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"ROADS" SCIENTIFIC-PROFESSIONAL AND INFORMATIVE JOURNAL



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Editorial Column

Dear readers,

Another pandemic year has gone by. It was difficult for all of us, but most of all for those who fought the disease or lost their loved ones. It is obvious that we are already becoming accustomed to the pandemic, and the return to normal should happen soon.

We had an ordinary year on the roads, with an announcement of a major investment cycle in the construction of the much-needed Corridor 8, through a direct agreement with the Bechtel/Enka consortium. What is missing is information about the whole procedure, the status of the required technical performance documentation, the projections after the increase of the public debt percentage of Macedonia's GDP, but also what the whole procedure will mean for the Macedonian construction companies and the construction materials industry, i.e. how they will participate in the whole project.

The end of the year was also marked by the news of the signing of a loan of 110 million euros with the European Bank for Reconstruction and Development and the European Union, for the construction and supervision of a 10.2 km section from Bukojcani to Kicevo. The European Union will further assist this project with a € 20 million grant through the WBIF Fund for the Western Balkans, reaffirming the European Union's interest in improving connectivity in the region.

All in all, a year of significant progress is expected in our sector, with the hope that the interaction between the scientific community in the field of roads will increase of the, the government and construction companies will increase, for the common objective of raising the level and quality of the road infrastructure.

I greet you and wish you all the best in 2022, as well as pleasant moments while reading the new issue of ROADS.

Editor-in-chief
Dr. Andrej Lepavcov MBA, d.g.i



MARE President's address

Dear ladies and gentlemen, fellow engineers,

Another pandemic year is behind us, perhaps one of the most difficult. However, construction workers, and especially us, the "roadmen", were one of the few who did not stop their work activities at any moment. Of course, the pace and completion of activities would be better in normal circumstance, but it is still important to emphasize that the construction industry had continuity in the business – unlike some other fields, we did not stop.

In 2021. RAM successfully organized the first Expert debate on the Draft Law on Construction. Fellow civil engineers were actively involved with their proposals, remarks and suggestions and the process was set in motion. Ours was followed by another Debate organized by the Chamber of Certified Architects and Certified Engineers. Just when we thought that everything finally started to move in a positive direction, as our proposals were accepted it suddenly all stopped. Elections. As it happens by us, everything comes to a halt during the elections. This time it was the same even after the elections. Waiting for a date to the start negotiations with the EU.

As for the law, nothing new yet.

By the end of the year, more precisely on 21.12.2021, RAM Electoral Assembly was held. Members of the Management Board were elected. On this occasion, allow me to thank the members of the RAM Assembly for the support and trust, and for electing me RAM President – unanimously, among all present. This trust presents an obligation for me to continue with the activities and development of RAM. Stojance Stojanov was elected Vice President, and Kiril Lazarov was elected Secretary. Other members of the Board are: Zoran Milkovski, Andrej Lepavcov, Irena Jakimoska, Goce Stojanovski, Zlatko Ilijovski, Aleksandar Janakieski, Aleksandar Smilkovski and Nikola Pandev. Also a new Supervisory Board was elected, with the following membership: Toni Jovev, President, Vasko Trajkovski, Toni Lazarov, Ruska Hadzi Mitrova and Toni Jovanovski.

The following was materialized during the tenure of the previous Board: 16 Board meetings, 1 expert visit to Turkey, 5 expert consultations with eminent professors from abroad, 2 Road Conferences, Anniversary Celebration



- 50 years since the Founding of RAM, Participation in the first international scientific project in the field of roads, as well as participation at international congresses and conferences on roads abroad. Also, the publication of the scientific-professional JOURNAL "Roads" was restarted, which, together with the number 14 in your hands, makes a total of 5 issues published. The crown of RAM activities was the organization of the First Macedonian Road Congress, with 350 participants from 16 countries.

During this term, the Management Board will face new goals and challenges, but these challenges may not necessarily be problems only; rather they can mean opportunities for us engineers to progress.

In the interest of the engineering profession, it is necessary that we activate all our capacities, in order not only to maintain the previously listed activities, but also to continue on the path of establishing and developing of road engineers in the profession and society.

The commitment to improve the status of road engineers can not remain merely declarative and among a small group of activists - enthusiasts, but it should become massive, spread among all 'roadmen', in order for all of us to strive not only for a better status of road engineers in the profession, but also for a better status of our construction companies in the society. We have common interests, we live off the roads and on the roads.

Simply put, we, the road engineers, and our association RAM feel the problems and know them best and that is why we should be involved in solving them.

As RAM, we must continue with two more activities in the future: deepening and development of the cooperation with the related international associations and institutions, as well as striving for continuous professional development and education of our members – road engineers.

The vision of the new Board of RAM can be expressed through just one sentence – a quote from the American politician Leslie Brown:

"Shoot for the moon. Even if you miss, you'll land among the stars."

Finally, allow me congratulate the new 2022 to all members of RAM, wishing for you and your loved ones, above all, good health, happiness and success in all fields. At the same time, I congratulate you on the great holiday of Christmas.

Prof. Dr. Goran Mijoski,
President of the MARE

Interview with the Rector of the University of "St. Cyril and Methodius" from Skopje, Prof. Dr. Nikola Jankulovski

Study programs quality results in increased interest in studying at technical faculties



Rector Jankulovski, this is your second as the leader of the University. How would you evaluate your achievements so far?

The university is a complex system consisting of 23 faculties and 5 scientific institutes, as well as associate members, which are public scientific institutions, dormitories etc., thus the needs and problems are significant. The units carry out higher-education activity in all educational areas, as established by the Frascati classification, meaning that everything that exists in the world is also available at UKIM. Many of the educational and scientific fields do not even have common points of contact, which means that you need to know the situation in all those areas in order to be able to coordinate things, to help, to lead the cooperation domestically and internationally. Then, of course, you have the students, as the most important segment and central entity of the University. By constantly communicating with the units and making joint decisions, which is not easy at all, we managed to create new processes and accelerate the ones we had already launched. At the same time, there are many limiting factors for the University to become what I have envisaged, which is why I have taken to be rector. You know, the processes at universities are generally slower, as one has to be very careful, make everyone happy, avoid favoring certain units and make it all an inclusive process that will unite everyone; otherwise it can very easily happen that some units require secession. There has been no such case during either of my terms, as my work is based on the principles of inclusiveness. I can freely say that I had a fruitful period in the past years; if I start to make list, it will take a lot of time, but all this is described in detail in the reports that I submit every year to the Senate of UKIM and the Assembly of RNM.

If you ask me if I am satisfied with UKIM's achievements during the period of my rectorship, no other answer to this question other than the affirmative is possible. Not only am I satisfied, but I am proud of UKIM's achievements. I am aware that there is still a lot to do. We undertake a series of activities for improvement in many segments of the educational process, science, internationalization and recognition of the University. We strive for each member of the academic community to give their contribution towards the common goals of UKIM and we have special respect for that. Some of our staff stand out for their excellence in the international scientific research field, we are proud of them, and we have created conditions for others to join them.

The Covid-19 pandemic has also left serious consequences for the educational process. How does UKIM deal with this situation?

The COVID-19 pandemic has dealt a major blow to the quality of the educational process. From the very beginning of this pandemic, we, as a University, "realigned" ourselves and introduced complete digitalization of instructions. Students have an unhindered course of classes that they can access either electronically or in a hybrid manner, then materials and textbooks are available electronically, and exams are conducted with the help of state-of-the-art electronic tools, in order to protect both students and teachers. However, the general impression is that the electronic way of instruction does not enable proper interaction between the student and the professor and does not ultimately have the same effect as compared to physical presence.

I hope that in 2022, humanity will finally identify a solution to the pandemic and bring it under control. This will mean returning of students to the academic desks and going back to the old, already well-proven teaching practices with physical presence, the quality and efficiency of which is undoubtedly much higher than online teaching that can be used in the future, but only in exceptional situations, in order for the students to always receive quality and continuous education.

I would add that over a very short period of several months, with its our own professional and financial resources, a distance-learning platform was implemented following the example of the world-renowned universities.

Today, a combined method is used at UKIM for the instruction process, in accordance with the healthcare protocols. Given the number of students and the specifics of the study programs, exercises and exams take place with physical presence, but wherever there is a high number of students lectures are delivered remotely using video conferencing tools. In this way, we manage to maintain the quality of the educational process, but also the communication between professors and students, which is certainly a great challenge.

How would you generally assess the situation in higher education in Macedonia?

You can always do better. Many universities were opened, which, in view of the economic processes inevitably leads to a decline in quality. However, I can conclude that UKIM has maintained the acquired quality, our diplomas are recognized in other countries and our staff is well listed on the labor market in the world. I responsibly believe that the legal regulations should strengthen the norms and standards for establishing universities and performing higher education activity.

Nonetheless, the situation in higher education for quite a long period of time is not at an enviable level. There are reasons for that, and most of them can be identified at the institutional level. I will start with the highest act that regulates this issue – the Law on Higher Education, which stipulates issues related to autonomy, funding and quality assurance in higher education. As the largest, oldest and at the same time best ranked University in our country, UKIM has always highlighted the shortcomings in all these segments. We have been calling upon the competent institutions for a long time in order to point to the limitation and the damping of the functional, financial and personnel autonomy of the University, and we have come up with concrete proposals to overcome such a situation.

Unfortunately, despite all our warnings, even before the Law on Higher Education was passed, such restrictions remained, and this significantly disrupts the instruction and educational process, funding and creation of the faculty-scientific youth at the university, which definitely affects quality. The second instance, which is also important for the quality in higher education, is the Agency for Quality in Higher Education, a body that should provide an equal basis for the development of higher education in the country and ensure the quality of the instruction and educational process at all public and private universities. Finally, the small amount of funding for the development of science, which is an inseparable part of higher education, does not allow us to develop scientific research, and without the results of such research and their publication in international and prestigious journals, we can not expect much higher ranking of our universities than at present. On the other hand, the unbreakable bond between science and higher education creates significant quality on both sides. In conditions of enormous growth of technology, digitalization that has permeated almost all pores of education, business and services sector, increasingly imposes a situation in which without science, the required quality in the teaching process can not be achieved. We, as a university, are fully aware of and strive at all costs, mostly through the international activity of the units, to provide funds for the development of scientific studies and research, and we seek to incorporate the results of such research in the teaching process and convey them to the students in the most appropriate way.

How would you assess the cooperation with the state institutions that are responsible for education in Macedonia?

I think that the Ministry of Education and Science is overloaded with the primary and secondary schools, which require a lot of attention, as they are the basis for quality staff to come to the universities ready to engage in university education, which means a lot of sacrifice and great commitment. Higher education and scientific and research field should be dealt with by a separate ministry, since higher education is not education in the classical sense of the word, as it rather means development. A national council composed of university professors was established recently, with



significant responsibilities concerning key issues in higher education, and I expect for many unresolved issues in higher education in the country to begin to be addressed.

What is the situation and the need for teaching staff at the faculties? How to choose the best professors, with innovative curricula that will create the professionals needed in our country?

Following its long tradition, the University particularly invests in the creation of quality faculty, who of course, come from the selection of our best students. Quality instruction and teaching, and scientific-research activity certainly requires a sufficient number of professors and assistants, who according to the standards, will work with an appropriate number of students. Unfortunately, this is not always the case, so given the social circumstances in our country, our teaching staff is draining as a result of retirement or departure of young people abroad, where we as an institution can have very little influence.

UKIM has always been a nursery for the highest quality staff who are proven alumni in the country and abroad. The tradition of retaining the best students and helping them develop in their academic careers has never stopped at our University. The development of teaching and scientific staff and scientific-research infrastructure is a long process, and this is the foundation of our quality. We struggle unreservedly to provide the best faculty for our students, to innovate study programs, to care for the students' career development and to increase their employability and adaptation to the needs of the labor market.

To this end, we work with great intensity on the accreditation of quality study programs that follow the world trends in all fields of science. They are prepared in cooperation with Macedonian companies in order to develop highly educated staff competitive in the labor market.

In recent years, the number of young people who want to study abroad has increased again. How can we keep young people at our faculties?

The outflow of young people abroad and their desire to study abroad, I would say, is more a result of the ambition of young people to create a retreat for their



complete emigration from the country than resistance to our higher education system. UKIM has always been a recognizable "brand" in higher education, not only in the country, but also in the region and much wider. We are witnessing many of our alumni who are today part of the world scientific elite. Last month it was announced that 6 Macedonian scientists are among the 2% of the best and most quoted scientists in the world, and they are all part of the broad academic family of UKIM. Our University still nurtures the values of quality higher education, transfers the latest knowledge and skills, constantly innovates its study programs and harmonizes them with the needs of the labor market. Here I want to emphasize that, if they want, young people can acquire quality knowledge, skills and practice at some of our universities, but the desire to migrate abroad is predominant reason for their departure. In that sense, the answer is in the policies for retaining the youth in the country, and such policies are created by the governments of the countries with a series of measures to retain the young labor force in the country.

The technical faculties managed to maintain the number of students, taking into account the high demand for technical staff all over the world. How can we help them modernize their laboratories and facilities for practical work?

You are absolutely right. Technical faculties not only maintain the number of students, but there is also an increase, which is a result of the growing interest in studying technical sciences. However, the number of students enrolling in some study programs is dynamic and depends on many factors. , I believe that in this case the quality of study programs and their being recognized in our country and beyond, employment opportunities in domestic companies and the European and world labor market, as well as the average salaries earned in this sector and the continuing efforts to improve the quality of the teaching process are the most important factors. I can quote a number of examples that have occurred recently, and strongly influenced the increase of the quality of the study and scientific and research process.

The Faculty of Electrical Engineering and Information Technologies conducted an international accreditation of the study programs; multiple faculties equipped and established new scientific research laboratories; an accreditation process was conducted in a number of laboratories, including some of the laboratories of the technical faculties. During the





last call announced by the Ministry of Education and Science, which referred to equipping laboratories, UKIM units achieved excellent results and a number of scientific research laboratories at several faculties will receive the necessary funds. This is a really positive process and we hope that in the future a growing number of UKIM units will be able to provide funding for laboratories from national sources.

This means that we work constantly on improving the conditions for studying, modernizing the laboratories, establishing new and more modern laboratories. However, the development of UKIM units is not balanced; some units are more advanced than others and indeed some of the units need support in this respect. We are already implementing activities to increase the interdisciplinary approach, which will enable joint performance of the units, increase access to scientific research resources and laboratories for academic staff and students. However, many things depend on the units themselves, and we are in constant communication with them seeking to support all their demands concerning modernization of the teaching-scientific process and improvement of the studying conditions.





Road construction is a complex process, as it involves a number of separate and different activities with different construction machines and technologies, which operate successfully in only one цпоседcycle. The profitability and success of companies in this industry relies on work efficiency and capacity, but also on well-anticipated costs. The last two years, the pandemic and the economic instability have brought significant consequences in the construction sector. Many companies faced financial problems and losses, reduced work capacity, increased transportation and raw material costs, as well as reduced supply chain and unavailability of components and products.

In this new situation, one of the ways for companies to adjust and increase efficiency is to follow the trends in terms of equipment and machinery they must have for unhindered and efficient operation. This primarily refers to products and technologies that mean cost savings, prompt action and increased performance capacity than before.

* * *

In our country, ***FIMAKO DOO*** *from Skopje is a company that offers construction machinery for road construction, which follows global trends and technologies for more than 27 years now. Founded in 1994 in Skopje, this company specializes in the sale and service of construction machinery and equipment, exclusively for the construction of roads and streets. The previous decades-long experience and involvement of this family company in construction machinery, after the independence of Macedonia, results in official representation of several world-leading manufacturers, and it becomes one of the few companies in our country, which specialize in machinery and equipment in the field of road infrastructure.*

Filip Rusevski, manager and one of the co-owners of FIMAKO, shares that from the very beginning, the company was among the first to pave the way on the Macedonian market by offering high quality products and services, aimed at more efficient and technologically advanced road construction:

"Continuous monitoring of trends and supply of new quality solutions through our partners, following the European and world regulations and innovations, transferring them to our construction companies, have contributed to mutual and long-term cooperation with them. We have proven to be trustworthy during all these years through our commitment, availability and

Interview with Filip Rusevski, owner of the company FIMACO

NEW PRODUCTS AND TECHNOLOGIES MEAN SAVINGS, SPEED AND QUALITY IN ROAD CONSTRUCTION



maximum support to the construction industry with high quality products, professional service and original spare parts."

Today, the company belongs among the few who offer construction machinery and equipment that cover the entire process of road construction. Many of FIMAKO's partner companies are world-leading manufacturers who are either interconnected or work closely together, thus making the end products the result of extensive experience, expertise and unique know-how in the market. Following are some of these long-term partners whose representative in the territory of Macedonia is FIMAKO:



BOBOMAG (Germany) - World leader in asphalt and earth compacting equipment, rollers, compactors, asphalt pavers, asphalt grinders etc.

MARINI (Italy) - World leader in the production of asphalt plants and asphalt treatment.

SECMAIR (France) - Number 1 manufacturer of road rehabilitation equipment.

MASSENZA (Italy) - Specialized manufacturer of machines for production and application of bitumen and emulsions.

STRASSMAYR (Poland) - Manufacturer of innovative road rehabilitation and repair machines.

KAESER (Germany) - World leader in the production of mobile construction compressors

CEDIMA (Germany) - Specialized company for asphalt and concrete cutting machines

BEMA (Germany) - European leader in street and road sweeper attachments

GREEN POWER SYSTEMS (Italy) - Manufacturer of electric units/generators for a wide range of applications, especially in civil engineering.

AIRSTAR/LUMOON (France/Germany) - Innovators in construction site lighting



"All the companies we represent produce machines and equipment that cover a specific part of the road construction process and together they form a whole in this process. From the very beginning of road construction - with the compaction of the subgrade, through asphalt production in plants, its installation by means of bitumen emulsion application equipment, asphalt laying and compaction, all the way to the equipment used in the rehabilitation of roads and streets, such as asphalt grinding, cutting or recycling, and the point of its cleaning and maintenance."

Efficiency and economy are reflected in the numerous innovative technologies and machines behind the names of BOMAG, MARINI, KAESER and others.



"To start with asphalt production, which is one of the initial stages in road construction, MARINI from Italy, as a leading manufacturer of asphalt plants that has been present on the market for more than 100 years, stands out with innovative and advanced products. MARINI asphalt plants have always been one step ahead in terms of the application of modern technologies and innovations in the production of quality asphalt. In addition to the advanced technology, their wide selection of models with different capacities, quality components and long-term cooperation with end users, often makes MARINI the first choice when investing in an asphalt plant."

Some of these MARINI innovations include technologies using high-percentage of recycled asphalt (RAP) of up to 100% (with the MasterTower model), the production of so-called "Warm" asphalt at a temperature of 100 ° C to 130 ° C (unlike the frequently used standard asphalt at a temperature of about 160 ° C), the use of various additives for the production of modern asphalt mixes, such as SMA or PMB asphalt, possibilities for use of plastic, glass or slag in asphalt mixes, as well as technologies associated with energy saving and reduced emissions into the atmosphere, which are increasingly in demand and necessary.

"With few exceptions, most of the asphalt plants in Macedonia are relatively old, with insufficient capacity and no capability to produce modern types of asphalt mixtures. The countries in the region are much quicker in following and accepting the European standards and new technologies and by using the available European programs and funding, they successfully implement such

technologies. These technologies include recycled asphalt (RAP) or JMA asphalt installation, the use of various additives and environmental protection, thus enabling higher-quality final products and meeting the criteria and trends in the near and distant future. Unfortunately, a precondition to start anything in our country is the low price. However, the seemingly lower initial cost, then significantly increases due to the complexity of the asphalt plants themselves, their age (if second-hand), thus omitting important technological solutions, which would mean more efficient, faster and more environmentally friendly operation and road construction, and of course lower costs and headaches in the future.

With more than 3,000 sold asphalt plants and four production plants in the world, MARINI is the only specialized manufacturer that has the largest range of asphalt plants.



"Our offer does not only include the sale of the final product - asphalt plant, but rather the whole process of introduction of the technology, training and discussions with customers, in order to identify jointly professional solutions for a very important part of this industry. Investing in new technologies when purchasing an asphalt plant, always and without exception means high quality asphalt, flexibility and fast adaptation to new trends and requirements, as well as a production process that without further investment will function in the market in the next 20-30 years, even more"

These novelties in the road construction, in addition to the asphalt bases, as the initial stage in the process, require new, modern machines with the capacity to follow the subsequent processes in the construction of roads. Here as the next process is asphalt laying and its compaction.

Asphalt and compaction is a complex and important process in itself, especially concerning efficiency, readiness and speed of work. An important place in the FIMACO program is given to the company of BOMAG from Germany, which is a world leader in the asphalt compaction, laying and grinding equipment.

"BOMAG products are well known in the construction sector and have developed their reputation as quality and durable machines. However, our experience in this business to date makes us admit that the use of modern technology offered by these machines in road construction is not so well known and applied. Pavers, rollers, asphalt grinders and all other BOMAG machines feature many technological innovations, which significantly improve the road construction process. The machines themselves today are like mobile laboratories, displaying, measuring and documenting the whole process of paving in a proven and relevant manner, thus eliminating the need for additional measurements, corrections, and thus leading to huge cost savings.

Of the many innovative technologies, I would single out ASPHALT MANAGER 2, ECONOMIZER and BOMAP. Asphalt manager is a unique technology of BOMAG, whereby the complete asphalt compaction process is carried out automatically and the roller fully adjusts the strength and direction of the compaction, while also providing relevant measurement and documentation thereof. This system is particularly well established and used throughout Europe and is the only compaction system that is flexible and applicable with all types of asphalt mixtures (SMA, PMB) and layers, regardless of the roller weight. The ECONOMIZER system is a simplified system, which only monitors and measures the compaction and eliminates operator guesswork and the need to supervise the sufficiency of asphalt or subgrade compactness, as well as expensive additional costs for measurements and repairs.

Both of these technologies can be connected to the BOMAP application, a simple Android application that shows the connected machines on a tablet, tracks their geo-location with up to 20 cm accuracy, monitors the compaction and the results of all the machines,

and then all this it is easily documented and sent to the persons in charge."

This is only part of the production program of **BOMAG**, which contains the widest professional range of construction machinery and equipment for construction of road, dams, landfills, etc. From lightweight compaction equipment with vibrating plates and compactors, to a wide selection of light and heavy rollers for soil and asphalt compaction, wide and innovative range of pavers and asphalt grinders, to recycling and road stabilization machines, waste compactors etc.

"In its DNA, every BOMAG product contains innovative solutions for more efficient, safer and more economical operation, be it ergonomics and safety for the operator, the concept of easy servicing for service technicians or cost savings for the company."

The other companies represented by FIMACO, which cover different parts of road construction, are also innovative in their field and are leading manufacturers in Europe and the world.

Some of them, such as SECMAIR (France), MASSENZA (Italy) and STRASSMAYR (Poland), are market leaders in rehabilitation technology and machinery, road maintenance and bitumen and bitumen emulsion handling.

The modern construction of quality roads requires quality and proper application of the bitumen emulsion, which will only be possible if a modern emulsion production plant is used together with a sprayer truck equipped with an efficient computer precision application system. In the FIMACO program, these 3 manufacturers offer innovative and technologically advanced solutions, meeting the strictest standards and criteria applicable in this part of the professional road construction.

Included in the whole rehabilitation process is also patching potholes, which are a nightmare for every participant in traffic. In the FIMACO sales program, one of the innovative machines is the SECMAIR and STRASSMAYR hole-patching machine. These machines use a simple computer process run by one or two people, which prepares a mixture of aggregate and bitumen, sprays it over and fills any type of cracks in the roads and forms a new layer that is far more durable and of higher quality than the former classic patches of cold or warm asphalt. Using the Patch Portal – electronic GPS



/ GSM system – makes it possible to locate the machine and map the filled holes, calculate the material used and the working conditions, completing this process as an efficient, flexible and cheap road maintenance solution.

The other companies represented by FIMACO in the Macedonian market, such as KAESER, CEDIMA, BEMA and GREEN POWER SYSTEMS, complete the portfolio of state-of-the-art machines that are part of the process of construction and efficient maintenance of roads.

"Over the years, our specialization in road construction equipment has allowed us to offer additional equipment, which also has a great impact on the construction and maintenance of roads and streets. Mobile compressors, asphalt cutting machines, power generators and street cleaning brushes are part of the wide selection and an inevitable part of everyday construction activities. One such product, which is in high demand owing to the increased flexibility and constructing roads at night, are the light balloons. "These light balloons are an innovative product of the company AIRSTAR from France, and with their way of illuminating (without shadows on the ground), they contribute to efficient and safe work in case of reduced visibility or night work."

The wide range of innovative products and technologies, service, after-sales activities, training and education, make the company of FIMACO today a reliable and trustworthy partner for many construction companies, who believe that investing in quality and innovative equipment means efficiency, reliability and quality of work in view of the current and future road construction challenges.

PRESENTATION OF CIVIL ENGINEERING FACULTY IN ZAGREB 100 YEARS TRADITION AND SCIENCE - EDUCATIVE ACTIVITY

HISTORY OF THE FACULTY

The beginnings of education of civil engineers in the territory of the present-day Croatia date back to 1919 when the University College of Engineering opened its doors in Zagreb. This university college subsequently engendered numerous prominent faculties of the University of Zagreb, one of them being the Faculty of Civil Engineering. The establishment of the University College of Engineering is primarily the result of attempts made by members of the *Croatian Society of Engineers and Architects* in order to enable education of experts in this region where, at that time, such education was not available, so that engineering activities were dominantly performed by engineers educated at engineering schools in Graz, Vienna, Budapest, and Prague, and at other foreign schools. Out of many prominent professors that marked this period, it would be appropriate to mention a distinguished professor Stjepan Prokofjevič Timošenko, who later became a world-renowned researcher, and is acclaimed as the father of structural mechanics. First students graduated from the University College of Engineering already in 1923, and as many as 44 students graduated from its Civil Engineering Department until 1926. The first doctorate was awarded at the University College of Engineering in 1922. It is interesting to note that the honorary doctorate in engineering sciences was awarded in 1926. to Nikola Tesla.

In 1926, the name of the University College of Engineering was changed into the Faculty of Engineering of the University of Zagreb and the number of student enrolments increased considerably. In 1937, design for the construction of parallel pavilions with the main entrance in Kačićeva Street is completed. The first pavilion, completed in 1939, accommodated and still accommodates the Faculty of Civil Engineering, together with the Faculty of Architecture and the Faculty of Geodesy.

In 1956, the faculty was divided into four faculties: Faculty of Architecture, Civil Engineering and Geodesy, Faculty of Mechanical Engineering and Na-

100 YEARS JUBILEY CIVIL ENGINEERING FACULTY IN ZAGREB



Building of the Faculty of Civil Engineering at Kačićeva 26 in Zagreb

val Architecture, Faculty of Electrical Engineering, and Faculty of Chemical Engineering, Food Technology and Mining, which ended the thirty years of continuous activity of the Faculty of Engineering of the University of Zagreb. In 1962, the Faculty of Architecture, Civil Engineering and Geodesy was divided into three faculties, and the newly formed Faculty of Civil Engineering was divided into Structural Engineering, Transport Engineering, and Water Engineering departments, which were further subdivided into ten departments that cover all areas of civil engineering. In the academic year of 1963/1964, the Faculty started to implement a two-year post-graduate studies program, upon completion of which the Master of Science (M.Sc.) degree was granted.

To provide for better material conditions and to improve professional activities, the Faculty of Civil Engineering and the Civil Engineering Institute of Croatia (IGH) joined forces and formed a single institution: Faculty of Civil Engineering – Zagreb. The merger took place in 1977, and the same process was conducted for the Faculty of Civil Engineering of the University of Split, which then joined the complex organisation called Civil Engineering Institute with the head office in Zagreb. At the same time, Civil Engineering Institute was also joined by the Faculty of Civil Engineering – Rijeka, and the Faculty of Civil Engineering – Osijek. The Technical College for Construction Industry and Civil Engineering from Bedekovčina, and College of Civil Engineering from Zagreb, also became parts of the Faculty of Civil Engineering – Zagreb.

In 1991, Civil Engineering Institute demerged into its former components. In that process, approximately 200 employees transferred to the Faculty of Civil Engineering – Zagreb, and this number has not significantly changed to this date. In 1996, the courtyard building was extended and the Faculty thus gained 3600 square meters of modernly refurbished space and about 1600 square meters of newly constructed areas. In this period, teaching programs were changed on several occasions to adjust the curriculum to current trends in civil engineering and to the needs of the construction market. The greatest change was the introduction of the so-called Bologna process in the higher education system of Croatia, which involved three years of undergraduate studies, followed by two years of graduate studies.

TEACHING ACTIVITIES

Undergraduate and graduate studies

Based on the Faculty's long-standing tradition of successful education of civil engineers, and in line with modern trends, teaching activities are currently organised at the Faculty of Civil Engineering in the form of three-year undergraduate studies after which 180 ECTS credits are granted as well as the academic title of Bachelor of Civil Engineering (univ. bacc. ing. aedif.). Undergraduate studies are followed two-year graduate studies at the end of which 120 CTS credits are granted and the academic title of Master of Civil Engineering (mag. ing. aedif.) is obtained. The following main core subjects (academic majors) can be selected at the start of graduate studies: Geotechnics, Water Engineering, Structures, Materials, Construction Management, Transport Facilities and Theory and Modelling of Structures.

Undergraduate studies in civil engineering are the same for all students. Each year, the Faculty enrols up to 240 students for undergraduate studies, while this number is 203 students for graduate studies. In addition to accreditation from the Croatian Agency for Science and Education, the Faculty's education programs also gained accreditation with the EUR-ACE marks, as granted to its undergraduate and graduate studies by the German Accreditation Agency ASIIN.



Academic majors for two-year graduate studies

Student Internship at the Faculty of Civil Engineering

One of the current activities at the Faculty of Civil Engineering is the GRASP Project (Student Internship at the Faculty of Civil Engineering), financed by the European Social Fund under the "Efficient Human Resources" Operational Programme. During a three-year period (March 2020 to March 2023) the project will be assisting students in gaining practical knowledge through Student Internship. Through an array of workshops, the beneficiaries will be able to further develop their professional, communication, soft, and digital skills. The main goals of the project are to elevate the study programme by developing a student internship model, to provide students with practical knowledge, to facilitate students' transition to the labour market and to help teaching and non-teaching staff build up and develop their mentoring and training skills. The following annual events assist in disseminating results and sharing experience gained by participants: GRADify Job Fair – an event following the traditional Career Day, which serves to provide networking opportunities between students and employers and iGRA Competition – a student competition in developing practical projects, in cooperation with civil society. All project activities are coordinated by the Career Centre via the central platform: https://www.grad.unizg.hr/ck



Students visit Pelješac Bridge construction site



Commencement Ceremony for graduate students

Doctoral studies in civil engineering

Benefiting from its teaching and research activities and potentials, the Faculty of Civil Engineering covers, at its postgraduate doctoral studies, all fields of civil engineering (geotechnics, water engineering, engineering structures, transportation engineering, construction technology and management) as well as fundamental technical sciences (in branches: construction materials in civil engineering and structural mechanics). The programme of doctoral studies is based on competitive scientific research in the scope of relevant national and international research projects, which have a very pronounced possibility of practical application, and are hence able to foster advancement of the society based on continuous development. The objective of doctoral studies is to educate researchers in the field of civil engineering, and so the studies are implemented not only through teaching activities but also through other mandatory and elective forms of work: publication of scientific papers, research seminars, discussion groups, summer schools, and by writing and defending doctoral dissertation. 180 ECTS credits are granted at the end of doctoral studies in civil engineering, and the successful candidate obtains the title of Doctor of Science in a scientific field of technical sciences.

Doctoral Studies Symposium

A Doctoral Studies Symposium was introduced in 2015 in the scope of doctoral studies conducted at the faculty. This symposium is held once a year and its objective is to develop research work, facilitate understanding of scientific methodology, and expand critical thinking of doctoral students. Almost 120 presentations were given by doctoral students during seven doctoral-studies symposia held so far. If invited lectures and lectures on experience from additional education and training of employees are added to this impressive activity, one can clearly grasp the benefit this symposium has for the scientific community of the Faculty of Civil Engineering, and for the society as a whole. Research activities carried out in the scope of doctoral dissertations prepared at postgraduate doctoral studies in civil engineering are almost always development-oriented, but are largely applicable in practical terms, and are often carried out in cooperation with construction companies.



Symposium of Doctoral Studies in Civil Engineering

Specialist studies at the Faculty of Civil Engineering

Specialist studies are carried out in several fields of study: Numerical and experimental analysis of structures, Bridges, Structures, Fire engineering, Organisation and management in civil engineering, and Water engineering.

SCIENTIFIC ACTIVITY

The Faculty's scientific work is conducted through various activities including those performed in the scope of postgraduate studies, work on scientific-research projects, publication of research papers, patenting activity, and organisation of scientific gatherings. A distinguishing mark of the Faculty of Civil Engineering is its participation in a considerable number of scientific research projects (both national and international), either led or collaborated by the Faculty's researchers. Over the past three years, a number of projects have been carried out at the Faculty in the scope of: HORIZON 2020, ERASMUS+, Croatian Science Foundation, and other programs funded through structural funds, under competence of the European Regional Development Fund, Ministry of Science and Education, and Ministry of Economy, Entrepreneurship and Crafts of the Republic of Croatia. Doctoral students take an active part or work on these projects, and funds raised through such activity are used to finance their research, advancement, participation at conferences, and study visits to other institutions. Scientific excellence of the Faculty and its researchers has been recognised by numerous institutions. The Faculty's employees are prominent scientists and experts, as well as holders of many significant awards, including those bestowed at highly prestigious international innovation exhibitions.



Crystal Globe for RUCONBAR Noise Barriers awarded by the International Road Federation (IRF) on November 7, 2018 in Las Vegas

LABORATORIES

The Faculty is in possession of the most advanced equipment for the conduct of teaching activities and so a part of the teaching process is also realised in laboratories. There are five laboratories at the Faculty, namely for materials, structure testing, geotechnics, transport facilities, and water engineering. The laboratories are accredited in accordance with the international standard HRN EN ISO/IEC 17025 for the use of appropriate construction-product testing methods. A number of final and graduation theses, and a considerable number of specialist theses and doctoral dissertations, have been prepared on the basis of tests conducted at the Faculty's laboratories or using mobile research equipment. Ingenious conceptualisation and proper implementation of research activities in laboratory have enabled development of innovative products that are a good reflection of the outstanding quality of programs and projects carried out at the Faculty. The quality and innovation levels achieved at the Faculty have been recognised at many instances, as confirmed by national and international innovation awards bestowed for innovative products.


Potvrda o akreditaciji
Accreditation Certificate

Ovime se utvrđuje da je
This is to recognize that

Sveučilište u Zagrebu
Građevinski fakultet
Laboratorij za materijale
Laboratorij za ispitivanje konstrukcija
Fra Andrije Kačića Miošića 26, HR-10000 Zagreb

osposobljen prema zahtjevima norme
is competent according to
HRN EN ISO/IEC 17025:2017
(ISO/IEC 17025:2017,
EN ISO/IEC 17025:2017)
za/to carry out

Ispitivanje građevnih proizvoda
Testing of construction products

u području opisanom u prilogu koji je sastavni dio ove potvrde o akreditaciji.
for the scope described in the annex which is the constituent part of this accreditation certificate.

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HAA-Ob-7/7-1/Izdanje/Issue 6

Laboratory accreditation certificate

CENTRE FOR RESEARCH AND DEVELOPMENT OF SAFE AND SUSTAINABLE BUILT ENVIRONMENT

The Faculty of Civil Engineering has initiated establishment of a centre of excellence under the name of *Centre for Research and Development of Safe and Sustainable Built Environment* to be situated at the Borongaj University Campus in Zagreb. The Centre will enable significant improvement of the scientific and research work of the Faculty of Civil Engineering and will become the main axis for the research and development of safe and sustainable built environment, appropriately linked with similar institutions operating in the Republic of Croatia and throughout the European Union. Thus, the role of this infrastructure will not be exclusively linked to scientific research to be conducted by the Faculty's researchers in the scope of new doctorates, postdoctoral studies and domestic and European research and development projects, but it will also be a tool through which scientific contribution will be implemented more easily into the real sector through non-economic cooperation with economic sector partners and national organisations. The establishment of this Centre will enable better-quality connection between economic operators and the academic community, and will ensure even more fruitful cooperation in research activities, laboratory testing campaigns, and in implementation of highly demanding projects.



View of future Centre for Research and Development of Safe and Sustainable Built Environment, Borongaj Campus

PROFESSIONAL ACTIVITY

In addition to regular teaching and scientific activities, the Faculty's staff also takes part in the design, professional supervision, and consulting on construction projects, reviews and checks design documents, prepares expert opinions and studies, conducts expert evaluations, performs physicochemical testing of water, develops physical hydraulic models, conducts hydrologic and hydraulic measurements, tests materials and structures, conducts laboratory and model testing, performs measurements on structures, conducts soil and rock properties testing, performs noise computations and measurements, tests energy efficiency of buildings, and conducts other professional activities in civil engineering.

ACTIVITIES AFTER THE EARTHQUAKE

The Faculty has greatly contributed to the coordination and implementation of all organisational activities needed after the March 2020 earthquake in Zagreb, and after earthquakes that struck the area of Glina, Petrinja and Sisak in December of the same year. Major activities undertaken by the Faculty of Civil Engineering after the earthquake were: organising a system for inspecting damaged buildings, and forming a crisis headquarters for the management of engineers and civil services involved in relief activities, organising a system for inspecting damaged buildings, developing a form for the assessment of damage and building usability, developing a digital platform for managing data on damaged structures, developing a system called GISCloud for assessing construction damage using unmanned drones and organising on-site education and training of engineers. Moreover, in March 2020, Faculty designs a platform "Croatian centre for seismologic engineering" (www.HCPI.hr) where all information and instructions for citizens, city and state officials, services, and engineers, is provided. Today, the Croatian centre for seismologic engineering has been established as a branch of the Faculty of Civil Engineering which will continue to deal with seismic engineering through scientific research, education of new generations and professional and advisory engagement needed by our economy. The Faculty also participated in damage assessment and estimation of reconstruction expenses for damaged buildings with World Bank in cost estimation for the Croatian Government, "Rapid Damage and Needs Assessment – RDNA", and carried out the same activity to assess damage and needs in the new devastating earthquakes in the affected Sisak-Moslavina County. During this extremely difficult and demanding period, the faculty has worked on important publications and conferences, published an instruction manual "Urgent program of seismic reconstruction" (UPPO) in collaboration with the Croatian chamber of Civil Engineers, and organized a series of meetings, webinars and online consultations to help all stakeholders involved in the reconstruction. To commemorate the anniversary of these events and to forge a path towards a resilient future, the University of Zagreb, Faculty of Civil Engineering organized the 1st Croatian Conference on Earthquake Engineering (1CroCEE) bringing together numerous international experts from the field of earthquake engineering. One of the main objectives was to explore the implications of the Zagreb earthquake on Croatia's future development and to raise awareness of seismic risk and the importance of earthquake construction and building strengthening. Experts from the Faculty of Civil Engineering have also prepared the University monograph "Earthquake Engineering – Renovation of Masonry Buildings", which attempted to cover and connect specific topics related to reconstruction. Among the many post-earthquake activities of the Faculty of Civil Engineering, the voluntary and compassionate engagement of its staff and students in helping the frightened population should be emphasized, followed by an organized and professional approach to inspecting damaged buildings and preparing guidelines for planning the reconstruction of earthquake-damaged buildings, establishing safe transport and rebuilding destroyed infrastructure.



Faculty staff takes part in post-earthquake activities

EXPERT DEBATE ON THE DRAFT LAW ON CONSTRUCTION



On July 14, 2021, at the Hilton Hotel, the MACEDONIAN ASSOCIATION OF ROAD ENGINEERS (MARE) organized an expert debate on the Draft Law on Construction. This is one of the most important laws for the construction profession, and probably one of the most commented laws since its adoption in 2009, with more than 20 Amendments, several revised texts and it was contested more than once by the Constitutional Court.

According to COVID-19 protocols, the number of attendees at this debate was limited to 50 and among those present were the Minister of Transport and Communications Mr. Blagoj Bochvarski, the Rector of the University of "St. Cyril and Methodius "in Skopje – Prof. Nikola Jankulovski, a Delegation from the Chamber of Certified Architects and Certified Engineers including the President Kristinka Radeski, MA, Vice President Rade Lazarevski and Secretary General Dimce Atanasovski, professors from the Faculty of Civil Engineering in Skopje, MP and Secretary of the Parliamentary Committee for Transport and Communications, Mr. Ljupчoo Balkoski, Deputy Director of PESR Mr. Blagojce Trpevski, Director of PE "Makedonijapat" Mr. Bekim Memedi, representatives of the largest and most important construction companies in the country dealing with design, construction and supervision, MARE members and other guests.

The debate was opened by MARE President – Prof. Dr. Goran Mijoski, who in his speech said: "If we are to judge by the amounts to be achieved through this law and all the capital investments in the country stipulated therein (motorways and all other roads, railways, dams, water supply and sewerage pipelines, treatment plants, buildings), dear colleagues and guests, today we are faced with the task of discussing the most important and definitely most valuable law in Macedonia!

Nevertheless, the general impression of fellow civil engineers is that the Law simply does not seem to consider roads and railways at an appropriate level. We constantly hear that, in the past few years, but in the years to come as well, Macedonia is experiencing a large investment cycle in transport infrastructure (construction of new highway sections, expressways, rehabilitation of hundreds of kilometers of existing roads) and that large financial resources are being invested, but this is not reflected in the new draft law. It is a matter of capital investments, and the treatment in the law is inappropriate."

The Rector of the University "St. Cyril and Methodius" in Skopje – Prof. Dr. Nikola Jankulovski, at the beginning of his presentation emphasized that construction, alongside medicine, was one of the industries which did not stop being active during the pandemic.

He went on to say: "The purpose of my presence today at this expert engineering-roadmen debate, although I am a doctor by occupation, is, as UKIM Rector, to express



unreserved support for the fellow professors at the Faculty of Civil Engineering, then the students who are future engineers – builders of our country, as well as those engineers who received their education at the Faculty of Civil Engineering of UKIM.

However, just like in my walk of life – medicine, construction industry should also strive to implement concepts specialty development, lifelong learning and development, in order to achieve progress at the professional level, which is an inherent part of the development of the whole society.

It is extremely important that I, as the Rector of the largest and best university in the country, emphasize that the support of the European concept of authorizations within narrow areas and the adoption of such a law will have an impact and enable further development of the Faculty of Civil Engineering as one of the oldest faculties and founders of UKIM, with balanced development of all majors and specialties studied there.



To put it simply, it is necessary that the new Law on Construction implement these proposals from the scientific and professional field, in order to facilitate its application, and at the same time to contribute to the development of the construction science, which is of exceptional interest for the University of “Ss. Cyril and Methodius".

The Minister of Transport and Communications, Mr. Blagoj Bochvarski, first gave a retrospective of the adoption of the Law in 2009, then spoke about its implementation and shortcomings, which gave rise to our today’s discussion on the need for a new modern law. Further in his speech, he said: "The construction business in Macedonia is of exceptional importance for the development of our country. The adoption of a new, modern Law on Construction represents an extremely important reform, which will further encourage the development of construction. The construction industry in the country participates with more than 30% in the Gross Domestic Product, it employs more than 40 thousand workers and thereby supports another 36 branches of economy."

He then referred to the Draft Law: "It is expected that the adoption of this law will produce additional conditions for continued construction business expansion, which will positively affect the entire economy. An expert debate of this kind is needed, as it allows for the position and voice of the construction profession to be heard. Today's gathering of all the parties involved, to whom this Law is of vital importance, shows that we are on the right path to finding the right solutions and making the right decisions, and at the same time, it is a democratic feature to hear the opinion of road engineers. I expect a successful debate and quality proposals, which will improve the performance of the Law.

In the end, I would like to thank everyone present at the debate and the organizer – the Road Association of Macedonia, for bringing us together today at this event, "said the Minister.

Then, in accordance with the agenda of the event, the representative of the proposer of the law, Ms. Ana Gjorgjioska of the Ministry of Transport and Communications took the floor and first presented the current procedure of drafting the law, the subsequent procedure of its adoption, and finally addressed the goals and the tasks of the law.



A discussion on the Draft Law followed, during which an exceptionally rich debate developed, with quality proposals concerning improvements to the law. Seventeen participants asked for the floor, while the rest sent their proposals to RAM by e-mail.

RAM considers that it is of utmost importance to hear the opinion of the professional circles, which is why they organized the debate that resulted in summary conclusions to be integrated into the new Law on Construction.

The informal conversations among the participants in the debate showed that the prevailing conclusion was that both the proposer of the Law and the professional circles have a common goal – enactment of a law on construction that will express the interests of the profession, and will be significantly better than both the previous one and the present draft law. If the goal is common, wisdom and vision are required to make the right decisions today, for a better tomorrow.

Or, as the President of the MARE, Prof. Dr. Goran Mijoski put it in his presentation: "It is necessary to have civil engineers involved in the drafting of the Law, **"in medias res"** (acting immediately), then to develop a professional debate and accept proposals from the engineering profession, so that they can become an inherent part of the new Law on Construction."

We report comments on the Draft Law and propose constructive solutions that should be implemented in the Law on Construction, in order to improve its performance and have a modern and European-type of Law on Construction enacted.

- The draft law is primarily adapted to the needs of building construction, and there are many provisions related to capital infrastructure facilities such as roads and railways, dams, gas pipelines, etc., which are insufficiently covered in this version. Given the capital investments (those underway and announced new ones) in the field of transport infrastructure (roads and railways), it is necessary that they receive appropriate treatment, as failing to do so may cause many new problems related to the process of design, audit, supervision, approvals and all aspects of such structures, especially if the principle of construction under "Yellow" Fidic is applied in the future, when the state should be institutionally prepared for timely fulfillment of its obligations, within legal deadlines, to prevent claims for damages.

Proposal: A separate law on such structures may likely resolve these aspects, or this Law may stipulate the treatment of such structures in a more precise manner.

- Article 36 paragraph 4, which refers to the constituent parts of the Basic Design, confirms the conclusion that the Draft Law does not consider the road infrastructure to the sufficient degree. One of the main stages in the design is omitted - Pavement structure dimensioning of the, which is one of the most expensive individual parts of the roads. None of the listed individual design – 11 in total, includes the design for Pavement structure dimensioning, regarding either the new, or the existing roads during rehabilitation or reconstruction. All previous designs are developed come up with the Pavement structure dimensioning design, for it to define the materials to be used based on additional laboratory and field tests of asphalts and roadbase, estimates of traffic load magnitude and climate factors, which will be used to dimension the pavement structure in terms of its type, composition and size. In the 21st century, it is simply unimaginable to drive on dirt roads – unpaved!

Proposal: In order to prevent problems in the design process, this article must be supplemented with a Basic Design for Pavement structure dimensioning..

- Article 36 paragraph 4, which refers to the components of the Basic Design, also lacks a Design for use and maintenance. The provisions stated in Article 38 refer more to buildings construction. Simply, when building a new road or during reconstruction/rehabilitation, it is inconceivable not to have such a design, which will elaborate all aspects of use (normal/ excessive for predicting future repairs) and all types of maintenance (regular, winter, periodic – investment and emergency maintenance – in cases of natural disasters).

Proposal: In order to eliminate design problems, this article must be supplemented with a design for use and maintenance of roads and pavement structures.

- Since the adoption of the Law on Construction in 2009, there has been one embedded anomaly in it, which refers to the authorizations granted to civil engineers, who, regardless of their professional orientation (4 majors of education at the Faculty of Civil Engineering), all receive the same work authorization! All are experts in all types of buildings (roads, motorways, railways, dams, skyscrapers, nuclear power plants, windmills...), while based on their major – education, they are not qualified to work on all types of facilities, but everyone has a certain specialty according to their major. Fellow architects, although without majors, are only granted 2 types of authorizations: architects and urban planning architects.

  In fact, the proposer of the Law follows the principles of expertise and professionalism in one part of the law. However, the inconsistency is present in the defined principles, visible in Article 112 paragraph 2 and 4, as well as Article 114 paragraph 6, where the proposer requires expertise in certain areas (conducting examinations and seismic tests), but fails to do so with respect to design, revision, construction and surveillance of roads.

Proposal: Following the modern European trends in construction, it is evident that the Law on Construction should be amended in the part that regulates the issuance of Authorizations to civil engineers. The current insufficient solution should be substituted for a modern and professional approach, which will manifest the determination of the proposer of the Law to accept and incorporate European experiences in this area. This solution will embrace the tendency of developed countries to issue authorizations according to narrow specialties or professional areas, i.e. authorizations according to what they have studied, thus giving priority to expertise, quality and professionalism. The solution is contained in the mandatory issuance of authorizations based on the professional field.

- Given the importance of the project documentation audit as a separate stage – the most important one, it is incomprehensible that, under Article 108 paragraph 5 and 6, all design engineers are granted this authorization after a certain period of designing, based on undefined criteria. It is unclear why the proposer of the Law elevates the design criteria and degrades the audit criteria. This solution, instead of improving the control of the project documentation, will result in reduced quality. Simply put, the audit process is much more complex and crucial in guiding the preparation of project documentation.

Proposal: In order to eliminate problems with the auditing procedure, the audit authorization must be retained as separate from the design authorization and it should be based on audit-specific criteria.

- The same comment applies to the supervision authorization in Article 108 paragraphs 7 and 8..

Proposal: The same recommendation as for the audit, the supervision authorization must be retained as separate from the design authorization and it should be based on supervision-specific criteria.

- It is necessary to make improvements in terms of introducing amendments to the existing articles in the draft law that specifically refer to the transport infrastructure, as the existing Draft Law only defines them in relation to building construction. One of the most important changes in the law refers to Article 5. This article defines the terms used in the law, but due to the great importance of the transport infrastructure projects for the state, it is necessary to supplement them.

Proposal: Specific definition of the terms reconstruction and rehabilitation of the transport infrastructure facilities - structures, for the following reasons:

- the term reconstruction of the existing transport infrastructure has a different meaning in building construction, since reconstruction of the existing transport infrastructure includes enlargement of traffic infrastructure (roads, streets, parking lots, road stations, railways, railway stations), improvement of access to transport infrastructure, improvement of the geometric elements of the routes in relation to those constructed for higher speed, improvement of the infrastructure's transport capacities, improvement of the traffic safety, improvement of the protection and stability of the existing facilities and drainage structures, improvement of the load capacity of the transport infrastructure components, reduction of the negative impacts on the environment.

- there is also a difference in meaning of the term 'rehabilitation' in the field of building construction, as opposed to transport infrastructure, where rehabilitation of public roads, or overhaul of railways, means construction works for periodic maintenance of infrastructure consisting of the



reconstruction of the constituent elements of the upper structure that are degraded, during the period of operation, to a degree that significantly increases the transport costs of the infrastructure users and/or impairs traffic safety.

- Article 106 paragraph 2 (related to "expert" supervision of aboveground infrastructure facilities performed by architects, where construction professionals are authorized for the design thereof), as well as Article 107 paragraph 2 (related to the control of the construction and site management of aboveground infrastructure facilities performed by architects, where construction professionals are authorized for the design thereof) impose inadmissible overlapping of competences, without defining clearly what those aboveground parts of infrastructural facilities are.

Proposal: To avoid overlapping of competences, i.e. involvement of persons in matters they are not qualified, it is necessary to delete these articles.

- In this context, and probably due to the focus on building construction problems, at numerous places certain professions are unnecessarily and repeatedly mentioned (basic ones, as architecture and construction, then mechanical engineering and electrical engineering), while many key disciplines are neglected (conditionally speaking they are discriminated against), such as engineering geodesy, geotechnics, traffic engineering, energy efficiency and others that are very important for the construction of large infrastructure facilities.

Proposal: In order to avoid unnecessary proceedings before the Constitutional Court due to, conditionally speaking, deprivation of the rights acquired by engineers in geodesy, geotechnics, geology, traffic and other professions, the use of more general terms in the Law is proposed, such as professions participating in construction, whereby the text of the Law will be consolidated without unnecessary repetition of the four professions at multiple places.

Details on the specific task of individual professions can go to a rulebook or by-law. Another option is to further burden the text, i.e. describe in detail what other professions would do as their duty during the construction process..

- Regarding the harmonization with the European legislation, considering the Euro codes are now officially applied as a state standard, if the current version remains, there will be parts the



Law that are not fully harmonized with the EU legislation. For example, in the part of Euro code 7 (regarding geotechnics) there are two separate books: one for design and the other for research, so there is a requirement that, in addition to the geotechnical research report, a geotechnical design (slope stability, foundation, deep construction pits, injection, etc.) should be prepared for many engineering projects. Hence, according to the part on Design, it is required to introduce a Geotechnical design (along with other designs: pavement structure, use and maintenance, etc.). In the area of investigations, it would be good to have a provision on the need for oversight when investigations are conducted.

Proposal: A careful analysis is needed of the parts that are not in line with the EU legislation, especially Euro codes, as well as the compliance of the former with other laws, which would refer to mining facilities, tailing facilities, etc.). Also, there should be precise stipulation defining which projects are necessary (also possible in a separate Rulebook).

- With regard to the Authorization granting procedures – Article 110, according to the proposed provisions most articles display inconsistent positions. The problem of rapid outflow of young staff abroad may be especially difficult, as due to the long procedures, the introduction of the State License Exam (the need for which is not entirely clear, neither is the format of its implementation). Therefore, young engineers would be without a clearly defined status of certified engineer for a long time. In this respect, it is necessary to shorten the deadlines for obtaining authorizations.

Proposal: Corrections should be made to the deadlines for obtaining authorizations. It is necessary to define the criteria and manner of taking the State License Exam and, based on our previous education and the degree obtained at the Faculty of Civil Engineering, it should refer to the knowledge of the legal and technical regulations in the field in which the authorization is granted. In our opinion, a single exam can not provide a correct assessment of the professional knowledge, compared to the 50 exams at the FCE.

In this respect, it is necessary to define carefully the actions related to the State License Examination for engineers who have already obtained authorizations (to be included in the transitional and final provisions).

Also, it is contrary to the principle of lifelong learning and professional development to have

authorizations that are not time-limited, as foreseen in Article 110 paragraph 7. With the proposed retrograde paragraph, every engineer will remain at the graduation level, without acquiring additional knowledge.

We believe that it is necessary for them to be valid within a specified time-frame, during which the principle of perfection will apply, to include attending professional seminars, lectures, congresses, etc. As for the extension of authorization validity, a provision should be inserted regarding mandatory continuing professional development (by gaining CPD points), during the validity period of the authorization.

- With regard to the Chamber of Certified Architects and Certified Engineers, if the position is accepted that there will be separate Chambers for architecture, construction, mechanical engineering, electrical engineering, other professions, etc., a practical question arises – will each of them have a separate Assembly, separate bodies, separate services, etc. This can complicate significantly the Chamber's operations, reduce its efficiency, and its functionality will probably be questionable. In addition, this will give rise to problems with the issuance of Authorizations, difficulties in communicating with the Ministry, etc.

Proposal: The Chamber should remain united, and the manner of its organization by departments should be left to the CCACE to define in its acts or in some by-law. It is also proposed that the current departments of geodesy, geotechnics, traffic engineering, energy efficiency and others be listed in the text of the law, and not to be included in the so-called other professions.



- Article 118 defines separate chambers of the respective engineering professions. According to the professional field of civil engineers, it is necessary to define departments that will represent their interests in the appropriate chamber.
- Article 25 paragraph 2 and Article 114 paragraph 6 and 7, which refers to the special expert review for mechanical resistance, stability and seismic protection.

Proposal: There is no need for a special expert audit based on monopolistic favoring of one institute. Moreover, in the existing legal solution, in order to prevent conflict of interest, the institute that performs this "super-audit" is prohibited from being a designer, auditor, contractor and supervisor. However, this possibility is fully open in the new draft law. That is, the proposal is that the same legal entity can be a project document auditor, and a "super-auditor" thereof, which simply does not make sense, and violates the essence of the special expert audit..

- Article 169, Transitional and final provisions, should provide that the Law's application shall be delayed by at least 6 months, given the serious changes that are introduced with it. If the provision on taking the license exam to obtain authorization remains, it should not apply to persons who have already obtained authorization from the Chamber. Considering that changes are proposed regarding the elected positions at the Chamber, a clarification should be provided in relation to the terms of office of the already elected holders of such positions.
- From the point of view of improvements to the Draft Law, the proposer of the Law should include representatives from relevant individual and institutional stakeholders his team (Faculty of Civil Engineering, Road Association of Macedonia, Chamber of Commerce, CCACE, etc.), so that a mutually acceptable solution is arrived at through multiple expert discussions.



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FROM IDEA TO NEW TECHNOLOGY IN ROAD NOISE PROTECTION

Abstract
In the past 20 years, Croatia has experienced an intensive development of its transport infrastructure. If referring to road infrastructure, then the region is considered, and Croatia leads in the quantity of constructed highways, as confirmed by data from the European Commission. For any modernisation to be successful, it must be closely linked with research and development performed by the scientific community. The Faculty of Civil Engineering – University of Zagreb has been actively involved in all such projects, not only in the process of their creation, but also in the application of innovative solutions and technologies. This paper present successful environmental and innovative product that the Faculty of Civil Engineering - University of Zagreb, in cooperation with its industrial partners, has applied successfully in regular engineering practice. The quality of this product has been recognised by the European Commission through co-financing of environmental programs and innovative products by the EU that have increased European added value and also by the international associations in the field of transport infrastructure, like International Road Federation.

Key words
transport infrastructure, innovation, new technologies, noise protection, RUCONBAR.

INTRODUCTION

Today, we live in a world of digital communications and digital networks. However, life today would be unthinkable without the transport infrastructure, i.e. roads and railways. The changes that are now occurring in this area are happening very quickly, and the reason for this is the increasing use of innovation, new technologies and materials. Selecting certain technologies and innovative solutions leads to a more efficient and faster construction of transport infrastructure, and subsequently of course better quality management. Naturally, these changes are inconceivable without innovative engineers, because only they are able to create something new or make something better. Future social and economic trends will impose new challenges for civil engineers. The role and importance of civil engineers in creating something new is well described in the following view: "It is a great profession. There is the fascination of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standards of living and adds to the comforts of life. That is the engineer's high privilege." Herbert Hoover, President of the United States

When observing the creation of something new, attention should be given to the important fact that there are no innovations and new technologies without cooperation and dissemination of knowledge. Innovation is not only based on the individual knowledge of researchers in narrow fields, but today it incorporates interdisciplinarity and exchanging knowledge and experience. This fact has been recognised particularly in Europe and consequently, cooperation between universities and industry is increasing encouraged, especially cooperation from small and medium enterprises. Here, big companies are not mentioned since they tend to have their own highly developed laboratories, and very often

a department or institute involved in development, which means that they are able to independently commercialise a new product or production process that has been developed. For small companies that also possess a research potential, this becomes much harder to achieve. Nonetheless, cooperation that is scientifically based and which exists in the academic community (universities, institutes), this can be achieved a lot easier since there exists a developed research infrastructure in most countries. Only through such cooperation can a particular sector become competitiveness. However, such cooperation is often difficult to come by in southern and eastern Europe. The reasons can be found in the following:

- Scientists often think that business entities should be the first to approach with their 'problem', which requires solved or with their 'idea' that needs to be further developed.
- Business entities often have an attitude that universities are mainly engaged in the research which provide impractical and inapplicable results.

These attitudes results in distrust, and therefore quite poor cooperation between industry and universities. The reasons for poor cooperation and the lack of trust can be explained by the fact that a very small number of engineers from industry enrol into postgraduate studies organised at universities. If this number were to increase, there would be a greater convergence of the business sector and the academic community, communication would become easier and greater trust would be acquired leading to better teamwork. This scenario could lead to improvements in certain technologies, technological processes, and to the creation of new technologies, new products and innovations. It is precisely this fact that can greatly help in boosting the competitiveness of business entities, which in today's market is most important.

The Department of Transportation Engineering at the Faculty of Civil Engineering in Zagreb has been striving for many years to link the academic community and industry in order to develop innovative products, new materials and technologies in the area of transport infrastructure. When research is conducted, it is necessary to keep in mind that results do happen immediately, but it is often much time-consuming and hard work is required to achieve a specific result and improve a particular process or create a new product. This paper will present an innovative product RUCONBAR - noise protection barriers with recycled rubber added that have been developed under research project RUCONBAR – Rubberised Concrete Noise Barriers funds of the EU CIP ECO-INNOVATION fund.

Absorbing concrete barriers with the addition of recycled rubber called RUCONBAR, were entirely developed at the Faculty of Civil Engineering, University of Zagreb. The whole idea behind the new product occurred at the Department of Transportation Engineering, but product development was done in close collaboration with the Department of Materials. Development, from the idea to the new product lasted about one and half years. After conducting all the necessary laboratory tests, the optimal mix for the new product was obtained and then followed transferring the technology to a company's production facilities for the purpose of manufacturing precast elements. The first samples of the product were produced at the factory, which were then subjected to comprehensive testing, confirming that this is a new, innovative, and in this case, the environmentally friendly product, since it produce from recycled products. In order to obtain verification that it indeed is an environmentally friendly and innovative product, and for it to received encouragement to market the product on the international market, the project was registered for the tender 2010 CIP ECO-INNOVATION. Selection of the project for funding from the EU CIP ECO INNOVATION programme, where the annually only approximately 15-20 % of proposals submitted are co-financed, is a confirmation that this is indeed a valuable environmentally friendly and innovative product.

Initiating the research and discovering something new in this area was driven by the state of the economy. During 2006-2007, the Department of Transportation Engineering at the Faculty of Civil Engineering in Zagreb had already made a similar product for the market (absorbing concrete barriers with expanded clay), which was also a new product in Croatia at the time. The product was then, completely accepted by the profession after only two years, and quickly took approximately 50 % of the market for noise protection barriers, Figure 1. The figure shows the percentage of types of noise protection barriers in use in Croatia after the introduction of absorbing concrete barriers with expanded clay to the market. Prior to this period, this type of barrier did not exist on the Croatian market.

This experience relating to the commercialisation of the product has helped in developing the environmentally friendly and innovative RUCONBAR barrier. The

development of the RUCONBAR barriers and its commercialising sought different requirements on the Croatian market for this product, so it was necessary to prepare the product for much wider market acceptance. The construction of road infrastructure in Croatia in 2011 was at an end, with the railway infrastructure sector only beginning to awaken. The situation on the market indicated to us that we had to find an appropriate way to commercialise a completely new product and find a way to make it distinctive and interesting for the market, especially the regional market. This was the development team's goal, to find the appropriate EU fund for branding the product and facilitating its commercialisation.

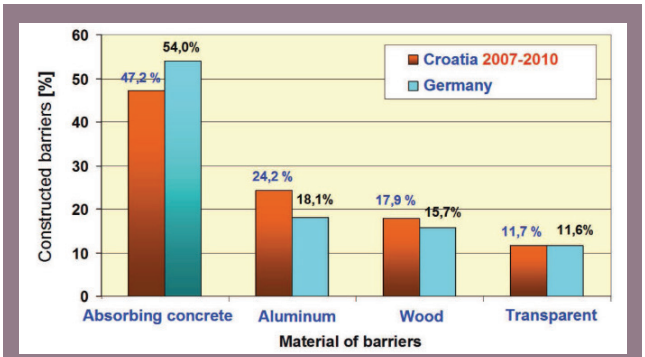


Figure 1. Percentage of the type of particular noise protection barriers on motorways in Croatia after 2007

Since this was an innovative and environmentally friendly product, the decision was made to apply to the CIP ECO-INNOVATION programme. When applying for this EU programme, besides the product being environmentally friendly, innovative, replicative and able to provide European added value, which is the case for the RUCONBAR product, when preparing for the EU project we prepared the material very carefully in order to answers several important facts:

a) Why should the EU Commission allocate funds for co-financing the proposed RUCONBAR product?
b) What makes the RUCONOBAR product stand out and what makes it different?
c) How will the project become recognisable in a large group of projects from many major EU countries?
d) How will the completely new product be commercialised on the international market.

To register at all for the tender against a large number of projects coming from EU member states, the RUCONBAR project had to be different. The next step was systematic preparation of the tender documentation in order to obtain a well defined, clear, interesting, easy to understand project possessing a good vision and purpose. With the vision defined, the required path was determined: obtaining finance from the EU funds, improving the quality of the manufacturing plant and systematic work on the market. This implies a good market analysis, identification of any problems and obstacles that can occur when commercialising new products, answering the question of why would the market want this new product, analysing how to confront a competitive product(s) , in what ways is our product better and more competitive. When looking at the product RUCONBAR, 21 countries are already interested in the stated product, providing proof that you can create a distinctive EU product. It is important to keep in mind one thing when referring to product innovation and new technologies: innovation without application in business is useless.

As noted previously, the Department of Transportation Engineering at the Faculty of Civil Engineering in Zagreb in 2006/2007 with industrial partner, developed absorbent noise protection concrete barriers. This product, which was then a completely brand new product in Croatia, had the absorbing barrier layer made from expanded clay (Fig. 2).

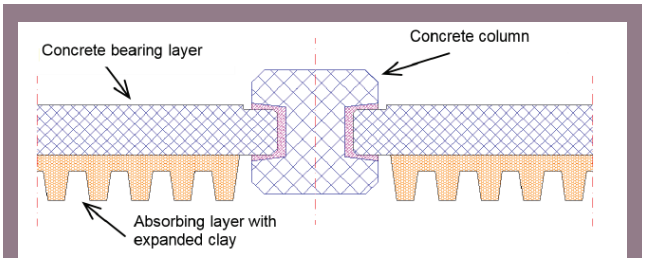


Figure 2. Cross-section of the absorbing concrete panel and bearing column

After the first use of the product on the test section and complete laboratory and field tests, market penetration began. In the beginning, this was very difficult. Since most infrastructure projects were in areas exposed to strong hurricane gusts, the proposed concrete barrier due to their greater weight and stability, proved to be the optimal solution. It was also aided by the fact that it was an entirely domestic product. Figure 3 shows the first absorbing concrete barrier in Croatia.



Figure 3. Absorbing concrete barrier at the entry to the City of Zadar (2007), [1]

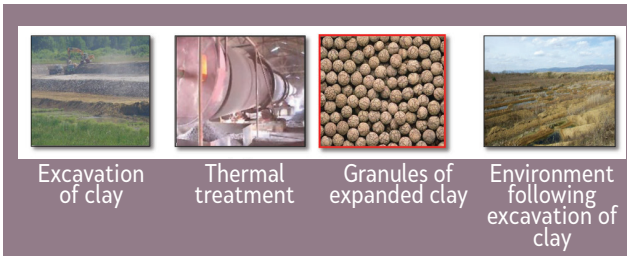


Figure 4. Process of producing expanded clay

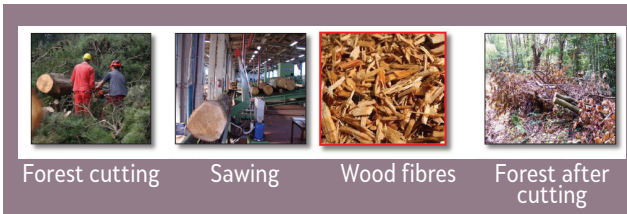


Figure 5. Process of producing wood fibres

By obtaining a stable barrier with the necessary absorptive properties, the product was ensured a rapid success on the market and already next year (2008) it was fully in use on the Split-Ploče motorway and the Šestanovac-Zagvozd and Zagvozd-Ravča sections. The corresponding sections had a total of approximately 15,000 m2 of noise protection barriers installed, ensuring the product's primacy on the market, as shown in Figure 1. Very quickly, other designers began fully implementation of the noise protection solutions by applying absorbent concrete barriers.

The important element in absorbent concrete barrier is primarily the absorbent layer made of a porous lightweight concrete. The first products that were marketed, as shown in Figure 2, were made of lightweight concrete with expanded clay granules that were imported. Since two Croatian companies had already adopted the production of these barriers, the desire was to produce the stated part of barriers from local materials. Today, manufacturers of absorbing noise protection concrete barrier use two materials, expanded clay and wood fibres. Were the production of these materials commenced in Croatia, it would not be in line with sustainable development. Namely, the production of expanded clay requires the excavation of clay in the environment, followed by thermal treatment to form the required granules for the production of lightweight concrete. Besides the irrecoverable consumption of natural resources for the production of expanded clay granules, it creates a stripped and devastated environment (Figure 4). Another material used for the production of porous lightweight concrete is wood fibres. The lack of such barriers is also an exploitation of natural resources, forests, for the purpose of producing the absorbent layer, Figure 5.

Due to these shortcomings in existing solutions for concrete barriers, the Faculty of Civil Engineering at the University of Zagreb continued its research into the field of noise protection for developing solutions compliant with sustainable development. The goal was to find a material for the production of lightweight concrete, which would have the appropriate absorption properties. The new material posed a number of requirements for its production and use in a new product:

a) That it be produced from recycled waste
b) That the waste to be recycled is found on roadways
c) That it contributes to waste management
d) That its application produces an environmentally friendly product,
e) That sustainable production is achievable,
f) That work be done on innovative products
e) That a completely domestic product be obtained..

To respond to such demands placed at the start of developing new products is not simple. The development of the barrier RUCONBAR commenced from the first presumptions, and that is, that the absorbing lightweight concrete be produced from materials obtained from recycling waste found on roadways. The analysis of transport equipment and transport infrastructure confirmed the assumption that the recycling of used tires

can provide granules for the production of lightweight concrete, Figure 6.

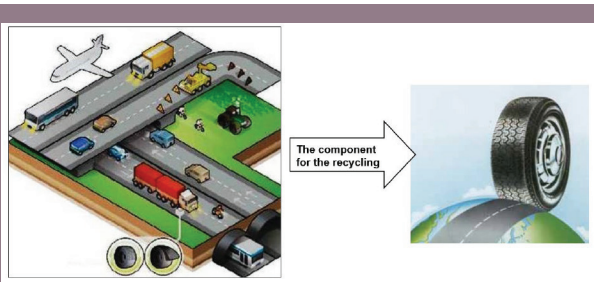


Figure 6. Transport resources and transport infrastructure – seeking suitable components for recycling following its lifetime of use

The use of tires in concrete was done before. There are studies that have dealt with the application of rubber in concrete, but from the point of view of improving the mechanical properties. Data and information on the use of recycled rubber for the production of concrete mixes for achieving absorption properties was not previously investigated. This fact prompted the development team at the Faculty of Civil Engineering in Zagreb to focus research into these new materials in this direction. A test program was defined in order to obtain an optimum mixture that would fully meet the set requirement, i.e. to obtain a lightweight concrete with the addition of recycled rubber that has absorptive properties. In addition to absorption properties, also investigated were other mechanical properties such as strength, fire resistance, freezing/thawing, compressive strength, tensile, impact resistance.

During research, most of the attention was given to the fact whether it was possible to improve or reduce certain mechanical properties of concrete, which contains in its composition a certain percentage of rubber granules. Another important piece of information that was to be kept in mind was that if satisfactory properties of lightweight concrete were obtained, and whether there are enough of used tires on the market from which to obtain the necessary raw materials. If taking into consideration the used tires sector, then about 12% of used tires are used for the retreading purposes, 54% are recycled in the form of rubber granules, and the remaining are used for burning in cement making facilities and recycled in the form of rubber thread, rubber powder and some other specially requested products. Furthermore, this innovative product does not only allow noise protection, but contributes to the disposal and management of waste tires in an appropriate, effective, innovative and economically efficient manner - with the development of new products. if we consider the barriers RUCONBAR in terms of sustainable development, then this innovative product is environmentally acceptable since waste tires creates a value added product, and also contribute to a cleaner environment (Figure 7).



Figure 7. The process of producing rubber granules – from a polluted to a clean environment

RUCONBAR contains in the structure of its absorbent layer 40 % rubber granules (Figure 8), obtained by recycling waste tyres and as such represents an innovative solution to the production of noise protection barriers. A patent has been taken out for the product at the State Intellectual Property Office of the Republic of Croatian (P20100483A) and the trademark (Figure 9).

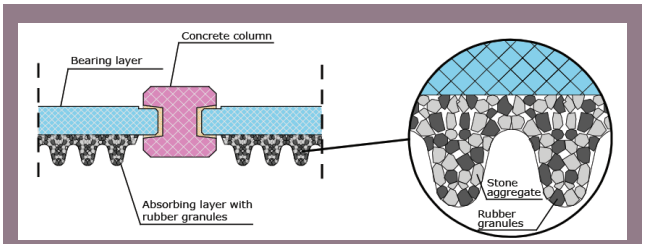


Figure 8. Cross-section of the innovative solution – RUCONBAR noise protection barrier

RUCONBAR
Rubberised Concrete Noise Barriers

Figure 9. Visual mark for the product RUCONBAR, [2]

According to data [3, 4], only 5 % of waste tires are uncontrollably disposed of in Western Europe, whereas in the area of the new member states and candidate countries 29 % of the resulting waste tires about 450 000 t, or about 42.5 million units) are uncontrollably disposed of, Figure 10. According to Directive 1999/31/EC as of 2006, any kind of disposal of waste tires in the environment is completely prohibited; hence, this decision has brought about an increase in the available quantity of waste tires used for recycling. This is the answer to the question of whether we have a sufficient amount of this type of waste for the production of rubber granules and what is the potential market for these barriers. These facts are rightly the reason for the high interest in this product. Two environmental components are related, noise protection, which is achieved with the product and the manufacturing of products with recycled material, whereby we have prevented its unauthorized disposal into the environment. A great interest in barrier RUCONBAR is currently expressed in the following countries: Bosnia and Herzegovina, Slovenia, Serbia, Romania, Lithuania, Bulgaria, Australia, Canada, Switzerland, India, Ukraine, Qatar, Turkey, France, Iran, Russia, USA, Canada, Germany, Hungary. Agreements on the transfer of technology with some companies are in the phase of being signed.

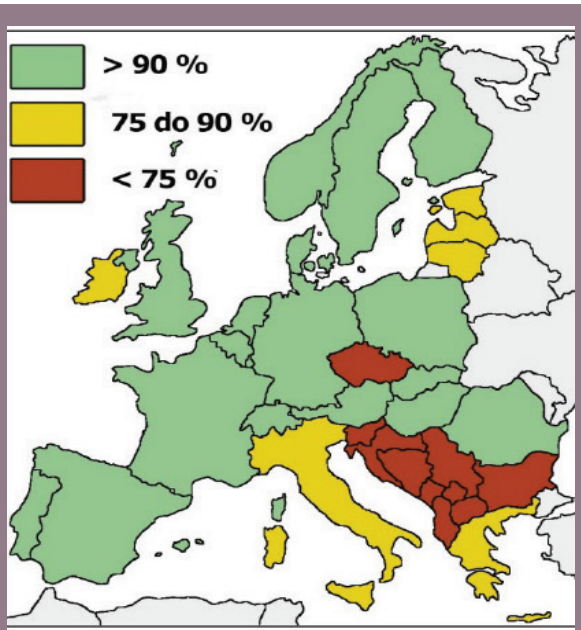


Figure 10. Percentage of recycling waste tyres in the area of Europe [3, 4]

FIRST APPLICATION OF THE RUCONBAR NOISE PROTECTION BARRIER

Given that the developed barrier meets the requirements relating to the reduction of noise levels set governed regulations and standards, each innovative solution seeks also a first application. Selecting the first application for any product is always the hardest. Since the Department of Transportation Engineering at the Faculty of Civil Engineering in Zagreb conducted a large number of surveys, and a large number of main and detailed design projects on noise protection, finding the first applications was somewhat easier. The settlement of Skot was chosen for the first noise protection application, near the toll station on the Krk Bridge. The stated application will be co-financed from the EU RUCONBAR project. To facilitate selection of a visual solution for the stated barriers, and its position illustrated in space, the first application of RUCONBAR noise barriers (Figure 11).



Figure 11. First application of RUCONBAR noise barriers on road section (noise road protection of the settlement Skot)

The first application of this novel innovative noise protection barrier was made on a road section near toll booths for Krk Bridge in Croatia. Following this example, RUCONBAR walls are being constructed on different road and railway sections.

Application of the RUCONBAR barriers was also realized at the Croatian Railways network. The first application of this innovative noise protection barrier was made on Perušić-Gračac railway line, Figure 12. Application of the RUCONBAR barrier on a railway line is interesting since this is a first noise protection implemented along a railway line in Croatia and on account of announced major investments in the future of this sector in the Republic of Croatia.



Figure 12. First application of RUCONBAR noise barriers on railways line (noise protection of the settlement near railways station Gospić)

INTERNATIONAL RECOGNITION OF THE INNOVATIVE PRODUCT RUCONBAR

The simple design makes absorbent concrete barriers a very practical application not only for new roadways (road or railway lines) but also along existing roads. It is actually the area of existing roads that the issue of noise protection is being increasingly investigated. If we consider current practice in Croatia, then noise protection is applied only to new highway sections. However, existing motorways should not be forgotten. In fact, many sections of motorways in Croatia were constructed 30 years ago or more, and in some parts of these roads there are frequent complaints from the local population relating to increased noise due to an increase in the number of vehicles. A particular application of this kind of barrier can be found in urban areas, where its ease and speed of construction but also very simple possibility architecture make it appealing. Application of the RUCONBAR noise protection barrier is very practical for aesthetic, economic and architectural reasons. Using a product made from recycled type waste in the absorption layer helps protect the environment by solving the problem of disposing of tyre waste, the consumption of natural resources, and compared with similar solutions reduces CO2 emissions and the actual price of ready-made barriers. These benefits were anticipated by the EACI Commission (European Agency for Competitiveness and Innovation) which accepted the project RUCONBAR for financing through EU funds based on the 2010 ECO-INNOVATION tender. Project RUCONBAR and its final product – the noise barrier – have been widely recognized as an excellent example of academic-professional cooperation to tackle major environmental challenges. This has been acknowledged by:

- ARCA 2012, 10th International innovation exhibition - Grand prix (Zagreb, Croatia, 2012)
- GREENOVATION Award for best technology of Croatian green business (Croatia, 2012)
- CEMEX – Building award 2015 (Sustainable building) - Noise protection of settlement Scott near toll stop for Krk Island (Croatia, 2015)
- Inventions Geneva 2016 – Golden medal with the congratulations of the jury (Geneva, Switzerland, 2016)
- Innova 2016 - Golden medal with the congratulations of the jury (Brussels, Belgium, 2016)
- Silicon Valley International Invention Festival 2018 – Silver medal (Santa Clara, USA, 2018)
- IRF Global Road Achievement Award 2018 in category "Research" (Las Vegas, USA, 2018), Figure 13
- RailTech 2019 Innovation Award in category "Infrastructure" (Utrecht, Netherlands, 2019), Figure 14.

The Awards are recognized as a prestigious industry accolade in their own right, but they also serve to remind a much wider audience that the mobility everyone takes for granted would not be possible without the talent and commitment of our industry. Faculty of Civil Engineering University of Zagreb now joins an elite group of scientific institutions whose exemplary projects have been recognized by their peers for their excellence, innovation, and societal impacts [5]. This project and innovation will continue serving as a model and inspiration for others in the road and transport secto0r.



Figure 13. Crystal Globe for RUCONBAR in category "Research", IRF Global Road Achievement Award 2018



Figure 14. RailTech 2019 Innovation Award for RUCONBAR in category "Infrastructure"

CONCLUSION

The economic development of a country is inconceivable without a properly developed transport infrastructure. In Croatia, intensive work on the construction of road infrastructure was carried out in the previous period, while very little attention was given to railway infrastructure. Today, all attention of builders is focused on the construction and modernisation of the railway infrastructure. Industry activities in both sectors of the Department of Transportation Engineering have been successfully monitoring this and through participation in a number of preliminary, main and detailed design projects and supervision of construction and testing of materials. A significant step forward has been made in developing new products and technologies which are recognised by the profession and which are increasingly find their place in daily engineering practice. The reason for this is the fact that most of the innovative products developed in collaboration with industry certainly facilitate market penetration. The direction in which today new trends move in the field of transport infrastructure is certainly the use of new products and technologies that contain a certain proportion of recycled material and in turn contribute positively to waste management, and thereby protection of the environment.

The innovative product RUCONBAR is designed to be replicable on any market in need of end-of-life tire recycling and quality noise protection on road and railway infrastructure. Technology transfer has been ensured through prepared procedures for production plant assembly and staff training documentation.

RUCONBAR concept is an economical, easy to implement, and environmentally sound noise protection solution. For orientation, 46.4 t of recycled rubber granules, obtained by recycling 7.800 waste car tires, can be used for manufacturing 1 kilometer of noise barriers 3 m in height (3,000 square meters of barriers). Major environmental benefits of using RUCONBAR are:

- 31% reduction in GHG emissions compared to similar solutions available on the market,
- reduced consumption of non-renewable resources (gravel or crushed stones, natural clay and tree felling),
- protection of natural environment against uncontrolled clay excavation and tree felling practices,
- recycling end-of-life car tires.

Desired sound absorption properties can be achieved by varying the thickness and shape of absorbing layer of the noise protection panel. Absorption properties have been tested according to HRN EN ISO 354 and HRN EN 1793-1. Class of A2 and A3 is expected for standard applications of

RUCONBAR. Class A1 can be achieved for special purpose applications. Aside from noise mitigation properties, product certification and compliance has been established through rigorous testing resulting in CE label (Conformite Europenne) issued by Notified Body in 2014.

Innovative and environmentally friendly concept of Ruconbar is applicable in all EU and beyond but it is most applicable in those countries that have need for waste tyres management and demand for noise protection barriers due to underdeveloped traffic infrastructure. With the introduction of EU Directive in SEE, which bans landfilling of whole (July 2003) and shredded (July 2006) tyres, it is clear that there is need to increase recycling capacities and develop markets for utilising recycled tyres. Ruconbar provides an opportunity to accelerate transit and adoption period of SEE countries and reduce the gap between them and other EU countries in the field of noise pollution and waste tyres management, [3]. Ruconbar production in each country of these contributes jointly to the implementation of the Waste Management which yields significant ecological benefits in reduction of noise pollution and waste tyres disposal.

AUTHOR'S NOTE

Овој труд е заснован на ракописот подготвен за поглавје во книгата Идни трендови во градежништвото (уред. Церић, А., Лакушић, С.), Загреб, 2014. Поради важноста на опфатената тема, поглавјето од книгата беше издвоено за целите на овој меѓународен конференциски настан, во скратена форма и поврзано со истражувањето спроведено на Градежниот факултет во Загреб, сè со цел да се овозможи подобра меѓународна промоција на истражувањето презентирано во трудот.

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INFLUENCE OF HIGH TEMPERATURES ON THE ASPHALT LAYERS OF THE ROAD CONSTRUCTIONS IN THE CITY OF SKOPJE

Апстракт

Коловозните конструкции на патиштата како дел од патната мрежа, претставуваат најскап и најекспониран дел од патот од кој зависи комфорот и безбедноста при возење, како и времето потрошено во патување, но исто така индиректно зависи и големината на вкупните трошоци предвидени за транспорт. Во Македонија има појава на голем температурен распон во текот на една година, за кој слободно може да се каже дека се достига и повеќе од 60°C. Затоа од големо значење е изборот на соодветен тип на асфалтна мешавина, односно тип на битумен кој ќе даде адекватен одговор на овие температурни разлики со што би се продолжил периодот до наредна рехабилитација и би се оптимизирале вложените финансиски средства во патната инфраструктура. Според извршените мерења и анализираните податоци, за регионот на град Скопје, е дефинирана само максималната температура на примена на битуменот, бидејќи се разгледувани само максималните температури.

Клучни зборови

асфалтна мешавина, битумен, коловозна конструкција, максимални температури.

Abstract

The pavement structures of roads, as part of the road network, represent the most expensive and most exposed part of the road from which depends the comfort and safety of driving, time spent on travel, but also the size of the total costs for transport that is also indirectly dependent. In the Republic of North Macedonia there is a large temperature range over the year, which can be said that reaches more than 60°C. Therefore, it is of great importance to choose the appropriate type of asphalt mix, ie the type of bitumen that will give an adequate response to these temperature differences, that would extend the period to subsequent rehabilitation and optimize the financial resources invested in road infrastructure. According to the performed measurements and analyzed data, for the region of Skopje, only the maximum bitumen application temperature is defined, because only the maximum temperatures are considered.

Key words

Asphalt mixture, bitumen, road construction, maximal temperatures.

1. INTRODUCTION

The developed road network enables mobility of the population and socio-economic development of the society, and thus development of the whole country. Starting from this point of view and knowing the fact that road structures are the most expensive and most exposed part of the road, it is extremely important that the quality and condition of the structures on a road network be at the highest possible level, because they directly affect the comfort and safety of driving, speed and travel time, but also indirectly affect the size of total transport costs.

In Macedonia, almost 90% of the traffic transport takes place on the roads, where the application of flexible road constructions dominates, on which, according to the obtained results from the measurement of the indicators of the road conditions, the occurrence of rutting has been determined. This phenomenon occurs as a result of plastic deformations in the asphalt layers,

especially at the final layer. The appearance of rutting (plastic deformations) is correlated with the size of the traffic load, the geometric elements of the road, and the climatic conditions of the micro-location of the route have a particularly negative impact.

Macedonia stretches in the central part of the Balkan Peninsula and on its territory there are several climatic types, such as modified - Mediterranean, temperate - continental and mountain climate. Temperatures in this area in summer are quite high, even above 40°C, while in winter due to the penetration of cold air masses from the north they drop more than 20°C below zero. From here, it can be concluded that the temperature range in RN Macedonia ranges from 60 - 80°C.

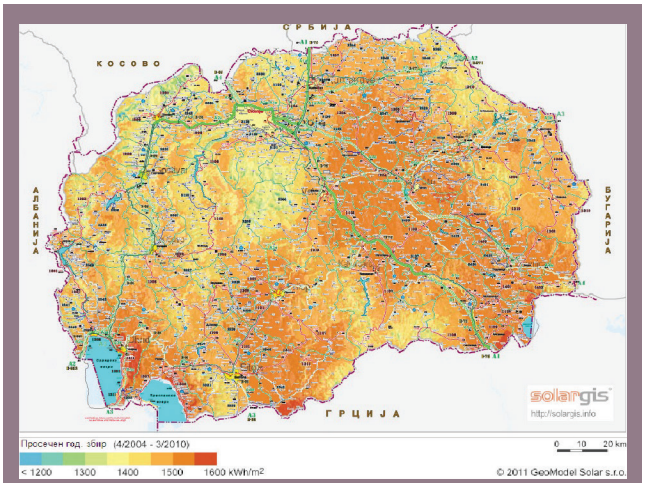


Figure 1.1 Overlay of the road and heat map of Macedonia [1]

This large temperature difference that occurs in a period of one year indicates a serious scientific and studio approach in choosing the appropriate asphalt mixture that will give an adequate response to these temperature influences for both low and high temperatures, without causing damage which will disorder driving safety and comfort.

When choosing adequate asphalt mixture, most of the variations can be made with the bitumen binder. Low temperatures require the application of softer bitumens, while high temperatures have opposite requirements, they require the application of certificated bitumen. Due to the specific climatic conditions in our country, there is a need to solve this complex task that will answer these two utterly extreme cases. The solution points to the application of a certain bitumen modifier that will change and improve the characteristics of conventional bitumen and will expand its temperature range of application.

2. HIGH TEMPERATURES IMPACT

Temperature oscillations both during the day and during the year cause variable effects on the road construction. When it comes to the effects of high temperatures, a special problem is the determination of the thermal regime inside the road construction, which occurs as a consequence of the action of internal and external factors. Internal factors are considered as constant, while external factors depend on the climatic conditions of the geographical location where the road structure is built.

When the temperature changes, the physical-mechanical properties of the asphalt mixtures change significantly, because the bituminous binder from a rigid elastic condition at low temperatures, through a high-elastic condition comes to a viscous condition at high temperatures. In order to be able to determine the sensitivity of the asphalt mixture to the effects of temperature, in addition to know the physical - mechanical properties of materials, known microclimatic conditions of the environment where the section passes and traffic load, it is necessary to know the process of transfer and retention of temperatures in the layers themselves.

The road construction, in space, is a physical body that receives and emits heat. Once the black surface of the pavement receives the heat, it further penetrates down into the layers and is retained for some time. Fourier's law is used to describe this process of amount of heat received and emitted.

The following characteristics of the materials have a significant impact on the temperature transfer through the layers of the road construction:

- Specific heat capacity per unit volume;
- Thermal conductivity for different layers;
- Coefficient of solar reflection from the surface of the asphalt layers;
- Initial temperature of the asphalt layers and the road bed and
- Bottom temperature of bonded layers. [2]

The temperature profile of the asphalt road is directly influenced by the thermal conditions of the environment. Apart from the characteristics of the materials, the change of temperature in the road construction is influenced by other factors such as:

- Ambient temperature;
- Solar radiation;
- Surface reflectivity;
- Wind speed and
- Relative humidity in the construction. [3]]

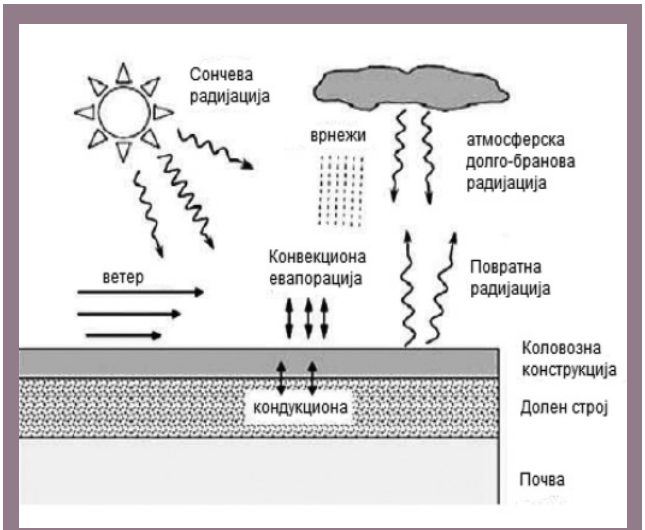


Figure 2.1. Factors affecting pavement's temperature change

3. EXPERIMENTAL PART

3.1 WORLDWIDE RESEARCHES

The effect of heat through the layers of road construction has been investigated by numerous researchers: Barber was the first to raise the issue of calculating high road temperatures based on weather reports, Rumny and Jimenez developed a road temperature prediction nomograph, Dempsy developed a simulation model based on the theory of thermal conductivity and energy balance on the road surface, Strategic Highway Research Program (SHRP) whose end result of the SMA research, is the creation of the SUPERPAVE method for designing asphalt layers based on expected minimum air temperatures and maximum seven-day average road temperature, Mohseny, Symons, Lukanen and Bosscher have analyzed the accuracy of the models created so far, Park and Marshal create an empirically based model that allows the calculation of the temperature profile inside the road construction for any period of the day, Liao created a model for predicting temperatures for highways in Taiwan, Matic formulated a new model for predicting maximum temperatures on the surface of road structures in Serbia, using a regression equation conditioned by ambient temperature, etc. [4-11]

3.2 RESEARCH IMPLEMENTED IN RN MACEDONIA

For the needs of this work, temperature measurements were made on a representative section in the city of Skopje, a city street that has the highest traffic load. The micro-location of the test section is on the boulevard "Partizanski Odredi", at the bus stop before the intersection with the boulevard "8th of September", on the street with direction of movement to the west, shown in Figure 3.1.

The temperature measurements were performed in the warmest period of the day, ie from 6 p.m. until 7 p.m. In that period, five readings of the temperature were performed, ie every 3 hours, only one day is an exception when the readings were performed in one hour, ie eight readings were made. The temperature was read with the instrument, TYPE "testo 922", which also measured the temperature of the asphalt surface, while the instrument TYPE "HANNA HI-9565" determined the ambient temperature and humidity.

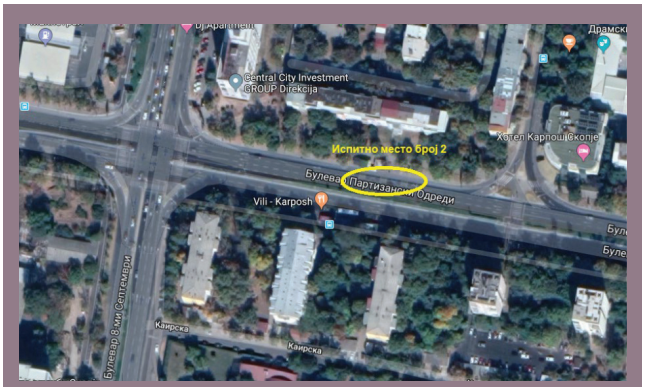


Figure 3.1. Exact location of the experimental section

In order to obtain the thicknesses of the asphalt layers of the road construction, as well as the depths at which the boreholes should be made, asphalt samples were taken from the test section. After determining the thickness of the layers and in accordance with the Superpave method, three boreholes were made in the field at 2 cm below the surface of each asphalt layer, as shown in Figure 3.3.



Figure 3.2. Data reading, according to the Superpave method

The boreholes are made the day before the measurement is started, with a drill Ø8 mm, an opening through which the probe is sufficient to pass, and yet the influence from the outside is minimized. To achieve this and prevent the wells from filling up, they are closed with a thick sponge, which is taken out during the measurement, and then returned to the place after each reading. The read data are written in a table respectively for each hour and day of measurement and it is then processed by computer.

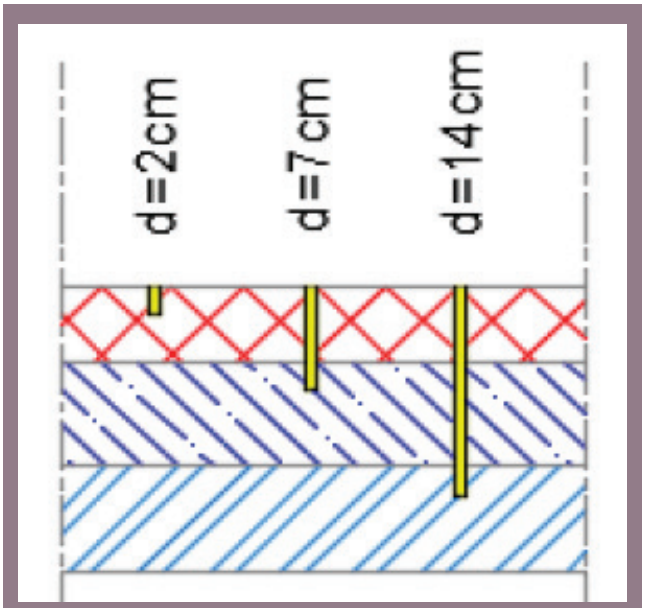


Figure 3.3. Cross section of measuring depths

In parallel with the direct on-site measurements, in order to make an analysis of the road temperature, other multi-day meteorological data are needed, which are shown in the following table.

Table 3.1. Average annual temperatures for the last five years [12]

Year		2013	2014	2015	2016	2017
Temperature (°C)	Maximum	26	25.6	26.6	27.5	28
	Average	12	13	13	12	12.5
	Minimal	0	0.8	-0.8	-0.5	-2.3

The measurements were performed during 7 days, in the period from 5.8.2017 until 11.8.2017 with five measurements each, except day 6 when eight measurements were performed during the day. The obtained data are presented tabular and graphical, respectively by day of measurement, with a display only of the maximum temperatures of all 7 days of measurement.

Table 3.2 Measured maximum temperatures

Date	Air	Surface	2 cm	7 cm	14 cm
05.08.2017	42.90	57.20	58.50	56.30	52.20
06.08.2017	41.60	57.80	59.30	57.50	52.90
07.08.2017	40.60	52.90	54.80	51.80	48.30
08.08.2017	39.30	54.80	54.40	51.40	47.20
09.08.2017	41.40	52.30	53.80	51.80	47.80
10.08.2017	44.00	55.20	57.70	50.40	47.70
11.08.2017	39.20	50.40	52.50	47.60	44.90

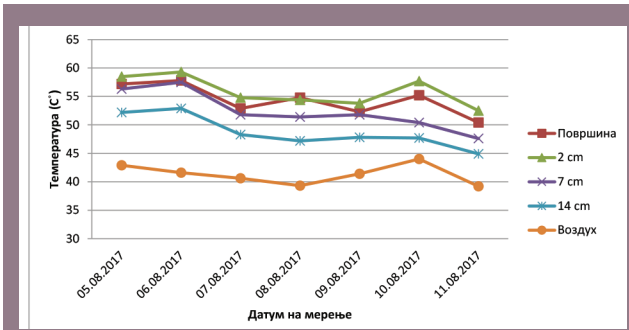


Figure 3.4 Graphic chat of measured maximum temperatures

3.3. PAVEMENT TEMPERATURE PREDICTION MODELS

Determination of road temperature can be done simply by direct measurement or can be calculated using models that take into account air temperature and other environmental factors. The search for the most suitable model that will answer requirements is a perennial issue that many engineers in this field work on.

The calculation of the temperature of the road surface, using the Superpave method, based on the air temperature is by calculating the 7-day maximum temperature of the road surface in the temperature of the road surface, calculating the 7-day maximum temperature of a certain depth, calculation of the minimum air temperature in the minimum temperature of the road surface and calculation of the minimum road temperature at a certain depth. The average 7-day maximum road temperature is an average of the highest road temperatures for the 7 warmest consecutive days of the year. The lowest annual road temperature is the coldest temperature in the year.

The projected depth for calculating the maximum road temperature used according to The Superpave method is 20 mm below the surface of the asphalt layer being analyzed.

Huber developed a simpler model for calculating the maximum road surface temperature, which follows: [13]

$$T_{s\,(max)} = T_{a\,(max)} - 0.00618 \times \Phi^2 + 0.2289 \times \Phi + 24.38 \quad (3.1)$$

Каде што:

$T_{s\,(max)}$ = maximum daily surface temperature (^{0}C);

$T_{a\,(max)}$ = maximum daily air temperature (^{0}C) and

Φ = latitude of the desired location (degrees).

The following equation calculates the maximum temperature when the analyzed depth is known and follows:

$$T_{pav\,(max)} = T_{s\,(max)} \times (1 - 0.063 \times d^2 - 0.007 \times d^3) \quad (3.2)$$

Where:

$T_{pav\,(max)}$ = maximum road temperature at depth (^{0}F);

$T_{s\,(max)}$ = maximum road surface temperature(^{0}F) and

d= depth below the surface (cm).

3.4. BETWEEN PREDICTED AND MEASURED PAVEMENT TEMPERATURES

Based on the previously studied literature and the conclusions from previous researches, as the most suitable model for temperature prediction are taken equations mentioned above and according to them the temperatures in all points are calculated, ie the depths at which measurements have already been made. The values for the maximum air temperature are taken from the meteorological data and are applied to replace the ambient temperature.

After obtaining the values for the calculated temperatures, a comparison of the calculated and measured temperatures for the same depth of measurement was performed. The results are shown graphically in the following Figure 3.5., Where the darker shade of the color shows the measured data, while the lighter shade shows the prediction values.

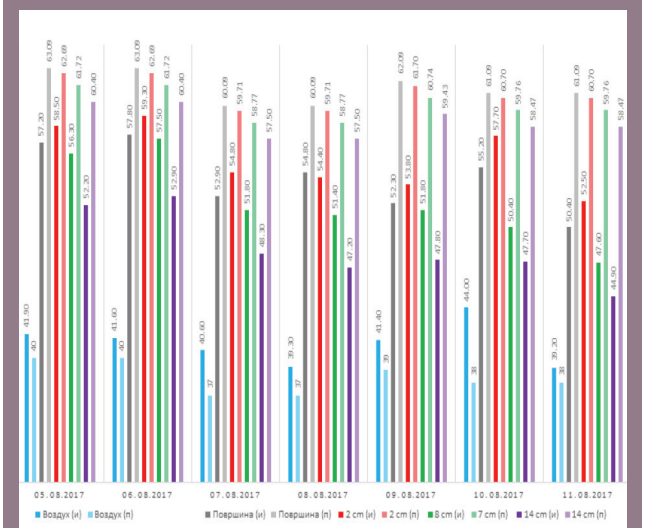


Figure 3.5. Comparison of predicted and measured maximum temperatures

CONCLUSIONS AND RECOMMENDATIONS

From everything presented in this work, it can be concluded that the bituminous binder in flexible road structures has a great importance for the quality of road structures, as well as their long-term exploitation. The choice of the appropriate type of binder is highly dependent on the different climatic regions and must have appropriate treatment, because the impact of high and low temperatures is crucial for the longevity and quality of pavement construction.

From this we can conclude the following:

1. As a result of these influences and taking into account that the heat is easily absorbed into the black surface of the asphalt, it is extremely important to emphasize that **the surface temperature of the pavement is higher than the air temperature**.
2. From the measured data in situ, it can be concluded that the highest, ie the maximum temperatures occur in the final layer, 2 cm below the surface of the road construction. The same can be concluded from the prediction data.
3. Further penetration of heat in the next layers of the pavement construction occurs with a certain time delay in terms of reaching the maximum temperature of the final layer. This means that as the depth of the pavement increases, so does the temperature.
4. According to the performed measurements and analyzed data in accordance with the SuperPave method, for the region of the city of Skopje in which the sub-Mediterranean climate prevails, it is recommended to apply a bonding agent PmB marked PG 58-y. Because in this work only the maximum temperatures are analyzed, only the first value of the mark can be defined, while to determine the second value - the minimum temperatures, can be the subject of another research. For other climatic regions in Macedonia, it is proposed to perform similar tests, in order to define the maximum temperature and the appropriate choice of the binder.

From the presented general conclusions, the following recommendations can emerge, which will contribute to the improvement of the road management on the road network in Macedonia and the City of Skopje, as follows:

- even in the design phase, to provide locations where mini meteorological stations will be set up to measure air temperature and humidity, wind speed, amount of precipitation, etc.
- also, during the design, to define micro-locations where the most modern types of probes will be placed in the layers of the road construction, in order to continuously monitor the temperature throughout the year.

The implementation of these proposed measures will contribute to the establishment of a database within the Road Management System and will provide a studious and modern scientific approach, which will allow changing the current intuitive approach in sizing new and rehabilitating existing roads. constructions, as well as appropriate selection of materials for their composition.



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EXPERIMENTAL RESEARCH ON THE EFFECTS OF GEOGRIDS IMPROVEMENT

Abstract
The introduction of geosynthetics as building materials, lightweight and standardized for production and use, has recently become very commonly used in engineering practice. This paper presents the results of experimental research to determine the load-bearing capacity of a shallow, massive, circular foundation based on a natural soft ground, improved material substitution foundation and reinforced foundation with geogrids. The comparison of the results indicates that the strengthened geogrid system has the highest load-bearing capacity and the lowest subsidence, which makes it the most respectable compared to other methods, and at the same time environmentally justified.

Key words
Foundation, Reinforced Earth, Geogrids, Geotextiles, material replacement.

INTRODUCTION

Very often engineers are faced with the construction of buildings in locations that are unfavorable from a geotechnical point of view, i.e. locations built of powerful deposits on poorly bearing coherent soils. In such conditions, it is necessary to apply certain methods for technical improvement, in order to ensure sufficient bearing capacity, and to reduce the total and differential settlement within the prescribed tolerance limits. The tests and application of the reinforcement method, known as reinforced earth, gave positive results. In different parts of the world there are buildings with great heights and durability. The concept of reinforced earth is not new, the basic principles are illustrated with many examples in engineering.

Basically, the improvement is achieved through two mechanisms: by replacing the material and strengthening with geogrids to accept the tensile



Figure 1. Comparative application and effects of the reinforcement method.

stresses. This technique has been used around the world for a long time, but unfortunately it is still rarely used in our country. Figure 1. shows the effect of geogrids.

This method allows efficient isolation - separation of terrestrial materials with different granulometric composition - fine-grained soils and coarse-grained gravel or crushed stone.

PHYSICAL METHODS AND OUTCOME RESULTS

In this research, an attempt was made to understand the effect of improving weak bearing soil with geosynthetics. This effect is obtained through experimental measurements of physical models. Using the possibility of controlled modeling of the soil substrate with quite high reliability, the soil capacity and subsidence of shallow circular foundation (D = H = 30cm) are analyzed as a physical model that simulates a osymmetric state of stress and deformation. For this experiment, a model of a steel cylinder with a diameter of 1.9 m and a height of 1.5 m was made, in which



Figure 2.
Model preparation and testing

the natural material is incorporated. (Figure 2).

To see the effect of the improvement with geogrids, three experiments were performed: a model of natural low bearing (SNP) foundation, a model of a foundation base where the replacement of the surface layer with better characteristics was performed- sand cushion (PP) and a model of a foundation, in which geogrids and reinforced earth (PP + GM) are additionally installed.

The first experiment concerns a test load on a foundation based on a low bearing ground (SNP). Loads of 25, 50, 75, 100, 125, 150, 175, 200, 225, 250 and 300 kPa are applied during the test. Figure 4 presents the results obtained from the experimental tests in the form of load - settlement and time - settlement diagrams.

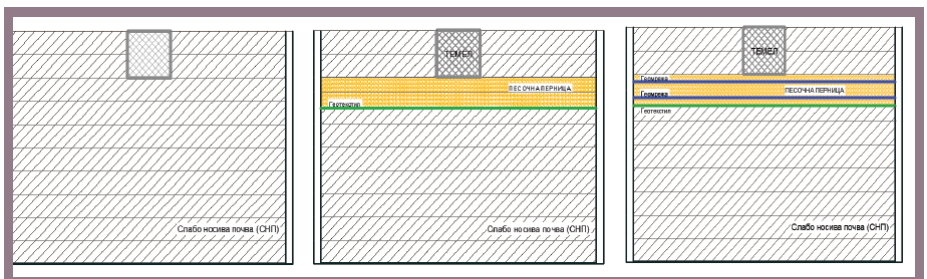
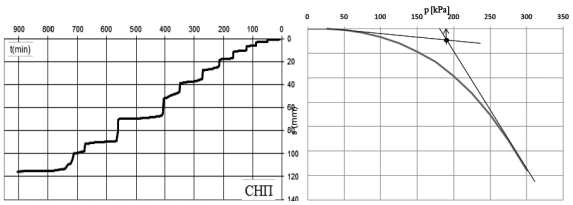


Figure 3.
Transverse model view.



(a) (b)

Figure 4.
Diagram of a) time - settlement and b) load - settlement (SNP).

Using the Butler-Hoy method, ultimate bearing capacity is estimated by pulling tangents in the elastic deformation part of the diagram and at the crossing point of the settlement curve. The results show a relatively low ultimate load of 180 kPa. It is noticed that there is no announced failure but creep of the material, where the deformations (settlements) are continuously growing. Failure in natural soil (vertical deformations are 115 mm) occurs for a total time of 905 min from the duration of the experiment. The failure time of natural soil is 395 min, but the deformation in which the failure occurs is significantly smaller (36 mm).

The second experiment was performed when there was an improvement of the low bearing soil by replacing the material (sand cushion d = 20cm) with better physical-mechanical characteristics separated by geotextile 300 g / m2 (Figure 9). Loads of 50, 100, 150, 200, 250, 300, 350, 400, 450, 500 and 550 kPa were applied during the test. The results in the form of diagrams, time - settlement and load - settlement are shown in Figure 5.

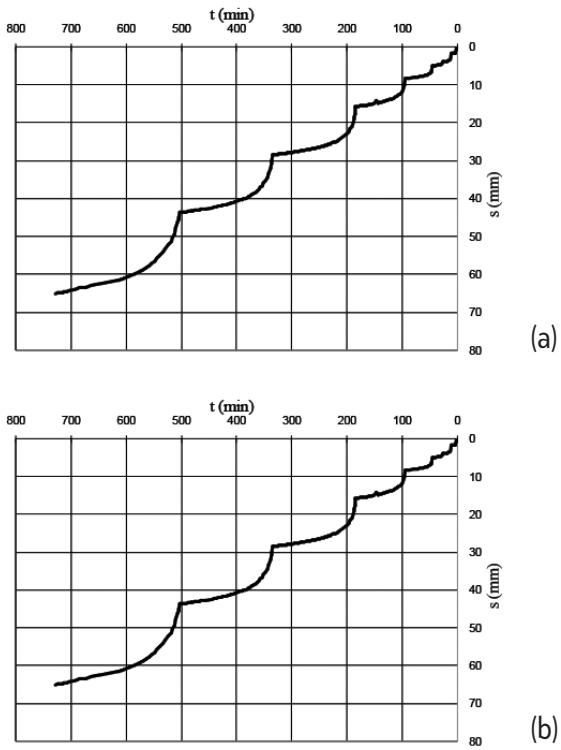


Figure 5. Diagram of a) time - settlement and b) load - settlement (PP)

The results show an increased load capacity of the foundation of 320 kPa. In this case the failiure is announced. At a load on the contact base of 400 kPa the deformations start to increase abruptly. The moment when the load capacity of the substrate is used is about 200 min from the beginning of the experiment. The settlement at that moment is 20 mm. If we compare the settlement with the previous experiment for the same loads (180 kPa) it is noticed that in that case they are 38.0 mm, while in this one 3.5 mm.

The third experiment was performed in the case when there is an improvement of low bearing ground by replacing the material (sand cushion) with better physical-mechanical characteristics and reinforcement with geogrids, where the material is embedded in the cylinder used in the first and second experiments.



Figure 6.
Procedure of embedding geonets by simulating field conditions.

In this way, an improved base is obtained with the method of reinforcement, which forms a structure called reinforced earth. The results of this experiment are compared with the first and second experiments.

Loads of 100, 200, 300, 400, 500, 600, 700, 400, 450, 500 and 550 kPa are applied during the improved soil test. The results in the form of diagrams, time - settlement and load - settlement are shown in Figure 7.

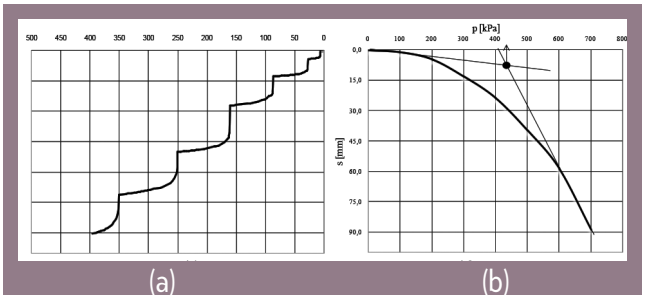


Figure 7. Diagram of a) time - settlement and b) load - settlement (Reinforced Earth)

The results show the highest load capacity of 420 kPa where an announced failure of 600 kPa is observed, where the deformations (settlement) increase abruptly. The moment when the load capacity of the base is used is about 160 min from the beginning of the experiment. The settlements at that moment are 30 mm.

COMPARISON OF RESULTS

If we compare the results obtained for the settlements for the three experiments for the same loads (180 kPa) it is noticed that in the first case they are 38.0 mm, in the second 3.5 mm, while in the third 2.5 mm. If we compare the settlements from the third experiment and the second, for loads when a failure occurs in the second case (320 kPa), then they are 20 mm and 15 mm, respectively.

Figure 8 shows the tripartite diagram of time - settlement, load - settlement and time - load for the three experiments.

From such a presentation of the results it can be noticed that the highest load shows the case with reinforced earth, then follows the case with replacement of material and finally the case with natural soil with the lowest bearing.

In terms of the duration of the experiment, the case with soil reinforcement with geogrids is the shortest, and at the same time the largest loads are applied. The experiment with low bearing soil lasts the longest, and the lightest loads are applied.

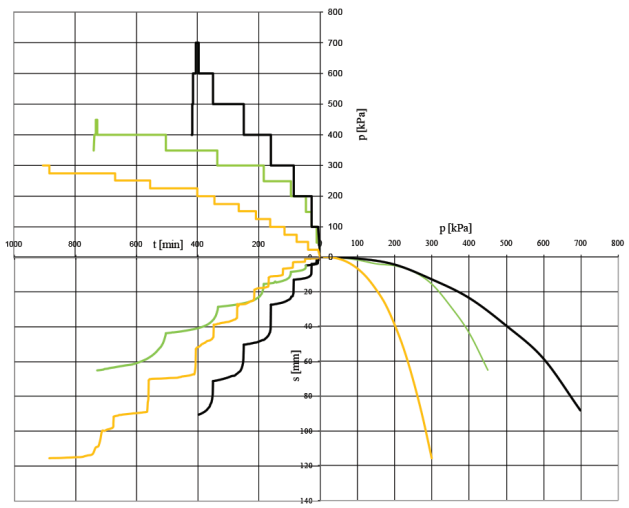


Figure 8. Diagram time – settlement, load - settlement and time - load for the three experiments

CONCLUSION

Experimental research shows that the improved reinforced earth substrate shows the highest load-bearing capacity. It has a load capacity of 34% higher compared to that improved with a sand cushion, and 2.4 times higher than the natural, slightly gray soil.

In terms of faилype, it occurs most quickly in the reinforced earth system, because with the reinforcement we get a stiffer improved construction of material and geogrids, so further deformations belong to the weak soil under the improved.

Subsoil settlement is lowest in a reinforced earth system. They are 10 times smaller than sand cushion improvement compared to the same loads, and 15 times smaller than natural, low bearing soil.

As a general conclusion from this research, it can be said that the reinforced earth system has a great advantage compared to conventional methods of improvement, which results in higher bearing capacity of the substrate and reduced subsidence.

The method of improvement with geogrid reinforcements is simple to perform, and at the same time economically and environmentally friendly.

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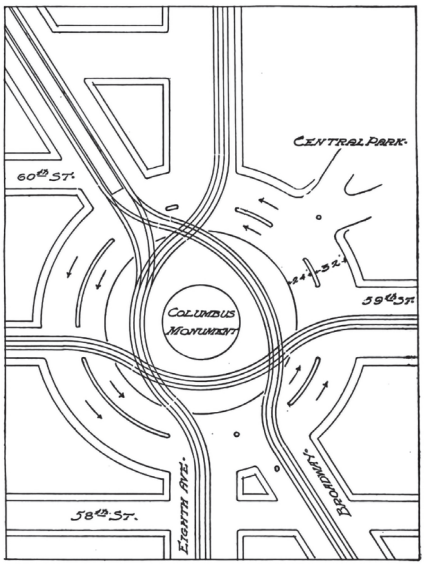
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CURIOSITIES ON THE ROAD

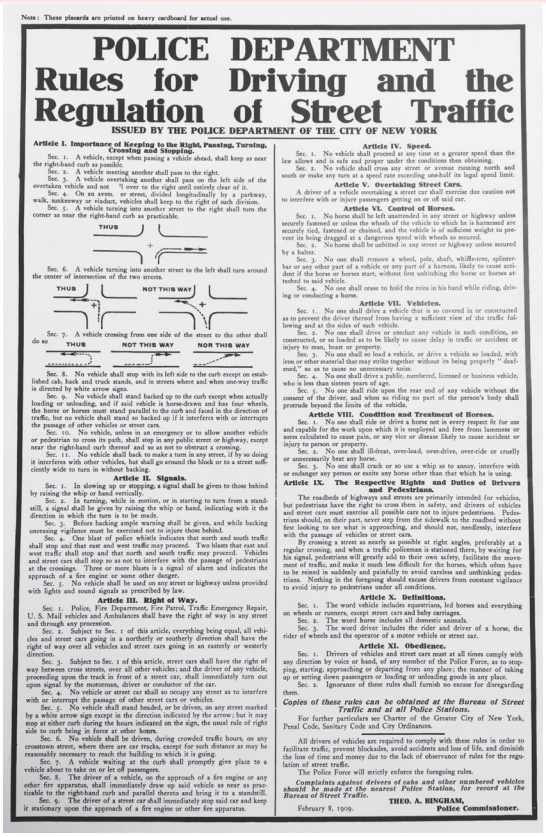


WILLIAM PHELPS ENO (1858 - 1945) was an American businessman credited with the earliest innovations and inventions in road safety. According to many, he is the "Father of traffic safety", thanks to his inventions, the most important of which are:
- the STOP sign,
- pedestrian crossing - Zebra,
- one-way street,
- parking for Taxi vehicles and
- refuge island.

William Phelps Eno never learned how to drive and never drove a car!



PERMANENT PLAN FOR HANDLING TRAFFIC AT COLUMBUS CIRCLE BY MEANS OF CHANGES IN CURB LINES.



Note: These placards are printed on heavy cardboard for actual use.

POLICE DEPARTMENT
Rules for Driving and the Regulation of Street Traffic
ISSUED BY THE POLICE DEPARTMENT OF THE CITY OF NEW YORK

Article I. Importance of Keeping to the Right, Passing, Turning, Crossing and Stopping.

Sec. 1. A vehicle, except when passing a vehicle ahead, shall keep as near the right-hand curb as possible.
Sec. 2. A vehicle meeting another shall pass to the right.
Sec. 3. A vehicle overtaking another shall pass on the left side of the overtaken vehicle and not "I over to the right until entirely clear of it.
Sec. 4. On an avenu.. or street, divided longitudinally by a parkway, walk, sunkenway or viaduct, vehicles shall keep to the right of such division.
Sec. 5. A vehicle turning into another street to the right shall turn the corner as near the right-hand curb as practicable.

THUS

Sec. 6. A vehicle turning into another street to the left shall turn around the center of intersection of the two streets.

THUS NOT THIS WAY

Sec. 7. A vehicle crossing from one side of the street to the other shall do so THUS NOT THIS WAY NOR THIS WAY

Sec. 8. No vehicle shall stop with its left side to the curb except on established cab, hack and truck stands, and in streets where and when one-way traffic is directed by white arrow signs.
Sec. 9. No vehicle shall stand backed up to the curb except when actually loading or unloading, and if said vehicle is horse-drawn and has four wheels, the horse or horses must stand parallel to the curb and faced in the direction of traffic, but no vehicle shall stand so backed up if it interferes with or interrupts the passage of other vehicles or street cars.
Sec. 10. No vehicle, unless in an emergency or to allow another vehicle or pedestrian to cross its path, shall stop in any public street or highway, except near the right-hand curb thereof and so as not to obstruct a crossing.
Sec. 11. No vehicle shall back to make a turn in any street, if by so doing it interferes with other vehicles, but shall go around the block or to a street sufficiently wide to turn in without backing.

Article II. Signals.

Sec. 1. In slowing up or stopping, a signal shall be given to those behind by raising the whip or hand vertically.
Sec. 2. In turning, while in motion, or in starting to turn from a standstill, a signal shall be given by raising the whip or hand, indicating with it the direction in which the turn is to be made.
Sec. 3. Before backing ample warning shall be given, and while backing unceasing vigilance must be exercised not to injure those behind.
Sec. 4. One blast of police whistle indicates that north and south traffic shall stop and that east and west traffic may proceed. Two blasts that east and west traffic shall stop and that north and south traffic may proceed. Vehicles and street cars shall stop so as not to interfere with the passage of pedestrians at the crossings. Three or more blasts is a signal of alarm and indicates the approach of a fire engine or some other danger.
Sec. 5. No vehicle shall be used on any street or highway unless provided with lights and sound signals as prescribed by law.

Article III. Right of Way.

Sec. 1. Police, Fire Department, Fire Patrol, Traffic Emergency Repair, U. S. Mail vehicles and Ambulances shall have the right of way in any street and through any procession.
Sec. 2. Subject to Sec. 1 of this article, everything being equal, all vehicles and street cars going in a northerly or southerly direction shall have the right of way over all vehicles and street cars going in an easterly or westerly direction.
Sec. 3. Subject to Sec. 1 of this article, street cars shall have the right of way between cross streets, over all other vehicles; and the driver of any vehicle, proceeding upon the track in front of a street car, shall immediately turn out upon signal by the motorman, driver or conductor of the car.
Sec. 4. No vehicle or street car shall so occupy any street as to interfere with or interrupt the passage of other street cars or vehicles.
Sec. 5. No vehicle shall stand headed, or be driven, on any street marked by a white arrow sign except in the direction indicated by the arrow; but it may stop at either curb during the hours indicated on the sign, the usual rule of right side to curb being in force at other hours.
Sec. 6. No vehicle shall be driven, during crowded traffic hours, on any crosstown street, where there are car tracks, except for such distance as may be reasonably necessary to reach the building to which it is going.
Sec. 7. A vehicle waiting at the curb shall promptly give place to a vehicle about to take on or let off passengers.
Sec. 8. The driver of a vehicle, on the approach of a fire engine or any other fire apparatus, shall immediately draw up said vehicle as near as practicable to the right-hand curb and parallel thereto and bring it to a standstill.
Sec. 9. The driver of a street car shall immediately stop said car and keep it stationary upon the approach of a fire engine or other fire apparatus.

Article IV. Speed.

Sec. 1. No vehicle shall proceed at any time at a greater speed than the law allows and is safe and proper under the conditions then obtaining.
Sec. 2. No vehicle shall cross any street or avenue running north and south or make any turn at a speed rate exceeding one-half its legal speed limit.

Article V. Overtaking Street Cars.

A driver of a vehicle overtaking a street car shall exercise due caution not to interfere with or injure passengers getting on or off said car.

Article VI. Control of Horses.

Sec. 1. No horse shall be left unattended in any street or highway unless securely fastened or unless the wheels of the vehicle to which he is harnessed are securely tied, fastened or chained, and the vehicle is of sufficient weight to prevent its being dragged at a dangerous speed with wheels so secured.
Sec. 2. No horse shall be unbitted in any street or highway unless secured by a halter.
Sec. 3. No one shall remove a wheel, pole, shaft, whiffle-tree, splinter-bar or any other part of a vehicle or any part of a harness, likely to cause accident if the horse or horses start, without first unhitching the horse or horses attached to said vehicle.
Sec. 4. No one shall cease to hold the reins in his hand while riding, driving or conducting a horse.

Article VII. Vehicles.

Sec. 1. No one shall drive a vehicle that is so covered in or constructed as to prevent the driver thereof from having a sufficient view of the traffic following and at the sides of such vehicle.
Sec. 2. No one shall drive or conduct any vehicle in such condition, so constructed, or so loaded as to be likely to cause delay in traffic or accident or injury to man, beast or property.
Sec. 3. No one shall so load a vehicle, or drive a vehicle so loaded, with iron or other material that may strike together without its being properly "deadened," so as to cause no unnecessary noise.
Sec. 4. No one shall drive a public, numbered, licensed or business vehicle, who is less than sixteen years of age.
Sec. 5. No one shall ride upon the rear end of any vehicle without the consent of the driver, and when so riding no part of the person's body shall protrude beyond the limits of the vehicle.

Article VIII. Condition and Treatment of Horses.

Sec. 1. No one shall ride or drive a horse not in every respect fit for use and capable for the work upon which it is employed and free from lameness or sores calculated to cause pain, or any vice or disease likely to cause accident or injury to person or property.
Sec. 2. No one shall ill-treat, over-load, over-drive, over-ride or cruelly or unnecessarily beat any horse.
Sec. 3. No one shall crack or so use a whip as to annoy, interfere with or endanger any person or excite any horse other than that which he is using.

Article IX. The Respective Rights and Duties of Drivers and Pedestrians.

The roadbeds of highways and streets are primarily intended for vehicles, but pedestrians have the right to cross them in safety, and drivers of vehicles and street cars must exercise all possible care not to injure pedestrians. Pedestrians should, on their part, never step from the sidewalk to the roadbed without first looking to see what is approaching, and should not, needlessly, interfere with the passage of vehicles or street cars.

By crossing a street as nearly as possible at right angles, preferably at a regular crossing, and when a traffic policeman is stationed there, by waiting for his signal, pedestrians will greatly add to their own safety, facilitate the movement of traffic, and make it much less difficult for the horses, which often have to be reined in suddenly and painfully to avoid careless and unthinking pedestrians. Nothing in the foregoing should excuse drivers from constant vigilance to avoid injury to pedestrians under all conditions.

Article X. Definitions.

Sec. 1. The word vehicle includes equestrians, led horses and everything on wheels or runners, except street cars and baby carriages.
Sec. 2. The word horse includes all domestic animals.
Sec. 3. The word driver includes the rider and driver of a horse, the rider of wheels and the operator of a motor vehicle or street car.

Article XI. Obedience.

Sec. 1. Drivers of vehicles and street cars must at all times comply with any direction by voice or hand, of any member of the Police Force, as to stopping, starting, approaching or departing from any place; the manner of taking up or setting down passengers or loading or unloading goods in any place.
Sec. 2. Ignorance of these rules shall furnish no excuse for disregarding them.

Copies of these rules can be obtained at the Bureau of Street Traffic and at all Police Stations.

For further particulars see Charter of the Greater City of New York, Penal Code, Sanitary Code and City Ordinances.

All drivers of vehicles are required to comply with these rules in order to facilitate traffic, prevent blockades, avoid accidents and loss of life, and diminish the loss of time and money due to the lack of observance of rules for the regulation of street traffic.

The Police Force will strictly enforce the foregoing rules.

Complaints against drivers of cabs and other numbered vehicles should be made at the nearest Police Station, for record at the Bureau of Street Traffic.

THEO. A. BINGHAM,
Police Commissioner.

February 8, 1909.



Our colleagues in South Korea came up with a solution to the problem of a nonexistent bikeway. They solved the problem by constructing one in the middle of the highway, and, in order to protect the cyclists from the sun and isolate them from the traffic, they installed solar panels for electricity production above the bikeway.



You can see the difference between them and us in terms of commitment to cyclists, if you look at the picture from a year ago on one of Skopje boulevards.

FERRUCCIO LAMBORGHINI (1916 - 1993), was a mechanic, engineer, Italian car inventor, winemaker, industrialist and businessman. On one occasion, Enzo Ferrari said to a man: "You may be able to drive a tractor, but you will never be able to deal with a car like Ferrari." These words offended and angered the man so much that he promised he would make a perfect sports car. The name of that man was Ferruccio Lamborghini, and the result of that conversation was the creation of a sports car, which is one of the most famous sports car brands





"Lamborghini", and also the fastest mass-produced car. We do not know for sure if any Lamborghini (Huracán or Aventador) is registered in Macedonia, but there is certainly a Lamborghini tractor that was recorded near Kocani with Macedonian license plates.



So many times in the past, our fellow engineers from China have amazed us with the projects they had implemented such as motorways, bridges, tunnels, etc. Their structures are at the very top of the world among the works of builders. This time, however, we are reporting about the collapse of a bridge over a highway near the Chinese city of Ezhou. Even the best will sometimes make mistakes.







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