
**ВИСШЕ СТРОИТЕЛНО УЧИЛИЩЕ
"ЛЮБЕН КАРАВЕЛОВ"**

**UNIVERSITY OF STRUCTURAL ENGINEERING
AND ARCHITECTURE
(VSU) "LYUBEN KARAVELOV"**

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XXI МЕЖДУНАРОДНА НАУЧНА КОНФЕРЕНЦИЯ ПО СТРОИТЕЛСТВО И АРХИТЕКТУРА VSU'2021, 14-16 ОКТОМВРИ 2021 Г.

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I

АРХИТЕКТУРА И УРБАНИЗЪМ

ARCHITECTURE AND URBANISM

1-1. TRAPS OF URBAN DISCONTINUITY: WANDERING IN THE PROCESS OF MODERN URBANIZATION OF SPACE

Aleksandar Videnović¹, Miloš Arandjelović²

Abstract: The period between the two World Wars was a golden age of the rise of Belgrade and other cities in Serbia based on proven European and world experiences. After the great violent destruction during the Second World War, there was a period of long decades of stagnation in urban areas. According to the rules of strict respect for urban and architectural norms, high achievements in the field of urban reconstruction in terms of functional and ambient improvement of space have appeared permanently. With the social changes that took place in the last two decades of the 20th century, with the advent of transition, the attitude towards the urban renewal of cities, especially Belgrade, also changed. These changes brought higher quantity, and lower and lower aesthetic quality of new construction in cities. This possible view of a small part of quality, but also inappropriate architectural - urban practice in the field of urban reconstruction of Belgrade, is accompanied by a picture of the social context in its basic features.

Key words: *Urban renewal, discontinuity, architectural achievements, urbanization process, paradox*

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1-2. SUPPLY AND DEMAND IN ENGINEERING AND MANAGEMENT

Bojidar Yanev¹

Abstract: All successful infrastructure products and processes exemplify the collaboration of engineering and economics in space and time. In their respective domains, the two specialized professions optimize supply and demand (S / D) of energy and money. If their priorities diverge, structural and economic failures result. The various stages of a bridge lifecycle and the transitions between them are examined as vulnerable nodes and links when diverging constraints of supply and demand must be reconciled. Robustness, resilience and sustainability are considered as properties which, if sufficiently defined, can model realistically the cost-effective performance of the infrastructure under varying conditions over extended lifecycles.

Key words: *bridge, demand, energy, money [\$], performance, resilience, robustness, supply.*

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1-3. INFLUENCE OF THE LOW-RISE, HIGH-DENSITY HOUSING ON THE QUALITY OF LIVING

Ivana Mihajlović¹, Branislava Stoiljković²

Abstract: The tendency of continuous expansion of cities, for economic and other reasons, is present all over the world. Due to an increasing number of inhabitants in cities, a problem of housing shortage arose. As one of the solutions to this problem, the low-rise, high-density (LRHD) model has been used in residential architecture for a few past decades, as it could increase the number of housing units without reducing the quality of life, without negative impact on existing urban settlements or ecological systems near cities. Appearing in the 1950s and 1960s as a reaction to the “tower in the park” model offered by some of the pioneers of modern architecture, this new type of urban complex showed the potential to overcome some shortcomings of mass urban renewal after the second world war, putting emphasis on life values and the social context. The paper will analyse the impact of basic characteristics of housing organization according to the LRHD model on the quality of living with the aim of affirming this model in modern architectural practice. The research relies on the analysis of relevant literature and good practice examples.

Key words: *low-rise, high-density, housing, quality of living.*

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1-4. PUBLIC OUTDOOR VS. PUBLIC INDOOR: EVALUATING THE QUALITY OF SHOPPING MALL PSEUDO-PUBLIC SPACES

Marija Cvetković¹, Aleksandar Grujičić², Nevena Lukić³

Abstract: Shopping centers (malls) are often seen in the literature as pseudo-public and private public space in which the public interaction that is often related to the open public spaces of the city (such as squares or parks) takes place. In shopping malls, which lately have become one of the basic characteristics of cities, behavior and interactions are defined by the primary purpose of this space - consumption. As the multifunctional buildings develop, with the primary purpose of trade and entertainment, the focus of our free time shifts from the open space squares to "pseudo public spaces" (both outdoor and indoor). Unlike the closed space of the shopping center, public spaces serve the public purpose by their characteristics and function, enable social communication and they are accessible and open to everyone.

Therefore, the relationship between public and pseudo-public spaces of shopping malls is analyzed in order to show their impact on the immediate urban surroundings. This paper examines the characteristics (physical, functional and social) of shopping mall Delta City, situated in the residential area of New Belgrade, where the influence of this multifunctional space is greater as it becomes the new city center and new meeting space. Compression and intensification of the functions of the public space with all necessary amenities under one roof leads to the transformation of the existing built structure of the urban area where the shopping centre is located.

Key words: *shopping mall, public space, urban environment, pseudo public space, Belgrade*

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1-5. AN ANALYSIS OF THE GREEN ROOF CONCEPT IMPLEMENTATION IN SERBIA

Marija Stamenković¹, Milica Živković²

Abstract: In terms of uncontrolled urbanization, the nature within built environment is often marginalized, rare, distant and, to a large extent, degraded and neglected. This negative global trend, also represented in Serbia, could be mitigated by the implementation of green roofs. Green roofs were chosen over vertical greening because they could provide an additional useful space when implemented within the flat roof structures. By implementing green roofs, numerous benefits can be achieved at the urban and building levels. The aim of the paper is to investigate the application of green roofs in Serbia through analysis of twelve examples. Several criteria were established, based on which the research was conducted. One of the results indicated their predominant usage on new buildings. This finding points to the facts that green roofs are relatively a new construction technique in our country and that there is no adequate mechanisms and polices for their wide spread usage (on existing buildings). Although the achieved benefits are significant for specific buildings, the goal of implementing green roofs should be also bring benefits at the urban level – to make urban areas a healthier environment. Regarding that, possible approaches for introducing the green roof concept into national legislation were considered.

Key words: *Green roofs, flat roofs, urban area, legislation, case studies*

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1-6. PRESERVING MODERN ARCHITECTURE – DESIGN STRATEGIES FOR UPDATING MODERN ERA HOTEL BUILDINGS

Milan Brzaković¹, Ana Momčilović-Petronijević², Marko Nikolić³

Abstract: Modern architecture defined design in the 20th century and continues to influence that which has followed, and its preservation is as crucial as that of the architecture of any previous period deemed historically significant. As it increasingly becomes part of the continuum of architectural history and its buildings experience threats that range from material to functional obsolescence, not to mention unprofessional repair and reconstruction, or even demolition due to abandonment and lack of appreciation, concern for its preservation has grown.

This paper examines tendencies in preservation of modern architecture, especially hotel buildings. As highly functional, commercially-driven structures, hotels should be subjected to continual adaptation in order to avoid the perception of functional obsolescence and to convey a sense of being modern and up-to-date. With ultra-efficiency comes the reality that any future changes in use will likely require alterations or, in extreme circumstances removal or demolition of specific features to accommodate new ones. The article presents contemporary theories and design strategies in the field of architectural preservation, closely reflected in relevant case studies.

Keywords: *Modern architecture, Preservation, Hotel building, Adaptive reuse, Conservation*

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1-7. RESHAPING THE SPA TOURISM – MODELS FOR TRANSFORMATION OF SPA HOTELS, THE CASE OF NIŠKA BANJA

Milan Brzaković¹, Branislava Stoilković², Marko Nikolić³

Abstract: The construction of hotel facilities started in 1930s and reached its peak, in both a qualitative and quantitative sense, in the short time period from the mid 1960-s to the mid-1970s. Several decades have passed since those times and yet the majority of today's hotel accommodation capacity still originates from the period of Socialist modernization. Although critically acclaimed, majority of these objects doesn't meet modern requirements. Buildings can become obsolete for a variety of reasons, however, even though their functional erosion is often faster than their physical ruin, they still possess many of the qualities we consider desirable. This emerging need for transformation of celebrated, but outdated hotels into a contemporary facilities is both highly delicate architectural challenge and potential risk, since it includes treatment of important, but unprotected modern heritage.

The primary objective of the research is to investigate whether existing hotels can fulfil the requirements of modern spa tourism, and to explore successful design approaches for their potential upgrade. The research covers hotels built during the first half of the 20th century in the area of Niška Banja.

Key words: *hotel architecture, adaptation, revitalization*

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1-8. AN EMPIRICAL STUDY ON THE CORRELATION BETWEEN HOUSING CONDITIONS AND COVID-19 PANDEMIC IN SERBIA

Milica Živković¹, Marija Stamenković²

Abstract: The COVID-19 pandemic has brought significant changes in the daily lives of people and societies. Extended stay within housing unit could potentially lead to multi-layered psycho-social conflicts which may, to a certain extent, be induced by the inability of the built environment to adapt to the emerging dynamics of housing and work functions. This issue particularly affects young population that has been forced to spend their time in conditions of intensive togetherness with other family members. The extent to which spatial qualities influence the quality of life, education, work and leisure during the pandemic was examined on the example of housing in Southeastern Serbia by conducting a survey among students of architecture who, in addition to age qualifications, possess certain knowledge necessary to identify housing problems. Examining their observations, needs and living conditions, the authors made conclusions about the extent to which the housing environment has managed to respond to the current health situation. The opinions of the respondents and the analysis of the interdependence of the health and housing crisis are of special importance for reviewing the current housing models and defining measures to improve their sustainability in the times to come.

Key words: *Housing, COVID-19, Sustainability, Survey Research*

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1-9. RE-THINKING A CITY WALL OF SHARM-EL-SHEIKH

Natasa Zivaljevic-Luxor¹, Nadja Kurtovic-Folic²

Abstract: The administrative authorities of Sharm-el-Sheikh in South Sinai (Egypt) announced their attention to build a wall around the city. It came in operation a few years after Trump`s The Wall, and related with it or not, this decision contributed public discourse on a wall as socially engaged element. Numerous historical evidences speak of a wall as a tool for implementation of a policy and execution of firmly predetermined agenda – or simply – a wall as a blunt statement. Having a radically different global context nowadays than in the times when city walls were common features, we thought over the (ab)use of a wall.

Key words: *The wall, Egypt, architectural history, urban development, society*

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1-10. HISTORICAL DEVELOPMENT OF INDUSTRIAL ARCHITECTURE IN BULGARIA

Polina Savcheva¹

Abstract: This paper presents a brief review of the historical development of industrial architecture in Bulgaria through highlighting some notable examples. Major foreign influences and key characteristics are outlined for the two main periods of this development – from the second half of XIX century to the Second World War and from the Second World War to the end of the 1980s. A third period that is still evolving for the last thirty years is noted and its features defined as a part of a global trend in industrial architecture linked with the digital revolution and dynamic changes in the industry after the 1980s.

Key words: *industrial architecture, industrial buildings, factories, architectural history, architectural design, industrial heritage*

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1-11. RECONSTRUCTION OF THE BUILDING HISTORY OF TWO DOMED BATH PREMISES FROM THE OTTOMAN PERIOD NEAR STARA ZAGORA

Radosveta Kirova-Delcheva¹

Abstract: Situated next to the adjacent Roman thermae and the prehistoric mound, the two domed bath premises from the Ottoman period functioned as the main functional elements respectively of the Women's and the Men's baths, that shaped the core of the contemporary settlement and mineral resort Starozagorski bani (Ladzhite). Lack of archaeological survey and encapsulation of the original structures hinder the on site research and the architectural-typological analysis. The significant dimensions in plan and height of the provincial baths place them next to the public baths in centers such as Plovdiv, Loveche, Stara Zagora, etc. While the vaqf document for the construction of the two domed bath premises is still unknown, the architectural analysis that proves the simultaneous construction of the both objects. Survey of the recent data from the Ottoman registers from the 16th century suggestedly identifies the settlement of Ladzhite.

Key words: *Ottoman baths, Kaplica, Vaqf foundation, Starozagorski mineralni bani*

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1-12. RESEARCH FOR IMPROVING THE HOUSING POLICY OF MONTENEGRO

Željka Beljkaš¹, Miloš Knežević², Strahinja Trpevski³, Meri Cvetkovska⁴

Abstract: House policy development in every society begins with the state intervention. By involving the state, housing policy becomes a part of the social policy thus unifying the concept of the development of social states. The state intervention in solving housing issues of its population is encouraged by the low quality of housing. Housing policy consists of various measures such as financial, legal, spatial, social and environmental. Inadequate housing is directly related to the problems of poverty and social discrimination. The housing crisis in the Balkans has led to the emergence of illegal construction. The main difference, when it comes to the concept of housing, is in housing as a choice or housing as a necessity. The concept of housing as a choice is related to the part of society that is economically viable and this category is not the subject of the housing strategy. Housing in a socio-psychological context is the basis for the realization of some of the basic human needs. It satisfies the need for survival, physical protection, security and enables the satisfaction of many other human needs. This paper presents general analysis of housing, standard and quality of housing in Montenegro, SWOT analysis, monitoring, reporting and evaluation of the implementation of housing policy.

Key words: *Research; Housing; Policy; SWOT; Analysis*

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1-13. НОВИ ТЕНДЕНЦИИ В ОБЩЕСТВЕНИТЕ КУЛТУРНИ СГРАДИ ЗА НОВА СТРАТЕГИЯ ОТВЪД ФУНКЦИЯТА И ФОРМАТА НА БИБЛИОТЕКИТЕ И МУЗЕЙНИТЕ СГРАДИ НА БЪДЕЩЕТО

Анета Славова¹

Резюме: Днес, културата се превърна в ранг на образование. Толкова е важно нейното присъствие в живота на съвременния човек. Дори се говори за значението и за националната сигурност на един народ. Затова акцентът в съвременните библиотеки и музей пада върху тяхната образователна стойност за хората и обществото. Те са като едно естествено продължение на образованието на всеки един човек през целия му живот. Така тези типологии от културните обществени сгради - библиотеки и музей, със скъпото си оборудване ще станат мощен социален фокус, където хората през целия си живот ще могат да се образуват, усъвършенстват, изживяват креативно част от свободното си време. Така СГРАДИТЕ ЗА КУЛТУРА се превръщат в съвременен храм на мъдростта, знанието, изкуството и социалните умения. Но какви са съвременните иновативни тенденции в тези културно-образователни обществени сгради днес? Кой е новият двигател на тези процеси в съвременната Архитектура днес? Всяка стъпка напред в усъвършенстване на модела на тези обновени сгради като среда и начин на използването им от хората ще се върне в пъти като положителен резултат за хората в България, за да се превърне в печеливша кауза – за децата и обществото ни.

Ключови думи: *Културно-образователни обществени сгради, тенденции, иновации, добри практики, архитектурно проектиране, социална мисия на архитектурата.*

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**NEW TRENDS IN PUBLIC CULTURAL BUILDINGS FOR A NEW
STRATEGY BEYOND THE FUNCTION AND SHAPE OF
LIBRARIES AND MUSEUM BUILDINGS OF THE FUTURE**

Aneta Slavova¹

Abstract: Today culture has gained the status of education in itself. This is how important its presence is in the modern person's life. It is even sometimes discussed in relation to national security. That is why modern libraries and museums emphasize their educational value for society. They are a natural extension to a person's quest for lifelong learning. That is how these cultural building typologies, mainly libraries and museums, with all their expensive equipment, will become a powerful social focus where people will be able to learn and educate themselves throughout their lives, by improving and spending creatively their spare time.

In this manner CULTURAL BUILDINGS become a modern temple of wisdom, knowledge, art and social skills. But what are the modern design tendencies in these building typologies? Which is the engine behind these processes in modern Architecture today? Each step towards improvement of the model of these newly understood buildings, in terms of their space and uses, will produce a tenfold result for Bulgaria's society and will become a successful cause – for our children and our society as a whole.

Keywords: *Cultural buildings, educational buildings, tendencies, innovations, good practices, architectural design, social mission of architecture*

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1-14. ОБЩЕСТВЕННОТО ХРАНЕНЕ ПРИ МАЛКИТЕ И СРЕДНИ ПРЕДПРИЯТИЯ

Б. Манчева – Велкова¹

Abstract: Докладът разглежда някои нови планировъчни решения и изисквания при проектирането на общественото хранене на малките и средни предприятия от градоустройствен и обемно - планов аспект. Тези обекти се разглеждат като социална инфраструктура, степенувани по отношението обслужването – централизирано (кухня майка) и децентрализираното (търговска мрежа). Разглеждат се проблемите при планирането на пълноценните кухни, разливни, бюфети, мобилни автомати за храни и напитки към зони за обществено хранене.

Ключови думи: *Обществено хранене, Пълноценните кухни, Разливни, Бюфети, Малки и средни предприятия*

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CATERING IN SMALL AND MEDIUM ENTERPRISES

Borislava Mancheva – Velkova¹

Abstract: The report examines some new planning decisions and requirements in the design of public catering for small and medium enterprises from the urban and spatial planning aspect. These sites are considered as social infrastructure, graded in terms of service - centralized (mother kitchen) and decentralized (commercial network.). The problems in the planning of full-fledged kitchens, spillage kitchen, buffets, mobile food and beverage vending machines to public catering areas are considered.

Key words: *catering, full kitchens, spillage kitchen, small and medium enterprises*

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**1-15. МАЛКИ РИБНИ ФЕРМИ В ПЛАНИНСКИТЕ И
ПОЛУПЛАНИНСКИ РАЙОНИ**

Димитър Власарев¹

Резюме: Хранително вкусовата промишленост се харacterизира със своята повсеместност като териториално разположение от консумативни и суровинни райони. Развитието на подотрасъл рибовъдство от селското стопанство на страната е интегриран с преработнащите подотрасли на хранително-вкусовата промишленост – рибопреработка, като продукцията от риба се реализира в цялата страна. Територията на планинските и полупланински райони на страната представлява приблизително 50 % от общата и площ. Малките и микропредприятия са възможен потенциал на развитие на тези райони, като добивен и преработващ подотрасъл на земеделието.

Ключови думи: *рибна ферма, планински и полупланински райони, агростопански територии*

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SMALL FISH FARMS IN MOUNTAIN AND SEMI-MOUNTAIN
AREAS

Dimitar Vlasarev¹

Abstract: The food industry is characterized by its ubiquity as a territorial location of consumable and raw material areas. The development of the fish farming sub-sector of the country's agriculture is integrated with the processing sub-branches of the food industry - fish processing, as the fish production is sold throughout the country. The territory of the mountainous and semi-mountainous regions of the country represents approximately 50% of its total area. Small and micro enterprises are a potential development potential of these areas, as a mining and processing sub-sector of agriculture.

Keywords: *fish farm, mountainous and semi-mountainous areas, agricultural areas*

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1-16. РАБОТНА СРЕДА И БЛАГОПОЛУЧИЕ НА СЛУЖИТЕЛИТЕ

Елена Кулова¹

Резюме: В последните три десетилетия темата за щастието и субективното благополучието на работното място се радва на все по-голям интерес както от страна на компаниите, така и в научните изследвания. Някои проучвания откриват, че по-високите нива на благополучие на служителите се свързват и с по-висока производителност. В настоящото изследване ще бъде потърсена връзката между характеристиките на работната среда като архитектура и дизайн и благополучието. Ще бъде потърсен отговор на въпроса кое в работната среда влияе положително върху емоциите и представянето на служителите и кое влияе отрицателно.

Ключови думи: Работна среда, Благополучие

WORKING ENVIRONMENT AND EMPLOYEES` WELLBEING

Elena Koulova¹

Abstract: In the recent three decades the interest of happiness and well-being at work has increased, both from companies and research. Some studies have found that higher levels of employee well-being can be associated with better productivity. This paper will explore the relationship between the architectural and design aspects of working environment and well-being. It will also try to answer the question which environment`s features have a positive impact on the emotions and performance of employees and which have a negative impact.

Key words: working environment, well-being, office space

1-17. ГРАДСКО ПРОИЗВОДСТВО – ИСТОРИЧЕСКО РАЗВИТИЕ И СЪВРЕМЕННИ ТЕНДЕНЦИИ

Емил Михов¹

Резюме: Разгледано е влиянието на социални и икономически фактори върху развитието на промишлената архитектура в контекста на градското производство. Представени са формите на градско производство в различните епохи – от Античността и Средновековието до наши дни. Акцентирано е върху характеристиките на производството в епохите на Индустриалната революция – масово производство, социални промени и екологични последици и Модернизма – градско зонироване и разделяне на производството от останалите градски функции. Посочени са факторите, определящи тенденцията през втората половина на XX век производството да напуска градовете на западния свят. Разгледани са съвременните концепции за възраждане на градското производство с оглед на създаване на динамичен, разнообразен и устойчив град.

Ключови думи: *Промислени сгради, Градско производство, Индустриална революция, Модернизъм, Устойчив град.*

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**URBAN MANUFACTURING – HISTORICAL DEVELOPMENT
AND CONTEMPORARY TRENDS**

Emil Mihov ¹

Abstract: The article examines the influence of social and economic factors on the development of industrial architecture in the context of urban production. The forms of urban production in different epochs are presented - from Antiquity and the Middle Ages to the present day. Emphasis is placed on the characteristics of production in the epochs of the Industrial Revolution (mass production, social change and environmental consequences) and Modernism (urban zoning and separation of production from other urban functions). The article indicates the factors determining the tendency that production leaves the cities of the western world in the second half of the XX century. Modern concepts for the revival of urban production with the vision for creating dynamic, diverse and sustainable cities are presented.

Key words: *urban manufacturing, industrial buildings, industrial revolution, modernism, sustainable city*

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1-18. КОНЦЕПЦИЯТА „ИНОВАЦИОНЕН КВАРТАЛ“ КАТО ФОРМА НА СЪВРЕМЕННА МНОГОФУНКЦИОНАЛНА ЗОНА

Мила Никифорова¹

Резюме: Докладът изяснява особеностите на иновационните квартали, тяхното възникване като разновидност и алтернатива на научно-технологичните паркове и постепенното им превръщане в устойчива градска структура. Представени са примери от чуждестранната практика, които са успешно интегрирани в градовете и допринасят за тяхното икономическо развитие. Обобщени са градоустройствените характеристики на модела.

Ключови думи: Иновационни квартали, Устройствено планиране

THE CONCEPT OF "INNOVATION DISTRICT" AS A FORM OF MODERN MIXED-USE AREA

Mila Nikiforova¹

Abstract: The report clarifies the features of innovation districts, their emergence as a variety and alternative to science and technology parks and their gradual transformation into a model for building a sustainable urban structure. Examples from foreign practice are presented, which are successfully integrated in the cities and contribute to their economic development. The urban characteristics of the model are summarized.

Key words: innovation districts, spatial planning

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1-19. ГРАДОУСТРОЙСТВЕНИ ПРЕДПОСТАВКИ ЗА ФОРМИРАНЕ НА ИНОВАЦИОННИ КВАРТАЛИ В СОФИЯ

Мила Никифорова¹

Резюме: Докладът разглежда иновационните квартали като устойчива съвременна градска структура, която допринася за икономическото развитие. Анализирани са възможностите за формиране на иновационни квартали в София. Проследено е досегашното градоустройствено развитие на София Тех Парк и са дадени препоръки за по-нататъшното му планиране. Локализирани са и други зони, които имат потенциал след реконструкция да се развият като иновационни квартали

Ключови думи: *Иновационни квартали, Устройствено планиране*

URBAN PLANNING CONDITIONS FOR THE FORMATION OF INNOVATION DISTRICTS IN SOFIA

Mila Nikiforova¹

Abstract: The report identifies innovation districts as a sustainable modern urban structure that contributes to economic development. The possibilities for formation of innovative districts in Sofia are analyzed. The current urban development of Sofia Tech Park has been monitored and recommendations for its further planning have been given. Other areas have been localized, which have the potential to develop as innovative districts after reconstruction.

Key words: *innovation districts, spatial planning*

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1-20. АНАЛИЗ НА СИСТЕМИ ЗА СУХО СТРОИТЕЛСТВО ЗА ИЗРАВНЯВАНЕ И ИЗОЛИРАНЕ НА ХОРИЗОНТАЛНИ ПОДОВИ ПОВЪРХНОСТИ

Офелия Лазова-Велинова¹, Димо Вълков²

Резюме: Извършен е анализ на системите за сухо строителство (ССС) при изравняване и изолиране на хоризонтални подови повърхности. Изследвано е приложението на сухи подове в строителното производство. Разгледани са необходимите материали за изграждане на сухи подове - дървени профили, крепежни материали, изолации, гипсокартонени плоскости и др. Изследвани са видовете двоен под изпълнявани със СССР. Предложени са типови и индивидуални детайли за изпълнението на сухи подове. Извършен е сравнителен икономически анализ на сухи подове и класическа циментово-пясъчна замазка. Посочени са предимствата и недостатъците на сухите подове и циментово-пясъчната замазка.

Ключови думи: *Сухи подове, Двоен под, Циментово-пясъчна замазка*

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**ANALYSIS OF DRY CONSTRUCTION SYSTEMS FOR
LEVELING AND INSULATING HORIZONTAL FLOOR
SURFACES**

Ofelia Lazova-Velinova¹, Dimo Valkov²

Abstract: An analysis of dry construction systems (DCS) in leveling and insulating horizontal floor surfaces has been performed. The application of dry floors in construction production has been studied. The necessary materials for construction of dry floors are considered - wooden profiles, fastening materials, insulations, gypsum boards, etc. The types of double floor performed with DCS were studied. Type and individual details for the implementation of dry floors are offered. A comparative economic analysis of dry floors and classic cement-sand screed was performed. The advantages and disadvantages of dry floors and cement-sand screed are indicated.

Key words: *dry floors, double floor, cement-sand screed*

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1-21. КЛИНИКАТА ЗА ОСОБЕНО ОПАСНИ ИНФЕКЦИИ, ДНЕС

Пламен Генев¹, Елена Иванова², Симона Тасева³

Резюме: Представена е посоката на развитие на клиниката за особено опасни инфекции в резултат от проведени предварителни проучвания и свързаните с тях проект и реализация.

Целта е свързване на традиционното понятие за клиника за особено опасни инфекции с лечението на особено опасни инфекции днес, и определяне посоките ѝ на развитие в бъдеще, в чисто архитектурен аспект.

Обект на изследването е спецификата на архитектурното обемно-пространствено решение, конструкцията и инсталационното обзавеждане на клиниката за особено опасни инфекции в резултат технологичния прогрес.

Ключови думи: *Еволюция на архитектурната форма на клиниката, Управление на особено опасни отпадъци, Демонтажен модел на клиника за особено опасни инфекции.*

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THE CLINIC FOR PARTICULARLY DANGEROUS INFECTIONS TODAY

Plamen Genov¹, Elena Ivanova², Simona Taseva³

Abstract: The direction of development of the clinic for particularly dangerous infections as a result of preliminary studies and related projects and implementation is presented.

The aim is to connect the traditional concept of a clinic for particularly dangerous infections with the treatment of particularly dangerous infections today, and to determine its directions of development in the future, in a purely architectural aspect.

The object of the research is the specifics of the architectural volume-spatial solution, the construction and the installation equipment of the clinic for especially dangerous infections as a result of the technological progress.

Key words: *evolution of the architectural form of the clinic, management of especially hazardous waste, dismantling model of a clinic for especially dangerous infections.*

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1-22. ХОРИЗОНТАЛНИЯТ НЕБОСТЪРГАЧ, ДНЕС

Пламен Генов¹, Елена Иванова², Елена Петрова³

Резюме: Представена е посоката на развитие на хоризонталния небостъргач в резултат от проведени предварителни проучвания и свързания с тях проект и евентуална реализация.

Целта е свързване на традиционното понятие за хоризонтален небостъргач с необходимостта от изграждането му днес и определяне посоките му на развитие в бъдеще, в чисто архитектурен аспект.

Обект на изследването е спецификата на архитектурното обемно-пространствено решение, конструкцията и инсталационното обзавеждане на хоризонталния небостъргач, резултат от технологичния прогрес.

Ключови думи: *Еволюция на архитектурната форма на небостъргача, Хоризонтален небостъргач, Проект "Континентален град", Проект "Планетарен град", Демонстрационен модел на градска среда*

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THE HORIZONTAL SKYSCRAPER – TODAY

Plamen Genov, Elena Ivanova, Elena Petrova

Abstract: Central Town Area related to the general conditions and policy of the European requirements on this matter, as well as the willingness and intended policy of the local government with concern for improvement of the living conditions and qualities of the central parts of these cities. With regards to the European forums having been held, as well as to the Leipzig Charter for Sustainable European Cities drawn up in 2007, and the 2010 Toledo Declaration on the Development of Small and Large Cities, the actuality of the topic may be deemed relevant.

Key words: *Urban planning, Urbanism, Sustainable development, Central urban parts.*

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**1-23. ЕДНОПРОСТРАНСТВЕНОСТ НА ГЛАВНИТЕ ФОАЙЕТА –
СЪВРЕМЕННА ТЕНДЕНЦИЯ В ПРОЕКТИРАНЕТО НА
ОБЩЕСТВЕНИ СГРАДИ**

Радина Писарска¹

Резюме: В съвременните обществени сгради се наблюдава тенденцията към еднопространственост на главните фойета. Преградите между обслужващите посетителите зони се дематериализират, създавайки усещането за цялост, за част от „общото“ – за по-силно осезаемата обществена функция. Обединяването може да се реализира и по вертикала чрез атриумни фойета. Налице е стремежът към постигане на повече визуални и пространствени връзки във фойето, превръщайки го в единен „социален организъм“, целящ да подготви посетителя за тип споделено преживяване според основната функция на сградата (изложба, концерт, обучение и др.). На базата на анализ на примери от световната практика, докладът разгръща различните аспекти в проектирането на еднопространствени фойета.

Ключови думи: *обществени сгради, главно фойе, атриум, еднопространственост, съвременни тенденции*

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**SINGLE SPACE OF THE MAIN LOBBIES – A MODERN TREND IN
THE DESIGN OF PUBLIC BUILDINGS**

Radina Pisarska

Abstract: In modern public buildings there is a tendency towards single space of the main lobbies. The barriers between the areas, serving the visitors, are dematerialized, creating the feeling of wholeness, of a part of the “common” - of the more tangible social function. The unification can also be realized vertically through atrium foyers. There is a desire to achieve more visual and spatial connections in the lobby, turning it into a single "social organism", aiming to prepare the visitor for a type of shared experience according to the main function of the building (exhibition, concert, training, etc.). Based on the analysis of examples from world practice, the report develops the various aspects in the design of single space foyers.

Key words: *public buildings, main lobby, atrium, single space, modern trends*

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1-24. НАСТИЛКИТЕ В ДЕТСКИТЕ ПЛОЩАДКИ ЗА ИГРА – ВИДОВЕ, ПРИЛОЖЕНИЕ И НОРМАТИВИ

Тодор Михайлов¹

Резюме: Изграждането на настилките е едно от най-скъпите пера в парковото строителство. Детските площадки не правят изключение – комплексните задачи в местата за игра поставят пред настилките дори по-високи изисквания, отколкото в повечето други паркови зони.

Проблемът с правилното икономично полагане на настилките е изключително съществен, тъй като голямата част от нараняванията в площадките се дължат падане върху тях, но от друга страна най-често бюджетът за дадена площадка е фиксиран и оптимизирането на това перо може да осигури повече съоръжения за игра или елементи от градския дизайн.

Статията анализира предимствата и недостатъците на основните видове настилки и разглежда основните нормативни изисквания към разполагането на ударопоглъщащи настилки.

Ключови думи: *Детски площадки, Безопасност, Настилки, Игрова стойност, Нормативни изисквания, Проектиране, Изграждане*

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THE FLOORING IN PLAYGROUNDS – TYPES, APPLICATION AND STANDARDS

Todor Mihaylov¹

Abstract: Laying of pavements is one of the most expensive items in park construction. Playgrounds are no exception – the complex tasks in the playgrounds place even higher demands on the floorings than in most other park areas.

The problem of proper design of pavements is extremely significant as most of the injuries in the playgrounds are due to falling on them, but on the other hand most often the budget for a playground is fixed and optimizing it can provide more play equipment or elements of urban design.

The article analyzes the pros and cons of the main types of flooring and discusses the main regulations and standards for shock-absorbing flooring.

Key words: *Playgrounds, safety, floorings, play value, standards, design*

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1-25. ЕЛЕМЕНТИ НА ДЕТСКАТА ПЛОЩАДКА – ИЗПОЛЗВАНЕ И ПРОЕКТИРАНЕ НА ТЕРЕНА

Тодор Михайлов¹

Резюме: Като част от поредица, посветена на различните аспекти и елементи, имащи отношение към проектирането на детските площадки за игра, настоящата статия разглежда терена като основен елемент, определящ вида и състава на съоръженията в тях.

Показани са примери от българската и световната практика за проектиране на площадки при различни теренни дадености. Анализирани са възможни подходи и е направена оценка на възможната игрова стойност при проектирането на местата за игра в зависимост от теренните дадености.

Разгледани са някои проблеми при проектирането, изпълнението, оценката и експлоатацията на площадките за игра върху сложни и динамични терени.

Направена е обща оценка за възможността и потребността от използването на различните теренни особености за обогатяване на цялостната градска среда и детската игра в частност.

Ключови думи: *Детски площадки, Динамичен терен, Игрова стойност, Градска структура, Проектиране*

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ELEMENTS OF THE PLAYGROUND – USE AND DESIGN OF TERRAIN

Todor Mihaylov¹

Abstract: The article focuses on terrain as a key element determining the type and composition of facilities in children's playgrounds.

Case studies in the world practice for designing sites in different terrain are shown. Possible approaches are analyzed and an assessment of playgrounds and their game values depending on the terrain is made. Some problems in the design, implementation, evaluation and operation of playgrounds on complex and dynamic terrains are considered. An general assessment was made of the possibility and need to use the various features of terrain to enrich the overall urban environment and children's play in particular.

Key words: *Playground, terrain, play value, design, urban structure*

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**1-26. ТЕАТЪРА И ТЕАТРАЛНИТЕ ЗАЛИ В 21 ВЕК ИЛИ КАКВИ СА
НОВИТЕ ТЕНДЕНЦИИ ПРИ ПРОЕКТИРАНЕТО**

Яна Лефтерова¹

Резюме: Театралната сграда е сложно архитектурно произведение. За да се изяснят основните проблеми, свързани с проектирането и построяването на един съвременен театър, отговарящ на новите тенденции и диктуващ иновации, е необходимо преди всичко да бъдат изучени и анализирани по-типичните образци от античния театър, а също театрите от близкото минало, допринесли за неговото развитие. В основата на всички проекти последните години е не как да направим сграда, която да покрива нуждите на потребителя днес, а да се създаде сграда отговаряща на потребностите на утрешния ден, да се създаде сграда диктуваща нови тенденции и покриваща най-висок клас енергоефективност.

Ключови думи: театър, нови тенденции, иновации, обществени сгради

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1-27. ИНОВАЦИОННО ПРОЕКТИРАНЕ НА СГРАДИ И ДЕТАЙЛИ

Янко Александров¹

Резюме: В статията са разгледани примери от иновационното проектиране на сгради и детайли, илюстриращи основните положения от теория на иновационните стъпки на автора без и с изобретателско равнище. Анализите на примерите от световни практики са пречупени през основните положения на дисертационния труд на автора: труд на “МОДЕЛИ НА ИНОВАЦИОННИ РЕШЕНИЯ С ИЗОБРЕТАТЕЛСКА СЪПКА, ИЗВЕДЕНИ ЧРЕЗ СТРУКТУРЕН АНАЛИЗ НА ПАТЕНТНИ ПРЕТЕНЦИИ” (на примерни изобретения за изпълнение на елементи за камери на хранилища и хладилни складове). Избраните примери разкриват възможностите за иновационното проектиране без и с изобретателска стъпка, (като неочаквани комбинации между известни и нови технически признаци). Комбинациите са функционално полезни за решението на всяка от поставените задачи.

Ключови думи: *Иновационно проектиране, Сгради, Детайли*

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INNOVATIVE DESIGN OF BUILDINGS AND DETAILS

Yanko Aleksandrov¹

Abstract: The article examines examples of innovative design of buildings and details, illustrating the basics of the theory of innovative steps of the author without and with an inventive step. The analyzes of the examples from world practices are refracted through the main provisions of the author's dissertation work: "Models of innovative solutions with inventive step derived through structural analysis of patent claims" (of exemplary inventions for the implementation of elements for storage chambers and cold stores). The selected examples reveal the possibilities for innovative design without and with an inventive step (as unexpected combinations between known and new technical features). The combinations are functionally useful for solving each of the tasks.

Key words: *innovative design, buildings, detail*

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1-28. АРХИТЕКТУРЕН ОБРАЗ НА ВЕНТИЛАЦИОННИ И КЛИМАТИЧНИ ИНСТАЛАЦИИ В ПРОМИШЛЕНИ СГРАДИ

Ангел Мазников¹

Резюме: Съвременната насока за вентилационни и климатични инсталации в подтиповете промишлени сгради е оптимално постигане на технологични и функционални параметри при максимална енергийна ефективност, опазване на околната среда, и минимални общи разходи. Производствената и складовата структура на сградата и приложената архитектурно–конструктивна система са определящи за вида и обхвата на техническите инсталации – централни и локални. Осигуряването на необходимия микроклимат в работната среда на закритите пространства е базова характеристика за устойчиво развитие на процесите и сградите в промишлеността.

Системното решение на техническите инсталации, като част от взаимосвързаната архитектурна конструкция на сградата, е със съществена роля за дефиниране на общата пространствена композиция. Пълноценното им интегриране в устойчив промишлен обект, участва активно във формирането на естетическо възприятие и художествено въздействие на неговия архитектурен образ в интериора и екстериора.

Ключови думи: *Архитектурен образ, Вентилационна инсталация, Климатична инсталация, Промислена сграда, Технически инсталации, Сградни системи, Архитектурно проектиране, Устойчива архитектура*

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ARCHITECTURAL ISSUES OF VENTILATION AND AIR- CONDITIONING SYSTEMS IN INDUSTRIAL BUILDINGS

Angel Maznikov¹

Abstract: The modern direction for ventilation and air-conditioning systems in subtypes of industrial buildings is the achievement of optimal technological and functional parameters with the achievement of maximum energy efficiency, overall environmental protection, high safety and minimal expenses. The production and warehouse pattern of the building and its architectural structural system determine the type and scope of building services - central and local. Providing the necessary indoor microclimate as an important factor of the working environment is the basis for sustainable development of manufacturing processes and industrial buildings.

The system solution of the technical installations, as part of the architectural structure of premises, has an essential role for defining the general spatial composition. Their full integration into a sustainable industrial building, actively participates in the creation of aesthetic perception and artistic impact of its architectural design.

Key words: *architectural design, ventilation systems, air-conditioning systems, industrial building, production building, warehouse building, building services, special services, architectural expression, sustainable architecture, sustainable design*

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II.

ИЗКУСТВО И ОПАЗВАНЕ НА АРХИТЕКТУРНОТО

НАСЛЕДСТВО

ART AND CONSERVATION OF ARCHITECTURAL

HERITAGE

2-1. URBAN REGENERATION AND CONVERSION OF INDUSTRIAL HERITAGE: ROTERMANN QUARTER IN TALLINN, ESTONIA

Uroš Antić¹

Abstract: The valorization of potentials and limitations of European industrial heritage has become a very important topic in recent years. Historical industrial buildings rarely meet contemporary industry standards, therefore, in order to preserve them as built heritage, it is often necessary to convert them into public, commercial or residential buildings, but also to convert and regenerate the entire industrial site and make it suitable for people of all age and predispositions. The purpose of this research is to understand the value of industrial heritage, but also to understand the necessity of regenerating historical industrial sites in central urban areas. Conversion of industrial buildings into commercial, recreational and housing facilities can benefit the community in several fields, such as education, economy, business and tourism. In this research, a case study of Rotermann Quarter (Rotermann City) in Tallinn, Estonia will be conducted

Keywords: *Industrial heritage, Estonia, Built heritage, Conversion*

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2-2. CHARACTERISTIC OF ROMAN AND LATE ANTIQUITY MORTARS FROM THE AREA OF SARNENA SREDNA GORA MOUNTAIN AND SOUTHERN FOOTHILLS (BULGARIA)

Ventseslav Stoyanov¹, Bilyana Kostova², Boyan Dumanov³, Zhivko
Uzunov³, Boyka Zlateva⁴

Abstract: This work deals with Roman (I–V c) and Late Antiquity (V–VI c) mortars from the area of Sarnena Sredna Gora Mountain and southern foothills (Bulgaria). The Roman samples were taken from the Roman villa complex Chatalka situated near Elhovo village. The Late Antiquity samples were taken from a fortified settlement close to Gorno Novo Selo village. To obtain a better characterization of mortars, they were: (i) attached to the geological setting of the area, and (ii) studied with X-ray fluorescence analysis and powder X-ray diffraction. Rock samples, as possible raw material for mortar preparation, were studied as well. The obtained results show good knowledge of the environment for both archaeological periods (use of local raw materials) and practically unchanged methods of mortar preparation from the Roman age to the Late Antiquity.

Keywords: *mortar, archaeological chemistry, Roman age, Late Antiquity.*

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2-3. PHASE ANALYSIS OF CLAY PLASTER AND POTTERIES FROM HELLENISTIC SETTLEMENT BY THE ORIZARE VILLAGE, BULGARIA

Zhivko Uzunov¹, Boyan Dumanov², Bilyana Kostova³, Ventseslav Stoyanov⁴,
Boyka Zlateva⁴

Abstract: Pottery and clay plaster are one of the first composite materials manufactured and developed by humans. They are the most abundant findings as archaeological artifacts due to their production in a wide time range, simple production process, high weather resistance, and low cost. The study of such materials aims to define the raw components used and parameters of firing process (maximal temperature, firing duration, etc.).

The present study investigated one clay plaster sample and four pottery fragments from Hellenistic settlement, located on a Harmanlaka summit, by the village of Orizare, Bulgaria. The obtained results of samples' powder X-ray analysis, define:
(i) phase composition (in general quartz, feldspar, mica, and hydro-mica);
(ii) firing temperature (three different temperature of ceramic firing - up to 500°C; 600-850°C, and 850-950°C); and
(iii) temperature of wall plaster burning (below 500°C).

Keywords: *Phase analysis, Clay plaster, Pottery, Hellenistic period*

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2-4. ИНТЕРАКЦИЯ МЕЖДУ ИЗКУСТВО И АРХИТЕКТУРА В ПЛОЩАДНОТО ПРОСТРАНСТВО

Александра Иванова¹, Стоян Дечев²

Резюме: Публичното пространство е разгледано в настоящото изследване под формата на площади и знакови пространства в София, места където гражданите се събират, за да споделят културен живот, своеобразна „агора“ на съвременния град. През 2019 година Столична община София реализира конкурс по програма „Навън“ за подкрепа на временни художествени инсталации в градска среда – площадка „Мавзолей“. Спечелилият проект се осъществи през 2020 година в лицето на интерактивната инсталация „Един Човек“ на Венелин Шурелов. Конкурсът на свой ред беше трансформиран от преподавателите художници във ВСУ в задание за разработване на проекти за интеракция между изкуство и архитектура в публичното пространство чрез макети и визуализации на студенти от специалността Архитектура. В изследването е заложено проучване с цел създаване на проекти с подходящо предназначение, стил и изразителност на художественото им внушение. Задачата е продиктувана както от проблемите на архитектурното моделиране, така и от творческото предизвикателство да се използва и осмисли по нов начин предназначението на площадното пространство.

Ключови думи: *Изкуство, Архитектура, Публично пространство*

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INTERACTION BETWEEN ART AND ARCHITECTURE IN THE SQUARE SPACE

Alexandra Ivanova¹, Stoyan Dechev²

Abstract: Public area is considered in the present study in the form of squares and landmarks in Sofia, places where citizens gather to share cultural life, a kind of "agora" of the modern city. In 2019, Sofia Municipality implemented a competition under the program "Outside" to support temporary art installations in an urban environment - "Mausoleum". The winning project took place in 2020 in the form of the interactive installation "One Man" by Venelin Shurelov. The competition, in turn, was transformed by the professors of arts at VSU into a task for the development of projects for interaction between art and architecture in the public area through models and visualizations of students in Architecture. The task includes a study in order to create projects with appropriate purpose, style and expressiveness of their artistic suggestion. The task is dictated both by the problems of architectural modeling and by the creative challenge to use and comprehend in a new way the purpose of the public square space.

Key words: *visual art, architecture, public area*

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2-5. ЕКСПОНИРАНЕ НА МОЗАЙКИТЕ НА ЕПИСКОПСКАТА БАЗИЛИКА В ПЛОВДИВ

Благовеста Иванова¹

Резюме: Анализът представя експонирането и оформянето на музейното пространство в Епископската базилика в Пловдив. Разгледани са начините на създаване на информационна среда като е обърнато специално внимание на детския кът. Мозайките са разположени на две нива и на втория етаж има две зони с познавателен и интерпретативен характер. Те са свързани с интерактивната роля на посетителите. В заключение се налага изводът, че в момента в Епископската базилика в Пловдив е най-добре експонирания паметник на културата в региона.

Ключови думи: *Епископската базилика в Пловдив, Мозайки, Експониране, Дизайн, Интерактивност*

EXHIBITION OF THE BISHOP'S BASILICA MOSAICS IN PLOVDIV

Blagovesta Ivanova¹

Abstract: The analysis presents the exposition and design of the Plovdiv Episcopal Basilica's mosaics in the museum space. The ways of creating the information environment are considered and special attention is take to the children's corner. The mosaics are located on two levels and on the second floor there are two areas of cognitive and interpretative character. They are related to the interactive role of visitors. In conclusion the Episcopal Basilica in Plovdiv is the best exposed cultural monument in the region lately.

Key words: *Episcopal Basilica in Plovdiv, mosaics, exposition, design, interaction*

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2-6. ЦЕНТРАЛНИТЕ СОФИЙСКИ ХАЛИ - ПАМЕТНИК НА КУЛТУРАТА В СЪВРЕМЕННАТА ГРАДСКА СРЕДА

Христина Грозданова¹

Резюме: Централните Софийски Хали без всякакво съмнение са сред най-ценните и красиви, сравнително добре запазени паметници на културата в сърцето на столицата. Макар сградата да е добре позната, броят на проучванията за нея не е голям. Обединяването на запазените и достъпни документи и чертежи в Централния държавен архив, свързани с първоначалния проект на арх. Наум Торбов и с изграждането на сградата, както и анализа на документацията на направената почти 90 години по-късно реставрация и реконструкция, и не на последно място - фотографиите от архива на Регионалния исторически музей-София с промените в интериора през годините, е важно и необходимо. Подобно изследване е особено актуално с оглед на належащата нужда от реставрация и съхраняване на паметника по възможно най-добър начин, съобразно както с настоящите му статут и състояние, така и с нуждите на съвременната градска среда.

Ключови думи: *Централните Софийски Хали, История, Документи, Опазване, Реставрация, Съвременност, Архитектура*

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THE CENTRAL SOFIA MARKET HALL CULTURAL MONUMENT IN URBAN ENVIRONMENT

Hristina Grozdanova¹

Abstract: The central Sofia Market Hall are without a doubt among the most valuable and beautiful, relatively well-preserved cultural monuments in the heart of the capital. Although the building is well known, the number of studies on it is not large. The unification of the preserved and accessible documents and drawings in The Central State Archives, related to the initial project of arch. N. Torbov with the construction, as well as documentation of the restoration and reconstruction made almost 90 years later, and archival photographs from the archives of Regional History Museum-Sofia of the changes in the interior over the years, is important and necessary. Such a study is particularly relevant in view of the urgent need for restoration and preservation of the monument in the best possible way in accordance with its current status and condition, as well as the needs of the modern urban environment.

Key words: *history, documents, preservation, restoration, modernity, architecture*

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III.

СТРОИТЕЛНИ МАТЕРИАЛИ И ТЕХНОЛОГИИ

BUILDING MATERIALS AND TECHNOLOGIES

3-1. PHASE TRANSFORMATION ON CAO-SIO₂-P₂O₅ NATURAL SYSTEM AT HIGH TEMPERATURE TREATMENT

Vilma Petkova¹, Bilyana Kostova², Ventseslav Stoyanov³

The CaO-SiO₂-P₂O₅ system is a part both of ancient and modern cement and ceramic composites, and it is obtained by firing different raw materials. Besides the temperature and duration of firing, the formed phases depend on the gas environment (CO₂ and H₂O), which can be used to solve practical tasks of archaeomineralogy and archaeological chemistry.

In present study a sample of raw material, containing CaO, SiO₂ and P₂O₅ was used. This material was a natural mineral aggregate of smectite, sanidine, quartz, calcite, apatite and plagioclase, and it is originated from Bulgaria. To determine the effects obtained during their treatment at high temperatures various methods were used: chemical analysis, X-ray powder diffraction, Fourier transformed infrared measurements, and Thermal analysis (TG/DTG-DSC).

The results and their analysis show that at high temperature treatment, calcium silicates and calcium silicate-phosphate are obtained. The characteristics of phase transformations can be used in the study of cement and ceramic materials (ancient and modern).

Keywords: *CaO-SiO₂-P₂O₅ system, High temperature treatment, Phase transformation*

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3-2. ОБЛАСТИ НА ПРИЛОЖЕНИЕ НА ТРОШЕН КАМЪК ОТ РЕЦИКЛИРАНИ СТОМАНОБЕТОННИ ТРАВЕРСИ

Румяна Захариева, Дженю Казанджиев

Резюме: Демонтираните и бракувани железопътни стоманобетонни траверси са сред най-големите потоци строителни отпадъци у нас – счита се, че техният брой е около 1 милион. У нас има изследвания и добри практики, свързани с повторната им употреба, но те са сравнително ограничени. Доскоро рециклирането на стоманобетонните траверси се считаше за икономически неизгодно поради необходимостта от усложнена технология за натрошаване и отделяне на стоманената армировка. В настоящата публикация са представени иновативният подход на рециклиране на стоманобетонните траверси и строително-техническите свойства на рециклирания трошен камък. Установено е, че той може да бъде използван за различни строителни цели – за насипи, в пътни основи и като едър добавъчен материал за направата на бетон, като решенията са устойчиво - технически и икономически обосновани и допринасят за опазване на околната среда.

Ключови думи: Рециклиран трошен камък, Бетон, Стоманобетонни траверси

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APPLICATION FIELDS OF CRUSHED STONE FROM RECYCLED REINFORCED CONCRETE SLEEPERS

Roumiana Zaharieva¹, Djeniu Kazandjiev²

Abstract: The dismantled and scrapped reinforced concrete railway sleepers are among the largest flows of C&D waste in our country - it is estimated that their number is over 1 million. In Bulgaria there are some good practices related to their reuse, but this recovery activity is relatively limited. Until recently, the recycling of reinforced concrete sleepers was considered economically unprofitable due to the need for sophisticated technology for crushing and separating steel reinforcement. This study presents the innovative approach to recycling reinforced concrete sleepers and the technical performance of recycled concrete crushed stone. It has been established that this crushed stone can be used for various construction purposes - for embankments, in road foundations and as a coarse concrete aggregate, thus providing sustainable solutions which contribute to both environmental protection and circular economy..

Key words: *C&D waste, sleepers, recycling, crushed stone, aggregate for concrete*

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IV.

СТРОИТЕЛНА МЕХАНИКА

STRUCTURAL MECHANICS

4-1. ИЗСЛЕДВАНЕ ДВИЖЕНИЕТО НА ТОЧКА ОТНОСНО ДРУГА ДВИЖЕЩА СЕ ТОЧКА

Асен Стоянов¹, Теодор Тодоров²

Резюме: Решена е примерна задача от кинематика на точка. Изследването се извършва с приложението Mathcad. Задачата разглежда сложното движение на точка спрямо друга движеща се точка. В статията се определят относителните кинематични характеристики на точка „В“ по отношение на точка „А“. Параметрите се определят за даден момент във времето, както и за период от време.

Ключови думи: *Mathcad, Относителни кинематични характеристики, Траектория на относителното движение*

STUDY OF THE MOTION OF A POINT WITH RESPECT TO ANOTHER MOVING POINT

Asen Stoyanov¹, Teodor Todorov²

Abstract: An example problem of kinematics of a point is solved. The study is performed with the MathCAD application. The problem considers the complex motion of a point relative to another moving point. In the article the relative kinematic characteristics of point “B” with respect to point “A” are determined. The parameters are determined for a given moment in time as well as for a time period.

Key words: *MathCAD, relative kinematic characteristics, trajectory of the relative motion*

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4-2. TEMPERATURE CONDITIONED RESONANCE CLUSTERS IN BRIDGES SUBJECTED TO MOVING LOADS

Alexander Tesar¹, Jozef Melcer²

Abstract: The objective of paper suggested is the analysis of temperature conditioned resonance clusters appearing in scope of dynamic testings of bridges by moving loads. As example is studied the assessment of actual bridge in Bratislava, exposed to such forcing. Presented are the results and final conclusions dealing with security and reliability of the structure.

Keywords: *Bridges, Durability, Moving loads, Resonance clusters, Temperature: variation*

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4-3. ANALYSIS OF THE STRESS AND STRAIN OF DISCRETE SPHERICAL DOME SUBJECTED TO ASYMMETRIC VERTICAL LOAD

Anita Handruleva¹, Simeon Atanasov²

Abstract: This article has studied stress and strain state of discrete spherical dome subjected to unsymmetrical vertical loading. As objects of study are discussed twenty-four models of discrete domes to generate are used frame finite elements. Computational models differ in the type of structural grid. It has been compared with smooth and continuous domes, and for this purpose are constructed three additional models. These domes are generated by shell finite elements with different dimensions of discrete grid. Compliance is a condition of uniformity of the removal of the applied point force, compared with the discrete models. The vertical load is concentrated force applied at different nodes in the radial farms. As a main parameter for comparison of calculation models are selected base reactions. Results are presented in graphical and tabular form.

Key words: *discrete spherical dome, asymmetric load*

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**ИЗСЛЕДВАНЕ НА НАПРЕГНАТОТО И ДЕФОРМИРАНО
СЪСТОЯНИЕ НА ДИСКРЕТНИ СФЕРИЧНИ КУПОЛИ,
ПОДЛОЖЕНИ НА НЕСИМЕТРИЧНО ВЕРТИКАЛНО
НАТОВАРВАНЕ**

Анита Хандрулева¹, Симеон Атанасов²

Резюме: В тази статия е изследвано напрегнатото и деформирано състояние на дискретни сферични куполи, подложени на несиметрично вертикално натоварване. Като обекти на изследване са разгледани двадесет и четири модела на дискретни куполи, за генерирането на които са използвани frame крайни елементи. Изчислителните модели се различават по вида на структурната решетка. Направена е и съпоставка с гладки непрекъснати куполи, като за целта са изградени три допълнителни модела. Споменатите куполи са генерирани с shell крайни елементи с различна размерност на дискретизационната мрежа. Съблюдавано е условието за еднаквост на преместването на приложната точка на силата, съпоставено с дискретните модели. Вертикалното натоварване е концентрирана сила, която се прилага в различни възли по радиалните ферми. Като основен параметър за съпоставка на изчислителните модели са избрани опорните реакции. Резултатите са представени в графичен и табличен вид.

Ключови думи: дискретни сферични куполи, несиметрично натоварване

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4-4. ANALYSIS OF SPACE TRUSSES SUBJECT TO SEISMIC EFFECTS. MANAGEMENT OF DYNAMIC RESPONSE

Anita Handruleva¹, Simeon Atanasov²

Abstract: Dynamic parameters as natural frequencies and modes of vibration are important indicators for the dynamic response of structures due to seismic excitations. These parameters are a basis the amplitude values of displacements and internal forces to be calculated. The modal analysis can be treated as a preliminary step for further dynamic studies, such as: spectral analysis, harmonic or periodic analysis and analysis due to arbitrarily loads (time history analysis). In this paper the dynamic responses of space trusses are studied. As objects of study are selected four representatives. An orthogonal structure of the grid on the upper and lower surfaces is accepted. The models differ in the type of supporting. The analysis was conducted in two stages: modal and spectral analysis. In the modal analysis is observed coefficient of effective modal mass and type of natural forms of vibration. The seismic action is defined by three independent components (two horizontal and one vertical) with 100% response spectrum. The purpose of the study is to manage the dynamic response of the d space trusses.

Key words: space trusses, seismic effect, management of dynamic response

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4-5. FROM THE PAST INTO THE FUTURE - DESIGN AND CONSTRUCTION USING THE EXAMPLE OF AXIAL COMPRESSION SHELL BUCKLING

Hartmut Pasternak¹, Zheng Li², Andreas Jäger-Cañás³

Abstract: Modern steel construction is greatly influenced by the pursuit of building material efficient and sustainable structures. The way from beginning of shell design, starting with Lorenz and Timoshenko at the beginning of the 20th c. to the current Eurocode took 100 years. A new development are ring-stiffened shells, built as a combination of very thin plates with strong ring stiffeners. The plates are prone to failure by axial buckling. However, the ring stiffeners greatly reduce the susceptibility to a loss of stability by axial buckling failure. Nowadays, this combination has received limited attention in research and practice. In this paper, small specimen experimental series are carried out to calibrate numerical models. These shells are manufactured by welding of two half-cylindrical shells and the ring stiffeners are spot welded to the cylindrical shell. The measured 3D geometric imperfection information is directly imported into the numerical model based on a mapping relationship and the buckling tests are recalculated by means of geometrically and materially nonlinear analysis with imperfection. The results indicate that the simulated buckling resistance is very close to that of the test. Furthermore, influence of the ring-stiffener parameter, including imperfection amplitude, radius over thickness ratio, geometry of ring stiffener on the buckling load and knockdown factor is discussed.

Keywords: *Design of shells, stability, ring-stiffened shells, imperfections, silos, tanks*

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4-6. THE VAULTED COVER OF RIVER SCHELDT AS PART OF THE ZOLLIKOFE-DE VIGNE PLAN IN GHENT

Philippe Van Bogaert¹

Abstract: In 1880 the city council of Ghent (Belgium) and the Compagnie Immobilière de Belgique signed a contract that would allow to reshuffle the Southern part of the city, by demolishing many smaller roads as well as unhealthy houses. The city would fund all infrastructure, whereas the Compagnie would purchase all property and be able to auction the new residences to be built. The plan intended to ease access from the city centre to the southern railway station, which was demolished in 1930. The plan was designed by the architect Edmond De Vigne and the Swiss engineer Edouard Zollikofer. The general idea was to establish wide roads from the Belfrey and Cathedral place to the station and to build 4 floor high residences. Neither the Compagnie nor the city council cared much about new homes for the people being expelled.

Part of the plan was to cover river Scheldt, which is running through the city. This was inspired by the big cities of Europe, creating more space and covering waterways as these were suspected to bring the XIXth century diseases cholera and typhoid along with the odour of the petrified water. Hence, the François Laurent place was created. It is supported by a double vaulted brickwork structure of 2 8m spans. Some of the original drawings still exist, as well as a photograph taken during the construction.

As the city wanted to renew the tramway bed across this cover, a detailed inspection of the structure was carried out. The latter revealed several weaknesses in the vaults and local defects. Consequently a more detailed analysis was carried out, to determine the load carrying capacity of the structure. In addition, some cracks were found at the extrados of the vaults near the abutments. The analysis was based both on a multi-block body mechanism as well as on elastic behaviour. Both processes have shown the structure, including its defects, shows sufficient safety to correspond to resist presently required design loads. Nevertheless, the owner was invited to proceed to some refurbishments in order to prevent further degradation of the structure's condition.

Keywords: *19th century views en urban development, Covering waterways in cities, Brickwork vaulted covers, Vault resistance to traffic, 3-D effect in long brickwork vaults*

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4-7. ARCH BUCKLING CONDITIONS, DUE TO AXIAL ROTATION AT LIMITED TORSIONAL STIFFNESS AT THE SPRINGS

Philippe Van Bogaert¹

Abstract: The connection of springs to concrete abutments is of paramount importance for the load carrying capacity of arch bridges. At this location the various reactions from the bridge superstructure are transferred to the abutments. The most important reaction is the arch thrust force, together with the vertical reactions. Whether bending moments are transferred to the infrastructure at the arch springs, depends on the use of hinges or clamping. The fabrication of hinges certainly is more complicated than complete clamping of arch springs. In most cases, the concept of the arch spring connections corresponds to clamping and bending moment transfer.

The connection can be made either by prestressing bars or by connectors. In both options, the torsional stiffness is substantially reduced, compared to the full arch cross sectional area. The influence of this lack of torsional stiffness on arch buckling is being researched, both numerically and experimentally. To reduce any residual stress during tests, wooden rods that simulate the arch were submerged in water and subsequently bent to the desired shape. Imperfections of the arch samples are measured. Two unequal concentrated loads are applied to the samples, thus simulating the effect of movable loads across half of the arch span. During loading, lateral deflections were measured until elastic buckling occurred. The simulation of more flexible rotation of the springs required replacing the cross section by thin equivalent side plates. Since all parameters have not been isolated, the results are limited yet. However, comparing the failure load of similar conditions, the reduction of torsion stiffness by 81.48% reduces the failure load by 26.3%. This indicates that total prevention of axial rotation may not be imperative for arch bridges and encourages to continue this research, in future by using a material with more constant characteristics.

Keywords: *Arch spring, Arch buckling load, Connections, Scaled tests, Nonlinear calculation.*

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4-8. COMPARISON BETWEEN ANALYTICAL AND NUMERICAL SOLUTIONS OF ONE-DIMENSIONAL, NON-STATIONARY WAVE PROPAGATION IN A VISCOELASTIC LAYER

Sergey Pshenichnov¹, Radan Ivanov², Maria Datcheva³

Abstract: Materials exhibiting hereditary properties are widely used in modern technology. One important aspect in the study of non-stationary wave processes in viscoelastic bodies is the verification of the ability of the FEM to model particular dynamic problems by comparing analytical solutions, wherever available, to their numerical counterparts. In this work, an analytical solution of the P-wave propagation through a viscoelastic layer subjected to a triangular stress pulse applied on the surface, is compared to the solution of the same problem obtained by a FE simulation using explicit dynamic analysis. It is shown that for the regular exponential hereditary kernels used in the study, the time-dependent elastic properties of the material can be represented by a Prony expansion of only one term and the Prony parameters can be directly related to the parameters of the kernels. On the other hand, as direct specification of parameters is not possible for the singular kernel used in the study, it is shown that again a single-term Prony series representation is adequate, whereby the parameters are obtained by curve fitting. Time-histories of normal stress in the direction of wave propagation at specific locations were obtained by both methods for a number of values of the Poisson ratio and compared. An excellent match is demonstrated for the wave propagation velocities and the shape of the stress spikes. A good match is demonstrated for the magnitude of the spikes and the apparent damping of the wave motion. In terms of FE modelling, a beam model, 3D-solid model and a plane-strain model were tried and the results obtained were practically identical.

Keywords: *Exponential kernels, Prony series, Explicit dynamic analysis*

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4-9. FRACTURE ANALYSIS OF CORNER JOINTS OF PVC WINDOW FRAMES

Zlatka Geshkova¹, Veselin Iliev¹, Radan Ivanov²

Abstract: Under normal operating conditions, structures made of welded profiles, such as PVC window frames, work together with the glazing and these two parts can be considered as a composite planar structure. However, before installation the two parts are transported separately, so it is necessary to secure them against static and dynamic transport loads. One of the most vulnerable locations of the window frames is the corner joints of its profiles. While for the thermal characteristics of these products a number of researches exist, research on their mechanical behavior is scarce. Detailed research of the total structure-load system and the fracture behavior is possible with the help of numerical modeling and computer simulation. The present article offers a methodology for the establishment of a model for numerical simulation of fracture behavior of UPVC window frames and identification of the parameters of the model related to the material characteristics. The methodology is based on the Cohesive Zone Model with maximum normal contact stress and contact gap at the completion of debonding as material characteristics of the model. Numerical experiments have been performed following the adopted methodology, varying the material characteristics, while the maximum stress at the tip of the crack and the crack status are monitored. The results obtained can be used in the identification of missing values of material characteristics and verification of models with similar features.

Keywords: *Fracture Analysis, UPVC Frames, Numerical Simulation*

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**4-10. ДИНАМИЧНО ИЗСЛЕДВАНЕ НА ПРАВИ ГРЕДИ С
ПРОМЕНЛИВО НАПРЕЧНО СЕЧЕНИЕ ПО ДЪЛЖИНАТА ИМ**

Димитър Лолов¹, Светлана Лилкова-Маркова²

Резюме: В статията са представени резултатите от динамично изследване на запъната греда с правоъгълно напречно сечение, чиято широчина се изменя по квадратна функция на осовата му координата. Решението е извършено като е трансформирано диференциалното уравнение описващо напречните трептения в матрично уравнение от първи ред.

Ключови думи: Греда, Собствени трептения, Кръгова честота

**DYNAMIC INVESTIGATION OF STRAIGHT BEAMS WITH
VARIABLE CROSS-SECTION OVER THE LENGTH**

Dimitar Lolov¹, Svetlana Lilkova-Markova²

Abstract: The article presents a dynamic study of a cantilever beam with a rectangular cross section, the width of which varies to the square function of the axial coordinate. The differential equation for the function of transverse displacements is rewritten into a first order matrix equation.

Key words: beam, natural vibration, circular frequency

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4-11. FINITE ELEMENT SIMULATION OF TENSILE TEST ON STEEL SAMPLES

Zhan Zhelev¹

Abstract: The article is devoted to the study of deformation of a steel sample when subjected to a controlled tension. The focus of the ANALYSIS is to obtain:

1. Engineering stress – engineering strain curve of the material that is as close as possible to the experimental curve obtained during the tensile test in the laboratory.
2. True stress - true strain output curve that is as close as possible to the input curve for the material.

All of the simulations of tensile testing are conducted in LS-DYNA. Comparison between samples with different types of element and mesh sizes is presented.

Key words: *Tensile test, FEA, Stress - strain curve, Necking*

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4-12. ДИНАМИЧНО РЕАГИРАНЕ НА КОНЗОЛНА СТОМАНОБЕТОННА ГРЕДА, ПОДЛОЖЕНА НА ХАРМОНИЧНО ВЪЗДЕЙСТВИЕ

Илиана Стойнова¹, Симеон Атанасов²

Резюме: Механичните вибрации върху конструктивните елементи могат да бъдат от различен произход - причинени от машини, породени от ударно въздействие, от действието на двигатели и др. В тази статия е изследвано поведението на конзолна стоманобетонна греда под действието на хармонично въздействие. Представени разликите между статичния и динамичния анализ на стоманобетонна греда със статическа схема конзола. Разработен е числен модел с програмен продукт, базиран на Метода на крайните елементи. За изследване на поведението на гредата е използван time-history анализ. Динамичното въздействие е приложено в свободния край на конзолната греда като товарния печат е с размери 25/25 см.

Ключови думи: *Динамичен анализ, Хармонично въздействие, Конзолна греда*

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DYNAMIC RESPONSE OF A REINFORCED CONCRETE CANTILEVER BEAM SUBJECT TO HARMONIC LOADS

Iliana Stoynova¹, Simeon Atanasov²

Abstract: The mechanical vibrations on the structural elements can be of different origin - caused by machines, caused by impact, by the action of engines and others. This article discusses the behavior of a cantilever reinforced concrete beam under the action of harmonic influence. The differences between the static and dynamic analysis of a reinforced concrete beam with a static cantilever scheme are presented. A numerical model with a software product based on the finite element method has been developed. Time history analysis was used to study the behavior of the beam. The dynamic impact is applied at the free end of the cantilever beam and the load seal is 25/25 cm.

Key words: *Dynamic analysis, harmonic analysis, cantilever R/C beam*

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4-13. СЕИЗМИЧЕН „TIME HISTORY“ АНАЛИЗ НА ЗАСИПАН ДЪГОВИДЕН СТОМАНОБЕТОНОВ ПЪТЕН МОСТ

Константин Казаков¹, Лена Михова², Дончо Партов³

Резюме: Направено е изследване на сеизмичната реакция на конструкцията на съоръжението от три знакови земетресения в района на Балканския полуостров – Вранча 1976г., Каламата 1986г., Перник 2012г., представени чрез акселерограми. Съставен е числен модел по МКЕ със софтуера Plaxis 2D, включващ мостовата конструкция и област от околния почвен масив, с демпферни опори по контура, които поглъщат в достатъчна степен сеизмичните вълни и симулират безкрайното полупространство на земната основа. За моделиране на почвата е използван съвременният еласто-пластичен конститутивен модел с уякчаване HSsmall, който борави с голям брой материални параметри и отчита деградацията на G- модула на почвата при динамично натоварване. За адекватно отчитане на затихването на трептенията в почвената среда, в модела се въвежда допълнително вискозно затихване от 5% по Rayleigh. Направен е сравнителен анализ на динамичните „time history“ решения от трите земетресения, както и съпоставка с псевдостатично земетръсно решение, регламентирано като подход в Еврокод 8.

Ключови думи: МКЕ, Конститутивен модел HSsmall, Акселерограма, PGA, G-модул

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SEISMIC TIME HISTORY ANALYSIS OF BURIED ARCH REINFORCED BRIDGE

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Abstract: Seismic response of the bridge's structure is studied. Three representative strong earthquakes for the Balkan Peninsula are considered – Vrancea 1976, Kalamata 1986, Pernik 2012. Dynamic analysis is performed using time history of acceleration for the input motion. FE model by the Plaxis 2D software is created of the soil-structure interaction. Dashpots are applied as supports of the soil body for simulation of the infinite soil space in the numerical analysis. The Hardening-Soil-Small (HSS) constitutive model is used for the soil. This constitutive model is a new scientific achievement which works with more than ten material parameters and can describe the mechanical behavior of the soil with a high accuracy. The most important feature of the HSS model is the determination of the soil stiffness degradation during the earthquake. Additional Rayleigh's viscose damping of 5% is applied to the soil. Seismic time history analysis of the bridge structure is compared with the pseudostatic analysis involved in the Eurocode 8.

Key words: *FEM, constitutive model HSsmall, earthquake, time history analysis, PGA, acceleration, G-modulus of the soil*

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4-14. ВЪРХУ ДВУСТРАННО ЗАПЪНАТАТА ДЪГА С ПРОМЕНЛИВА ДЕБЕЛИНА

Лилия Б. Петрова¹

Резюме: Изследвана е дъга с променливо напречно сечение от ключа към опорите. Дъгата е двустранно запъната, с опори на едно и също ниво и с криволинейно очертание. Дъгата е три пъти статически неопределима. Височината на напречното сечение в произволна точка от оста на дъгата се определя от условието за изменение на напречното сечение от ключа към опорите. Приложен е методът на крайните елементи (МКЕ). Изследването е извършено автоматизирано. Възлите на дискретизираната система са разположени през равни хоризонтални разстояния. Всеки от елементите на дъгата се приема праволинеен и с постоянна височина на напречното сечение. Анализите са извършени при подходяща дискретизация. Определени са преместванията и усилията в дъгата при произволно натоварване. Построени са линии на влияние за усилията в сечения от дъгата. Направени са анализ и сравнение на получените резултати.

Ключови думи: *Двустранно запъната дъга, Променлива дебелина, Криволинейно очертание, Метод на крайните елементи*

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ON THE BILATERAL FIXED ARC WITH VARIABILITY THICKNESS

Liliya B. Petrova¹

Abstract: It is investigated an arc with variable cross sections from the key to the supports. The arc is fixed at both ends, with the supports at the one - same level and with curvilinear outline. The arc is three static undetermined. The height of the cross section in an arbitrary point of her axis to determine from the condition for changes of the section from a key to the supports. The method of finite element (FEM) is applied. The investigation is made automated. The joints of the discretisation system are distributed trough equal horizontal distance. Each of the elements of the arc to accept straightlinear and with constant height of the cross section. The analysis are made with equal discretisation steps. The displacements and forces in the arc is determined under arbitrary loading. The forces lines influences in the sections of the arc are constructed. It is made the analysis and comparisons of the results obtained.

Keywords: *bilateral fixed arc, variable thickness, curvilinear outline, finite element method.*

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4-15. УРАВНЕНИЯ ОТ ТРЕТА СТЕПЕН – РЕШЕНИЕ

Лилия Б. Петрова¹

Резюме: Разгледани са възможности за аналитично решение на уравнение от трета степен и анализ на решението. По приведените начини за решение на уравнението, в зависимост от коефициентите, са решени и представни примери. Уравнения от трета степен намират приложение например в механиката на носещите конструкции.

Ключови думи: Уравнения от трета степен, Аналитично

EQUATIONS OF THIRD DEGREE – SOLUTION

Liliya B. Petrova

Abstract: It is examine the possibilities for the analytical solution of the equation of third degree and an analysis of the solution. On the produced manner for solution of the equation, in depending of the coefficients, are solved and presenting examples. Equations of third degree have an application, for example, in the mechanics oh the carrier constructions.

Keywords: equations of third degree, analytical solution

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**4-16. ОТНОСНО РАЗРАБОТВАНЕТО НА ЕКВИВАЛЕНТЕН
РАМКОВ МОДЕЛ ЗА НЕЛИНЕЕН СЕИЗМИЧЕН АНАЛИЗ НА
ЗИДАНИ СГРАДИ И ПРИЛОЖЕНИЕТО МУ В БЪЛГАРСКАТА
ПРОЕКТАНТСКА ПРАКТИКА ЧАСТ I (ТЕОРЕТИЧЕН
ПОДХОД)**

Петър Греков¹, Антон Гороломов², Дончо Партов³,
Гаetano Пианессе⁴

**ABOUT DEVELOPMENT OF AN EQUIVALENT FRAME MODEL FOR
THE NONLINEAR SEISMIC ANALYSIS OF MASONRY BUILDINGS
AND ITS APPLICATION IN BULGARIAN DESIGN PRACTICE PART I
(THEORETICAL TREATMENT)**

Petar Grekov¹, Anton Gorolomov², Doncho Partov³ and
Gaetano Pianesse⁴

Abstract: For design of new masonry buildings and assessment and retrofitting of existing ones, in last time effective tools for seismic analysis of such types of buildings requires reliable nonlinear models. Performance based assessment is in last decades is mainly oriented now to the use of nonlinear analysis methods, thus their capability to simulate the nonlinear response, in particular in case of masonry buildings, is crucial. Among the different modelling strategies proposed in literature, the equivalent frame approach seems particularly attractive, since it allows the analysis of complete 3D buildings with a reasonable computational effort, suitable also for practice engineering aims. Moreover, it is also expressly recommended in several national and international codes. Within this context, the paper presents the solutions adopted for the implementation of the equivalent frame model in the TREMURI program for the nonlinear seismic analysis of masonry buildings in Italy and its application in one study case in Bulgaria.

Ключови думи: Masonry buildings, Equivalent frame, Nonlinear analysis methods

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**4-17. ОТНОСНО РАЗРАБОТВАНЕТО НА ЕКВИВАЛЕНТЕН
РАМКОВ МОДЕЛ ЗА НЕЛИНЕЕН СЕИЗМИЧЕН АНАЛИЗ НА
ЗИДАНИ СГРАДИ И ПРИЛОЖЕНИЕТО МУ В БЪЛГАРСКАТА
ПРОЕКТАНТСКА ПРАКТИКА ЧАСТ-II (ЧИСЛЕНА РЕАЛИЗАЦИЯ)**

Петър Греков¹, Антон Гороломов², Дончо Партов³,
Гаetano Пианессе⁴

**ABOUT DEVELOPMENT OF AN EQUIVALENT FRAME MODEL FOR
THE NONLINEAR SEISMIC ANALYSIS OF MASONRY BUILDINGS
AND ITS APPLICATION IN BULGARIAN DESIGN PRACTICE PART-
II (NUMERICAL EXPERIMENTS)**

Petar Grekov¹, Anton Gorolomov², Doncho Partov³ and
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Abstract: For design of new masonry buildings and assessment and retrofitting of existing ones, in last time effective tools for seismic analysis of such types of buildings requires reliable nonlinear models. Performance based assessment is in last decades is mainly oriented now to the use of nonlinear analysis methods, thus their capability to simulate the nonlinear response, in particular in case of masonry buildings, is crucial. Among the different modelling strategies proposed in literature, the equivalent frame approach seems particularly attractive, since it allows the analysis of complete 3D buildings with a reasonable computational effort, suitable also for practice engineering aims. Moreover, it is also expressly recommended in several national and international codes. Within this context, the paper presents the solutions adopted for the implementation of the equivalent frame model in the TREMURI program for the nonlinear seismic analysis of masonry buildings in Italy and its application in one study case in Bulgaria.

Ключови думи: *Masonry buildings, Equivalent frame, Nonlinear analysis methods*

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4-18. ГРАФИЧЕН МЕТОД ЗА ОПРЕДЕЛЯНЕ НА ЯДРОТО НА НАПРЕЧНО СЕЧЕНИЕ

Светлана Лилкова-Маркова¹, Теодор Тодоров²

Резюме: Решението на редица практически задачи е свързано с построяване на ядрото на сечение. В статията са представени два примера за прилагане на графичния метод за тази цел. Обосновани са неговите предимства за случаите, когато сечението няма ос на симетрия и когато в очертанията му има изпъкнала крива. За реализация е приложен програмният продукт AutoCAD.

Ключови думи: Ядро на сечение, Графичен метод

GRAPHICAL METHOD FOR DETERMINING THE CORE OF A CROSS SECTION

Svetlana Lilkova-Markova¹, Teodor Todorov²

Abstract: Solving a variety of practical problems requires the determination of the core of a cross section. In the article two examples for application of the graphical method are demonstrated for this purpose. Its advantages are substantiated for the cases when the section has no axis of symmetry and when there is a convex curve in its outline. The AutoCAD software product is applied for realization.

Key words: core of a section, graphical method

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V.

ФУНДИРАНЕ И ГЕОТЕХНИКА.

ПЪТНО И ЖЕЛЕЗОПЪТНО СТРОИТЕЛСТВО.

FOUNDATION AND GEOTECHNICS.

ROAD AND RAILWAY CONSTRUCTION.

**5-1. ПРОУЧВАНЕ И ИЗСЛЕДВАНЕ НА ИЗПОЛЗВАНИТЕ
МАТЕРИАЛИ ЗА ИЗГРАЖДАНЕ НА СТОМАНЕНИ МОСТОВЕ
В ПОСЛЕДНИТЕ 150 ГОДИНИ**

Мартина Благоева¹

**RESEARCH AND INVESTIGATION OF THE MATERIALS USED FOR
THE CONSTRUCTION OF STEEL BRIDGES FOR THE LAST 150
YEARS**

Martina Blagoeva¹

Abstract: 331 steel bridges with a total length of 11201.70 m and a total area of 356409 m² are operated in the railway infrastructure of the Republic of Bulgaria. In order to conduct an adequate analysis of their structural behavior, it is necessary to establish the main mechanical characteristics of the respective old steels from which the facilities are built.

This publication examines and analyzes the materials used in the old steel bridges, the development of materials over time and their application in bridge construction. The development of the properties and characteristics of steels and how this affects the constructive behavior is presented. The experimental study of material from a dismantled old riveted bridge with I-beam structure, built in 1930, is presented.

Ключови думи: Old steel bridges, Materials, Iron, Steel, Inspection, Testing

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**5-2. АНАЛИЗИРАНЕ НА ВЗАИМОДЕЙСТВИЕТО МЕЖДУ
ГОРНОТО СТРОЕНЕ НА ЖЕЛЕЗНИЯ ПЪТ И МОСТОВИ
КОНСКРУКЦИИ ПРИ БАЛАСТОВО И БЕЗБАЛАСТОВО
ПРЕМИНАВАНЕ НА ЖЕЛЕЗНИЯ ПЪТ**

Цветан Благоев¹

**ANALYSIS OF THE INTERACTION BETWEEN RAILWAY TRACK
AND BRIDGE STRUCTURES IN CASE OF BALLAST AND
BALLASTLES CROSSING OF THE RAILWAY**

Tsvetan Blagoev¹

Abstract: The interaction between the superstructure of the railway and the bridge structures is not always easy to assess adequately. However, it is of great importance for determining the effects of the rolling stock on the superstructure of the bridge as well as on its substructure (reaction on bearings). In the case of continuously welded rails, it is appropriate to take into account the additional forces arising in the rails from the temperature difference between the bridge and the rails, as well as the additional stresses in the rails caused by braking and traction forces. It is also appropriate to take into account the effects of the rotation of the bridge at its bearings. These additional stresses should not exceed the permissible in the norms for the respective impact.

In the present article two bridge structures with small and medium spans are investigated, for which the interaction between the superstructure of the railway and the bridge structures at ballast and ballast crossing is taken into account.

Ключови думи: *Ballasted track, Ballastless track, Interaction, Continuously welded rails, Bridge*

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5-3. ИЗСЛЕДВАНЕ НА ЕФЕКТИТЕ ОТ ВНЕДРЯВАНЕ НА ВИСОКО ЕЛАСТИЧНИ ПОДЛОЖКИ НА СКРЕПЛЕНИЯТА ПРИ БАЛАСТОВ И БЕЗБАЛАСТОВ ЖЕЛЕЗЕН ПЪТ

Цветан Благоев¹

INVESTIGATION OF THE EFFECTS OF IMPLEMENTATION OF HIGHLY ELASTIC FASTENING RAIL PADS ON BALLASTED AND BALLASTLESS RAILWAY TRACK

Tsvetan Blagoev¹

Abstract: Nowadays the requirements of geometry of railway track are very high. The operational velocity, intensity of traffic and axle load of rolling stocks increase at the time as well as the requirement of the travel comfort. This necessitates more and more intensive maintenance of the railway lines in the ever shorter windows for repair works.

Various railway administrations are implementing modern structures and methods, such as a monolithic track, pads under the sleepers, more elastic fasteners, frequent grinding of the rail heads, etc., in order to reduce the adverse effects of the impact of the rolling stock on the track.

In the present article an analysis of the implementation of a slab track system is made. The implementation of different elastic rail pads in the transition zone between ballast and ballastless track, as well as in the conventional ballast system is analyzed.

Ключови думи: *Ballasted track, Ballastless track, Transition zone, Fastening system, Highly elastic rail pad*

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VI.

СТРОИТЕЛНИ КОНСТРУКЦИИ

BUILDING STRUCTURES

6-1. A NUMERICAL APPROACH FOR STRENGTHENING BY TIES EXISTING RC STRUCTURES TO AVOID PROGRESSIVE COLLAPSE UNDER SEISMIC SEQUENCES

A.Liolios¹, D. Partov², K. Liolios³, T. Tsalkatidis⁴, B. Folic⁵

Abstract: The present study deals with a numerical approach, which concerns the computational seismic analysis of framed reinforced concrete (RC) structures under the removal of some columns and the so-induced requirement of a strengthening by ties (tension only elements). As well-known, existing RC buildings are sometimes subjected to obligatory removal of some structural element-members, e.g. columns, and so to the risk of a progressive collapse. In order to avoid such a progressive collapse, especially under seismic sequences, a modification of the structural response and a redistribution of internal actions can result to a requirement for strengthening the remaining structure after the removal of the degraded elements. The unilateral behaviour of these cable-ties, which can undertake only tension, is strictly considered, and the response of the remaining structure strengthened by ties is computed under seismic sequences. Finally, in a practical case of an old framed RC structure, the effectiveness of the proposed methodology is shown.

Keywords: *Progressive collapse, Removal of columns, Strengthening by ties, Seismic sequences*

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6-2. ABOUT THE CURVED ORTHOTROPIC BRIDGES AROUND THE WORLD AND ITS APPLICATION IN BULGARIAN DESIGN PRACTICE

Doncho Partov¹, Hartmut Pasternak², Alfred Mangus³, Yvona Kolekova⁴, Lazar Georgiev⁵

Abstract: The focus of this article is the discussion about conceptual solutions, an overview of the fundamental issues or choices in practicable curved orthotropic bridges. This paper describe successful curved bridges built around the world. Many owners of such type of the bridges think, that orthotropic steel bridges are too challenging to design and offer little benefit. The advantages of large piece erection of orthotropic steel decks will be demonstrated. Closed box girders have high torsional resistance at economical costs. Case histories show that the low weight orthotropic option is desirable, and floating, lifting, launching and moving with multi-wheeled trailers will be discussed. Curved bridges are necessary in many natural and urban bridge sites. Curved orthotropic bridges are very efficient in handling torsional forces thus pedestrian bridges have been built taking advantage of large piece erection techniques.

Keywords: *Curved orthotropic bridges, Closed box girders*

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6-3. MECHANICAL ANALYSIS OF A HERITAGE STRUCTURE IN THE CITY CENTER OF SOFIA

Gaetano Pianese¹, Nicola Chieffo², Antonio Formisano³, Doncho Partov⁴

Abstract: Recent earthquakes have highlighted worldwide the high seismic vulnerability of the structures, in particular of the old masonry buildings. The scope of vulnerability analysis is to assess the propensity at seismic damage of buildings. In this perspective, the proposed research aims at estimating the seismic vulnerability of a historical building in a district of Sofia in Bulgaria and to improve the seismic behavior with retrofitting interventions. The building of study is a structure of 1908, located on the boulevard “Knyaginya Maria Luiza”, near the women market and the Bania Bashi mosque and it belongs to the group of heritage structures in Sofia.

A mechanical analysis has been performed through non-linear analysis, using the 3Muri software (S.T.A.data srl, 2017) and the expected damage has been estimated in terms of fragility curves. The analysis has shown the poor seismic performance of the building, so to require a structural retrofitting intervention with carbon fiber-reinforced polymers sheets and reinforced plaster aiming at improving its seismic capacity.

Keywords: *Vulnerability assessment, Masonry building, Heritage buildings, Mechanical analysis, Fragility curves, Seismic retrofitting*

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**6-4. MODELING AND CALCULATING OF CREEP IN HARDENED
CONCRETE ACCORDING ACI 209R-92, CEB MC90-99, GL2000
AND BAZANT&BAWEJA B3 MODELS (GENERAL AND
THEORETICAL APPROACH-PART I)**

Konstantin Kazakov¹, Chavdar Stoyanov², Doncho Partov³

Abstract: To predict the strength and serviceability of reinforced, composite steel-concrete and prestressed concrete structures, the structural engineering requires and appropriate description of the mechanical properties of the materials, including the prediction of the time-dependant strains of the hardened concrete. The prediction of creep is important to assess the risk of concrete cracking, the migration of stresses from the concrete to steel part of the reinforced composite structures, which cause the additional deflections in such type of structures. As discussed in above mentioned provisions, however, the mechanical properties of concrete are significantly affected by the temperature and availability of water during curing, the environmental humidity and temperature after curing, and the composition of the concrete, including the mechanical properties of the aggregates. Among the time – dependant properties of concrete that are of interest to the structural engineer, loss of moisture to the environment, and the creep under sustained load. Drying before loading significantly reduces creep, and is a major complication in the prediction of creep, stress relaxation, and strain recovery after unloading. While there is a lot of data on compressive creep, not much data are available for creep recovery, and very limited data are available for relaxation and tensile creep. Creep under variable stress and the stress responses under constant or variable imposed strains are commonly determined adopting the principle of superposition. The limitation of this assumption are discussed in this paper. The prediction of capabilities of the four creep compliance models were evaluated by comparing calculated results using example of steel concrete composite beam from bridge practice.

Keywords: *Serviceability, Creep compliance models, Prediction of creep, Steel-concrete composite beam, Migration of stresses*

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**6-5. MODELING AND CALCULATING OF CREEP IN HARDENED
CONCRETE ACCORDING ACI 209R-92, CEB MC90-99, GL2000
AND BAZANT&BAWEJA B3 MODELS (GENERAL AND
THEORETICAL APPROACH-PART II)**

Konstantin Kazakov¹, Chavdar Stoyanov², Doncho Partov³

Abstract: To predict the strength and serviceability of reinforced, composite steel-concrete and prestressed concrete structures, the structural engineering requires and appropriate description of the mechanical properties of the materials, including the prediction of the time-dependant strains of the hardened concrete. The prediction of creep is important to assess the risk of concrete cracking, the migration of stresses from the concrete to steel part of the reinforced composite structures, which cause the additional deflections in such type of structures. As discussed in above mentioned provisions, however, the mechanical properties of concrete are significantly affected by the temperature and availability of water during curing, the environmental humidity and temperature after curing, and the composition of the concrete, including the mechanical properties of the aggregates. Among the time – dependant properties of concrete that are of interest to the structural engineer, loss of moisture to the environment, and the creep under sustained load. Drying before loading significantly reduces creep, and is a major complication in the prediction of creep, stress relaxation, and strain recovery after unloading. While there is a lot of data on compressive creep, not much data are available for creep recovery, and very limited data are available for relaxation and tensile creep. Creep under variable stress and the stress responses under constant or variable imposed strains are commonly determined adopting the principle of superposition. The limitation of this assumption are discussed in this paper. The prediction of capabilities of the four creep compliance models were evaluated by comparing calculated results using example of steel concrete composite beam from bridge practice.

Keywords: *Serviceability, Creep compliance models, Prediction of creep, Steel-concrete composite beam, Migration of stresses*

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6-6. EXPERIMENTAL TESTS OF CONNECTORS FOR TIMBER - CONCRETE COMPOSITE STRUCTURES

Lukáš Velebil¹, Petr Červený², Jan Jochman³, Petr Kuklík⁴, Robert Jára⁵, Jan
Pošta⁶, Martin Hataj⁷

Abstract: The stiffness and strength of the connectors between the timber and concrete part of the cross-section have a great influence on the load-bearing capacity of the timber-concrete composite structures. The connection parameters can be described by the shear strength and the slip modulus of the connectors used and determined by push-out tests. This paper presents the experimental results of 47 push-out tests performed on three types of connectors: pressed punched metal plates, glued metal plates, and screws with plate-shaped heads. The specimens further differed by a concrete slab which was made of either conventional strength grade concrete reinforced with steel mesh, or high-performance concrete reinforced with carbon reinforcement, basalt reinforcement, or dispersed steel fibers. The value of maximum load-bearing capacity, slip between timber and concrete, and failure mode was analyzed for all specimens and summary results were discussed. The obtained results showed high shear strength and stiffness of the connectors and proved their possible use for timber-concrete composite structures.

Keywords: *Timber-concrete composite structure; Punched metal plate connectors; Screw connectors; Push-out tests; Shear strength; Slip*

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6-7. ASSESSMENT AND VULNERABILITY OF MASONRY BUILT HERITAGE

Radomir Folic¹, Nadja Kurtovic Folic², Milos Cokic³

Abstract: Masonry structures are very vulnerable under seismic effects. These constructions very often represent structures of architectural heritage, so they require special treatment in maintenance and their management. These masonry structures are also the subject of many research projects in which many aspects are considered, especially those related to vulnerability assessment, condition assessment and design proposals of interventions on buildings. In that sense, it is important to ensure the appropriate safety of the construction, but also to preserve their authentic architectural values because they represent historical evidence. This paper discusses few evaluation methodologies for assessing the situation with comparative analysis. The emphasis is on old masonry structures (stone and brick ones) without special reinforcements with reinforced concrete (RC) vertical elements. The constructions of arches, vaults and domes, which are integral parts of the built heritage constructions, will also be considered. Newer assessment methodologies will be also analyzed, such as: displacement-based approach for the vulnerability evaluation, design intervention, proposed in PERMATURE (European) Project and performance-based design. Application and validation of the methodology to a case study will be explained. The purpose of the paper is to formulate appropriate recommendations for assessing the condition and evaluation of the vulnerability of masonry monuments representing built heritage that would lead to its seismic risk mitigation.

Keywords: *Built heritage, Masonry Structures, Assessment, Vulnerability, Methodology*

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6-8. ASSESMENT OF ENGINEERING DESIGN AND TECHNICAL INNOVATION OF STAMBOLOV'S BRIDGE IN VELIKO TARNOVO

Radosveta Kirova-Delcheva¹, Doncho Partov²

Abstract: The historical monument Stambolov's bridge in Veliko Tarnovo, which features outstanding architectural design and innovative Pratt- truss single-spanned, open spandrel arch iron structure an innovative truss structure as well as cutting-edge technology of installation is left without maintenance for almost thirteen decades. The cultural monument, which contributes essentially to the extraordinary atmosphere in the historical part of the Bulgarian touristic centre, deserves the focus of the scholarship as well as adequate rehabilitation.

Key words: *statically determinate Pratt-truss, single-span arched open-spandrel iron riveted bridge, joint-rod, Stefan Stambolov, Veliko Tranovo, historical environment*

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**6-9. ОПРЕДЕЛЯНЕ НА КОРАВИНАТА В РАВНИНАТА НА ЗИДАНА
СТЕНА, УСИЛЕНА С ВЕРТИКАЛНИ ИВИЦИ ОТ FRP
МАТЕРИАЛИ**

Антон Гороломов¹, Анита Хандрулева², Петър Греков³

**CALCULATION OF THE IN-PLANE STIFFNESS OF A MASONRY
WALL, STRENGTHENED BY VERTICAL FRP STRIPES**

Anton Gorolomov¹, Anita Handruleva², Petar Grekov³

Abstract: A formula for calculation the in-plane stiffness of a masonry wall, strengthened by vertical (and if needed horizontal) FRP stripes is investigated in this study. This formula can be used in computer modeling of such structures – definition of bending stiffness modifiers

Ключови думи: *Stiffness, Strengthening with FRP, Strengthening of masonry structures*

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6-10. АНАЛИЗ НА ВЛИЯНИЕТО НА АРМИРАНЕ ВЪРХУ УСТОЙЧИВОТО ПОВЕДЕНИЕ НА НЕУКРЕПЕНИ ДЪГОВИ СТОМАНОБЕТОННИ ЕЛЕМЕНТИ НАТОВАРЕНИ ИЗВЪН РАВНИНАТА СИ

В. Николов¹, Д. Димитров²

Резюме: Дъговите конструкции са изключително ефективни за преодоляване на средни и големи подпорни разстояния. Поради това те намират все по-голямо приложение в разнообразно конструктивно решение, например в мостови конструкции. Съвременната дъгова конструкция имат стройна форма с висока прецизност на изпълнението и със значителна редукция на материала. Това води до значителното влияние на устойчивостта като критерий за носимоспособност. Един от ключовите фактори за поведението на стоманобетонни елементи е тяхната степен на армиране. Целта на представените анализи е да се покаже значението на степента на армиране върху поведението на стоманобетонни дъгови елементи, които са натоварени извън равнината си. Направено е сравнение на комплексни модели с различна степен на армиране и с приложението на МКЕ.

Ключови думи: *Дъги, Устойчивост, Метод на крайни елементи, МКЕ*

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**ANALYSIS OF THE EFFECTS OF CONCRETE REINFORCEMENT
OVER STABILITY OF UNBRACED REINFORCE CONCRETE ARCH
ELEMENTS LOADED OUTSIDE OF THEIR PLANE OF REFERENCE.**

Vasil Nikolov¹, Dimitar Dimitrov²

Abstract: Arch structures are extremely efficient for spanning over average to high distances. Due to that they find more widespread used in different structural designs, bridge construction for example. Modern arch structures have slender form with precise manufacturing and significant material quantities reductions. That leads to major influence over the stability of the structure capacity as design criteria. One of the key factors of the behaviour of reinforced concrete elements is the amount of provided reinforcement. The aim of the presented analysis is to quantify the significance of the reinforcement over the behaviour of reinforced concrete arch elements, loaded out of their plane of reference. Comparison analyses are made with complex models with different reinforcement ratio and with application of FEM.

Key words: *Arches, Stability, Finite Element Method, FEA*

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6-11. ГЕОТЕХНИЧЕСКИ ПРОВЕРКИ НА ПЪТНИ НАСИПИ В СЪОТВЕТСТВИЕ С НОРМАТИВНАТА БАЗА И ПРОЕКТНИ МЕРКИ ЗА ТЯХНОТО УДОВЛЕТВОРЯВАНЕ

Лена Михова¹

Резюме: Извършват се проверки на насипи на автомагистрала у нас по крайни гранични състояния (ULS) и експлоатационни гранични състояния (SLS) съгласно Еврокод и действащата Наредба за проектиране на пътища от 2018г. Проверява се устойчивостта на откосите при основна и земетръсна комбинация на натоварване. При върха на насипа се определят абсолютните и относителни деформации в напречно направление на пътя. Деформациите на насипите се получават при отчитане на консолидацията на земната основа при наличие на НПВ в рамките на активната зона на слягане. За целта се прилага 1D теорията на Терцаги за филтрационна консолидация. За удовлетворяване на изискванията на нормативната база се предвиждат алтернативни здравителни мерки за насипите – заскалявка на откосите и основата на насипите, влагане на геомрежи в тялото на насипа, химическо здравяване на основата. Направен е анализ на различните вариантни решения на насипите.

Ключови думи: *Пътни насипи, Устойчивост на откоси, Слягане, Консолидация, Заздравяване, Геомрежи*

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**GEOTECHNICAL CHECKS FOR ROAD EMBANKMENTS
ACCORDING TO THE CODES AND DESIGN MEASURES TO THEIR
SATISFACTION**

Lena Mihova¹

Abstract: Ultimate Limit States (ULS) and Serviceable Limit States (SLS) geotechnical design for motorways' embankments is performed according to Eurocode and Bulgarian standard for road design/2018. Checks of slope stability at basic and seismic load combinations are made. Settlements of embankments and ground are determined taking into account the process of soil consolidation in the cases of high water level. For this purpose the Terzaghi's consolidation theory is applied. Different strengthening measures are undertaken to satisfy the requirements of the codes – building of a rock layer at the base of the embankment, using of geogrids, chemical strengthening of the soil. Analysis is made of alternative design conceptions.

Key words: *road embankment, slope stability, settlement, soil consolidation, strengthening of the soil, geogrid*

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6-12. НЯКОИ ПРИНЦИПИ ПРИ СТРОИТЕЛНО- КОНСТРУКТИВНОТО ПРОЕКТИРАНЕ НА СТОМАНОБЕТОННИ РЕЗЕРВОАРИ ЗА ВОДА

Станислав Цветков¹, Георги Янчев²

Резюме: Напоследък, строителството на стоманобетонни резервоари за вода започна постепенно да се „събужда“. Техничко-икономическите и архитектурно-конструктивните особености на подобен тип конструкции, представляват изискване, което определя формата и тяхната функционалност. Наред с изпълнението, задължителен аспект е и автоматизираното строително-конструктивното проектиране.

В доклада са показани основни начини за компютърно моделиране на резервоари със специализиран софтуер. На база вариантни решения са сравнени стойности на разрезни усилия и е предложен метод за инженерен анализ и проверки.

Докладът има за цел – ефективното конструиране на армировките за съоръжението, от гледна точка на адекватното използване на определен програмен продукт, както и предпоставките, заложиени в изготвянето на изчислителен модел.

Ключови думи: *Стоманобетонен резервоар, Софтуер по МКЕ, Разрезни усилия, Армировки*

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SOME PRINCIPLES IN THE DESIGN OF REINFORCED CONCRETE WATER TANKS

Stanislav Tsvetkov¹, Georgi Yanchev²

Abstract: The technical-economic and architectural-structural specifics for a similar type of structures, are representing requirements that determine the format and their functionality. Along with the implementation, the obligatory aspect is the automated construction design. The report aims at - the effective solutions of bars of reinforcement, by terms of adequate use of a particular software product, as well as the prerequisites in the preparation of a computational model.

Key words: *R.C. water tank, FEM software, internal forces, reinforcing bars*

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6-13. „УКРЕПВАЩИТЕ“ ВРЪЗКИ ПРИ СТОМАНОБЕТОННИТЕ КОНСТРУКЦИИ НА СГРАДИТЕ

Станислав Цветков¹

Резюме: Укрепващите връзки при сградите са основен конструктивен елемент, от който зависят: устойчивостта, коравината и деформативността на главните антисейсмични конструкции. Не само сградите от сглобяеми (монтажни) елементи имат необходимост от укрепване, а и монолитните. Това е показател, който довежда до въпроси, свързани с избор на напречни сечения и конфигурация на системите.

В доклада, чрез параметрични анализи, са разгледани, както „класическите“ решения със стоманени елементи, така и използването на стоманобетонни елементи, изпълняващи укрепваща функция.

Представените решения имат задачата да покажат картина на стойностите на усилия и премествания в самите връзки, чрез които да се даде едно по-нататъшно смислено конструиране.

Ключови думи: укрепващи връзки, стоманобетонни сгради, софтуер по МКЕ, разрезни усилия и премествания/провисвания.

Ключови думи: Укрепващи връзки, Стоманобетонни сгради, Софтуер по МКЕ, Разрезни усилия и премествания/провисвания

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STABILITY LINKS IN REINFORCED CONCRETE STRUCTURES OF BUILDINGS

Stanislav Tsvetkov¹

Abstract: The stability links in buildings are the main structural element on which they depend: the stability, stiffness and deformability of the main anti seismic structures. The report, through parametric analyzes, examines the "classic" solutions with steel elements. The presented solutions have the task to show a picture of the values of internal forces and displacements in the links themselves, through which to give a further meaningful construction.

Key words: *stability connections, reinforced concrete buildings, FEM software, internal forces, displacement*

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**6-14. ПРЕДПАЗНИ СТЕНИ НА МАГИСТРАЛА „ЕВРОПА” –
АСПЕКТИ НА НАТОВАРВАНЕ И ОРАЗМЕРЯВАНЕ**

Явор Михов¹, Лена Михова²

Резюме: В настоящето изследване се разглежда натоварването и оразмеряването на конструкцията на предпазна мрежа за птици и шумозащитна стена – самостоятелни или комбинирани. Конструкцията на стените се състои от регулярно разположени по дължина на стената вертикални метални стойки, които в зависимост от геоложките условия се фундират с плоски фундаменти или с пилоти. Вторият тип фундиране е целесъобразен и при разположение на стената върху новоизграден пътен насип. Натоварването на връхната конструкция включва собствено тегло, вятър и обледяване. За предпазните мрежи натоварването от обледяване се приема съгласно стандарта BDS ISO 12494, 2018 г. (Атмосферно обледяване на строителни конструкции). Поради липса на карта за райониране на България относно обледяване на конструкции е направена експертна оценка за класа на обледяване на съоръжението според съдържащата се в посочения стандарт петстепенната скала.

Ключови думи: Шумозащитни стени, Мрежа за птици, Вятър, Клас на обледяване, Пилоти

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**PROTECTIVE WALLS ALONG THE MOTORWAY EUROPE –
ASPECTS OF LOADING AND DESIGN**

Yavor Mihov¹, Lena Mihova²

Abstract: The loading and design of protective walls against birds and traffic noise are considered. Two structures are presented – a single wall and a multipurpose wall. The structures involve row of steel columns which works for the actions of the wall – self weight, wind loading and ice deposit. The loading of ice deposit is determined according to the standard BDS ISO 12494/2018 (Atmospheric icing of structures). Single or pile foundations of the columns are performed depending on the geological conditions. Because of lack of map of ice classes in Bulgaria an expert estimation of the ice loading of the considered walls is made.

Key words: *protective walls, traffic noise, grid against birds, wind action, loading of ice, ice class, pile foundation*

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VII.

СЕЙСМИЧНО ИНЖЕНЕРСТВО

EARTHQUAKE ENGINEERING

**7-1. СРАВНЕНИЕ НА СЕИЗМИЧНОТО РЕАГИРАНЕ НА ГРЕДОВИ
МОСТ С ЕЛАСТОМЕРНИ И ТРОЙНО ТРИЕЩИ СЕ ИЗОЛАТОРИ
ОТ МАХАЛОВИДЕН ТИП (TFPB)**

Александър Илиев¹, Димитър Стефанов², Димитър Димитров³

**COMPARISON BETWEEN ELASTOMERIC AND TRIPLE FRICITION
PENDULUM BEARING (TFPB) EARTHQUAKE RESPONSE OF
REINFORCED CONCRETE BEAM TYPE**

Alexander Iliev¹, Dimitar Stefanov², Dimitar Dimitrov³

Abstract: Earthquake events pose significant risk to the infrastructure and civil structures. One option to mitigate earthquake induced damages and failure is through seismic isolation. There are many devices at the market nowadays, but friction bearings are believed to offer some advantages over the rubber bearings. The main objective of this paper is to investigate the differences in the dynamic response of a reinforced concrete bridge with elastomeric and triple friction pendulum bearings (TFPB). The case study bridge is an existing 7 spans, 154m long reinforced concrete beam type bridge. To evaluate the seismic response of the bridge, time history analysis is performed using the finite element software ETABS. Based on the results it is concluded that triple friction pendulum bearing (TFPB) realize higher earthquake reduction of shear forces, bending moments in the columns and accelerations at the top of structure, compared to the elastomeric bearings and provides reliable choice for eventual seismic strengthening of the bridge.

Key words: *Triple friction pendulum bearing, Concrete bridge, Earthquake response*

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VIII.

ОРГАНИЗАЦИЯ НА СТРОИТЕЛСТВОТО

CONSTRUCTION ORGANIZATION

8-1. APPLICATION OF THE MONTE CARLO METHOD FOR THE DYNAMIC PLAN DEVELOPMENT

Biljana Matejević-Nikolić¹, Lazar Živković¹, Jelena Malenović-Nikolić²

Abstract: Planning of construction works is usually done by applying the conventional critical path method (CPM). This method uses deterministic quantities to estimate the duration of the project, which is not the case in practice. The only thing that is certain about the project completion date calculated by the traditional CPM method is that it will be wrong. Even assuming that the schedule of activities is in line with best practice and that estimates of duration of activities are reasonable or calculated on the basis of norms and standards of work, internal norms or extensive experience on previous similar projects, there is a high probability that the project will not be completed according to plan. This happens because every project is subject to uncertainty and risk. Unlike the Critical Path Method, the Monte Carlo method is a technique that provides more accurate estimates of activity duration using mathematical calculations that take uncertainty into account. The Monte Carlo method relies on a random calculation of values that fall into a certain probability distribution over a large number of simulations. This paper presents the application of the Monte Carlo method for the development of a dynamic plan for the execution of works on a short example. The same example was done by applying the traditional Critical Path Method for the purpose of comparative presentation. Comments are given based on a comparison of these two methods for making dynamic plans for construction works.

Keywords: *Critical path method, Monte Carlo method, Risk, Dynamic plan.*

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8-2. PLANNING WITHIN CONSTRAINED RESOURCE

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Abstract: The mostly used planning methods, such as the Critical Path Method (CPM) and Program Evaluation and Review Technique within in all their variants, Activity on the Arrow, Activity on the Node and Precedence Diagramming, do not support synchronized planning accomplishment of construction works and planning of resources utilization. Planning using these methods is based on the availability of unlimited resources, which in practice is rarely the case. In order to accomplish realistic plans, constrained amount of resources are often shared and used for more activities and even more projects at the same time. Since it is planned without considering the availability of resources, there is over allocation available amount of resources, so it is had to apply a leveling method. An activity is, usually, move within its available float, which is not extending deadline or it such an allocation of resources that satisfy given constraint, the corresponding prolongation of the project. There are numerous attempts to develop methods that will be in addition to technological, and include the resource dependency. In this paper, beside review of research on this issue, there is a short example of display problems with possible solution.

Keywords: *Planning, Constrained resource, Allocation, Float.*

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8-3. APPLICATION OF THE CONTINUOUS METHOD WITH GANTRY CRANE ON RAILWAY RECONSTRUCTION

Jelena Dimitrijević¹, Zlatko Zafirovski², Biljana Matejević³, Marko Milijić⁴

Abstract: There are several applicable methods for railway reconstruction. This work presents continuous method with gantry crane on the specific railway route Svrljig-Knjaževac. It is shown how adaptable continuous method can be in a long gorge with lot of series tunnel-bridge. At great length there were no other approaching roads but railway itself. The route is characteristic, with difficult conditions for machine approach and work. Mentioned method provided good results, but there were some situations that could not be resolved by it. These problems are solved under favour of contractor practise. Other available methods are mention for comparison, with short explanation of their characteristics.

Keywords: *Railway reconstruction, Continuous method, Gantry crane, Svrljig Knjaževac*

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8-4. ОРГАНИЗАЦИЯ И УПРАВЛЕНИЕ ПРИ ИЗПЪЛНЕНИЕ НА ОКАЧЕНИ ФАСАДНИ СИСТЕМИ

Валентин Вангелов¹

Резюме: Организацията и управлението при изпълнение на окачени фасадни системи е комплексна и важна задача, стартираща още на ранен етап, а именно работно проектиране, но все още не прилагана в пълният си обхват в България. Необходимостта от структуриран подход е породена от факта, че в процеса участват голям брой специалисти с различни направления, както и от взаимовръзката между отделните строителни процеси, свързани пряко или косвено с изпълнение на окачени фасадни системи.

С цел успешно управление на цялостния процес е необходимо да се изготви организационен план, както и методи за контрол върху качеството на изпълнение.

Настоящият доклад структурира методологията по прилагане организационния подход, като са отчетени ползите при прилагането му и нуждата от промени в обхвата и съдържанието на инвестиционните проекти. Целта на изследването е да допринесе за повишаване нивото на организация и управление, и използването на тези знания за подобряване на процеса по изпълнение на окачени фасадни системи.

***Ключови думи:** Организация, Управление, Строителен процес, Окачени фасадни системи*

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MANAGEMENT AND ORGANIZATION IN THE IMPLEMENTATION OF CURTAIN WALL SYSTEMS

Valentin Vangelov¹

Abstract: The organization and management in the implementation of curtain wall facade systems is a complex and important task, starting at an early stage, namely working design. The need for a structured approach is due to the fact that the process involves a large number of specialists from different fields, namely architect-designer, design engineer, structural engineer, persons exercising safety and health control, as well as contractors of construction works related to specific systems.

In order to successfully manage the entire process, it is necessary to prepare an organizational plan, including a schedule for the sequence of construction works, as well as methods for quality control of performance. The development of an organizational plan aims to provide a complete picture of the implementation of the production process on the construction site.

Quality control is performed through a quality plan in construction, which is based mainly on structuring and carrying out inspection actions and testing plans. The quality control methodology aims to avoid the occurrence of anomalies / pathologies by ensuring that the requirements for efficiency and quality are met. During the construction, general inspections are made, common to all types of curtain wall facade systems, in order to ensure adequate working conditions and inspection of the construction works.

Key words: *curtain wall systems, organization, managements, plan, quality control*

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**8-5. ИДЕНТИФИЦИРАНЕ НА РИСКОВИ СЪБИТИЯ ПРИ
ВЪЗЛАГАНЕ НА ОБЩЕСТВЕНИ ПОРЪЧКИ**

Йордан Караиванов

**IDENTIFICATION OF RISK EVENTS WHEN AWARDING PUBLIC
PROCUREMENTS**

Yordan Karaivanov

Резюме: Докладът анализира идентификацията от управлението на риска при възлагане на обществени поръчки за строителство. Обобщени са основните рискове при провеждане на обществени поръчки на базата на реални примери и добри практики. Изведени са препоръки и са предложени конкретни мерки, предотвратяващи негативните последици от възможните рисковете при тръжни процедури.

Ключови думи: *Идентифициране, Управление на риска, Обществени поръчки, Строителство.*

**8-6. МЕТОДИ ЗА УПРАВЛЕНИЕ НА РИСКА ПРИ ВЪЗЛАГАНЕ НА
ОБЩЕСТВЕНИ ПОРЪЧКИ ЗА СТРОИТЕЛСТВО**

Йордан Йорданов Караиванов

**METHODS FOR RISK MANAGEMENT WHEN AWARDING PUBLIC
PROCUREMENTS IN CONSTRUCTION**

Yordan Karaivanov

Резюме: Докладът анализира методите и техниките за управление на риска при възлагане на обществени поръчки за строителство. Чрез практически примери и сравнителен анализ са обобщени препоръки за прилагане на методи и техники, чрез които управлението на рисковете е максимално ефективно.

Ключови думи: *Методи, Управление на риска, Практически примери, Препоръки*

8-7. СЪВРЕМЕННИТЕ ПРОБЛЕМИ ПРЕД СТРОИТЕЛНИЯ БРАНШ

Я. Иванов, А. Янакиева

Резюме: През последните две години строителния бранш работи в условията на пандемия COVID -19 и изпитва редица затруднения при доставките на материали, управлението на процесите, а така също и в ограниченията при контактите. Едновременно с това в ход е и дигитализацията. Браншът е един от основните работодатели в ЕС и има решаващо значение за постигане на целите на устойчивото развитие. В тези условия с пълна сила важи констатацията за изключителна роля на инженерството в отрасъла, за което ЮНЕСКО в своя инженерен доклад, представен на 4. 03.2021 г. по случай Световния ден на инженера в служба на устойчивото развитие, отбелязва „ самото инженерство трябва да се трансформира, за да стане по – иновативно, приобщаващо, кооперативно и отговорно”. Браншът има и задължението да изпълнява и приетия Професионален кодекс на инженерите от Световната федерация на инженерните организации (WFEO) “ Принципи за адаптиране към изменението на климата”, което включва и участието ни в намалението на емисиите на CO₂ с което ще съдействаме и за изпълнението на Зелената сделка на ЕС и за превръщане на Европа в първия независим от климата континент.

Посочените по – горе нови изисквания налагат и промени в подготовката на специалисти за строителството, при което имаме и задължение да спазваме Европейската харта за специалистите.

В доклада се анализират проблемите, които поставят тези изисквания, както и ролята на браншовите организации и държавната администрация при решаването на проблемите.

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CONTEMPORARY PROBLEMS FACING THE CONSTRUCTION INDUSTRY

Yatchko Ivanov¹, Ana Yanakieva²

Abstract: Over the past two years construction industry has been operating in a contest of COVID 19 pandemic and has experienced several difficulties in supplying materials, the management of processes, as well as contacts. At the same time, digital §and is critical for achieving sustainable goals and restart of the economy. In these conditions, the constant applies to the area for which UNESCO is noted that engineering “itself must be transformed to make it more innovative, attached and responsible” [1]. The Branch also must comply with the adopted Professional Code of Engineers of the World Federation of Engineering Organizations (WFEO) [2]. The new requirements also require changes in the preparation of specialists in construction, which we also must comply with the European Charter of specialists.

Report analyses the problems that place these requirements as well as the role of industry, organizations, government, and public administration in solving the problems.

Key words: *COVID -19, construction branch, sustainable development, education*

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IX.

БЕЗОПАСНОСТ И СИГУРНОСТ В СТРОИТЕЛСТВОТО

SAFETY AND SECURITY IN CONSTRUCTION

**9-1. АНАЛИЗ НА НЯКОИ СПЕЦИФИЧНИ ИЗИСКВАНИЯ ЗА
ОСИГУРЯВАНЕТО НА ДИХАТЕЛНАТА ЗАЩИТА ПРИ
ОБУЧЕНИЕ И ПРОВЕЖДАНЕ НА ОСНОВНИТЕ ДЕЙНОСТИ
НА ОРГАНИТЕ ЗА ПОЖАРНА БЕЗОПАСНОСТ И ЗАЩИТА
НА НАСЕЛЕНИЕТО**

Митко Ненов¹

Резюме: В работата се анализират някои от специфичните нормативни изисквания и се предлагат целесъобразни решения за осигуряването на дихателната защита в процеса на обучение и при провеждане на основните дейности на органите за пожарна безопасност и защита на населението.

**ANALYSIS OF SOME SPECIFIC REQUIREMENTS FOR ENSURING
RESPIRATORY PROTECTION IN TRAINING AND CONDUCTING
THE MAIN ACTIVITIES OF FIRE SAFETY AND CIVIL PROTECTION
AUTHORITIES**

Mitko Nenov¹

Abstract: The report analyzes some of the specific regulatory requirements and proposes appropriate solutions for providing respiratory protection in the training process and in carrying out the main activities of the fire safety and civil protection authorities.

Key words: *Requirements, respiratory protection, air breathing apparatus.*

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9-2. ИЗСЛЕДВАНЕ ВЪРХУ ОПТИМИЗИРАНЕ ПРОЦЕСА НА СЕРВИЗНОТО ОБСЛУЖВАНЕ НА ПОЖАРОГАСИТЕЛИТЕ

Митко Ненов¹, Костадин Иванов

Резюме: В работата се анализират някои от изискванията за експлоатационните изпитвания и поддържането на противопожарното оборудване и се правят препоръки за прилагане на решения с цел повишаване безопасността на експлоатационния персонал.

RESEARCH ON OPTIMIZATION OF THE PROCESS OF SERVICE OF FIRE EXTINGUISHERS

Mitko Nenov¹, Kostadin Ivanov²

Abstract: The report considers the existing situation and offers an opportunity to optimize the activity of filling in, keeping and storing the documentation, and hence the whole process of servicing the fire extinguishers.

Key words: *optimization, process, service, fire extinguishers.*

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9-3. КОНТРОЛ НА ДЕБИТА НА ПОЖАРНИ ХИДРАНТИ ПО ВРЕМЕ НА ЕКСПЛОАТАЦИЯ

Свилена Арабаджиева

Резюме: Докладът представя кратък анализ на организацията на контролните дейности по време на проектирането и експлоатацията на пожарни кранове в Република България. Преглед на методите за определяне на дебита и нормативните изисквания за проверка на пожарни хидранти в други страни: Германия - член на ЕС, Великобритания - бивш член на ЕС, Русия и Беларус - страни, с които Република България има сходни подходи за пожарна безопасност, САЩ - държава с различни подходи.

Ключови думи: *Пожарна безопасност, Пожарни хидранти, Измерване на дебит*

FIRE HYDRANTS FLOW CONTROL DURING EXPLOITATION

Svilena Arabadzhieva

Abstract: The article reviews the legislative and other requirements for maintenance of fire hydrants and control of their water flow. Analysis of the specific requirements, the special equipment, the different formulae and the scientific base for the control of the water flow of the fire hydrants has been performed.

Key words: *fire hydrants, water flow, exploitation, maintenance and control*

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X.

**УСТОЙЧИВО СТРОИТЕЛСТВО И ЕКОЛОГИЧНА
СИГУРНОСТ**

**SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL
SECURITY**

10-1. EARLY WARNING SYSTEMS FOR THE TRANSPORT ENGINEERING AREA

Boyko Ranguelov¹, Atanas Mangarov², Elka Radeva⁴, Simeon Panev⁵, Blagovest Panev⁶, Ina Antonova⁷, Philip Philipoff³, Diana Bankova⁸, Dimo Dimov⁹

Abstract: The report presents an early warning system against earthquakes of the conceptual design of the tunnel under the Shipka Pass. Bulgaria gives many victims on the roads - those killed in traffic crashes and accidents. In the case of tunnel facilities in seismic areas, chain accidents in tunnel pipes are particularly dangerous. Early warning systems for tunnels make it possible to immediately stop traffic by the traffic police, to include additional ventilation equipment and to reserve lighting installations.

Keywords: SARS-CoV-2; Insurance System; Early Warning Systems against Earthquakes; Tunnel Structures; Crisis Management

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10-2. ENVIRONMENTAL HAZARDS BY RAILWAY EMISSIONS TO SOIL AND WATER RESOURCES

Jelena Dimitrijević¹, Dragan Milićević², Slaviša Trajković³

Abstract: There is justified concern regarding environmental pollution by various models of transport. For a long time, the pollution of the environment from the railway was considered insignificant, until some of the more modern research showed that it was not so. Railway operations, both in the past and today, increase the possibility of pollution due to the drainage of water from the railway belt into the drainage canals and the environment. Pollutants in such water can be of different origin and composition. It is necessary to pay more attention on the railway impact on surface and groundwater quality. In order to properly perform certain research regarding the impact of railway traffic on the quality of groundwater and surface water, it is necessary to understand how water moves in nature and how it comes in contact with the railway. The task presents some types of pollutants and measurement results with their share in pollution. Soil and water tests for this researching purpose are very rare. In this way, the opinion that the railway slightly pollutes the environment was refuted.

Keywords: *Railway drainage, Railway hazards, Soil pollution, Water pollution*

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10-3. АНАЛИЗ РАЗХОДИ-ПОЛЗИ И УСТОЙЧИВО СТРОИТЕЛСТВО

Борис Сачански¹, Жулиета Манчева²

Резюме: Прилагането на анализ „разходи-ползи“ (АРП) (Cost-Benefit Analysis (CBA)) позволява да се оцени инвестицията в сграда, проектирана по начин, който минимизира използването на суровини през целия ѝ жизнен цикъл, като намалява негативното влияние върху околната среда и повишава икономическата устойчивост на проекта. Настоящият доклад дефинира различните стъпки при изготвянето на АРП в контекста на характеристиките на устойчивото строителство. Целта на изследването е да се систематизират предимствата на АРП като аналитичен инструмент при изграждане на устойчиви сгради и ползите от практическото му прилагане.

Ключови думи: *Разходи, Ползи, Инвестиция, Жизнен цикъл, Строителен проект, Сграда, Устойчиво развитие*

COST-BENEFIT ANALYSIS OF CONSTRUCTION PROJECTS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Boris Sachansky¹, Julieta Mancheva²

Abstract: The cost-benefit analysis (CBA) application allows the investment analysis of a building designed in a way that minimises the resources usage throughout its life cycle, thus reducing the negative impact on the environment and increasing the economic sustainability of the project. This report defines the different steps in the preparation of CBA in the context of sustainable construction. The purpose of the study is to systematize the advantages of CBA as an analytical tool in the construction of sustainable buildings and the benefits of its practical application.

Key words: *costs, benefits, life-cycle, investment, sustainable, building, environment*

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10-4. ОКАЧЕНИ ФАСАДНИ СИСТЕМИ И УСТОЙЧИВО СТРОИТЕЛСТВО

Валентин Вангелов¹

Резюме: Сред технологиите за постигане на стандартите за устойчиво строителство се нареждат окачените фасадни системи с вградени фотоволтаични инсталации, соларни колектори, вентилационните системи и др.

Качествата и функционалностите на фасадната обвивка дават отражение и определят редица параметри на сградните инсталации, като например инсталираните мощности за отопление, охлаждане, вентилация и осветление, които пряко влияят върху инвестиционния и експлоатационния разход на сградите. Енергийните съображения са основната движеща сила на новите разработки във фасадната индустрия: необходимостта от спестяване на енергия, изолация срещу топлина и студ, мерки за съхранение на енергия, както и алтернативите за генериране на енергия.

Настоящият доклад анализира връзката между окачените фасадни системи и устойчивото строителство, като са отчетени ползите и икономическата ефективност при прилагането им, както и технологичните разработки във фасадната индустрия. Целта на изследването е да допринесе за по-добро разбиране влиянието на фасадната технолигия върху устойчивото строителство и използването на тези знания за подобряване на процеса на прилагане на окачени фасадни системи.

Ключови думи: *Устойчиво строителство, Фасадна индустрия, Технология, Окачени фасадни системи*

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CURTAIN WALL FACADE SYSTEMS AND THEIR CONTRIBUTION TO SUSTAINABLE CONSTRUCTION

Valentin Vangelov¹

Abstract: The main idea of sustainable construction is to ensure a healthy and safe life in the buildings of the people who inhabit them, so requirements and norms have been introduced for all stages of the life cycle of sites - from design to demolition. Less harmful emissions, less resource consumption, greater use of renewable and natural resources, cleaner air inside and outside.

The curtain wall facade system qualities and functionality reflect and determine a number of parameters of building installations, such as installed capacity for heating, cooling, ventilation and lighting, which directly affect the investment and operating costs of buildings. Photovoltaic installations for generating electricity or solar collectors for hot water can be used for active use of solar radiation. System solutions have been developed that allow their integration into the facade construction.

Energy considerations are the main driving force of new developments in the facade industry: the need to save energy, insulation against heat and cold, energy storage measures, and alternatives for energy generation.

Key words: *curtain wall systems, sustainable construction, environment, adaptive facade*

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10-5. РЕЗУЛТАТИ ОТ ПРОУЧВАНЕ СРЕД ПОТРЕБИТЕЛИ ЗА ИЗПОЛЗВАНЕТО НА СИСТЕМАТА ЗА РАЗДЕЛНО СЪБИРАНЕ НА ОТПАДЪЦИ ОТ ОПАКОВКИ В ГР. СТАРА ЗАГОРА

Виктория Гецова¹, Ралица Берберова¹

Резюме: Разделното събиране и последващо рециклиране на отпадъците са в основата на тяхното съвременно управление. Голяма част от битовите отпадъци са т. нар. „масово разпространени отпадъци”, сред които са отпадъците от опаковки. Нормативната уредба на европейско и национално ниво залага конкретни цели за справяне с този проблем. Разделното събиране се осъществява чрез общините посредством организации по оползотворяване на отпадъци от опаковки, които изграждат системи за разделно събиране. В основата на ефективното функциониране на тези системи са гражданите. Целта на настоящата работа е да представи резултати от анкетно проучване сред потребители на системата за разделно събиране на отпадъци от опаковки в град Стара Загора за установяване на тяхната информираност и нагласите им относно процеса на разделно събиране. Получените резултати може да послужат за подобряване на ефикасността на системата.

Ключови думи: Анкетно проучване, Система за разделно събиране на отпадъци от опаковки, Град Стара Загора

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10-6. ОПОЛЗОТВОРЯВАНЕ НА ГИПСОВИ СТРОИТЕЛНИ ОТПАДЪЦИ

Даниел Евлогиев¹ Румяна Захариева²

Резюме: Гипсът отдавна е широко използван в строителството, като през последните 30 години се наблюдава значително нарастване на дела на гипсокартонените и гипсофазерните плоскости. Интензивната употреба поставя на дневен ред въпроса с управлението на гипсовите отпадъци, тъй като те не са инертни, а при депониране на депа за битови отпадъци участват в метано-генезата и отделянето на сероводород, при което възниква опасност от пожар. Съществуват нормативни изисквания за разделно събиране и депониране на гипс-съдържащи отпадъци. От друга страна, гипсът е напълно рециклируем материал, а процесите се отличават с малка енергоемкост и опростена технология. Настоящото проучване изследва добрите практики по оползотворяване на гипсовите отпадъци в контекста на устойчивото развитие - разгледани са техническите, екологичните и икономическите аспекти на процесите по рециклиране и повторна употреба на продукти на основата на строителен гипс. Установени са основните параметри, при които дейностите по оползотворяване на гипсови отпадъци биха се вписали успешно в концепцията за кръгова икономика в строителството.

Ключови думи: *Строителни отпадъци, Гипс, Рециклиране*

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RECOVERY OF GYPSUM BASED CONSTRUCTION AND DEMOLITION WASTE

Daniel Evlogiev¹, Roumiana Zaharieva²

Abstract: Gypsum has long been widely used in construction, and in the last 30 years there has been a significant increase in the share of gypsum plasterboard and gypsum fiberboard. Intensive use puts on the agenda the issue of gypsum waste management, as it is not inert, and when landfilled, it might participate in the methanogenesis and release of hydrogen sulfide, which creates a fire hazard. There are regulatory requirements for separate collection and disposal of gypsum-containing waste. On the other hand, gypsum is a completely recyclable material, and the processes are characterized by relatively low energy consumption and simple technology. The present study examines good practices in the recovery of gypsum waste in the context of sustainable development - the technical, environmental and economic aspects of the processes of recycling and preparation to reuse are considered. The main parameters have been established, under which the activities for recovery of gypsum waste would successfully fit into the concept of circular economy in construction.

Key words: *C&D waste, gypsum, recycling, environmental footprint, economic viability*

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XI.

СТРОИТЕЛНО ПРАВО И НЕДВИЖИМИ ИМОТИ

CONSTRUCTION LAW AND REAL ESTATE

11-1. ANALYSIS OF THE DEMOGRAPHIC INFLUENCE ON THE APARTMENT RENTS IN GERMANY

Dimitar Dospevski¹

Abstract: The objective of this research is to quantify the influence of the demographic development on the apartment rents in Germany.

The analyses carried out in the scope of the research are based on the quoted rents of apartments in multifamily residential buildings and 12 selected factors with a demographic background (natural balance, emigration balance abroad, total fertility rate, population density, household size, household income, residential area per capita, residents aged 65 and older, GDP, emigration balance within the country, population working outside the place of residence, completed new apartments) in 106 cities in Germany in the period from 2004 to 2017.

The influence of demographic development is analysed statistically and quantified by means of correlation analyses. The timelag of the influence is determined by cross-correlation. In order to analyse the effect of the simultaneous impact of the selected factors multiple regression models are developed. The models' quality is evaluated by statistical significance tests.

Keywords: *Demography, Demographic Development, Residential Market, Apartment Rents, Correlation, Multiple Regression*

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11-2. ANALYSIS OF THE DEMOGRAPHIC INFLUENCE ON THE OFFICE RENTS IN GERMANY

Dimitar Dospevski¹

Abstract: The objective of this research is to quantify the influence of the demographic development on the office rents in Germany.

The analyses carried out in the scope of the research are based on the average office rents in the five biggest office locations in Germany (so called "Big 5": Berlin, Dusseldorf, Frankfurt am Main, Hamburg and Munich) and 12 selected factors with a demographic background (natural balance, emigration balance abroad, total fertility rate, population density, GDP, emigration balance within the country, population working outside the place of residence, unemployment rate, employees in the service sector, labour force, employees with an academic education, vacant office areas) in the period from 2000 to 2017.

The influence of demographic development is analysed statistically and quantified by means of correlation analyses. The timelag of the influence is determined by cross-correlation. In order to analyse the effect of the simultaneous impact of the selected factors multiple regression models are developed. The models' quality is evaluated by statistical significance tests.

Keywords: *Demography, Demographic Development, Office Market, Office Rents, Correlation, Multiple Regression*

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XII.

**ДИГИТАЛИЗАЦИЯ В СТРОИТЕЛСТВОТО,
АРХИТЕКТУРАТА И ОБУЧЕНИЕТО**

**DIGITIZATION IN CONSTRUCTION, ARCHITECTURE AND
EDUCATION**

12-1. IMPLEMENTATION OF CIRCULAR ECONOMY IN CONSTRUCTION BY USING BIM TECHNOLOGY

Milena Senjak¹, Igor Peško², Vladimir Mučenski³, Mirjana Terzić⁴

Abstract: Waste generated by demolition and construction of buildings, as well as the waste generated by building manufacturers, constitutes more than 45% of the total controlled waste. Demand for resources is constantly increasing, and resources themselves are limited. The introduction of circular economy (CE) and its principles while still in the design stages would significantly affect the regulation of waste problems in the country. However, the full adoption of the CE principle in organizations and supply chains encounters a number of obstacles, identified primarily with the lack of advanced technologies. CE is closely related to digitalization, as it enables monitoring of processes and the production of a particular product. BIM technology allows for the transition from a linear to a circular economy, making it possible to minimize design changes during construction, providing all information related to possible waste generation from the project model, recognizing construction activities in which materials could be reused. It also allows for the use of a visual model for construction in order to reduce processing, as well as the adoption of modular techniques. The purpose of this paper was to investigate the application of BIM methodology with the aim of implementing circular economy.

Key words: *Construction, Circular economy, Building information, modelling, Construction waste, Closed-loop material.*

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12-2. АУГМЕНТИРАНАТА РЕАЛНОСТ КАТО ИНСТРУМЕНТ В ПРОЕКТИРАНЕТО, ИЗПЪЛНЕНИЕТО И ПОДДРЪЖКАТА НА СГРАДИ И СЪОРЪЖЕНИЯ

Димитър Димитров

Резюме: Проектирането на дигитално изображение върху физическа среда в реално време, се демонстрира за първи път през далечната 1968г. Технологичната еволюция позволява през 1992 тази нова за времето си технология, да бъде използвана като инструмент за асистиране при асемблирането и поддръжката на сложни електронни системи. През този период се налага и името, с което е известна и днес – Аугментирана Реалност. Днес широкомащабното прилагане на BIM в проектирането, както и наличието на свързани мобилни устройства с висока производителност, създават предпоставки за прилагане на аугментирана реалност в процесите на проектиране, строителство и най-вече експлоатация на сградите и инсталациите. Все по-голямата достъпност до лесни за усвояване, платформи за създаване на дигитални приложения, предоставят на проектантите и мениджърите по поддръжка арсенал от неограничени възможности. Възможности за лесен и автоматизиран достъп до информация, инструкции за поддръжка и използване на физическата среда, като декор за дигитално им проектиране. Навлизането на концепцията за дигитално сдвояване, създава предпоставки за все по-задълбочено търсене на решения за аугментирана реалност в цялостния цикъл на инвестиционното проектиране. През следващите години стотиците чертежи и класъри необходими за организирането на информацията за един средно сложен строителен обект, ще бъдат заместени от облачно базирана информация, достъпна посредством мобилен телефон или таблет. Тези устройства с помощта на все по-усъвършенстваните камери с които са снабдени, ще имат възможност автоматично да разпознават обекти и да възпроизвеждат техните дигитални копия с цялата съпътстваща ги информация. Всичко това както и разработката на специализирани инструменти за прилагане на аугментирана реалност обуславят доминиращата позиция на тази технология през следващите десетилетия.

Ключови думи: *Аугментирана реалност, Виртуална реалност, Дигитализация, Строителен информационен модел, Дигитални двойници, Сградна автоматизация, Дигитални технологии*

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AUGMENTED REALITY AS INSTRUMENT IN THE DESIGN, CONSTRUCTION AND EXPLOITATION OF BUILDING AND INSTALLATIONS

Dimitar Dimitrov¹

Abstract: The projection of digital image over the physical world in real time is demonstrated for the first time in the far 1968. In 1992 the technological evolution makes possible the implementation of this new technology as an assistance instrument for assembly and maintenance of complex electronic systems. Through this period is formed the name with which is known – Augmented Reality. Nowadays the wide deployment of BIM technologies in the design and the availability of smart connected devices with high processing capacity, are creating possibilities for implementation of augmented reality during the design, construction and mostly the exploitation of the buildings and installations. With the wider integration of user-friendly solutions for creation of digital applications provide the designers and facility managers with nearly limitless opportunities. Opportunities for easy and automated access to information, maintenance manuals and the possibility to use the physical environment as background for displaying them. The adoption of digital twinning concept is increasing the research for implementation of augmented reality through the whole project life cycle. In the next years the necessary hundreds of drawings and folders needed to organize the information of a project with medium complexity, will be replaced by cloud-based data accessible by mobile phones and tablets. These devices with their range of improved camera capabilities will be able to perform automatic object recognition and overlay the physical object with the digital model with all the supplementary information. All of this and the development of specialized AR tools define the dominant position of this technology in next decades.

Key words: *augmented reality, virtual reality digitalization, BIM, digital twins, building automation, digital technologies*

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12-3. ДВУМЕРНА КОМПЮТЪРНА ГРАФИКА ЧРЕЗ VBA В MS EXCEL ЗА ЦЕЛИТЕ НА ОБУЧЕНИЕТО

Стоянка Иванова¹

Резюме: Изображения като диаграми, чертежи и графики често се използват за изясняване и решаване на инженерни проблеми. Общоприето е, че MS Excel и други приложения на MS Office се използват за обработка на цифрови и текстови данни, но тези данни могат да бъдат и геометрични. Приложенията на MS Office включват мощни, макар и по-слабо популярни инструменти за геометрична и графична визуализация. Тази публикация разглежда няколко различни възможни подходи за генериране на двумерна псевдо-растерна и векторна графика с помощта на VBA и начините за тяхното комбиниране в средата на MS Excel. Това значително разширява възможностите на всеки, който изучава вградения в MS Office език за програмиране VBA, добавяйки знания в областта на растерната и векторната графика и визуализацията. VBA кодовете на програмите, необходими за изпълнение на задачите, са записвани като XLSM файлове в комбинация с показаните примери и са достъпни като архив за изтегляне.

Ключови думи: VBA, MS Excel, Псевдо-растерна графика, Гама корекция, RGB

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TWO-DIMENSIONAL COMPUTER GRAPHICS VIA VBA IN MS EXCEL FOR EDUCATIONAL PURPOSES

Stoyanka Ivanova¹

Abstract: Images in the form of two-dimensional diagrams, drawings, and graphics are often used to clarify and solve engineering problems. It is generally accepted that MS Excel and other MS Office applications are used for numerical and text data processing, but this data can also be geometric. MS Office applications include a powerful, albeit less popular, tools for geometric and graphical visualization. This publication discusses some different possible approaches to generating two-dimensional pseudo-raster and vector graphics using VBA and ways to combine them in the MS Excel environment. This content significantly expands the capabilities of anyone who learns the built-in MS Office programming language VBA, adding knowledge in the field of raster and vector graphics and visualization. The VBA program codes required to complete the tasks are saved as XLSM files, combined with the examples shown, and are available in a downloadable archive.

Key words: *VBA, MS Excel, pseudo-raster graphic, vector graphic, gamma correction, RGB*

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12-4. ТРИМЕРНА ВЕКТОРНА КОМПЮТЪРНА ГРАФИКА ЧРЕЗ VBA В MS EXCEL ЗА ЦЕЛИТЕ НА ОБУЧЕНИЕТО

Стоянка Иванова¹

Резюме: Общо мнение е, че MS Excel и други приложения на MS Office се използват за обработка на цифрови и текстови данни, но тези данни могат да бъдат и геометрични. Приложенията на MS Office включват мощни, макар и по-малко популярни инструменти за геометрична и графична визуализация. Тази публикация обсъжда някои различни възможни подходи за генериране, манипулиране и визуализиране на тримерна векторна графика с помощта на VBA в средата на MS Excel. Това значително разширява възможностите на всеки, който учи вградения в MS Office език за програмиране VBA, добавяйки знания в областта на 3D векторната графика и визуализацията. VBA кодовете на програмите, необходими за изпълнение на задачите, са записвани като XLSM файлове в комбинация с показаните примери и са достъпни като архив за изтегляне.

Ключови думи: *VBA, MS Excel, Векторна графика, Кабинетна проекция, Транслация, Ротация, Мащабиране*

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THREE-DIMENSIONAL VECTOR COMPUTER GRAPHICS VIA VBA IN MS EXCEL FOR EDUCATIONAL PURPOSES

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Abstract: It is generally accepted that MS Excel and other MS Office applications are used for numerical and text data processing, but this data can also be geometric. MS Office applications include a powerful, albeit less popular, tools for geometric and graphical visualization. This publication discusses some different possible approaches to generate, manipulate and visualize three-dimensional vector graphics using VBA in the MS Excel environment. This content significantly expands the capabilities of anyone who learns the built-in MS Office programming language VBA, adding knowledge in the field of 3D vector graphics and visualization. The VBA program codes required to complete the tasks are saved as XLSM files, combined with the examples shown, and are available in a downloadable archive.

Key words: *VBA, MS Excel, vector graphic, cabinet projection, translation, rotation, scaling*

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