetry is based on (CIE XYZ or CIE L*a*b*).

ISO specifications for Offset print

When it comes to colour management, there is always an issue related to the correction of the CIE L*a*b* values for process colours. These values are defined and described in the international standard ISO 2864 and ISO 12647-2. ISO 12647-2 (offset printing process and rotary offset magazine printing), which define the parameters and test methods, the necessary conditions for the development of proof print, as well as the production process. These standards do not contain only target colorimetric values for five classes of paper classification, but also the specifications related to working with colours, dot gain, halftoning rule and other parameters. The standards of production classify printing papers into five categories and specify the CIELAB colour values for the production dyes shown in Table 1.

Table 1. CIELAB values for five paper categories measured on white background [5]

Paper grade	L[1]	a[1]	b[1]	Gloss	Grammage g/m²
1. glossy coated wood-free	95	0	-2	65	115
2. matt coated wood-free	94	0	-2	38	115
3. glossy LWC	92	0	5	55	65
4. uncoated white	95	0	-2	6	115
5. uncoated yellowish	90	0	9	6	115
Tolerance	±3	±2	±2	±5	

[1]Specified values per ISO/CD 12 647 - 2.2: D50, 2°, 0/45 or 45/0

Table 2. CIELAB values of the primary and secondary colours measured in full fields on white background for five paper categories [5]

Paper grade	1+2			3			4			5		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
on white substrate												
Black	16	0	0	20	0	0	31	1	1	31	1	3
Cyan	55	-37	-50	58	-38	-44	60	-26	-44	60	-28	-36
Magenta	48	74	-3	49	75	0	56	61	-1	54	60	4
Yellow	91	-5	93	89	-4	94	89	-4	78	89	-3	81
Red(M+Y)	49	69	52	49	70	51	54	58	32	53	58	37
Green(C+Y)	50	-68	33	51	-67	33	53	-47	17	50	-46	17
Blue(C+M)	20	25	-49	22	23	-47	37	13	-33	34	12	-29

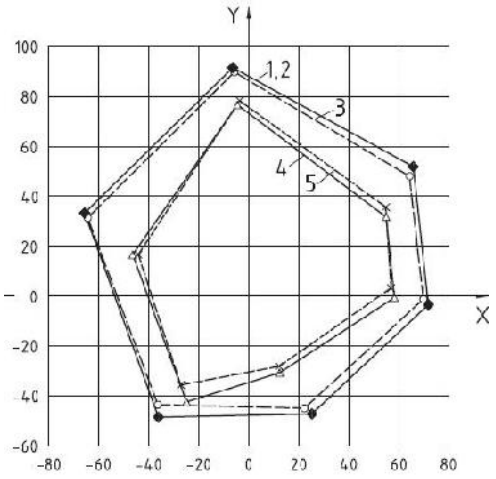

Figure 1. Gamut color for 5 different categories of paper shown in the CIELAB color space

Printing Press calibration

Printing press calibration depends on numerous factors which must be taken into account, including purchased dyes in accordance with ISO 2846-1, the type of printing substrate and the printing conditions. We must categorize the used printing substrate into one of the 5 given categories based on its properties in order to compare the measurement results with the appropriate values.

Creating linearized printing forms

The first step is the preparation of test form containing the control strips for controlling colour parameters using spectrometry and densitometry measurement methods.

It is necessary to calibrate the process for the preparation of printing forms, which is determined by measuring the printing forms and defining the exposure curve. In this way, linearised printing forms are made.

Printing the test form

Printing starts by applying a small amount of CMYK colour dyes, increased steadily until the excessive application is reached. When the colouring of the print on the machine is brought into the framework of the ISO specifications, several best prints are chosen and inspected in terms of the transfer of dot values to the surface.

Measuring printed quire of paper

First, the change in density of coloration across the width of the sheet is checked. The difference between the minimum and maximum coloration density values may not exceed 10%, but in case they do exceed this given maximum allowed value, the dye riding rollers must be adjusted. CIELAB colour values (ISO 13655 measurement conditions: 0/45, D50, 2°, CIELAB) and the corresponding density values of full fields colorations are measured in a wet state. Afterwords, they are stored as values for a wet sheet and the obtained data will be used as target values for the upcoming steps. The individual sheets from the press lot are evaluated, as early as possible, 20 hours after the procedure because the standard CIELAB values refer to the dry sheet, based on the mean value of three measurements. Dot gain of the print is measured and is set as the basis for any change or adjustment of the LUT curve on the RIP for CMYK colour.

Creating corrected printing forms and re-printing

After the correction, the LUT curve on the RIP of the print form is re-lit. This is when the new densities full-field printing is made.

Conclusion

In this stage, we must check whether the changes or adjustments of the RIP LUT curves gave result on the print or not. The achieved values in the print must meet the densitometric specifications of rich tone and specifications related to the dot gain according to the categorization of dot gain depending on the type of the printing substrate. The individual parameters (CIELAB values, the density of coloration, tone value increase) are again noted as parameters of the print and set as the target values. All settings must be repeated for each type of paper and individually set because colorimetric values and tone value increase depend on the printing material. The individual sheets from the lot of the press are evaluated the earliest 20 hours after the sheet is dry. Using the measuring device, in certain areas of measurement pins, color characteristics that are relevant for quality control in the print are measured. Mandatory elements of measurement evaluation of the print are CIELAB values and the calibration of the reproduction process is based on them, while the other color characteristics are the informative ones.

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Kvalitet štampe u Offset štampi

SAŽETAK

Na kvalitetu otiska u savremenoj grafičkoj tehnologiji utječe velik broj čimbenika. Stoga ih je potrebno kontrolirati na temelju standardnih vrijednosti kako bismo dobili predvidljiv i ponovljiv rezultat. Da bi se mogli ostvariti ujednačeni otisci visoke kvalitete, u reprodukcijski proces je potrebno ukomponirati upravljanje bojama (eng. color management) s dobrom kalibracijom i izrađenim ICC profilima tiskarskih strojeva. U ovom radu analiziran je reprodukcijski proces na osnovi ISO specifikacija.

Ključne riječi; kvalitet, offset tisak, upravljanje bojom.

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