

**“RENAISSANCE” COMPLEX - BEHIND THE GREEN BUILDING IDEA
-DESIGN AND TECHNOLOGY-**

Lecturer Prof. Dr. Mihai Corneliu Drișcu, arch.

”GH. ASACHI” Technical University, Iași, **Romania**

ABSTRACT

This study aims to investigate the environmental and economic performances of sustainable building technologies applicable to a multi-family residential and office ensemble situated in Iasi, Romania. The technologies mentioned in this study include: exterior insulation, double envelope system, TRI-generation of the energy, BMS (building management system), LED technology.

All three buildings of the Renaissance ensemble benefit from south-oriented green requirements of contemporary architecture: double-skin facades, curtain walls, terracotta panels, etc.

A second skin façade may also cause an increase in materials and design costs, but would save energy consumption. We have implemented the TRI-generation of the energy (electrical, heating, cooling), which is a quite efficient and modern solution. Building Management System will provide comfort at a minimum energy cost. In order to allow the effective space utilization, a zonal energy distribution was designed. LED technology has been very useful especially for dynamic lighting of low energy consuming places/surfaces (facades, parking areas, etc).

The conclusions of the study applied to a certain investment – Renaissance ensemble - indicates that the sustainable building technologies, although the initial investment costs are higher than conventional technologies, are more economical and efficient in terms of life-cycle cost due to the reduction of energy and environmental costs.

Keywords: double envelope system, dynamic lighting, sustainable technology, life cycle cost analysis.

ACOUSTIC PROPERTIES OF LIGHT- WEIGHT ECOLOGICAL BUILDING ENVELOPE BASED ON STRAW

Ing. Nada Zdrzilova¹

Ing. Jiri Winkler²

Ing. Iveta Skotnicova, Ph.D.³

^{1,2,3} VSB – Technical University of Ostrava, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

The theme of building acoustics is very actual, especially in connection with the development of ecological structures and using of natural light-weight infilling materials. Their bulk density is much lower in comparison with traditional building materials and therefore they do not ensure primary protection against noise coming from the exterior of building. The purpose of this paper and related measurements is the determination of airborne sound reduction index R_w of selected types of the light-weight building envelopes, where the filling material is crushed straw. Effect of the variant cladding of these structures to their sound reduction index is also observed. These specific structures and filling insulator were chosen because they are relatively cheap and ecological materials with great potential, used in green buildings focused on sustainability. These defined acoustic properties enable (together with a thermal insulating and fire properties) these types of structures to become competitive alternative to traditional building materials.

Keywords: Light - weight structures, sound insulation, airborne sound reduction index, straw, filling materials, cladding

ALTERNATIVE WALL INSULATION FOR ENERGY EFFICIENT BUILDINGS

Assoc. Prof. Silvia Vilčeková¹

Assoc. Prof. Anna Sedláková¹

Assist. Prof. Eva Krídlová Burdová¹

Eng. Ladislav Ťažký¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Nowadays, heating energy demand has become a significant estimator used during the design stage of any new building. The residential building sector consumes a significant amount of fossil fuel energy and thereby produces a large percentage of greenhouse gas emissions that contribute to global warming and climate change. The aim of the paper is analysis of thermophysical parameters of proposed versions of exterior wall structures.

Keywords: passive houses, energy efficient building, building structure, thermal insulation, thermophysical parameters

ANALYSIS OF A FAMILY HOUSE ON THE BASIS OF WOOD AFTER 35 YEARS OF USE

Pavel Oravec¹

Brno University of Technology, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

Each building is modified and reconstructed during its life cycle. Building modifications are intended to extend the life of constructions and maintain the user's comfort. High quality of a construction shows minimal demands for a retrofit after some years. Any adjustments need significant financial costs. The analyzed house has been used by the same residents since 1978. The paper clearly states and justifies the list of significant investments in constructions and technologies during the usage. The described arrangements can be seen as representative because gradually all users of this kind of building access to the house in a similar form. More than 20,000 buildings have been built. The paper also includes the assessment of the building envelope and compares the energy inputs into the house.

Keywords: family house, wooden house, heating costs

ANALYSIS OF DOUBLE-SHELL ROOF VENTILATION IN A PREFABRICATED APARTMENT BUILDING

Assist. Prof. Jaroslav Vojtus¹

Assist. Prof. Martin Kovac¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

The principle functionality of double-skinned flat roofs is sufficiently obvious. The actual design and technological solution of such roofs is by itself quite complicated, especially where the actual geometry of the roof, orientation - windward / leeward side and particular elements supporting structure, solutions vents and other sheath perforations can worsen air flow in the cavity. This work was based on the need to gain a better understanding of the air velocity using simulation as a form of verification of the functionality of ventilated air gaps in real constructions. The moisture regime of roofs with open air layers is usually assessed as satisfactory in terms of operational reliability by a sufficient margin [1]. Flow simulation is used to reveal local imperfections, realize moisture diffusion from residential spaces, through ceilings without a vapour barrier, which would ensure the free flow of unwanted condensation on cold surfaces of the envelope leading to defects in the roof.

Keywords: roof, building construction, double skinned roofs, air gap, thermal insulation,

APPLICATION OF DIFFERENT STANDARD METHODS WHEN CONTROLLING THE STRENGTH OF CONCRETE IN STRUCTURE

Assoc. Prof. Dr. Alena Sicakova¹

Eng. Lenka Kyjakova¹

¹ Technical University of Kosice, Faculty of Civil Engineering, **Slovakia**

ABSTRACT

When assessing strength of concrete in finished structure and determining the strength class, two standard methods may be used in Europe, while the result may not be the same. For evaluation of concrete in the structures ISO 13822 is used, which states general procedure how to determine characteristic properties of all types of materials. Characteristic value of property (strength) is determined based on calculation using variable coefficient V_x and coefficient for determining 5% fractile.

The second method is given by EN 13791, where the value of characteristic strength is determined based either on standard deviation, or average value depending on number of samples.

The article covers an example of evaluation of concrete strength in structure by both methods, using samples taken from the real structure and aged for 14 days and 1 year. Differences in concrete strength that may occur due to the method used and testing time are pointed out. Results show that evaluation according to ISO standard is greatly influenced by diffusion of the results within the set of samples, as well as specification of strength classes being rather strict, thus evaluated concrete get assigned lower strength class. Difference in evaluation of the samples after 1 year shows as much as 3 classes.

Keywords: sustainability, durability of concrete, strength of concrete, strength class

APPLICATION OF PHASE CHANGE MATERIALS IN BUILDING STRUCTURES IN NORDIC CLIMATE

Post doc res Mihkel Kiviste

Prof. Ralf Lindberg

Tampere University of Technology, **Finland**

ABSTRACT

The study is based on nearly two-decade research at the Department of Civil Engineering at Tampere University of Technology. The purpose of current study is to find out structural solutions for the thermal storage of solar radiation in buildings. A significant effect of solar gains was noticed in massive external wall as well as roof structures in sunny days from March until September. However, modern lightweight materials lack thermal inertia in order to store energy. An idea to utilize the latent heat of phase change materials (PCMs) inside an insulation of light-weight roof structure enables to overcome this problem. The idea is supported with a principal example of diurnal performance of metal sheet roof structure as well as comparative calculation of energies consumed and gained. The results of current study show that PCMs have a potential in the future application of light-weight roof structures. In general, efficient solar solutions still need to be developed in order to store energy in summer and to release it in winter.

Keywords: 10-year data, temperature distribution, heat losses.

CHARACTERIZATION OF POLYMER CONCRETE WITH CALCAREOUS POWDER

Professor Ph.D. Marinela Barbuta¹

Lecturer Ph.D. Daniel Lepadatu¹

Associate Professor Ph.D. Ana Nicuta¹

Lecturer PhD. Loredana Judele¹

Ph.D. Student Raluca Mitroi²

¹Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services, **Romania**

²Gh. Asachi" Technical University of Iași, Faculty of Hydrotechnical Engineering, Geodesy and Environmental Engineering, **Romania**

ABSTRACT

In the last decades new types of concrete had developed or improved their properties. Polymer concrete is used more and more in the construction domain because it has some advantages in comparison with cement concrete, such as: high strength, corrosion resistance and rapid hardening. However, the high cost of polymer concrete is the most important disadvantage. Because of that, obtaining polymer concrete with lower prices is an important objective. Polymer concrete is a composite in which the aggregates are bound together by a resin. The use of different types of addition can reduce the costs of polymer concrete by reducing the resin content.

In this study, calcareous powder is added as filler in epoxy polymer concrete. The effects of this type of addition on the properties of polymer concrete were investigated. As a result, the physical-mechanical properties, experimentally determined, were compared with the characteristics of epoxy polymer concrete without addition used as witness. For characterizing this type of polymer concrete, the physical-mechanical properties (such as density, workability, compressive strength, flexural strength, split tensile strength) are presented in the paper. Calcareous powder used as filler, has a good effect on the mechanical properties of epoxy polymer concrete and resulted in a reduction of epoxy resin dosage in the mix.

Keywords: polymer concrete, mechanical characteristics, calcareous powder

CHOOSING THE OPTIMAL TYPE OF EXTERNAL WALL CONSTRUCTIONS FOR APPLICATION IN THE FIELD OF PASSIVE HOUSES

PhD Student Eng. Emanuel Megyesi,

Prof. Dr. Mariana Brumaru,

PhD Student Eng. George - Sebastian Naghiu ,

PhD Student Eng. Raluca - Andreea Felseghi

Technical University of Cluj-Napoca, Faculty of Building Services, **Romania**

ABSTRACT

The paper is highlighting the technical criteria used for choosing the optimal type of exterior wall construction to be applied in the field of passive houses. In this respect, the state-of-the art has been studied and 5 types of exterior wall structures were chosen for further analysis. The specific characteristics, as well as the decision criteria have been established for the selected types of exterior walls. In order to choose the most appropriate solution, two methods using multi-criteria analysis in rationalising the decisions have been applied for finding the best version, compatible with the specific requirements of the approached domain. In the end, the acquired results have been compared and conclusions have been formulated.

Keywords: multi-criteria analysis, exterior walls, passive house, assessment criteria, Onicescu Method

COMPOSITE STEEL-CONCRETE TRUSSES FOR RAILWAY BRIDGE SUPERSTRUCTURES

Assoc. Prof. Ștefan I. Guțiu

Lecturer Dr. Cătălin Moga

Lecturer Alexandra D. Danciu

Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

ABSTRACT

Composite steel-concrete structures with the steel substructure as a truss can offer a number of benefits from the point of view of material consumption, both in the case of civil or industrial buildings and in the case of road and railway bridges.

For composite truss structures the design methodology is not presented in detail in the Eurocode 4. The design implies some particularities that are not included in the literature.

In this paper an adaptation of Euro norms EN 1994-1-1:2004. Eurocode 4 - Design of composite and concrete structures – Part 1-1: General rules for buildings and EN 1994-2:2004. Eurocode 4 - Design of composite and concrete structures – Part 2: General rules and rules for bridges to the design of bridge superstructures with steel trusses are presented.

A railway bridge superstructure with a 30.0 m span was calculated after the presented methodology and a number of observations and comments useful in the design activity were formulated.

Keywords: composite steel-concrete decks, steel trusses, bridge design

ECOLOGICAL COMPOSITE WITH GLASS FROM WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT CONTENT

PhD. Eng. Ofelia Corbu¹,

PhD. Student Eng. Antonela Popovici^{2*},

PhD. Researcher Gabriela-Emilia Popița³,

PhD. Eng. Prof. Tiberiu Rusu²,

PhD. Eng. Prof Cristina Roșu.³

PhD. Eng. Lecturer Attila Puskas¹

¹ Faculty of Civil Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**,

² Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**

³ Faculty of Environmental Science and Engineering, Babes Bolyai University, Cluj-Napoca, **Romania**

ABSTRACT

Waste landfilling has a considerable impact on the environment, due to the priority substances and priority hazardous substances that are released from the waste. Metals such as Pb, Ni, Cd, Zn and Hg and their compounds, are considered to be priority hazardous substances due to their persistence and bioaccumulation in ecosystems.

Due to the presence of the hazardous substances in the electrical and electronic equipment, at the end of life, this equipment became hazardous waste and has a specific management way in the European Union.

In the current concept of the sustainable development, the recovery represents a priority direction in the flow of waste management system. The purpose of this study is to propose for a composite material with CRT (cathode ray tubes) glass waste. The CRT glass waste is mechanically processed and is coming from WEEE. The used method for achieving the composite is an ecological recovery method, using hazardous waste from WEEE, with low energy consumption, reducing hereby the CO₂ emissions that would be generated during conventional recovery processes thereof. Due to the ecological recovery method the composite material has a low cost.

The experimental results, obtained after testing the compressive strength of the composite samples (55.98 N/mm²), showed that the composite outperforms mortars in terms of mechanical strength.

As a result, the obtained composite can be considered as construction material, framed in the mortars class, based on its aggregate size (particle size <4 mm) and on mechanical strength and can be successfully used for the production of decorative elements.

Keywords: WEEE, CRT, composite, waste recovery.

ECOLOGICAL MATERIALS FOR CONSTRUCTION

PhD. Stud. Eng. Călătan Gabriela ¹

PhD. Eng. Hegyi Andreea ¹

Prof. PhD. Eng. Mircea Călin ²

¹ INCĐ URBAN-INCERC Cluj-Napoca Branch, **Romania**

² Technical University from Cluj-Napoca, **Romania**

ABSTRACT

This work is a study that includes comparative experimental research carried out on mixtures of soil, sand, lime, oil and other natural additives, used to manufacture masonry bodies. Experimental tests were aimed at studying the physico-mechanical properties of materials and their variation depending on the additives used.

The purpose of this experimental research was to fixing some optimum compositions for making masonry bodies used in the construction of green houses, energy-efficient and with low impact on the health of users, applying basic principles of traditional vernacular architecture and improving their knowledge using current technology.

Based on the experimental results, it was found that: addition of sand has positive influences of density and linear shrinkage, reducing the risk of cracking and the compressive and flexural strength of tested specimens was influenced by the amount of sand introduced into the mix (maximum values of strength are obtained for the 65% ground - 35% sand). In the case of mixtures earth - sand – lime it was noted that linear shrinkage was small, but this is probably due to sand in the mixture. Unsatisfactory results in terms of mechanical strength and the density recorded indicated the need to reduce the amount of slurry lime in the mixtures. In the case of mixtures earth – different solutions (NaCl, NaOH and bone glue) it was noted that linear shrinkage are not significantly influenced by changing the liquid (water or other solution) and high mechanical strength are recorded but the apparent densities are below the allowable value according to the literature, which leads us to the idea of the possibility of improving apparent density by introducing controlled amounts of sand

The experimental results showed that organic materials can successfully replace or minimize the use of traditional building materials (concrete, cement).

Keywords: Building from earth, compressive strength, flexural tensile strength, axial shrinkage

EFFECT OF GREEN ROOF ON THERMAL PERFORMANCE OF BUILDINGS. A CASE STUDY

Adriana Lucia Kadhim-Abid¹

Adrian Iacob²

Assoc. Prof. Dr. Irina Baran³

Assoc. Prof. Dr. Tania Mariana Hapurne⁴

¹ Faculty of Civil Engineering/Technical University "Gheorghe Asachi" Iassy, **Romania**

² National Institute for Research and Development in Constructions, Urban Planning and Sustainable Development "URBAN-INCERC" Iassy, **Romania**

³ Faculty of Civil Engineering/Technical University "Gheorghe Asachi" Iassy, **Romania**

⁴ Faculty of Architecture/Technical University "Gheorghe Asachi" Iassy, **Romania**

ABSTRACT

This paper analyzes the extent to which the improvement with a green roof leads to variations in the energy performance of an existing building. The applied assessment criteria is the energy consumption to compensate for heat loss during heating period, with highlights on the entire building envelope, but also on the specific influence of the roof solution.

The heating and cooling demand has been evaluated for the initial configuration of the roof-top terrace and for modifications drawn in order to fill the terrace.

Keywords: energy performance, green roof, heating and cooling demand

EFFECT OF PHYSICAL TREATMENT OF HEMP HURDS ON THE PROPERTIES OF BIOCOMPOSITES

Prof. RNDr. Nadezda Stevulova, PhD.

Eng. Ivana Schwarzova

Eng. Julia Cigasova

Eng. Jozef Junak, PhD.

Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering, Kosice, **Slovakia**

ABSTRACT

Nowadays, using renewable sources of energy instead of non-renewable is very current topic in developed countries. The increased attention is devoted to the use of alternative materials that are environmentally friendly. The use of natural fibres (plant fibres from hemp, jute, sisal and the others) as reinforcement for composite materials is attractive for the purpose of the construction. The using of this material has environmental and economical advantages because it is fast-growing and renewable material. The great importance is attached to the industrial hemp as rapidly renewable fibers and non-waste material.

Hemp hurds as the woody part of the fibres is a very prospective building material because of its unique properties (exceptional thermal insulation, antiseptic, acoustic and mechanical properties). Due to the low density and high porosity of the hemp hurds, the combination of hemp and binder creates a building material with good thermal and acoustic insulation properties. Today hemp hurds can be used in high-quality products such as hemp concrete, fibre board and composites.

In this paper, the attention is given to the physical treatment (cooking in water for 1h) of hemp hurds and to the preparation of the lightweight composites based on 3 different mean particle lengths of this organic filler and on an alternative binder MgO-cement. The effect of water treatment to the physical and mechanical properties (compressive strength, density, water absorbability, thermal conductivity) of the biocomposites hardened in indoor condition for a time period is studied. Based on the results of experiments, significant effect on the properties of prepared composites based on hemp hurds has a particle size of used hemp hurds as well as its physical treatment.

Keywords: biocomposites, hemp hurds, physical modification, mean particle length, MgO-cement

EFFECTS OF WATER AND FROST ON 100% RECYCLED HALF-WARM ASPHALT MIXTURES FOR RAILWAY SUBBALLAST

Petr Kucera

Martin Lidmila, PhD.

Czech Technical University in Prague, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

The main purpose of subballast layers in railway track bed is to guarantee a sufficient bearing capacity and to protect subgrade from negative effects of rain water and frost. Since 1960's several railway administrations have utilized hot-mix asphalt instead of conventional granular subballast in selected tracks with special requirements, such as high-speed or heavy traffic tracks. The experiences gained during the last decades have shown that the hot-mix asphalt layers provide a good support for ballast bed, distributing the load equally to the subgrade. Moreover, their impermeability prevents the rain water from penetrating to the subgrade. Also, significant savings of granular materials can be achieved while introducing the bituminous subballast instead of the all-granular solution. Incorporation of a high percentage of recycled asphalt pavement and a decrease in production temperatures is a way to make the use of bituminous subballast cheaper and greener than it currently is. However, both these alternations may negatively affect durability, performance and resistance of the bituminous mixtures to water and frost.

The aim of this study was to assess the effects of water and frost on selected mechanical and physical parameters of 100% recycled half-warm asphalt mixtures. The standard water-sensitivity and freeze-thaw resistance tests were carried out. The effect of water content on thermal conductivity, which is an important parameter in terms of frost protection of the subgrade, was also observed. During soaking, the height of the specimens was measured to proof whether any swell was occurring. The results showed a significant influence of water and frost on the mechanical performance of the 100% recycled asphalt mixtures, particularly for compacting temperature of 80°C. Higher water content after soaking was probably a cause of increased thermal conductivity. Some swell of the specimens immersed in water was observed, but only at a negligible rate.

Keywords: recycled, asphalt mixture, subballast, water resistance, frost

ENERGY PERFORMANCE OF BELGRADE RESIDENTIAL BUILDINGS – INVESTIGATION, QUANTIFICATION AND IMPROVEMENT POTENTIAL

Assoc. Prof. BSc. Arch. Dušan Ignjatović¹

Assoc. Prof. MSc. Arch. Nataša Ćuković Ignjatović¹

Teaching fellow, PhD candidate, M.Arch. Bojana Stanković¹

¹ Faculty of Architecture University of Belgrade, Serbia

ABSTRACT

Belgrade City authorities have commissioned a team of researchers from Faculty of Architecture, University of Belgrade to investigate energy performance of residential buildings and explore potentials for energy improvements and related savings in heating costs. The paper presents the methodology for structuring, investigation and improvement of residential building stock in Belgrade, developed for the purpose of this project.

Typology of buildings has been generated based upon building stock periodization, applied building technology and architectural qualities (features which should remain undisturbed). These aspects define typology matrix which was further investigated and analyzed in detail. Totally, 30 multifamily and 2 family buildings were analyzed. In-situ thermographic imaging was used as an investigation means for technical detection of main energy losses through building facades. These data, compared to the original detail drawings obtained through insight into archive technical documentation provide valuable findings regarding actual quality of facade structures and their improvement strategies. At the same time, it also reveals faults which occurred through construction process and as a consequence of poor detailing. Defined improvement strategies vary significantly based on complexity of improvement measures application.

Theoretical calculations based upon available technical documentation and measurements were conducted for every building, resulting in data about overall energy reduction, energy reduction costs, improvement measures payback period, improvement investment per m² and improvement investment per flat. The paper presents the summary results highlighting the most interesting building types regarding each analyzed criteria.

Keywords: energy performance of residential buildings, building envelope, building refurbishment

ENGINEERED CEMENTITIOUS COMPOSITES (ECC) – SELF-HEALING POTENTIAL BY CRACK CONTROL MEANS

PhD. student Cornelia Baeră¹

Dr. Mircea Păstrav¹

Dr. Henriette Szilagyi¹

Prof. Dr. Călin Mircea²

Dr. Ofelia Corbu²

Carmen Dico¹

Dr. Horia Constantinescu¹

¹ NRD “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

Cracks in concrete elements are considered the main cause for beginning and further development of concrete structures deterioration. In the reality where concrete and generally cement-based materials represent the most widely used building materials, the large amounts of concrete civil infrastructure that requires repairs and maintenance constitute huge consumption of economic and energetic resources. The numbers are impressive: 18 to 21 billion US dollars annual cost for infrastructure repair only in USA, according to specialized data [1].

The green drive of the last decades, after general awareness that resources are not renewable and they have to be saved as much as possible, encouraged development of new, intelligent building materials, with improved physico-mechanical and durability characteristics, necessary for building-up a sustainable future.

In the category of High-performance fibre-reinforced cementitious composites (HPFRCC) there was developed a new concept of cementitious material capable of developing a quite important self-healing behaviour due to its crack control well developed design: Engineered Cementitious Composites, a self-compacting mortar characterized by induced microcracking metal like behaviour under the applied load [2].

The aim of this paper is to present a state-of-the-art evaluation regarding ECC materials: development, design criteria, evolution and potential of ECC as building material for a long-term energy and resources saving civil infrastructure.

Keywords: concrete cracks, energy saving, Engineered Cementitious Composites (ECC), crack control, self-healing capacity

ESTIMATION OF THERMAL PERFORMANCE OF TYPICAL BUILDING ENVELOPES IN SERBIA USING INFRARED THERMOGRAPHY

Assist. Prof. Dusan Ignjatovic

Assist. Prof. Dr. Alekstandar Rajcic

Assist. Prof. Mr. Natasa Cukovic Ignjatovic

University of Belgrade – Faculty of Architecture, **Serbia**

ABSTRACT

Working on the scientific project with the aim of formulation of National Typology of Residential buildings in Serbia, a group of researchers from the Faculty of Architecture University of Belgrade has analyzed diverse building types in Serbia, classifying them and identifying relevant construction elements. This typology has been finalized as the matrix of real buildings being chosen as typical representations of statistical averages of all relevant characteristics. At the same time energy performance of all types has been defined both by numerical calculation and on site inspection. By using infrared thermography for analysis of all identified types a distinct thermal envelope signature has been recorded and further discussed. This paper presents some of the most common envelope types with analysis of their thermal performance. Infrared inspection has been used as the main investigation tool, while verification of obtained results has been confirmed by the means of mathematical modeling using the computational method of infinite differences derived from the actual construction drawings obtained from the archives. Paper discusses the diversities of applied construction technologies and their influence on energy performance defining the most common problems.

Keywords: Thermography in architecture, energy efficiency, building envelope

EVOLUTIONARY METHOD FOR RE-TRIANGULATION

Lecturer Alexandra D. Danciu¹

Eng. Dan I. Danciu²

Lecturer Dr. Cătălin Moga¹

Assoc. Prof. Ștefan I. Guțiu¹

¹ Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

² ISDC Romania, **Romania**

ABSTRACT

One of the most important aspects in the Finite Elements Method is the refinement of a coarse mesh that should take into account a number of parameters given by the necessities of the problem: singularities, error estimation, etc. Following this idea and taking into account that the best suited algorithms nowadays for optimization problems are the genetic and evolutionary algorithms, the authors pursued the idea of optimizing and refining a given triangular mesh using evolutionary procedures.

The paper presents the proposed evolutionary procedure and it shows that, after just a few generations one can obtain acceptable triangular meshes that can be used in analysis after a minimum correction. The triangulations obtained are optimized after two parameters: the quality of the triangles obtained and the refinement of the mesh. Through the implemented operators we tried to keep the quality of the newly generated triangles and, where possible, to improve the quality of the initial triangles.

All the steps of the procedure are presented in detail. The operators presented in the literature have been implemented and their performance evaluated for the new procedure proposed. Two new cross-over operators have been proposed and implemented, as well as a new mutation operator responsible for the mesh refinement. A situation appearing during mutation was named as fan mutation and ways to resolve it have been presented. The fitness of the individual is evaluated through a cumulative function that takes into account the quality of the individual through the deviation fitness and the refinement obtained through the refinement fitness.

For a plane octagonal domain the influence of the number of generations, the division rate, the mutation rate, the cross-over rate and the initial triangulation are investigated.

Next the issue of solving a domain with holes is addressed. The procedure starts with a set of initial triangles that take into account the geometry of the body to be meshed and the operators proposed are not modifying the geometry; therefore, any type of geometry can be meshed.

The strong and the weak points of the procedure are investigated and ways of improving it are proposed.

Keywords: Evolutionary procedure, triangulation, meshing, mesh refinement, finite element method.

**EXPERIMENTAL ANALYSIS OF FATIGUE BEHAVIOR OF
STRENGTHENED REINFORCED CONCRETE SHORT CORBEL BY
EXTERNALLY BONDED CARBON FIBRES FABRICS**

Dr. Ivelina Ivanova¹,

Dr. Jules Assih¹,

Prof. Alex Li¹,

Prof. Dimitar Dontchev²

¹ University de Reims Champagne-Ardenne, Reims, **France**

² University de Technologie Chimique et de Métallurgie Sofia, **Bulgarie**

ABSTRACT

This paper presents experimental study of strengthening reinforced concrete corbel by gluing carbon fibres fabrics. Indeed, in buildings and in civil engineering reinforced concrete corbels often are used.

A preliminary study to determine the number of layers necessary optimal and effective strengthening. Then, we compare usefully unstrengthen and strengthened reinforced concrete short corbels with monotonic loading to failure and cyclic loading up to one million cycles. Cracking of corbels are described and different failure modes observed.

The effect of some parameters on behavior of the strengthening structure is examined. As such as, influence of the type of strengthened reinforced concrete corbels directly on either sides or wrapping by externally bonded the carbon fiber sheet. The influence of the orientation of the carbon fibres fabrics is also examined.

The influence of the extensometer technique based on electrical strain gauge strain is used to study the local behavior of the structure. This technique allows to measure strain of steel, carbon fabrics and concrete.

The ultimate load and displacement of the specimen are compared to the reference structure of static tests monotonous load applied. The cracking and the mode of failure under static loading are presented.

The results show an increase of more than 82% of the bearing capacity of corbels and improving their rigidity of the third.

Cyclic loading modifies the stress distribution within the corbels therefore also the cracks where some cracks appear in the stake but not observed in the case of monotonic loading.

Cracking corbels are different depending on the case load (monotonic or cyclic).

Keywords: strengthening, short corbel, fatigue behavior, reinforced concrete composite materials.

**EXPERIMENTAL RESEARCH FOR DETERMINING THE EFFECTS OF
CLIMATIC CYCLES ON THE DURABILITY OF THERMAL INSULATING
SYSTEMS THAT USE POLYSTERENE**

Senior Researcher eng. Livia Miron, PhD

Senior Researcher eng. Constantin Miron, PhD

National Institute for Research and Development in Constructions, Urban Planning and Sustainable Territorial Development „URBAN - INCERC”- Iasi Branch – IHS Hygrothermal / Climatic Research and Testing Laboratory, **Romania**

ABSTRACT

This paper deals with the tests performed in the IH Hygrothermal / Climatic Research and Testing Laboratory (*[http://www.incerc2004.ro/Proiecte/CEEX- M4_111_Iasi.htm](http://www.incerc2004.ro/Proiecte/CEEX-M4_111_Iasi.htm)) meant to determine the durability of composite systems for exterior thermal insulation for buildings, that use polystyrene, as well as their behavior under the action of increasingly severe climatic conditions, causing the climatic changes taking place at a global level.

We discuss the normative deficiencies caused by the absence of the proper European normative provisions adapted to the new conditions of regional or local climatic manifestations, as well as the irreversible degradation effects of composite systems for exterior thermal insulation for buildings, with significant repercussions on the efficiency of thermal insulation solutions and implicitly on the energy consumption.

The paper presents the results and conclusions of the research performed through cyclic tests of temperature, humidity, frost and thaw, and solar radiation on composite systems based on synthetic thermal insulation materials of low durability.

Keywords: energy, efficiency, thermal insulation, low energy consumption home

**EXPERIMENTAL STUDY OF DIELECTRIC AND FUNCTIONAL
PROPERTIES OF POLYMER MATRIX/Cu₂O/BaTiO₃ HETEROGENEOUS
COMPOSITES IN BROAD BAND FREQUENCY**

PHD Haddi Bakhti^{1,2}, Pr Nacerdine Bouzit²

¹Department of electronics, Faculty of technology University of M'sila, BP166, **Algeria**

²Laboratory Scientific Instrumentation LIS, Department of Electronics, Faculty of technology, University Ferhat Abbas Sétif-1, **Algeria**

ABSTRACT

In this work, we present an experimental study on a novel ternary composite material. In this case, several samples with barium titanate (BaTiO₃) and copper oxide (Cu₂O) particles in powder form in various amounts dispersed in a host matrix of epoxy resin (Re/BT/Cu₂O) are carried out and sintered at 150°C. Their dielectric constants spectra were measured in the frequency range DC–3GHz by time domain spectroscopy (TDS). Low frequency has also been performed throughout this work, and it has primarily concentrated on conductivity behaviour which may be attributed to the effects of a percolation process. Experimental data were analyzed by means of dielectric permittivity and electric modulus formalisms. The functionality of the composite systems is related to the abrupt variation of the real part of permittivity, and to the relaxation process of the Cu₂O particles. In addition, the behaviour obtained experimentally has been validated by the random mixture law of Lichtenecker in order to predict the electromagnetic behaviour of such composite material.

Keywords: Composite, Copper oxide (I), modelling, Relaxation phenomena, electrical modulus.

HALL BUILDINGS – LOWER STRUCTURE

Assoc. Prof. Anna Sedláková

Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Most industrial hall type buildings are large and. the accurate design of the substructure construction is influenced by many entry parameters from the standpoint of structural analysis, building thermal technology, building hydro-insulation technology and anti-radon measures. By respecting these specific requirements of individual science disciplines, the symbiosis expressing the optimal solution in the theory of structural production of buildings are presented.

The solution of problems of building thermal technology in the substructure field of industrial buildings and ground connections based on the knowledge of the thermal regime of soil - sub base, as one of the important components of soil climate. It is obvious, that every correct thermo technical calculation requires a precise specification of boundary conditions. Soil temperature is presented in our case as one of the boundary conditions of substructure details of for analyzed buildings.

Keywords: industrial buildings, thermal protection of building, building construction, ground floor, thermal insulation

HYDRO INSULATION CHARACTERISTICS OF PLASTERS BASED ON ORGANIC BINDERS – EXPERIMENTAL PROCEDURES

PhD. student Cornelia Baeră¹

PhD. Henriette Szilagyi¹

Carmen Dico¹

PhD Attila Puskas²

¹ NRDI “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

The new millennium general tendency of energy saving and effort making for non-renewable resources reduction in all humankind activities implies development of more efficient products and technologies, advanced solutions and permanent improvement in all directions, including the construction field. Considering its magnitude, importance and also its impact in our everyday life, civil infrastructure and its means (resources and energy consumption, materials, technologies and procedures) represent a strategic pillar in the concept of sustainability.

Special attention must be given to general preservation of structural and non-structural construction elements against natural and artificial degradation, which can affect the safety and the quality of life; the better prevention the less maintenance and repair costs involved. From this perspective the buildings external coatings are essential; representing buildings outer skin, they are thermo insulation barriers and protective layers and against aggressive agents, fulfilling both decorative and protective role. As consequence, the development of external renders as coating materials and their performances evaluation represent important although indirect topics in general ecology agenda [1]. The aim of this paper is to present the second set of results of the experimental program performed upon plasters based on organic binders, regarding the hygro-thermal properties of these coating materials. The experimental procedure started in 2012 and the first results were presented in the 13th International Multidisciplinary Scientific GeoConference SGEM 2013 [2]. The present paper shows later outcomes, concerning the same type of products and the hygro-thermal characteristics (liquid water permeability), essential for moisture transfer mechanisms and determined according to the standardized method [3], as requested by recently occurred (July 2009) of the “harmonized” European standard EN 15824 [4].

Keywords: energy saving, structural preservation, organic binder renders, thermal insulation, testing methods

IMPACT OF ULTRASONIC TREATMENT OF HEMP HURDS ON THE MECHANICAL PROPERTIES OF COMPOSITES

RNDr. Eva Terpakova, PhD.

Prof. RNDr. Nadezda Stevulova, PhD.

Assoc. Prof. Alena Sicakova, PhD.

Eng. Ivana Schwarzova

Technical University of Kosice, Civil Engineering Faculty, Institute of Environmental Engineering, Kosice, **Slovakia**

ABSTRACT

Lightweight composites based on natural fibers as organic filler are studied for several years. In this article, the attention is given to the study of the properties of lightweight composites based on hemp hurds (the woody part of hemp plant). From the experimental point of view, the observation is focused on the influence of the particle size of hemp fibers and also on the study of using different types of binders in the lightweight composites. Significant part of the experiments was dedicated to chemical modification of hemp hurds and to physical modification of hemp hurds by ultrasonic treatment before its using as filler in the lightweight composites. The cohesion of the filler and of the binder is an important factor in the development of mechanical properties. The durability of produced composites was studied under different conditions.

In this paper, the impact of ultrasonic treatment of hemp hurds on the mechanical properties of the composites was studied.

Keywords: renewable source, hemp hurds, ultrasonic treatment, composites

IMPROVING OF THE CORROSION PROCESS ON THE HEAT EXCHANGERS

Lecturer PhD.Eng.

Florin Ciofu

“Constantin Brâncuși” University of Targu Jiu, **Romania**

ABSTRACT

The need to provide an optimum level of safety and the possibility of rehabilitation technical systems, the components is always present in all sectors.

The problem becomes particularly acutely in the nuclear industry, energy, mining, chemical, petrochemical, or generally in areas with stringent regimes of operation of technical systems where inspection and maintenance activities are treated as priority elements of managerial work.

Heat exchangers used in particular the areas of activity in energy production work in corrosive environment. The thermal agent used is usually water, which results in a corrosion process of working installations. In this paper will be analyzed remedies to combat corrosion process of these installations by a proper choice of materials they are made and performing thermochemical treatments in regards the extension of lifetime between two repairs.

Keywords: heat exchangers, thermal agent, thermochemical treatments;

INDOOR MATERIALS AND AIR QUALITY ASSESSMENT

Prof. Ing. Ingrid Senitkova, CSc.

The Institute of Technology and Businesses in Ceske Budejovice, **Czech Republic**

ABSTRACT

The material combination impact on perceived indoor air quality for various surface interior materials is presented in this paper. Traditional and progressive materials comparison reveals new fact regarding the sum of volatile organic compounds (TVOCs) concentration. The using possibility of individual material surfaces sorption ability was investigated. The chemical analysis and sensory assessments identifies health adverse of indoor air pollutants (TVOCs). In this study, emissions and odors from different common indoor surface materials were investigated in test chamber under standardized conditions. Chemical measurements (TVOCs concentration) and sensory assessments (odor intensity, perceived air quality) were done after building materials exposure to standardized conditions. The impact of individual materials and their interaction effects to the perceived air quality will be discussed within the paper. The knowledge of targeted sorption effect can be used already in the interior design phase. The results demonstrate the various sorption abilities of various indoor materials as well as the various sorption abilities of the same indoor materials in various combinations.

Keywords: volatile organic compounds, indoor materials, chemical assessment, sensory assessment, indoor air quality

INFLUENCE OF ALKALINE TREATMENTS ON TENSILE PROPERTIES OF ALPACA FABRIC REINFORCED EPOXY COMPOSITES

Menderes Koyuncu

Yuzuncu Yil University, Van Vocational of Higher School, Department of Textile, Van,
Turkey

ABSTRACT

A study on the effect of alkaline treatment on tensile properties of Alpaca fabric reinforced epoxy composites is presented in paper. The treatment was carry out using NaOH solutions at different concentration. The hydrophilic nature of Alpaca fabric makes it difficult to adhere to hydrophobic epoxy and there therefore posed three problem of interfacial bonding between fabric and matrix and such treatment was need to alleviate such problem. The composite samples were tested for tensile properties determination. Some fractured samples were examined under scanning electron microscope (SEM) to study the microstructure of the materials. SEM observations on the fracture surface of composites showed that the surface modification of fabric occured and improved fibre-matrix adhesion and proved the effectiveness of the treatment

Keywords: Fabric, Adhesion, Alkaline, Composites, Wettability

INFLUENCE OF CROSS-SECTIONAL SHAPE ON THE VALUES OF THE CRITICAL BUCKLING FORCE

Lecturer Dr. Cătălin Moga

Assoc. Prof. Ștefan I. Guțiu

Lecturer Alexandra D. Danciu

Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

ABSTRACT

The relevant buckling mode for hot-rolled steel members, with the type of cross-sections commonly used for compression members is generally flexural buckling; however, in some cases, torsional or flexural-torsional modes may govern and they must be investigated for all sections with small torsional resistance.

In this paper, after a brief presentation of the aspects regarding the calculation of the critical buckling force, a series of compressed members having a class 4 cross-section are analysed according to the European norms EN 1993-1-1: Design of steel structures. Afterwards, the members are modelled in Abaqus and a comparison is made with the results obtained based on the design method given in the Euronorms. Six constructive solutions for open cross-sections are taken into account and the buckling mode and the values of the critical buckling force are analysed.

Conclusions are drawn regarding the efficiency of each type of cross-section regarding the critical buckling force. It can be seen that for classical types of cross-sections the buckling mode is flexural-torsional, for a double symmetrical cross-section, with the highest efficiency to buckling, the buckling mode is flexural and for a cross shape cross-section the buckling mode is torsional.

Keywords: buckling resistance, compression members, comparative analysis, critical buckling force

**LOCAL STABILITY AND FATIGUE FAILURE
OF THIN-WALLED STEEL MEMBERS**

Prof. Ing. Pavol Juhas, DrSc.

Prof. Ing. Ingrid Senitkova, CSc.

The Institute of Technology and Businesses in Ceske Budejovice, **Czech Republic**

ABSTRACT

The thin webs of steel members are laterally buckling under static loading and laterally vibrating under repeated dynamic loading. The consequence of that can be arising and successive development of fatigue cracks along the welded connections of the thin webs with flanges and stiffeners. Therefore, the fatigue strength and life-time of thin-walled steel members depend beside of usual material-technological and structural influences also on local stability aspects. The extensive experimental-theoretical investigation of thin-walled hybrid steel plate girders and columns with accent on their fatigue failure mechanisms and local stability aspects is presented within the paper. The outcome of obtained knowledge and results is the original empirical formula for the limitation of web slenderness that can be used for the reliable and economical design of steel members which are subjected under repeated dynamic loading.

Keywords: steel element, local stability, thin web, failure mechanism, fatigue crack

MECHANICAL CHARACTERISTICS PREDICTON ON POLYMER CONCRETE WITH SILICA FUME USING ARTIFICIAL NEURAL NETWORK

Senior Lecturer Ph.D. Daniel Lepadatu¹

Professor Ph.D. Marinela Barbuta¹

Senior Lecturer Ph.D. Judele Loredana^{1*}

Ph.D. Student Raluca Mitroi²

Eng. Andrei Ilas¹

¹"Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services, **Romania**

²"Gh. Asachi" Technical University of Iași, Faculty of Hydrotechnical Engineering, Geodesy and Environmental Engineering, **Romania**

ABSTRACT

In the paper the Artificial Neural Network - ANN was used for prediction the mechanical characteristics such as flexural strength and split tensile strength of polymer concrete with silica fume. Neural network modeling generated the mixes with the lowest cost and maximum strength. The association of these two materials has unpredictable effects on the properties of concrete. The experimental mixes of polymer concrete realized of epoxy resin, silica fume and aggregate were established using the mixture design of experiments that is a suitable method for checking an adequate mathematical modeling of real phenomenon which is strongly nonlinear. Flexural strength and split tensile strength where experimentally determined for all mixtures. An artificial neural network - ANN is a computational model inspired by the biological natural neuron. The complexity of real neurons is highly abstracted by mathematical equation when modeling artificial neuron. This transforms the input data in output data function the operator ability of choosing and connecting more neurons or more layers for obtaining the expected performance. Their capacity of learning and adapting to operator demands makes a useful tool in math modeling and optimization of nonlinear processes. ANN presents a high potential of adaption to mathematical modeling of processes or phenomena type black box, generally with a pronounced nonlinear character and which are difficult to describe and model with simple mathematical models. ANN has ability to solve new problems by applying information learned from past experience, as human brain.

Keywords: artificial neural network, epoxy resin, mechanical characteristics, polymer concrete, silica fume.

NEW IDEA FOR ENERGY SAVING AND AIR PURIFICATION IN URBAN AREAS BUILDINGS

Dr. Arch. Codrina Grecu¹

Drd. Arch. Andrei Purcaru²

¹ ‘ Ion Ionescu de la Brad’ University of Agricultural Sciences and Veterinary Medicine of Iasi,
Romania

² ‘ Gheorghe Asachi’ Technical University of Iasi, **Romania**

ABSTRACT

In order to fulfill the european and world wide directives for the energy economy, an essential part belong to the construction sector stakeholders. In some cases, the constructive solutions to reduce energy consumption adversely affect indoor environmental quality, creating imbalances in the way of achieving natural ventilation. Thus, during doctoral study of the author on the buildings ventilation problem and building elements ventilation, in terms of comfort, air quality and energy efficiency, was born the idea of an independent systems combination, that are specific to passive buildings, using a new concept - "permanent garden-façade ". This paper underline the solution of combining two already known and widely used systems: the ventilated glass façades and Canadian or Provençal well. The vegetation enhance the ambiental effect of this sistem and it may be located within interior ventilated façades or to outdoor of buildings envelope and is itself a natural air filter plant.

Keywords: scale physical model, Canadian / Provençal well, ventilated façade, energy saving, vertical gardens.

OPPORTUNITIES FOR BUILDING MATERIALS WASTE RECYCLING

PhD Eng. Henriette Szilágyi¹

PhD Eng. Ofelia Corbu²

PhD student Eng. Cornelia Baeră¹

PhD Eng. Lecturer Attila Puskás²

PhD Eng. Mircea Păstrav¹

¹ N.I.R.D. “URBAN-INCERC”, Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

Recycled aggregates obtained from: concrete, debris or bricks waste, has different properties, such as strength, particle shape, surface roughness, water absorption, etc., than natural aggregates (river sand and gravel). That is the major reason for the experimental results obtained on various concrete mixes, showing significant differences between the properties of the concrete made with recycled aggregates to those of concrete made with natural aggregates. Several researches were conducted worldwide in order to establish the optimal ratio of designed concrete composition considering different aggregate properties, water/cementitious material ratio, etc. which determine the strength, workability and durability of concrete. Opportunities for recycled concrete aggregates use are restricted by different requirements, specific for several countries or organizations.

Keywords: waste recycling, green building materials, concrete compositions

RECYCLING AND WASTE RECOVERY IN THE CONSTRUCTION FIELD

PhD. Eng. Ofelia Corbu¹

PhD. Eng. Researcher CSII Henriette Szilagyi²

PhD. Eng. Lecturer Attila Puskas¹

PhD. Student Eng. Antoanela Popovici³

PhD. Student Eng. Researcher CSIII Cornelia Baera²

PhD. Eng. Assoc. Prof. Ligia Moga¹

¹ Faculty of Civil Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**, r

² INCD “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

³ Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**

ABSTRACT

Because of exhaustive consumption of non-renewables resources of energy in all sectors, saving trends at all levels is an absolute necessity. In this respect an important role is given to the industry sector. Reductions of the energy consumptions can be achieved by recycling waste and reuse them as raw materials or as secondary raw materials construction sector. Waste recycling and recovery is an imperative measure necessary to reduce consumption of non-renewable raw materials. By introducing in the industry circuit materials obtained through waste recycling, significant savings of natural resources and of energy can be obtained. Obtaining building materials by using various industry wastes is one of the ways that the scientific community is called to provide in order to ensure a sustainable future for humanity. Concrete is a material widely used in huge volumes, that has a real potential of embedding waste.

Keywords: waste recycling, waste recovery, non-renewable resources, sustainability, energy reduction, concrete

REUSING AND RECYCLING POTENTIAL OF SERBIAN HOUSING STOCK

Assoc. Prof. Miloš Nedić

Prof. Nataša Ćuković Ignjatović

Prof. Dušan Ignjatović,

Faculty of Architecture, University of Belgrade, **Serbia**

ABSTRACT

Having in mind great impact that building industry causes to the environment throughout building life cycle, construction and demolition (C&D) waste management is significant part of overall waste management program of local society. It is of great importance to project possible outcomes of local building stock at final stage of its life cycle, regarding possibilities for reusing or recycling of certain parts of buildings. This paper deals with unsolved issue of C&D waste management in Serbia, where with lack of regulation mechanism, generated waste mostly ends up in a city landfill. On the other hand, taking into account significant age of greatest part of Serbian building stock, it is obvious that it is of great importance to perceive overall amount and content of possible waste that Serbia has to deal with. In that respect, relevant portion of national housing typology is presented, reviewing typical housing types, quantities and structure of building materials used.

Keywords: C&D waste management, building life cycle, reuse, recycle

RHEOLOGICAL PARAMETERS OF 100% RECYCLED HALF-WARM ASPHALT MIXTURES

Petr Kucera

Josef Zak

Czech Technical University in Prague, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

Since 1960s several railway administrations have utilized asphalt mixtures instead of conventional granular subballast in selected tracks or track sections. Gained experiences have shown that asphalt layers provide a good support for ballast bed, distribute load equally to subgrade and due to their impermeability protect subgrade from rain water penetration. However, production of conventional asphalt mixtures demands high amounts of energy and natural materials, particularly bitumen and aggregates. Production of asphalt mixtures at lower temperatures can significantly decrease energy consumption of the process. A possible way to preserve resources of natural materials is utilization of high percentages of recycled asphalt pavement material in production of asphalt mixtures. This study is focused on investigation of 100% recycled half-warm asphalt mixtures. Development of a new approach to design subballast layers made of these mixtures is proposed. The design approach employs deformation modulus as the main criterion for assessment of bearing capacity of subballast layers. To evaluate the effect of subballast, made of recycled asphalt mixtures, on the bearing capacity of railway track bed it is necessary to gather enough data including deformation modulus on formation surface, subballast thickness and resulting deformation modulus on subballast surface. The data can be gathered by measurements on real structures, measurements on physical models or by numerical modeling. For the purpose of this study, the latter approach was chosen. First steps to establish a corresponding material model were carried out. The creep compliances were calculated from direct compression test as the dimensionless physical parameter of recycled asphalt mixtures. The effect of several stress levels is presented and the linear-viscoelastic boundaries are assessed. The measured creep compliances were fitted with the Kelvin-Voight model.

Keywords: recycled, asphalt mixture, subballast, creep, linear viscoelasticity

SELF MANAGING BUILDINGS

Dr. Mircea Păstrav¹

Cornelia Baeră¹

Dr. Henriette Szilagy¹

¹ National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development “URBAN-INCERC”, Cluj-Napoca Branch, **Romania**

ABSTRACT

The concept of smart or green or eco-friendly building is usually referring to the energy efficiency of the buildings dealing with the passive or active measures to achieve zero energy consumption. The attention is focused on the reducing the loss of heat, the efficiency of lighting and other types of energy consumption in buildings.

The proposed concept of self managing buildings is focused on the new design and detailing of the building structures, and advanced materials rather than on the insulation materials or the building equipment.

This new concept is based on experimental studies on the behavior under seismic type loadings of a different kind of reinforced concrete frame structure as well as on the special characteristics of advanced cement-based grouts used as self-healing materials.

The reinforced concrete frame structure is made out of precast elements assembled by non-adherent partial post-tensioning. The detailing of the column-girder joints, called modified special hybrid joint, consist of two different type of horizontal reinforcement which go through the beams ends and the column and in the interfaces gaps a high resistance grout is used. The former type of reinforcement is made of strands, used also for the general structural assembly by post tensioning, and is located in the centroid of the beams. The latter consist of ductile steel bars, located at the beam top and bottom ends, having the role of bending moment transfer and also of energy dissipation, mainly due to their plastic behavior under extreme loadings. As for the interface grout the innovative solution is the use a high resistance fiber reinforced self-healing cementitious compounds.

The paper emphasizes the auto-balancing structural behavior of the new RC frame structures with modified hybrid joints, as well as the self-healing grout properties which determine the closure of the remaining micro cracks after a seismic type or other accidental loading as well as the sustainable aspects of the use of such structures.

Keywords: modified special hybrid joint, seismic type test, self-healing advanced cementitious compound

SOLUTION OF THE RISING DAMP IN THE CHURCH IN GEMERSKÝ JABLONEC

Assoc. Prof. Anna Sedláková¹

Assist. Prof. Ladislav Ťažký¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Moisture is a major source of damage in historic solid masonry. Rising damp is a well-known phenomenon around the world and occurs when groundwater flows into the base of a construction and is allowed to rise through the pore structure. From practical experience it is known that many factors may play a role regarding permeability problems in masonry. The amount of possible causes of moisture problems in historic masonry underlines the complexity of this phenomenon. Evaporation is an important factor in rising damp. The surface of an affected wall contains moisture that has risen from the ground and this moisture is then subject to evaporation. The factors controlling evaporation include: temperature, humidity, air movement and surface condition (the masonry been painted). [1,3,5,6]

The most cost-effective way of preventing damp problems in buildings, including those resulting in damp masonry at the foot of walls, is to minimize moisture sources and provide adequate passive moisture sinks to dissipate any penetrative moisture so as to make the system fail-safe. Traditional and more effective detail is to use a ventilated and drained 'dry area' around the foot of the wall. Alternatively, a perforated plastic land drain can be laid to falls in a trench lined with geo-textile and back filled with 'beach cobbles' or large diameter hard core. [1,7,8]

Keywords: rising damp, sub-floor ventilation, drainage, historical building, masonry

**STRENGTH DEVELOPMENT OF FIBER REINFORCED SELF-
COMPACTING CONCRETE (RFSCC): TEMPERATURE EFFECT ON
MECHANICAL PROPERTIES**

Safi B¹ and Saidi M¹

¹ Research Unit: Materials, Processes and Environment (UR/MPE), Boumerdes University, Algeria

ABSTRACT

The strength development of Fiber Reinforced Self-Compacting Concrete (FRSCC) was investigated in this work. The variable is the heat curing at different temperatures (20°C and 60°C) applied at 7 and 14 days of curing of concretes studied. Two temperatures 20 and 60 °C were applied to samples with intermediate levels (depending on the drying method applied to precast concrete) for 18 hours in total. In this study, a Portland cement (CEMII), limestone fillers were used in the binders of FRSCC and the steel fibers are also used as reinforcement for concrete. The results show that the compressive strength to 14 days of concretes studied, increases with heating (60 °C) compared to that measured at 20 °C. Also, values of compressive strength of FRSCC at 14 days that are best to those obtained without 28 days curing treatment. Indeed, the compressive strength values of treated concretes (14journs) obtained are 15% and 25% respectively obtained for fibers reinforced self-compacting concretes made with 1.5% of steel fibers.

Keywords: Fibers reinforced self-compacting concrete, steel fibers, compressive strength, flexural strength, temperature.

STRUCTURE AND ROLE OF ADDITIVES IN BITUMEN ADHESION TO NATURAL AGGREGATES

Senior Lecturer Ph.D. Judele Loredana¹,

Professor Ph.D. Marinela Barbuta¹

Senior Lecturer Ph.D. Daniel Lepadatu¹

**¹Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services,
Romania**

ABSTRACT

The road works at getting hot bituminous mixtures and not only an important requirement of bitumen is to wet better natural aggregates. In order to ensure a stable connection between aggregate and bitumen are used increasingly more frequently in the addition (doping) of bitumen, i.e. bitumen mass addition of small amounts of additive (0.1-0.5%). Although the percentage of additive is small, laboratory tests show that adhesiveness increases substantially after introduction. The adhesion is one of the complex phenomena that occur at the contact bitumen - aggregate, some physical or physico-chemical phenomena (aggregate surface texture and porosity, bitumen viscosity, interfacial tension) and other chemical (mineralogical nature of the aggregates and the chemical composition of bitumen) . Typical adhesion is defined as the ability to cover a binder with an aggregate to disperse upon contact with water or traffic aggressions. Bitumen is a natural or artificial fluid of semi-solid consistency - dark color of brown to black, consisting of complex mixtures of organic substances with colloidal structure. The paper presents two of the additives with which I worked, their structure, how they act bitumen and some of the results obtained for adhesion (using both pure bitumen and bitumen additives). It should be binding to the aggregated particles or between particles and the surface of the existing connection. Although the incidence of premature rupture attributable to adhesion is relatively rare, substantial costs to breakdowns may occur at the time.

Keywords: additives, adhesiveness, aggregate, bitumen

STUDY OF STRENGTHENED REINFORCED CONCRETE SHORT CORBEL BY EXTERNALLY BONDED CARBON FIBRES FABRICS

Dr. Ivelina Ivanova¹,

Dr. Jules Assih¹,

Prof. Alex Li¹,

Prof. Dimitar Dontchev²

¹ University de Reims Champagne-Ardenne, Reims, **France**

² University de Technologie Chimique et de Métallurgie Sofia, **Bulgarie**

ABSTRACT

The present paper investigates experimentally the mechanical behavior of reinforced concrete corbels strengthened with carbon fibers fabrics, including the local and global strain distribution, load-carrying capacity and mode of failure. The effect of fibers fabrics configuration and some geometrical and structural parameters are studied experimentally and analyzed: the number of layers and the thickness of carbon fiber fabrics, the type of strengthening, and the orientation of the fibers in carbon fibers fabrics (unidirectional, bidirectional). As such as, effect of the type of strengthened reinforced concrete corbels directly on either sides or wrapping by externally bonded the carbon fiber fabrics.

A preliminary study to found the number of layers necessary for optimal and effective strengthening is realized. Then, we compare usefully unstrengthened and strengthened reinforced concrete short corbels subjected to monotonic loading to failure. Cracking of corbels are described and different failure modes are observed. The testing shows better results for the unidirectional fibers as well as by wrapped strengthening.

The extensometer technique based on electrical strain gauge is used to study the local behavior of the structure. This technique allows to measure the strain of steel, carbon fabrics and concrete. The effect of the same parameters on local behavior of the strengthening structure is examined.

The ultimate load and strain of the specimens are compared to the reference corbel. The cracking mechanisms and the mode of failure under static loading are presented and analyzed. The results show an increase of more than 82% of the load carrying capacity of the corbels and improving their rigidity of the third.

Keywords: strengthening, short corbel, reinforced concrete, mechanical behavior, composite materials;

SUSTAINABILITY OF CONSTRUCTION FROM PERSPECTIVE OF APPLICATIONS TECHNOLOGIES FOR GREEN BUILDINGS

Prof. Ing. Mária Kozlovská, PhD.¹

Ing. Marek Krajňák¹

Assoc. Prof. Ing. Renáta Bašková, PhD.¹

Ing. Alena Tážiková, PhD.¹

¹Institute of Civil Engineering Technology and Management, Faculty of Civil Engineering, Technical University of Košice, **Slovakia**

ABSTRACT

A worldwide trend in terms of sustainability is the construction of green buildings. Green buildings are efficient in resource using (energetic, natural and social) and environmentally friendly throughout their life cycle (selection of land and project, construction process, the operation of the building, reconstruction or liquidation). Sustainability of buildings is currently investigated by a number of evaluation systems that reflect their design, technical, technological and material solutions. In one of the first green building in Slovakia "EcoPoint Kosice Office Center", which obtained pre-certificate "Seal of the sustainable construction (DGNB)" in the category of silver, was used a number of "green technologies". This paper presents the process of building certification under the LEED and selected structural-technical solutions that support the principles of sustainability. Combining geothermal wells connected to a heat pump with reinforced Concrete Core Activation (CCA) of ceilings is created highly effective way of surface heating and cooling of buildings. Contribution points out that although the use of new green technologies raises several unexplored risks, ultimately form the necessary framework to meet the requirements of sustainability.

Keywords: sustainable development, green technologies, concrete core activation, building certification, reinforced concrete structures

SUSTAINABLE PAVEMENTS: INFLUENCE OF THE SAW-CUTTING METHOD ON THE PERFORMANCE OF JPCP

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Section Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, the election of concrete as material for pavements is limited when only the construction costs are considered in the analysis. There is a continuing development of technology in order to reduce the costs of concrete pavements while maintaining the good performance and durability. Early-Entry Saw-Cutting (EESC) consists of a shallow cut (up to 30 mm depth) that allows a faster construction of Jointed Plain Concrete Pavements (JPCPs) because the joints can be cut just 3-5 hours after concrete placement. In addition, EESC is useful to avoid repair costs for random cracking because it relieves internal concrete stresses. Although EESC has become more accepted, especially in U.S.A, there are some concerns regarding to its influence on the JPCP performance. The objective of this paper is to evaluate the influence of the saw-cutting method on the JPCP performance. For that, a modelling of the activation of transverse joints and their crack width value is made. The modelling takes into account the cut depths of the EESC and the conventional saw-cutting method when they are applied to traditional and short slab JPCPs. In addition, the Load Transfer Efficiency (LTE), related with the crack width, and representative for the JPCP performance is estimated using the experimental verification of the finite-element software EverFE. Finally, practical experiences of JPCP projects in similar conditions as assumed in the modelling are considered in the evaluation, including fibre-reinforced concrete (FRC). It was concluded that EESC is effective to avoid random cracking but special measures need to be taken to evade higher stresses in the JPCPs that are not considered in the design and will negatively influence the JPCP performance. In short slabs, for the analysed conditions, a Relative Joint Depth (RJD) $\leq 25\%$ results in LTE $\leq 52\%$ and uncracked joints, therefore longer slabs than the designed ones. In traditional JPCPs a RJD $\leq 25\%$ results in a very low LTE ($\leq 30\%$).

Keywords: Sustainable, Pavements, Concrete, Saw-Cutting.

SUSTAINABLE PAVEMENTS: UNSEALED JOINTS IN JOINTED PLAIN CONCRETE PAVEMENTS

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Section Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, concrete as material for pavements is hardly chosen when only the construction costs are considered in the analysis. The use of Jointed Plain Concrete Pavements (JPCPs) with unsealed joints not only yields the savings of sealing the joints, but also the ones for keeping them sealed. The total savings for not sealing the joints can reach 45% in 10 years. The objective of the present paper is to determine the conditions where it is feasible to use unsealed joints in JPCPs. For that, the technical basis of the unsealed joints are taken into account, together with the experiences of these kind of joints in different scenarios, for instance: JPCP applications for streets, bus corridors, highways, low volume roads and industrial yards; different times in service and climatic conditions. The necessary conditions to use unsealed joints in JPCPs are narrow saw-cuts (not more than 3 mm wide) and a base/soil layer with limited fines content. The applications where it is feasible to use unsealed joints are streets, low volume roads, industrial JPCPs (warehouses) and any JPCP application where the seals are not maintained. For JPCPs with higher traffic demands, as highways and bus corridors, the feasibility of JPCPs with unsealed joints will depend on the traffic and the weather. There are bus corridors with good performance in climate without excessive rainfall. Although there is not consensus about the performance of unsealed joints under heavy traffic and very demanding climates, there are unsealed joints in these conditions with excellent results.

Keywords: Sustainable, Pavements, Concrete, Unsealed Joints.

SUSTAINABLE PAVEMENTS: AN ANALYSIS OF THE CRACKS WIDTH IN JOINTED PLAIN CONCRETE PAVEMENTS WITH SHORT SLABS

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, the election of concrete as material for pavements is limited when only the construction costs are considered in the analysis. Because of the load configuration and the curling reduction, the Jointed Plain Concrete Pavements (JPCPs) with short slabs allow less thickness and therefore less construction costs (savings up to 30%). The objective of the present paper is to analyze the crack width under the joints of JPCPs with short slabs and the implications of these values for the performance of the pavement. For that, a comparison of the magnitude of the crack width is made with the traditional JPCP, using a model developed by the authors, field data of cracks width and Load Transfer Efficiency (LTE), and taking into account practical experiences of JPCPs with short slabs. For the analyzed conditions a reduction of 40% of the average cracks width of the JPCP with short slabs in comparison with the value of the traditional JPCP was found. This means better aggregate interlock, then higher LTE and less deterioration of the pavement, which is in agreement with the good performance that JPCPs with short slabs have shown in U.S. and Chile

Keywords: Sustainable; Pavements, Concrete; Crack Width.

THE AGGREGATE INFLUENCE ON THE PHYSICAL AND MECHANICAL PROPERTIES OF THE CONCRETES FOR USE AS GAMMA RADIATION SHIELDING

Prof. PhD. Maria Gheorghe¹,
Assoc. Prof. PhD. Nastasia Saca¹,
Assoc. Prof. PhD. Lidia Radu¹
PhD Adriana Moanta² ,
PhD Viorel Fugaru³

1: Technical University of Civil Engineering, Research Center of Inorganic Waste Valorization in Building Materials, **Romania.**

2: CEPROCIM SA **Romania.**

3: The National Institute of R&D for Physics and Nuclear Engineering Horia Hulubei **Romania**

ABSTRACT

This paper presents an experimental study on physical and mechanical properties of the concretes prepared with different type of cements and aggregates. The reference concretes carried out with river aggregate and with two type of cement namely ordinary Portland cement and composite Portland cement with 20% Ba compounds addition. The high-density concretes have been prepared with ordinary Portland cement and high density aggregates as hematite and mineral steril with barite from barite rock processing.

The concrete gamma linear attenuation coefficients were tested for γ -rays energy of 0.37 MeV (Ir-192), 0.663 MeV (Cs-137) and 1.25 MeV (Co-60). The concrete density, ultrasonic wave velocity and compression strengths were tested too. The fresh and hardened concrete properties were considerably influenced of the water/cement ratio and of fine particles/coarse aggregate volume ratios. The high concretes density significantly favored the attenuation of gamma rays energy.

Keywords: high density aggregate, heavy concrete, gamma linear attenuation coefficients

**THE ENVIRONMENTAL, ENERGY PERFORMANCE EVALUATION OF THE
REAL WOODEN HOUSE AND THE COMPARISON OF ITS LOCATION IN
THE DIFFERENT CLIMATIC CONDITIONS**

Ing. Silvia Baďurová, PhD.¹

Ing. Radoslav Ponechal, PhD.²

¹Research Centre, University of Žilina, **Slovakia**

²Faculty of Civil Engineering, University of Žilina, **Slovakia**

ABSTRACT

This paper deals with an evaluation of an existing wooden panel house in the passive standard and its comparison with the alternative material composition (porous concrete masonry house). The criteria for the evaluation are the energy performance (according to EU standards and norms), the size of the usable area and the environmental impact (according to OI3 methodology). Furthermore, this paper assesses a potential benefit for the energy savings in heating (or cooling) based on the change of the locations (changing of the climate dates). These comparisons are based on the numerical simulation which is calibrated from in situ measurements.

Keywords: passive house, energy efficiency, eco indicator OI3, natural materials, energy simulation

**THE FORMATION OF THE MICROSTRUCTURE OF THE MULTISILICON
GROWN FROM REFINED METALLURGICAL SILICON**

Dr. Svetlana Peshcherova

Dr. Liudmila Pavlova

Assoc. Prof. Dr. Aleksander Nepomnyaschikh

Vinogradov Institute of Geochemistry, Siberian Branch, Russian Academy of Sciences, **Russia**

ABSTRACT

Distribution of impurities in multisilicon, grown from metallurgical silicon by the Bridgmen-Stockbarger method has been studied using electron probe microanalysis. It has been found that most of the impurities occur as primary and secondary microinclusions. Primary microinclusions are large (1-100 micron) intermetallic agglomerates formed in the melt from primary microinclusions of metallurgical grade silicon. Secondary microinclusions are smaller (to 1 micron) and contain not more than three metal elements.

Keywords: Multicrystalline silicon, impurities, electron probe microanalysis

THE GREEN CONSTRUCTION TECHNOLOGIES FROM SAFETY AND HEALTH POINT OF VIEW

Ing. Zuzana Struková, PhD.

Prof. Ing. Mária Kozlovská, PhD.

Technical University of Košice, Faculty of Civil Engineering, **Slovakia**

ABSTRACT

The Europe 2020 strategy sets target for reducing the greenhouse gas emissions is contributing mainly to the development of renewable energy technologies and activities to support energy efficiency, particularly in construction industry, as one of the sectors most directly linked to green or green economic activities. The assessment of the occupational hazards and risks that might be associated with new green technologies and related jobs is now becoming part of many discussions. The paper deals with the initiative of the European Agency for Safety and Health at Work aimed at examination of the potential safety and health risks associated with the technologies being used in the development of “green jobs” that are becoming an important part of the construction labor workforce. Moreover, the occupational safety and health implications and scope for emergent risks in green construction technologies are discussed in the paper. The increasing drive towards green buildings is leading to innovative design and construction processes and the use of alternative materials and so development and greater implementation of new technologies. New work situations connected with new technologies, substances and work processes connected with the design and construction of buildings that have potential to reduce energy use may result in some emergent safety and health risks. Consideration should be given to the safety and health of those who build and maintain those designs and the mentioned risks should demand some approaches to ensure high level of occupational safety and health.

Keywords: green construction, green technology, sustainable construction, new technology, green job, safety and health

THE ISSUE OF BUILDING ENVELOPE OF MODULAR STRUCTURES

Ing. Barbora Hrubá

Ing. Marcela Cerniková

Ing. Nada Zdrážilová

Prof. Ing. Darja Kubecková, Ph.D.

VŠB – TU Ostrava, Faculty of civil engineering, **Czech Republic**

ABSTRACT

Building envelopes must request very stringent thermal insulation requirements. All in connection with the implementation of the regulation of the European Parliament and Council 2010/31/EU of the energy performance of buildings into law 318/2012 Sb., of energy management, which changes the law 406/2000 of energy management. This paper deals with the issue of modular structures. Modular structures also called residential containers have many prerequisites for creating quality living. It is possible to assemble objects of almost any floor plan and elevation dimensions from these residential containers. In terms of the impact on the internal environment of these buildings it is difficult to solve thermal bridges and thermal bonds, which are one of the most important factors in the possible formation of mold on the inner surface of the structure.

Keywords: Building envelope, modular structure, thermal insulation, thermal bridges

THE PROPERTIES OF BASALT ROCKS OF GEORGIAN DEPOSITS AND THE FIBERS OBTAINED FROM THEM

Prof. Nikoloz Chikhradze^{1,2},

Prof. Guram Abashidze²,

Ms. Sc. George Pkhaladze²,

Eng. Davit Tsverava

¹ Georgian Technical University, **Georgia**

² LEPL G. Tsulukidze mining Institute **Georgia**

ABSTRACT

With the advent of 21-st century the intensive investigations carried out all over the world for preparation of technical purpose fibers of new type. Among them is basalt fiber which may be considered as an alternative of glass fiber. Basalt fiber is distinguished from glass one by improved physical-mechanical characteristics, especially by elasticity module, enhanced heat resistance and stability against various aggressive media. Taking into consideration the fact that the technology of preparation of basalt fiber is not much different from the technology of preparation of glass fiber and their cost is the same order, the technologies of preparation of the products from basalt fiber occupy a highly important place in advanced industrially developed countries.

There are large resources of basalt raw material in Georgia. In presented work the characteristics of basalt rocks of three deposits (Marneuli, Tetrtskaro, Bolnisi) are given as well as such properties of obtained melt as viscosity and crystallization ability, the conditions of fiber formation, fiber physical-chemical and mechanical characteristics, including short-term resistance and long-term strength at tension.

THERMAL ANALYSIS OF PERFORMANCE OF THE BUILDING ENVELOPE

Ing. Denisa Donova¹

Ing. Veronika Kucerikova¹

Ing. Nada Zdrazilova¹

¹ VSB – Technical University of Ostrava, Faculty of Civil Engineering, **The Czech Republic**

ABSTRACT

The aim of this paper is to evaluate performance of a light wooden structure in terms of the temperatures in the structure. The evaluation is done with respect to the type of the building envelope. Specifically there is a comparison of the structure with ventilated air gap and the structure without ventilated air gap. To evaluate the performance of structures there are used experimental data which are measured in the experimental passive house. Then the paper focuses on comparing of the real performance of the structures with generated numerical models.

Keywords: thermal analysis, building envelope, experimental passive house

which is used as a vocational training center MSDK. The facade of this building is partially solved with ventilated air gap and partly without ventilated air gap, see Figure 1.



Fig. 1: Object of Vocational training center MSDK

CONSTRUCTIONS OF PASSIVE TIMBER BUILDING

The peripheral wall of this experimental passive house is designed as a lightweight wooden construction. The construction is diffuse open. As supporting elements there were used beams Steico based on wood which are positioned axially at a distance of 600 mm. The structure is insulated by wood-fiber boards Steico.

Detailed section of both structures is shown in Figure 2. From this figure it is obvious that the structures differ in terms of compositions of the external insulation. While in case of the structure without the ventilated air gap is on the external side of structure used thermal insulation in a total thickness of 140 mm, for the construction with ventilated air gap, the thickness of insulation is reduced to 100 mm. Then there follows up the ventilated air gap. Thermal resistance of structures, in the axis between the beams, is then 12.3 (m².K)/W for the construction without air gap and 11.3 (m².K)/W for a ventilated design. Thermal resistance of the structure with ventilated air gap is almost 10% lower than in a case of non-ventilated construction.

MONITORING OF THERMAL – TECHNICAL CHARACTERISTICS

Since the building became operational there are monitored heat and humidity characteristics of the external walls in 8 locations. In the cross-section of structure there are disposed sensors for measuring temperature on the inner and outer side of the construction and 3 sensors are located inside the structure to measure temperature and humidity inside of this structure. Placement of the sensors inside the design is shown in Figure 2. In addition to these parameters, in this object there are also measured parameters of the internal and external environment using spatial sensors. Thanks to this

it can be comprehensively evaluated the structural behavior in response to the conditions that are in the vicinity of construction (on the internal and external side).

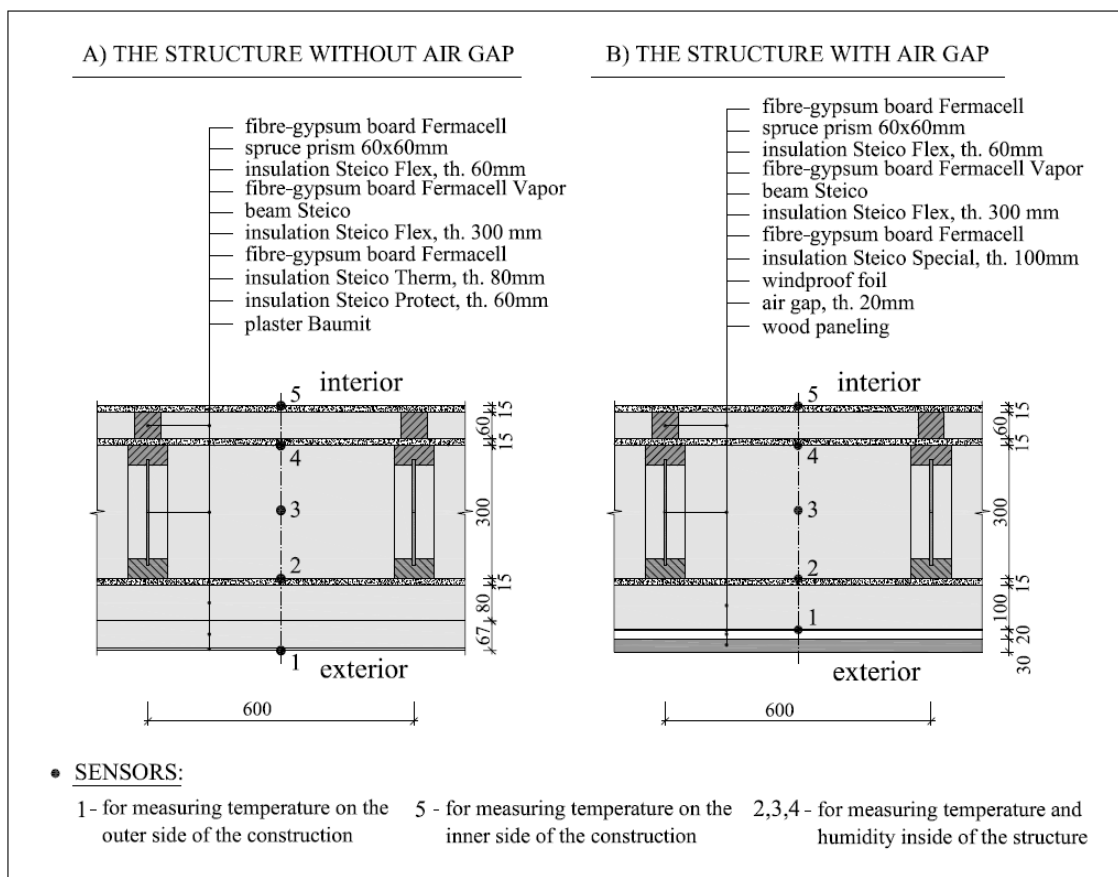


Fig. 2: Constructions composition and placement of the sensors

ASSESSED DATA

For the purpose of this paper there was used data obtained in measurements in two areas of the building envelope - from the south side of the building where there is facade without ventilated air gap and on the east side of the building where is the facade with air gap. In both cases, there were chosen places on the axis between the Steico beams, it means outside the thermal bridge. These two places were chosen because of similar internal boundary conditions inside the rooms where the sensors are placed. Due to the minimal differences in indoor air temperatures it is possible to compare the behaviour of these structures from the heat - technical view. For evaluation of construction design there was chosen data measured during the January 2014, when the temperature dropped below 0°C during a few days consistently. Measured values of temperatures in the structures are shown in Figures 3 and 4.

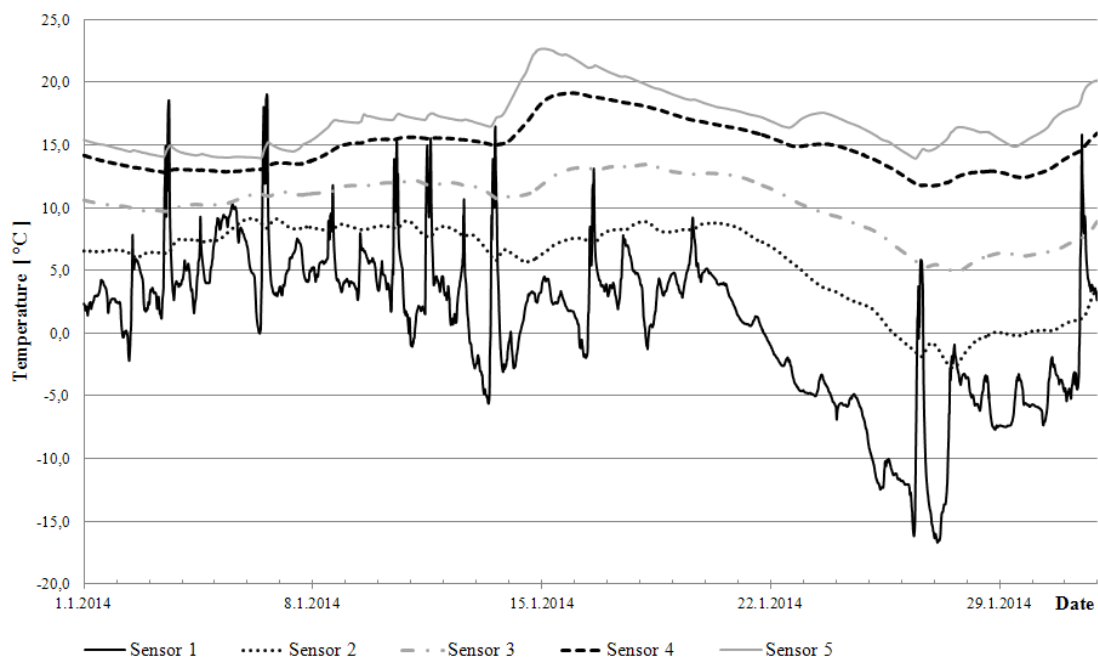


Fig. 3: Temperatures in the facade without ventilated air gap during January 2014

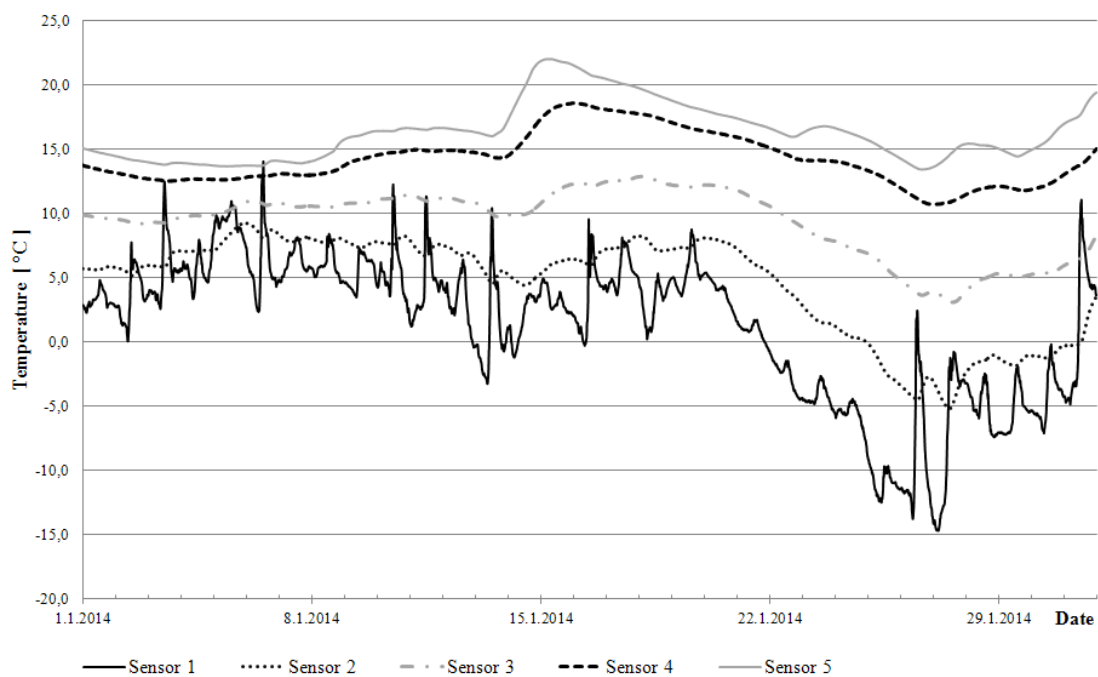


Fig. 4: Temperatures in the facade with ventilated air gap during January 2014

TEMPERETURES ON THE EXTERIOR SIDE OF CONSTRUCTION

In the case of external wall without an air gap, it is clear that the surface of structure is exposed to large temperature differences. These are caused by changes of outside air temperature and also by sunlight, which has an influence on the facade during the day. This thermal stress of the external surface of structure is inappropriate in the terms of the wear of used material and its thermal expansion. It is eliminated in the case of construction with ventilated air gap. Temperature curves of the exterior surface of structures are shown in figure 5. Here, in addition to course of temperatures it is also shows the temperature difference between these temperatures for both structure compositions. There was calculated the difference between the temperature on the external side of these structures - with ventilated air gap and without the air space. Values are mostly at around 0.5 ° C. It means that the temperature on the external surface behind the ventilated air gap is precisely higher by this value than in the case of a direct action of the external temperature on the exterior surface of the structure without the air gap. Conversely, in the case of direct sunlight on facade, when temperature in the ventilated air gap is significantly lower than in the case of the structure without the ventilated air gap.

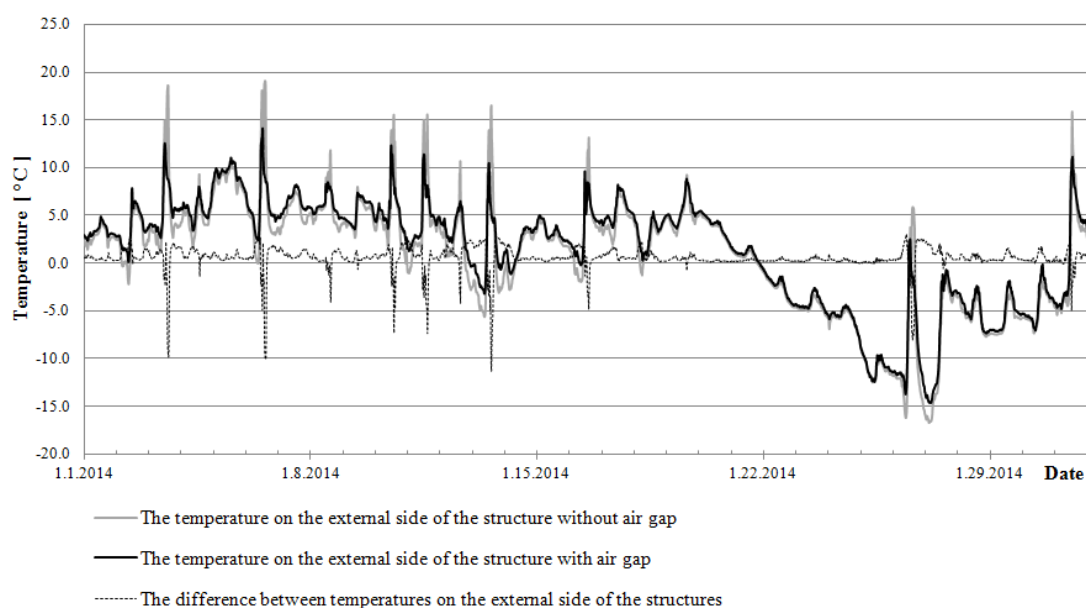


Fig. 5: Temperature curves on the external side of the structures

COURSE OF TEMPERATURE INSIDE THE STRUCTURE

For temperature inside the structures there were evaluated differences in temperature between the structures assessed at the same point in the structure construction. Positive values indicate that the temperature in the structure without ventilated air gap is higher than in the construction with air gap. From Figure 6 it is obvious that these differences are mainly higher inside the structure closer to its exterior surface. Closer to the interior of the structure the difference in temperature gradually decreases. This is evident at lower outdoor air temperatures, ie. from 22nd to 28th January 2014. From this it follows that the thermal insulating ability of construction with ventilated air gap is

lower than in the case of construction without ventilated air gap. This is of course due to the insulation of the outer surface of each structure, the construction of ventilated air gap is isolated in a smaller thickness and its thermal resistance is therefore lower. Furthermore, from Figure 6 it is clear that the difference between the temperature inside the structure at the point closer to the outer surface decreases with increase in outside air temperature.

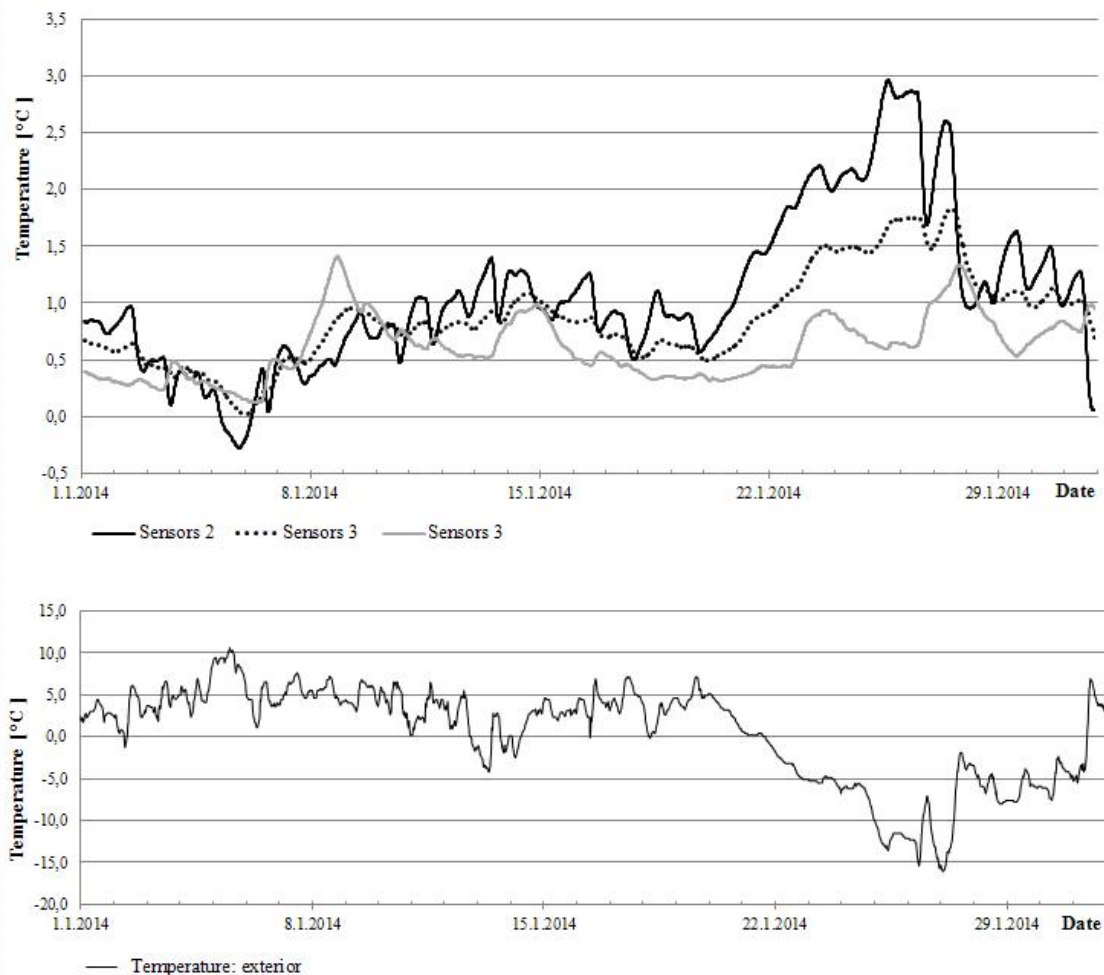


Fig. 6: Waveforms of temperature differences between the structures at given points – depending on the boundary conditions of external environment

TEMPERATURES ON THE INTERIOR SIDE OF CONSTRUCTION

For temperatures on the inner surface structure it was observed the difference between the temperature of the internal air in the room and the temperature on the inner surface of the structure. Differences between these temperatures for both types of construction are shown in Figure 7. It is obvious that the difference of these temperatures in the case of construction with ventilated façade is in average 0.6 °C higher than for facade without the vented air gap. It means that the heat-insulating ability of structure with ventilated air gap is slightly lower than in the case of the structure without the air gap. However, it is necessary to emphasize the difference between the heat resistance

of structures where for construction with ventilated air gap it is almost 10% lower than for structure without it. Obvious differences in temperature increases of the internal air and the inner surface temperature that are caused by solar gains are also interesting.

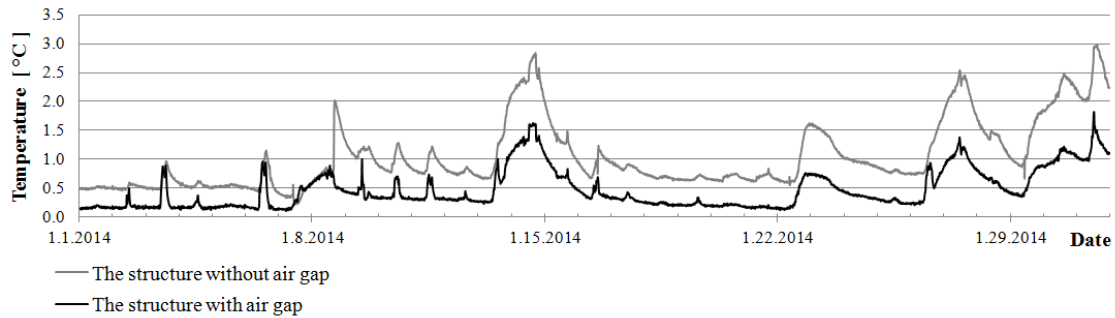


Fig. 7: Waveforms of differences between temperatures of the interior air and the inner surface temperature of construction

COMPARISON OF MEASUREMENT RESULTS WITH NUMERICAL MODEL

The results of experimental measurements were compared with the results of numerical calculation (like in [4]). It was performed using Area 2011 software, where it was modeled 2D temperature array. Stationary boundary conditions were modeled for the design boundary conditions in winter, according to CSN 73 0540, therefore the design temperature of outdoor air in Ostrava is $-15\text{ }^{\circ}\text{C}$ and the design temperature of indoor air for residential buildings is $20\text{ }^{\circ}\text{C}$. Thermal resistance on the inner side of the structure for calculation of temperature field is $0.25\text{ (m}^2\text{K) /W}$, on the outside of the structure if construction is unventilated it is $0.04\text{ (m}^2\text{K) /W}$ and for ventilated construction $0.13\text{ (m}^2\text{K) /W}$.

It was found that the difference in internal surface temperatures is for this boundary conditions about $0.65\text{ }^{\circ}\text{C}$. This is consistent with the results of measurements where the difference of internal surface temperatures during the reference period was mostly just $0.6\text{ }^{\circ}\text{C}$. The results are shown in Figure 8.

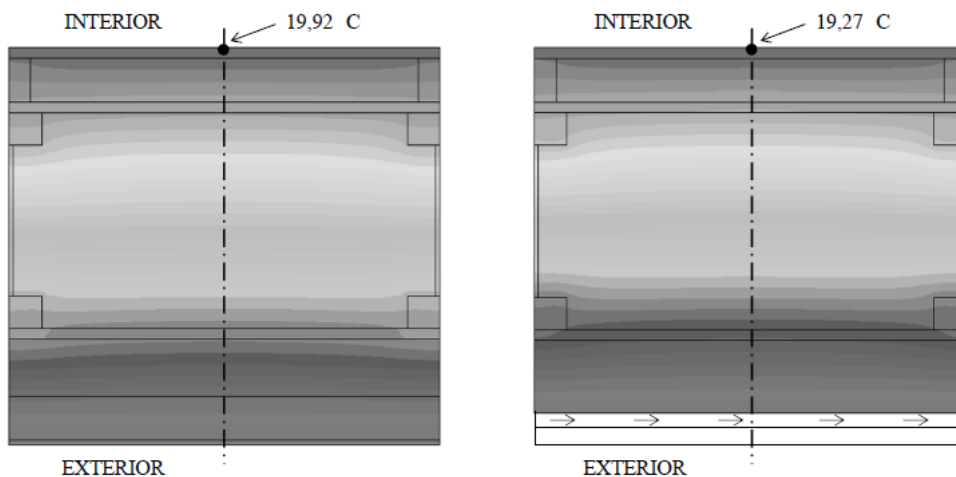


Fig. 8: Results of the numerical model

CONCLUSION

It was found that construction with ventilated air gap has insignificantly worse heat - insulating characteristics than the structure without this air gap. This is, of course, due to the thermal resistance of the construction, which is almost 10% lower than in the case of construction without an air gap, which insulated used thicker layer of thermal insulation. Furthermore, it was performed a comparison of differences between internal surface temperatures specified by numerical calculation with actual measured data, which practically correspond to the numerical model.

Acknowledgment

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REFERENCES

- [1] LAHUTA, Hynek & Iveta SKOTNICOVA. *Dynamic thermal performance of building structures in experimental lightweight timber-frame passive house*. In: SGEM 2013: Albena, Bulgaria, 2013-06-20, pp 403-410. ISBN 978-619710506-3. ISSN 13142704. DOI: 10.5593/SGEM2013/BF6/S26.008.
- [2] SKOTNICOVA, Iveta, Zdenek GALDA, Petra TYMOVA & Lenka LAUSOVA. *Experimental measurements and numerical simulations of dynamic thermal performance of external timber frame wall*. In: *Advanced Materials Research*, vol. 899, pp 988-99, 2014. DOI: 10.4028/www.scientific.net/AMR.899.126.
- [3] KUCEROVA, Lucie, Marcela CERNIKOVA & Barbora HRUBA. *Thermal technical assessment of selected constructions of wooden houses*. In: *ICMEMSCE 2013: Beijing, China*, vol. 470, pp. 988-991. ISBN 978-303785961-2. ISSN 16609336. DOI: 10.4028/www.scientific.net/AMM.470.988.
- [4] KUCEROVA, Lucie, Marcela CERNIKOVA & Barbora HRUBA. *Thermal properties of wooden buildings in relation to computer software*. In: *Advanced Materials Research*, vol. 899, pp 193-196, 2014. DOI: 10.4028/www.scientific.net/AMR.899.193.
- [5] PASEK, Jan & Daniela BOSOVA. *Impact of facade colouring on temperature and light conditions of buildings, housing estates, and environment*. In: *Advanced Materials Research*, vol. 899, pp 135-138, 2014. DOI: 10.4028/www.scientific.net/AMR.899.135.
- [6] PATANIA, Francesco, Antonio GAGLIANO, Francesco NOCERA, A. FERLITO & A. GALES. *Thermofluid – dynamic analysis of ventilated facades*. In: *Energy and Buildings*, vol. 42, pp 1148-1155, 2010. ISSN:03787788. DOI: 10.1016/j.enbuild.2010.02.006.
- [7] SUAREZ, Christian, Patrice JOUBERT, Jose L. MOLINA & Francisco Jose SANCHEZ. *Heat transfer and mass flow correlations for ventilated facades*. In: *Energy and Buildings*, vol. 43, pp 3696-3703, 2010. ISSN:03787788. DOI: 10.1016/j.enbuild.2011.10.002.

THERMAL BRIDGES HYGROTHERMAL PERFORMANCE IN BUILDING ENVELOPES SUBMITTED TO ENERGY REHABILITATION

Assistant Researcher, PhD Eng. Adrian Iacob

Senior Researcher 3rd rank, PhD Phys. Monica Lilioara Cherecheş

National Institute for Research and Development in Construction, Urban Planning and Sustainable Territorial Development “URBAN-INCERC”, Jassy Branch, **Romania**

ABSTRACT

The necessity of adopting a responsible attitude when using resources is rendered in all areas concerning energy through specific regulations derived from the general expressions of the principles of sustainable development. Buildings hold a major position in resource consumption, and if for the construction stage the materials investment is foreknowledge, the expense in controlling the indoor climate over a building's life cycle is for certain indefinable. For each type of building envelope, minimum insulation levels are required in national building codes, with a scope extent from new projects to the existing stock that undergoes processes for thermal improvement. This paper reviews several alternatives in hygrothermal upgrading of enclosure elements with reinforced concrete structural walls or frames, in order to lay out good building practice for minimizing thermal bridges effects. By performing numerical simulations of heat and mass transfer in specific constructive details, for Jassy typical climate, comparisons between hygrothermal performance of mineral wool and renewable natural materials are drawn.

Keywords: sustainable development, energy performance, heat and mass transfer, thermal bridges, numerical simulation.

**TYPICAL RENOVATION MEASURES OF BRICK HOUSES
FROM 1970 - 1990**

Pavel Oravec

Brno University of Technology, Faculty of Civil Engineering, Brno, **Czech Republic**

ABSTRACT

In the Czech Republic the construction of family houses by self-support of actual investors with the minimum of contractor participation is common. Since 1970's most houses have been built from molded bricks with concrete ceilings and reinforcing rims, covered by a wooden roof. The case study analyzes the typical range of reconstruction measures, which the specified houses are undergoing at present. The common denominator of the construction impacts are measures aimed at reducing the amount of energy needed to heat buildings. Are processes, technologies and investments of this type adequate? The part of this paper is also a test of the air tightness of the building and a measurement of the thermal insulation of the structures in the original condition and after the reconstruction.

Keywords: family house renovation, insulation of a construction, airtightness

VALORIZATION OF MINERAL WASTE WITH HEAVY METALS CONTENT INTO SILICATE MATRIX

Prof. PhD. Maria Gheorghe,

Assoc. Prof. PhD. Nastasia Saca,

Assoc. Prof. PhD. Lidia Radu

Technical University of Civil Engineering, Research Center of Inorganic Waste Valorization in Building Materials, **Romania**

ABSTRACT

Article presents a study concerning the embedding of some mineral waste with heavy metal content (electroplating sludge) into solidification/stabilisation (s/s) vitreous/vitroc ceramic matrix of glass products type and into cementitious matrix of concrete products type. The leaching tests showed that the obtained materials of vitreous, vitroc ceramic type and of hydraulic matrix type (based on Portland cement – PC and granulated blast-furnace slag - GBS) present no risk to the environment contamination. Also, the mechanical strengths of cementitious matrix and concretes are influenced of the Portland cement/granulated slag ratio, waste/cement ratio and water/cement ratio. The 28 days-compressive strengths of matrix with CP/GBS ratio from 80/20 to 20/80 varied from 80 MPa to 40 MPa. The cementitious matrix with GBS content more than 40/60 and with higher waste/cement ratio of 3/10 and 4/10 developed the lowest 28 days-compressive strengths due to a high content of Zn and Cu.

Keywords: waste, valorisation, vitreous, cementitious matrix, leaching, heavy metals

VEGETATIVE SLOPED ROOF ALTERNATIVE SOLUTIONS

Ing. Stanislav Tóth, PhD.¹

Ing. Arch. Zuzana Poórová ²

Doc. Ing. Zuzana Vranayová, PhD.³

^{1,2,3} Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Roof construction with substrate and vegetation layer raises quality parameters of artificial environment, raises quality parameters of the building and its internal comfort. It also raises qualitative index of the vegetative roof construction in compare with roof construction without substrate and vegetation layer. Vegetation layer on roof construction has an ecological aspect for the entire building that cannot be overlooked. Green roofs are also both architecturally and visually appealing forms of roof construction. It allows creating new volumes, new architectural surfaces that depend on design of the construction and aesthetical possibilities of the vegetative roof. Solving details and sloped vegetative roof structures directly affects reliability of the roof in term of damp proof course and building thermal physics. Construction design of the details and all roof structures intervene applied building physics. With its theoretical and experimental rules it must eliminate ineligible water penetration, but it must respect the request of designed vegetation. This paper deals with vegetative roofs advantages, mentions its mostly ecological contributions and its related roofs design specifics and structure solutions.

Keywords: current state, designed state, double-wall roof, single-wall roofs, thermal transmittance, triple-wall roof, relative humidity, structure solutions

**“RENAISSANCE” COMPLEX - BEHIND THE GREEN BUILDING IDEA
-DESIGN AND TECHNOLOGY-**

Lecturer Prof. Dr. Mihai Corneliu Drișcu, arch.

”GH. ASACHI” Technical University, Iași, **Romania**

ABSTRACT

This study aims to investigate the environmental and economic performances of sustainable building technologies applicable to a multi-family residential and office ensemble situated in Iasi, Romania. The technologies mentioned in this study include: exterior insulation, double envelope system, TRI-generation of the energy, BMS (building management system), LED technology.

All three buildings of the Renaissance ensemble benefit from south-oriented green requirements of contemporary architecture: double-skin facades, curtain walls, terracotta panels, etc.

A second skin façade may also cause an increase in materials and design costs, but would save energy consumption. We have implemented the TRI-generation of the energy (electrical, heating, cooling), which is a quite efficient and modern solution. Building Management System will provide comfort at a minimum energy cost. In order to allow the effective space utilization, a zonal energy distribution was designed. LED technology has been very useful especially for dynamic lighting of low energy consuming places/surfaces (facades, parking areas, etc).

The conclusions of the study applied to a certain investment – Renaissance ensemble - indicates that the sustainable building technologies, although the initial investment costs are higher than conventional technologies, are more economical and efficient in terms of life-cycle cost due to the reduction of energy and environmental costs.

Keywords: double envelope system, dynamic lighting, sustainable technology, life cycle cost analysis.

ACOUSTIC PROPERTIES OF LIGHT- WEIGHT ECOLOGICAL BUILDING ENVELOPE BASED ON STRAW

Ing. Nada Zdrzilova¹

Ing. Jiri Winkler²

Ing. Iveta Skotnicova, Ph.D.³

^{1,2,3} VSB – Technical University of Ostrava, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

The theme of building acoustics is very actual, especially in connection with the development of ecological structures and using of natural light-weight infilling materials. Their bulk density is much lower in comparison with traditional building materials and therefore they do not ensure primary protection against noise coming from the exterior of building. The purpose of this paper and related measurements is the determination of airborne sound reduction index R_w of selected types of the light-weight building envelopes, where the filling material is crushed straw. Effect of the variant cladding of these structures to their sound reduction index is also observed. These specific structures and filling insulator were chosen because they are relatively cheap and ecological materials with great potential, used in green buildings focused on sustainability. These defined acoustic properties enable (together with a thermal insulating and fire properties) these types of structures to become competitive alternative to traditional building materials.

Keywords: Light - weight structures, sound insulation, airborne sound reduction index, straw, filling materials, cladding

ALTERNATIVE WALL INSULATION FOR ENERGY EFFICIENT BUILDINGS

Assoc. Prof. Silvia Vilčeková¹

Assoc. Prof. Anna Sedláková¹

Assist. Prof. Eva Krídlová Burdová¹

Eng. Ladislav Ťažký¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Nowadays, heating energy demand has become a significant estimator used during the design stage of any new building. The residential building sector consumes a significant amount of fossil fuel energy and thereby produces a large percentage of greenhouse gas emissions that contribute to global warming and climate change. The aim of the paper is analysis of thermophysical parameters of proposed versions of exterior wall structures.

Keywords: passive houses, energy efficient building, building structure, thermal insulation, thermophysical parameters

ANALYSIS OF A FAMILY HOUSE ON THE BASIS OF WOOD AFTER 35 YEARS OF USE

Pavel Oravec¹

Brno University of Technology, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

Each building is modified and reconstructed during its life cycle. Building modifications are intended to extend the life of constructions and maintain the user's comfort. High quality of a construction shows minimal demands for a retrofit after some years. Any adjustments need significant financial costs. The analyzed house has been used by the same residents since 1978. The paper clearly states and justifies the list of significant investments in constructions and technologies during the usage. The described arrangements can be seen as representative because gradually all users of this kind of building access to the house in a similar form. More than 20,000 buildings have been built. The paper also includes the assessment of the building envelope and compares the energy inputs into the house.

Keywords: family house, wooden house, heating costs

ANALYSIS OF DOUBLE-SHELL ROOF VENTILATION IN A PREFABRICATED APARTMENT BUILDING

Assist. Prof. Jaroslav Vojtus¹

Assist. Prof. Martin Kovac¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

The principle functionality of double-skinned flat roofs is sufficiently obvious. The actual design and technological solution of such roofs is by itself quite complicated, especially where the actual geometry of the roof, orientation - windward / leeward side and particular elements supporting structure, solutions vents and other sheath perforations can worsen air flow in the cavity. This work was based on the need to gain a better understanding of the air velocity using simulation as a form of verification of the functionality of ventilated air gaps in real constructions. The moisture regime of roofs with open air layers is usually assessed as satisfactory in terms of operational reliability by a sufficient margin [1]. Flow simulation is used to reveal local imperfections, realize moisture diffusion from residential spaces, through ceilings without a vapour barrier, which would ensure the free flow of unwanted condensation on cold surfaces of the envelope leading to defects in the roof.

Keywords: roof, building construction, double skinned roofs, air gap, thermal insulation,

APPLICATION OF DIFFERENT STANDARD METHODS WHEN CONTROLLING THE STRENGTH OF CONCRETE IN STRUCTURE

Assoc. Prof. Dr. Alena Sicakova¹

Eng. Lenka Kyjakova¹

¹ Technical University of Kosice, Faculty of Civil Engineering, **Slovakia**

ABSTRACT

When assessing strength of concrete in finished structure and determining the strength class, two standard methods may be used in Europe, while the result may not be the same. For evaluation of concrete in the structures ISO 13822 is used, which states general procedure how to determine characteristic properties of all types of materials. Characteristic value of property (strength) is determined based on calculation using variable coefficient V_x and coefficient for determining 5% fractile.

The second method is given by EN 13791, where the value of characteristic strength is determined based either on standard deviation, or average value depending on number of samples.

The article covers an example of evaluation of concrete strength in structure by both methods, using samples taken from the real structure and aged for 14 days and 1 year. Differences in concrete strength that may occur due to the method used and testing time are pointed out. Results show that evaluation according to ISO standard is greatly influenced by diffusion of the results within the set of samples, as well as specification of strength classes being rather strict, thus evaluated concrete get assigned lower strength class. Difference in evaluation of the samples after 1 year shows as much as 3 classes.

Keywords: sustainability, durability of concrete, strength of concrete, strength class

APPLICATION OF PHASE CHANGE MATERIALS IN BUILDING STRUCTURES IN NORDIC CLIMATE

Post doc res Mihkel Kiviste

Prof. Ralf Lindberg

Tampere University of Technology, **Finland**

ABSTRACT

The study is based on nearly two-decade research at the Department of Civil Engineering at Tampere University of Technology. The purpose of current study is to find out structural solutions for the thermal storage of solar radiation in buildings. A significant effect of solar gains was noticed in massive external wall as well as roof structures in sunny days from March until September. However, modern lightweight materials lack thermal inertia in order to store energy. An idea to utilize the latent heat of phase change materials (PCMs) inside an insulation of light-weight roof structure enables to overcome this problem. The idea is supported with a principal example of diurnal performance of metal sheet roof structure as well as comparative calculation of energies consumed and gained. The results of current study show that PCMs have a potential in the future application of light-weight roof structures. In general, efficient solar solutions still need to be developed in order to store energy in summer and to release it in winter.

Keywords: 10-year data, temperature distribution, heat losses.

CHARACTERIZATION OF POLYMER CONCRETE WITH CALCAREOUS POWDER

Professor Ph.D. Marinela Barbuta¹

Lecturer Ph.D. Daniel Lepadatu¹

Associate Professor Ph.D. Ana Nicuta¹

Lecturer Ph.D. Loredana Judele¹

Ph.D. Student Raluca Mitroi²

¹"Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services, **Romania**

²"Gh. Asachi" Technical University of Iași, Faculty of Hydrotechnical Engineering, Geodesy and Environmental Engineering, **Romania**

ABSTRACT

In the last decades new types of concrete had developed or improved their properties. Polymer concrete is used more and more in the construction domain because it has some advantages in comparison with cement concrete, such as: high strength, corrosion resistance and rapid hardening. However, the high cost of polymer concrete is the most important disadvantage. Because of that, obtaining polymer concrete with lower prices is an important objective. Polymer concrete is a composite in which the aggregates are bound together by a resin. The use of different types of addition can reduce the costs of polymer concrete by reducing the resin content.

In this study, calcareous powder is added as filler in epoxy polymer concrete. The effects of this type of addition on the properties of polymer concrete were investigated. As a result, the physical-mechanical properties, experimentally determined, were compared with the characteristics of epoxy polymer concrete without addition used as witness. For characterizing this type of polymer concrete, the physical-mechanical properties (such as density, workability, compressive strength, flexural strength, split tensile strength) are presented in the paper. Calcareous powder used as filler, has a good effect on the mechanical properties of epoxy polymer concrete and resulted in a reduction of epoxy resin dosage in the mix.

Keywords: polymer concrete, mechanical characteristics, calcareous powder

CHOOSING THE OPTIMAL TYPE OF EXTERNAL WALL CONSTRUCTIONS FOR APPLICATION IN THE FIELD OF PASSIVE HOUSES

PhD Student Eng. Emanuel Megyesi,

Prof. Dr. Mariana Brumaru,

PhD Student Eng. George - Sebastian Naghiu ,

PhD Student Eng. Raluca - Andreea Felseghi

Technical University of Cluj-Napoca, Faculty of Building Services, **Romania**

ABSTRACT

The paper is highlighting the technical criteria used for choosing the optimal type of exterior wall construction to be applied in the field of passive houses. In this respect, the state-of-the art has been studied and 5 types of exterior wall structures were chosen for further analysis. The specific characteristics, as well as the decision criteria have been established for the selected types of exterior walls. In order to choose the most appropriate solution, two methods using multi-criteria analysis in rationalising the decisions have been applied for finding the best version, compatible with the specific requirements of the approached domain. In the end, the acquired results have been compared and conclusions have been formulated.

Keywords: multi-criteria analysis, exterior walls, passive house, assessment criteria, Onicescu Method

COMPOSITE STEEL-CONCRETE TRUSSES FOR RAILWAY BRIDGE SUPERSTRUCTURES

Assoc. Prof. Ștefan I. Guțiu

Lecturer Dr. Cătălin Moga

Lecturer Alexandra D. Danciu

Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

ABSTRACT

Composite steel-concrete structures with the steel substructure as a truss can offer a number of benefits from the point of view of material consumption, both in the case of civil or industrial buildings and in the case of road and railway bridges.

For composite truss structures the design methodology is not presented in detail in the Eurocode 4. The design implies some particularities that are not included in the literature.

In this paper an adaptation of Euro norms EN 1994-1-1:2004. Eurocode 4 - Design of composite and concrete structures – Part 1-1: General rules for buildings and EN 1994-2:2004. Eurocode 4 - Design of composite and concrete structures – Part 2: General rules and rules for bridges to the design of bridge superstructures with steel trusses are presented.

A railway bridge superstructure with a 30.0 m span was calculated after the presented methodology and a number of observations and comments useful in the design activity were formulated.

Keywords: composite steel-concrete decks, steel trusses, bridge design

ECOLOGICAL COMPOSITE WITH GLASS FROM WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT CONTENT

PhD. Eng. Ofelia Corbu¹,

PhD. Student Eng. Antonela Popovici^{2*},

PhD. Researcher Gabriela-Emilia Popița³,

PhD. Eng. Prof. Tiberiu Rusu²,

PhD. Eng. Prof Cristina Roșu.³

PhD. Eng. Lecturer Attila Puskas¹

¹ Faculty of Civil Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**,

² Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**

³ Faculty of Environmental Science and Engineering, Babes Bolyai University, Cluj-Napoca, **Romania**

ABSTRACT

Waste landfilling has a considerable impact on the environment, due to the priority substances and priority hazardous substances that are released from the waste. Metals such as Pb, Ni, Cd, Zn and Hg and their compounds, are considered to be priority hazardous substances due to their persistence and bioaccumulation in ecosystems.

Due to the presence of the hazardous substances in the electrical and electronic equipment, at the end of life, this equipment became hazardous waste and has a specific management way in the European Union.

In the current concept of the sustainable development, the recovery represents a priority direction in the flow of waste management system. The purpose of this study is to propose for a composite material with CRT (cathode ray tubes) glass waste. The CRT glass waste is mechanically processed and is coming from WEEE. The used method for achieving the composite is an ecological recovery method, using hazardous waste from WEEE, with low energy consumption, reducing hereby the CO₂ emissions that would be generated during conventional recovery processes thereof. Due to the ecological recovery method the composite material has a low cost.

The experimental results, obtained after testing the compressive strength of the composite samples (55.98 N/mm²), showed that the composite outperforms mortars in terms of mechanical strength.

As a result, the obtained composite can be considered as construction material, framed in the mortars class, based on its aggregate size (particle size <4 mm) and on mechanical strength and can be successfully used for the production of decorative elements.

Keywords: WEEE, CRT, composite, waste recovery.

ECOLOGICAL MATERIALS FOR CONSTRUCTION

PhD. Stud. Eng. Călătan Gabriela ¹

PhD. Eng. Hegyi Andreea ¹

Prof. PhD. Eng. Mircea Călin ²

¹ INCĐ URBAN-INCERC Cluj-Napoca Branch, **Romania**

² Technical University from Cluj-Napoca, **Romania**

ABSTRACT

This work is a study that includes comparative experimental research carried out on mixtures of soil, sand, lime, oil and other natural additives, used to manufacture masonry bodies. Experimental tests were aimed at studying the physico-mechanical properties of materials and their variation depending on the additives used.

The purpose of this experimental research was to fixing some optimum compositions for making masonry bodies used in the construction of green houses, energy-efficient and with low impact on the health of users, applying basic principles of traditional vernacular architecture and improving their knowledge using current technology.

Based on the experimental results, it was found that: addition of sand has positive influences of density and linear shrinkage, reducing the risk of cracking and the compressive and flexural strength of tested specimens was influenced by the amount of sand introduced into the mix (maximum values of strength are obtained for the 65% ground - 35% sand). In the case of mixtures earth - sand – lime it was noted that linear shrinkage was small, but this is probably due to sand in the mixture. Unsatisfactory results in terms of mechanical strength and the density recorded indicated the need to reduce the amount of slurry lime in the mixtures. In the case of mixtures earth – different solutions (NaCl, NaOH and bone glue) it was noted that linear shrinkage are not significantly influenced by changing the liquid (water or other solution) and high mechanical strength are recorded but the apparent densities are below the allowable value according to the literature, which leads us to the idea of the possibility of improving apparent density by introducing controlled amounts of sand

The experimental results showed that organic materials can successfully replace or minimize the use of traditional building materials (concrete, cement).

Keywords: Building from earth, compressive strength, flexural tensile strength, axial shrinkage

EFFECT OF GREEN ROOF ON THERMAL PERFORMANCE OF BUILDINGS. A CASE STUDY

Adriana Lucia Kadhim-Abid¹

Adrian Iacob²

Assoc. Prof. Dr. Irina Baran³

Assoc. Prof. Dr. Tania Mariana Hapurne⁴

¹ Faculty of Civil Engineering/Technical University "Gheorghe Asachi" Iassy, **Romania**

² National Institute for Research and Development in Constructions, Urban Planning and Sustainable Development "URBAN-INCERC" Iassy, **Romania**

³ Faculty of Civil Engineering/Technical University "Gheorghe Asachi" Iassy, **Romania**

⁴ Faculty of Architecture/Technical University "Gheorghe Asachi" Iassy, **Romania**

ABSTRACT

This paper analyzes the extent to which the improvement with a green roof leads to variations in the energy performance of an existing building. The applied assessment criteria is the energy consumption to compensate for heat loss during heating period, with highlights on the entire building envelope, but also on the specific influence of the roof solution.

The heating and cooling demand has been evaluated for the initial configuration of the roof-top terrace and for modifications drawn in order to fill the terrace.

Keywords: energy performance, green roof, heating and cooling demand

EFFECT OF PHYSICAL TREATMENT OF HEMP HURDS ON THE PROPERTIES OF BIOCOMPOSITES

Prof. RNDr. Nadezda Stevulova, PhD.

Eng. Ivana Schwarzova

Eng. Julia Cigasova

Eng. Jozef Junak, PhD.

Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering, Kosice, **Slovakia**

ABSTRACT

Nowadays, using renewable sources of energy instead of non-renewable is very current topic in developed countries. The increased attention is devoted to the use of alternative materials that are environmentally friendly. The use of natural fibres (plant fibres from hemp, jute, sisal and the others) as reinforcement for composite materials is attractive for the purpose of the construction. The using of this material has environmental and economical advantages because it is fast-growing and renewable material. The great importance is attached to the industrial hemp as rapidly renewable fibers and non-waste material.

Hemp hurds as the woody part of the fibres is a very prospective building material because of its unique properties (exceptional thermal insulation, antiseptic, acoustic and mechanical properties). Due to the low density and high porosity of the hemp hurds, the combination of hemp and binder creates a building material with good thermal and acoustic insulation properties. Today hemp hurds can be used in high-quality products such as hemp concrete, fibre board and composites.

In this paper, the attention is given to the physical treatment (cooking in water for 1h) of hemp hurds and to the preparation of the lightweight composites based on 3 different mean particle lengths of this organic filler and on an alternative binder MgO-cement. The effect of water treatment to the physical and mechanical properties (compressive strength, density, water absorbability, thermal conductivity) of the biocomposites hardened in indoor condition for a time period is studied. Based on the results of experiments, significant effect on the properties of prepared composites based on hemp hurds has a particle size of used hemp hurds as well as its physical treatment.

Keywords: biocomposites, hemp hurds, physical modification, mean particle length, MgO-cement

EFFECTS OF WATER AND FROST ON 100% RECYCLED HALF-WARM ASPHALT MIXTURES FOR RAILWAY SUBBALLAST

Petr Kucera

Martin Lidmila, PhD.

Czech Technical University in Prague, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

The main purpose of subballast layers in railway track bed is to guarantee a sufficient bearing capacity and to protect subgrade from negative effects of rain water and frost. Since 1960's several railway administrations have utilized hot-mix asphalt instead of conventional granular subballast in selected tracks with special requirements, such as high-speed or heavy traffic tracks. The experiences gained during the last decades have shown that the hot-mix asphalt layers provide a good support for ballast bed, distributing the load equally to the subgrade. Moreover, their impermeability prevents the rain water from penetrating to the subgrade. Also, significant savings of granular materials can be achieved while introducing the bituminous subballast instead of the all-granular solution. Incorporation of a high percentage of recycled asphalt pavement and a decrease in production temperatures is a way to make the use of bituminous subballast cheaper and greener than it currently is. However, both these alternations may negatively affect durability, performance and resistance of the bituminous mixtures to water and frost.

The aim of this study was to assess the effects of water and frost on selected mechanical and physical parameters of 100% recycled half-warm asphalt mixtures. The standard water-sensitivity and freeze-thaw resistance tests were carried out. The effect of water content on thermal conductivity, which is an important parameter in terms of frost protection of the subgrade, was also observed. During soaking, the height of the specimens was measured to proof whether any swell was occurring. The results showed a significant influence of water and frost on the mechanical performance of the 100% recycled asphalt mixtures, particularly for compacting temperature of 80°C. Higher water content after soaking was probably a cause of increased thermal conductivity. Some swell of the specimens immersed in water was observed, but only at a negligible rate.

Keywords: recycled, asphalt mixture, subballast, water resistance, frost

ENERGY PERFORMANCE OF BELGRADE RESIDENTIAL BUILDINGS – INVESTIGATION, QUANTIFICATION AND IMPROVEMENT POTENTIAL

Assoc. Prof. BSc. Arch. Dušan Ignjatović¹

Assoc. Prof. MSc. Arch. Nataša Ćuković Ignjatović¹

Teaching fellow, PhD candidate, M.Arch. Bojana Stanković¹

¹ Faculty of Architecture University of Belgrade, Serbia

ABSTRACT

Belgrade City authorities have commissioned a team of researchers from Faculty of Architecture, University of Belgrade to investigate energy performance of residential buildings and explore potentials for energy improvements and related savings in heating costs. The paper presents the methodology for structuring, investigation and improvement of residential building stock in Belgrade, developed for the purpose of this project.

Typology of buildings has been generated based upon building stock periodization, applied building technology and architectural qualities (features which should remain undisturbed). These aspects define typology matrix which was further investigated and analyzed in detail. Totally, 30 multifamily and 2 family buildings were analyzed. In-situ thermographic imaging was used as an investigation means for technical detection of main energy losses through building facades. These data, compared to the original detail drawings obtained through insight into archive technical documentation provide valuable findings regarding actual quality of facade structures and their improvement strategies. At the same time, it also reveals faults which occurred through construction process and as a consequence of poor detailing. Defined improvement strategies vary significantly based on complexity of improvement measures application.

Theoretical calculations based upon available technical documentation and measurements were conducted for every building, resulting in data about overall energy reduction, energy reduction costs, improvement measures payback period, improvement investment per m² and improvement investment per flat. The paper presents the summary results highlighting the most interesting building types regarding each analyzed criteria.

Keywords: energy performance of residential buildings, building envelope, building refurbishment

ENGINEERED CEMENTITIOUS COMPOSITES (ECC) – SELF-HEALING POTENTIAL BY CRACK CONTROL MEANS

PhD. student Cornelia Baeră¹

Dr. Mircea Păstrav¹

Dr. Henriette Szilagyi¹

Prof. Dr. Călin Mircea²

Dr. Ofelia Corbu²

Carmen Dico¹

Dr. Horia Constantinescu¹

¹ NRD “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

Cracks in concrete elements are considered the main cause for beginning and further development of concrete structures deterioration. In the reality where concrete and generally cement-based materials represent the most widely used building materials, the large amounts of concrete civil infrastructure that requires repairs and maintenance constitute huge consumption of economic and energetic resources. The numbers are impressive: 18 to 21 billion US dollars annual cost for infrastructure repair only in USA, according to specialized data [1].

The green drive of the last decades, after general awareness that resources are not renewable and they have to be saved as much as possible, encouraged development of new, intelligent building materials, with improved physico-mechanical and durability characteristics, necessary for building-up a sustainable future.

In the category of High-performance fibre-reinforced cementitious composites (HPFRCC) there was developed a new concept of cementitious material capable of developing a quite important self-healing behaviour due to its crack control well developed design: Engineered Cementitious Composites, a self-compacting mortar characterized by induced microcracking metal like behaviour under the applied load [2].

The aim of this paper is to present a state-of-the-art evaluation regarding ECC materials: development, design criteria, evolution and potential of ECC as building material for a long-term energy and resources saving civil infrastructure.

Keywords: concrete cracks, energy saving, Engineered Cementitious Composites (ECC), crack control, self-healing capacity

ESTIMATION OF THERMAL PERFORMANCE OF TYPICAL BUILDING ENVELOPES IN SERBIA USING INFRARED THERMOGRAPHY

Assist. Prof. Dusan Ignjatovic

Assist. Prof. Dr. Alekstandar Rajcic

Assist. Prof. Mr. Natasa Cukovic Ignjatovic

University of Belgrade – Faculty of Architecture, **Serbia**

ABSTRACT

Working on the scientific project with the aim of formulation of National Typology of Residential buildings in Serbia, a group of researchers from the Faculty of Architecture University of Belgrade has analyzed diverse building types in Serbia, classifying them and identifying relevant construction elements. This typology has been finalized as the matrix of real buildings being chosen as typical representations of statistical averages of all relevant characteristics. At the same time energy performance of all types has been defined both by numerical calculation and on site inspection. By using infrared thermography for analysis of all identified types a distinct thermal envelope signature has been recorded and further discussed. This paper presents some of the most common envelope types with analysis of their thermal performance. Infrared inspection has been used as the main investigation tool, while verification of obtained results has been confirmed by the means of mathematical modeling using the computational method of infinite differences derived from the actual construction drawings obtained from the archives. Paper discusses the diversities of applied construction technologies and their influence on energy performance defining the most common problems.

Keywords: Thermography in architecture, energy efficiency, building envelope

EVOLUTIONARY METHOD FOR RE-TRIANGULATION

Lecturer Alexandra D. Danciu¹

Eng. Dan I. Danciu²

Lecturer Dr. Cătălin Moga¹

Assoc. Prof. Ștefan I. Guțiu¹

¹ Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

² ISDC Romania, **Romania**

ABSTRACT

One of the most important aspects in the Finite Elements Method is the refinement of a coarse mesh that should take into account a number of parameters given by the necessities of the problem: singularities, error estimation, etc. Following this idea and taking into account that the best suited algorithms nowadays for optimization problems are the genetic and evolutionary algorithms, the authors pursued the idea of optimizing and refining a given triangular mesh using evolutionary procedures.

The paper presents the proposed evolutionary procedure and it shows that, after just a few generations one can obtain acceptable triangular meshes that can be used in analysis after a minimum correction. The triangulations obtained are optimized after two parameters: the quality of the triangles obtained and the refinement of the mesh. Through the implemented operators we tried to keep the quality of the newly generated triangles and, where possible, to improve the quality of the initial triangles.

All the steps of the procedure are presented in detail. The operators presented in the literature have been implemented and their performance evaluated for the new procedure proposed. Two new cross-over operators have been proposed and implemented, as well as a new mutation operator responsible for the mesh refinement. A situation appearing during mutation was named as fan mutation and ways to resolve it have been presented. The fitness of the individual is evaluated through a cumulative function that takes into account the quality of the individual through the deviation fitness and the refinement obtained through the refinement fitness.

For a plane octagonal domain the influence of the number of generations, the division rate, the mutation rate, the cross-over rate and the initial triangulation are investigated.

Next the issue of solving a domain with holes is addressed. The procedure starts with a set of initial triangles that take into account the geometry of the body to be meshed and the operators proposed are not modifying the geometry; therefore, any type of geometry can be meshed.

The strong and the weak points of the procedure are investigated and ways of improving it are proposed.

Keywords: Evolutionary procedure, triangulation, meshing, mesh refinement, finite element method.

**EXPERIMENTAL ANALYSIS OF FATIGUE BEHAVIOR OF
STRENGTHENED REINFORCED CONCRETE SHORT CORBEL BY
EXTERNALLY BONDED CARBON FIBRES FABRICS**

Dr. Ivelina Ivanova¹,

Dr. Jules Assih¹,

Prof. Alex Li¹,

Prof. Dimitar Dontchev²

¹ University de Reims Champagne-Ardenne, Reims, **France**

² University de Technologie Chimique et de Métallurgie Sofia, **Bulgarie**

ABSTRACT

This paper presents experimental study of strengthening reinforced concrete corbel by gluing carbon fibres fabrics. Indeed, in buildings and in civil engineering reinforced concrete corbels often are used.

A preliminary study to determine the number of layers necessary optimal and effective strengthening. Then, we compare usefully unstrengthen and strengthened reinforced concrete short corbels with monotonic loading to failure and cyclic loading up to one million cycles. Cracking of corbels are described and different failure modes observed.

The effect of some parameters on behavior of the strengthening structure is examined. As such as, influence of the type of strengthened reinforced concrete corbels directly on either sides or wrapping by externally bonded the carbon fiber sheet. The influence of the orientation of the carbon fibres fabrics is also examined.

The influence of the extensometer technique based on electrical strain gauge strain is used to study the local behavior of the structure. This technique allows to measure strain of steel, carbon fabrics and concrete.

The ultimate load and displacement of the specimen are compared to the reference structure of static tests monotonous load applied. The cracking and the mode of failure under static loading are presented.

The results show an increase of more than 82% of the bearing capacity of corbels and improving their rigidity of the third.

Cyclic loading modifies the stress distribution within the corbels therefore also the cracks where some cracks appear in the stake but not observed in the case of monotonic loading.

Cracking corbels are different depending on the case load (monotonic or cyclic).

Keywords: strengthening, short corbel, fatigue behavior, reinforced concrete composite materials.

**EXPERIMENTAL RESEARCH FOR DETERMINING THE EFFECTS OF
CLIMATIC CYCLES ON THE DURABILITY OF THERMAL INSULATING
SYSTEMS THAT USE POLYSTERENE**

Senior Researcher eng. Livia Miron, PhD

Senior Researcher eng. Constantin Miron, PhD

National Institute for Research and Development in Constructions, Urban Planning and Sustainable Territorial Development „URBAN - INCERC”- Iasi Branch – IHS Hygrothermal / Climatic Research and Testing Laboratory, **Romania**

ABSTRACT

This paper deals with the tests performed in the IH Hygrothermal / Climatic Research and Testing Laboratory (*[http://www.incerc2004.ro/Proiecte/CEEX- M4_111_Iasi.htm](http://www.incerc2004.ro/Proiecte/CEEX-M4_111_Iasi.htm)) meant to determine the durability of composite systems for exterior thermal insulation for buildings, that use polystyrene, as well as their behavior under the action of increasingly severe climatic conditions, causing the climatic changes taking place at a global level.

We discuss the normative deficiencies caused by the absence of the proper European normative provisions adapted to the new conditions of regional or local climatic manifestations, as well as the irreversible degradation effects of composite systems for exterior thermal insulation for buildings, with significant repercussions on the efficiency of thermal insulation solutions and implicitly on the energy consumption.

The paper presents the results and conclusions of the research performed through cyclic tests of temperature, humidity, frost and thaw, and solar radiation on composite systems based on synthetic thermal insulation materials of low durability.

Keywords: energy, efficiency, thermal insulation, low energy consumption home

**EXPERIMENTAL STUDY OF DIELECTRIC AND FUNCTIONAL
PROPERTIES OF POLYMER MATRIX/Cu₂O/BaTiO₃ HETEROGENEOUS
COMPOSITES IN BROAD BAND FREQUENCY**

PHD Haddi Bakhti^{1,2}, Pr Nacerdine Bouzit²

¹Department of electronics, Faculty of technology University of M'sila, BP166, **Algeria**

²Laboratory Scientific Instrumentation LIS, Department of Electronics, Faculty of technology, University Ferhat Abbas Sétif-1, **Algeria**

ABSTRACT

In this work, we present an experimental study on a novel ternary composite material. In this case, several samples with barium titanate (BaTiO₃) and copper oxide (Cu₂O) particles in powder form in various amounts dispersed in a host matrix of epoxy resin (Re/BT/Cu₂O) are carried out and sintered at 150°C. Their dielectric constants spectra were measured in the frequency range DC–3GHz by time domain spectroscopy (TDS). Low frequency has also been performed throughout this work, and it has primarily concentrated on conductivity behaviour which may be attributed to the effects of a percolation process. Experimental data were analyzed by means of dielectric permittivity and electric modulus formalisms. The functionality of the composite systems is related to the abrupt variation of the real part of permittivity, and to the relaxation process of the Cu₂O particles. In addition, the behaviour obtained experimentally has been validated by the random mixture law of Lichtenecker in order to predict the electromagnetic behaviour of such composite material.

Keywords: Composite, Copper oxide (I), modelling, Relaxation phenomena, electrical modulus.

HALL BUILDINGS – LOWER STRUCTURE

Assoc. Prof. Anna Sedláková

Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Most industrial hall type buildings are large and. the accurate design of the substructure construction is influenced by many entry parameters from the standpoint of structural analysis, building thermal technology, building hydro-insulation technology and anti-radon measures. By respecting these specific requirements of individual science disciplines, the symbiosis expressing the optimal solution in the theory of structural production of buildings are presented.

The solution of problems of building thermal technology in the substructure field of industrial buildings and ground connections based on the knowledge of the thermal regime of soil - sub base, as one of the important components of soil climate. It is obvious, that every correct thermo technical calculation requires a precise specification of boundary conditions. Soil temperature is presented in our case as one of the boundary conditions of substructure details of for analyzed buildings.

Keywords: industrial buildings, thermal protection of building, building construction, ground floor, thermal insulation

HYDRO INSULATION CHARACTERISTICS OF PLASTERS BASED ON ORGANIC BINDERS – EXPERIMENTAL PROCEDURES

PhD. student Cornelia Baeră¹

PhD. Henriette Szilagyí¹

Carmen Dico¹

PhD Attila Puskas²

¹ NRDI “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

The new millennium general tendency of energy saving and effort making for non-renewable resources reduction in all humankind activities implies development of more efficient products and technologies, advanced solutions and permanent improvement in all directions, including the construction field. Considering its magnitude, importance and also its impact in our everyday life, civil infrastructure and its means (resources and energy consumption, materials, technologies and procedures) represent a strategic pillar in the concept of sustainability.

Special attention must be given to general preservation of structural and non-structural construction elements against natural and artificial degradation, which can affect the safety and the quality of life; the better prevention the less maintenance and repair costs involved. From this perspective the buildings external coatings are essential; representing buildings outer skin, they are thermo insulation barriers and protective layers and against aggressive agents, fulfilling both decorative and protective role. As consequence, the development of external renders as coating materials and their performances evaluation represent important although indirect topics in general ecology agenda [1]. The aim of this paper is to present the second set of results of the experimental program performed upon plasters based on organic binders, regarding the hygro-thermal properties of these coating materials. The experimental procedure started in 2012 and the first results were presented in the 13th International Multidisciplinary Scientific GeoConference SGEM 2013 [2]. The present paper shows later outcomes, concerning the same type of products and the hygro-thermal characteristics (liquid water permeability), essential for moisture transfer mechanisms and determined according to the standardized method [3], as requested by recently occurred (July 2009) of the “harmonized” European standard EN 15824 [4].

Keywords: energy saving, structural preservation, organic binder renders, thermal insulation, testing methods

IMPACT OF ULTRASONIC TREATMENT OF HEMP HURDS ON THE MECHANICAL PROPERTIES OF COMPOSITES

RNDr. Eva Terpakova, PhD.

Prof. RNDr. Nadezda Stevulova, PhD.

Assoc. Prof. Alena Sicakova, PhD.

Eng. Ivana Schwarzova

Technical University of Kosice, Civil Engineering Faculty, Institute of Environmental Engineering, Kosice, **Slovakia**

ABSTRACT

Lightweight composites based on natural fibers as organic filler are studied for several years. In this article, the attention is given to the study of the properties of lightweight composites based on hemp hurds (the woody part of hemp plant). From the experimental point of view, the observation is focused on the influence of the particle size of hemp fibers and also on the study of using different types of binders in the lightweight composites. Significant part of the experiments was dedicated to chemical modification of hemp hurds and to physical modification of hemp hurds by ultrasonic treatment before its using as filler in the lightweight composites. The cohesion of the filler and of the binder is an important factor in the development of mechanical properties. The durability of produced composites was studied under different conditions.

In this paper, the impact of ultrasonic treatment of hemp hurds on the mechanical properties of the composites was studied.

Keywords: renewable source, hemp hurds, ultrasonic treatment, composites

IMPROVING OF THE CORROSION PROCESS ON THE HEAT EXCHANGERS

Lecturer PhD.Eng.

Florin Ciofu

“Constantin Brâncuși” University of Targu Jiu, **Romania**

ABSTRACT

The need to provide an optimum level of safety and the possibility of rehabilitation technical systems, the components is always present in all sectors.

The problem becomes particularly acutely in the nuclear industry, energy, mining, chemical, petrochemical, or generally in areas with stringent regimes of operation of technical systems where inspection and maintenance activities are treated as priority elements of managerial work.

Heat exchangers used in particular the areas of activity in energy production work in corrosive environment. The thermal agent used is usually water, which results in a corrosion process of working installations. In this paper will be analyzed remedies to combat corrosion process of these installations by a proper choice of materials they are made and performing thermochemical treatments in regards the extension of lifetime between two repairs.

Keywords: heat exchangers, thermal agent, thermochemical treatments;

INDOOR MATERIALS AND AIR QUALITY ASSESSMENT

Prof. Ing. Ingrid Senitkova, CSc.

The Institute of Technology and Businesses in Ceske Budejovice, **Czech Republic**

ABSTRACT

The material combination impact on perceived indoor air quality for various surface interior materials is presented in this paper. Traditional and progressive materials comparison reveals new fact regarding the sum of volatile organic compounds (TVOCs) concentration. The using possibility of individual material surfaces sorption ability was investigated. The chemical analysis and sensory assessments identifies health adverse of indoor air pollutants (TVOCs). In this study, emissions and odors from different common indoor surface materials were investigated in test chamber under standardized conditions. Chemical measurements (TVOCs concentration) and sensory assessments (odor intensity, perceived air quality) were done after building materials exposure to standardized conditions. The impact of individual materials and their interaction effects to the perceived air quality will be discussed within the paper. The knowledge of targeted sorption effect can be used already in the interior design phase. The results demonstrate the various sorption abilities of various indoor materials as well as the various sorption abilities of the same indoor materials in various combinations.

Keywords: volatile organic compounds, indoor materials, chemical assessment, sensory assessment, indoor air quality

INFLUENCE OF ALKALINE TREATMENTS ON TENSILE PROPERTIES OF ALPACA FABRIC REINFORCED EPOXY COMPOSITES

Menderes Koyuncu

Yuzuncu Yil University, Van Vocational of Higher School, Department of Textile, Van,
Turkey

ABSTRACT

A study on the effect of alkaline treatment on tensile properties of Alpaca fabric reinforced epoxy composites is presented in paper. The treatment was carry out using NaOH solutions at different concentration. The hydrophilic nature of Alpaca fabric makes it difficult to adhere to hydrophobic epoxy and there therefore posed three problem of interfacial bonding between fabric and matrix and such treatment was need to alleviate such problem. The composite samples were tested for tensile properties determination. Some fractured samples were examined under scanning electron microscope (SEM) to study the microstructure of the materials. SEM observations on the fracture surface of composites showed that the surface modification of fabric occured and improved fibre-matrix adhesion and proved the effectiveness of the treatment

Keywords: Fabric, Adhesion, Alkaline, Composites, Wettability

INFLUENCE OF CROSS-SECTIONAL SHAPE ON THE VALUES OF THE CRITICAL BUCKLING FORCE

Lecturer Dr. Cătălin Moga

Assoc. Prof. Ștefan I. Guțiu

Lecturer Alexandra D. Danciu

Technical University from Cluj-Napoca, Faculty of Civil Engineering, **Romania**

ABSTRACT

The relevant buckling mode for hot-rolled steel members, with the type of cross-sections commonly used for compression members is generally flexural buckling; however, in some cases, torsional or flexural-torsional modes may govern and they must be investigated for all sections with small torsional resistance.

In this paper, after a brief presentation of the aspects regarding the calculation of the critical buckling force, a series of compressed members having a class 4 cross-section are analysed according to the European norms EN 1993-1-1: Design of steel structures. Afterwards, the members are modelled in Abaqus and a comparison is made with the results obtained based on the design method given in the Euronorms. Six constructive solutions for open cross-sections are taken into account and the buckling mode and the values of the critical buckling force are analysed.

Conclusions are drawn regarding the efficiency of each type of cross-section regarding the critical buckling force. It can be seen that for classical types of cross-sections the buckling mode is flexural-torsional, for a double symmetrical cross-section, with the highest efficiency to buckling, the buckling mode is flexural and for a cross shape cross-section the buckling mode is torsional.

Keywords: buckling resistance, compression members, comparative analysis, critical buckling force

**LOCAL STABILITY AND FATIGUE FAILURE
OF THIN-WALLED STEEL MEMBERS**

Prof. Ing. Pavol Juhas, DrSc.

Prof. Ing. Ingrid Senitkova, CSc.

The Institute of Technology and Businesses in Ceske Budejovice, **Czech Republic**

ABSTRACT

The thin webs of steel members are laterally buckling under static loading and laterally vibrating under repeated dynamic loading. The consequence of that can be arising and successive development of fatigue cracks along the welded connections of the thin webs with flanges and stiffeners. Therefore, the fatigue strength and life-time of thin-walled steel members depend beside of usual material-technological and structural influences also on local stability aspects. The extensive experimental-theoretical investigation of thin-walled hybrid steel plate girders and columns with accent on their fatigue failure mechanisms and local stability aspects is presented within the paper. The outcome of obtained knowledge and results is the original empirical formula for the limitation of web slenderness that can be used for the reliable and economical design of steel members which are subjected under repeated dynamic loading.

Keywords: steel element, local stability, thin web, failure mechanism, fatigue crack

MECHANICAL CHARACTERISTICS PREDICTON ON POLYMER CONCRETE WITH SILICA FUME USING ARTIFICIAL NEURAL NETWORK

Senior Lecturer Ph.D. Daniel Lepadatu¹

Professor Ph.D. Marinela Barbuta¹

Senior Lecturer Ph.D. Judele Loredana^{1*}

Ph.D. Student Raluca Mitroi²

Eng. Andrei Ilas¹

¹"Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services, **Romania**

²"Gh. Asachi" Technical University of Iași, Faculty of Hydrotechnical Engineering, Geodesy and Environmental Engineering, **Romania**

ABSTRACT

In the paper the Artificial Neural Network - ANN was used for prediction the mechanical characteristics such as flexural strength and split tensile strength of polymer concrete with silica fume. Neural network modeling generated the mixes with the lowest cost and maximum strength. The association of these two materials has unpredictable effects on the properties of concrete. The experimental mixes of polymer concrete realized of epoxy resin, silica fume and aggregate were established using the mixture design of experiments that is a suitable method for checking an adequate mathematical modeling of real phenomenon which is strongly nonlinear. Flexural strength and split tensile strength where experimentally determined for all mixtures. An artificial neural network - ANN is a computational model inspired by the biological natural neuron. The complexity of real neurons is highly abstracted by mathematical equation when modeling artificial neuron. This transforms the input data in output data function the operator ability of choosing and connecting more neurons or more layers for obtaining the expected performance. Their capacity of learning and adapting to operator demands makes a useful tool in math modeling and optimization of nonlinear processes. ANN presents a high potential of adaption to mathematical modeling of processes or phenomena type black box, generally with a pronounced nonlinear character and which are difficult to describe and model with simple mathematical models. ANN has ability to solve new problems by applying information learned from past experience, as human brain.

Keywords: artificial neural network, epoxy resin, mechanical characteristics, polymer concrete, silica fume.

NEW IDEA FOR ENERGY SAVING AND AIR PURIFICATION IN URBAN AREAS BUILDINGS

Dr. Arch. Codrina Grecu¹

Drd. Arch. Andrei Purcaru²

¹ ‘ Ion Ionescu de la Brad’ University of Agricultural Sciences and Veterinary Medicine of Iasi,
Romania

² ‘ Gheorghe Asachi’ Technical University of Iasi, **Romania**

ABSTRACT

In order to fulfill the european and world wide directives for the energy economy, an essential part belong to the construction sector stakeholders. In some cases, the constructive solutions to reduce energy consumption adversely affect indoor environmental quality, creating imbalances in the way of achieving natural ventilation. Thus, during doctoral study of the author on the buildings ventilation problem and building elements ventilation, in terms of comfort, air quality and energy efficiency, was born the idea of an independent systems combination, that are specific to passive buildings, using a new concept - "permanent garden-façade ". This paper underline the solution of combining two already known and widely used systems: the ventilated glass façades and Canadian or Provençal well. The vegetation enhance the ambiental effect of this sistem and it may be located within interior ventilated façades or to outdoor of buildings envelope and is itself a natural air filter plant.

Keywords: scale physical model, Canadian / Provençal well, ventilated façade, energy saving, vertical gardens.

OPPORTUNITIES FOR BUILDING MATERIALS WASTE RECYCLING

PhD Eng. Henriette Szilágyi¹

PhD Eng. Ofelia Corbu²

PhD student Eng. Cornelia Baeră¹

PhD Eng. Lecturer Attila Puskás²

PhD Eng. Mircea Păstrav¹

¹ N.I.R.D. “URBAN-INCERC”, Cluj-Napoca Branch, **Romania**

² Technical University of Cluj-Napoca, **Romania**

ABSTRACT

Recycled aggregates obtained from: concrete, debris or bricks waste, has different properties, such as strength, particle shape, surface roughness, water absorption, etc., than natural aggregates (river sand and gravel). That is the major reason for the experimental results obtained on various concrete mixes, showing significant differences between the properties of the concrete made with recycled aggregates to those of concrete made with natural aggregates. Several researches were conducted worldwide in order to establish the optimal ratio of designed concrete composition considering different aggregate properties, water/cementitious material ratio, etc. which determine the strength, workability and durability of concrete. Opportunities for recycled concrete aggregates use are restricted by different requirements, specific for several countries or organizations.

Keywords: waste recycling, green building materials, concrete compositions

RECYCLING AND WASTE RECOVERY IN THE CONSTRUCTION FIELD

PhD. Eng. Ofelia Corbu¹

PhD. Eng. Researcher CSII Henriette Szilagyi²

PhD. Eng. Lecturer Attila Puskas¹

PhD. Student Eng. Antoanela Popovici³

PhD. Student Eng. Researcher CSIII Cornelia Baera²

PhD. Eng. Assoc. Prof. Ligia Moga¹

¹ Faculty of Civil Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**, r

² INCD “URBAN-INCERC” Cluj-Napoca Branch, **Romania**

³ Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, **Romania**

ABSTRACT

Because of exhaustive consumption of non-renewables resources of energy in all sectors, saving trends at all levels is an absolute necessity. In this respect an important role is given to the industry sector. Reductions of the energy consumptions can be achieved by recycling waste and reuse them as raw materials or as secondary raw materials construction sector. Waste recycling and recovery is an imperative measure necessary to reduce consumption of non-renewable raw materials. By introducing in the industry circuit materials obtained through waste recycling, significant savings of natural resources and of energy can be obtained. Obtaining building materials by using various industry wastes is one of the ways that the scientific community is called to provide in order to ensure a sustainable future for humanity. Concrete is a material widely used in huge volumes, that has a real potential of embedding waste.

Keywords: waste recycling, waste recovery, non-renewable resources, sustainability, energy reduction, concrete

REUSING AND RECYCLING POTENTIAL OF SERBIAN HOUSING STOCK

Assoc. Prof. Miloš Nedić

Prof. Nataša Ćuković Ignjatović

Prof. Dušan Ignjatović,

Faculty of Architecture, University of Belgrade, **Serbia**

ABSTRACT

Having in mind great impact that building industry causes to the environment throughout building life cycle, construction and demolition (C&D) waste management is significant part of overall waste management program of local society. It is of great importance to project possible outcomes of local building stock at final stage of its life cycle, regarding possibilities for reusing or recycling of certain parts of buildings. This paper deals with unsolved issue of C&D waste management in Serbia, where with lack of regulation mechanism, generated waste mostly ends up in a city landfill. On the other hand, taking into account significant age of greatest part of Serbian building stock, it is obvious that it is of great importance to perceive overall amount and content of possible waste that Serbia has to deal with. In that respect, relevant portion of national housing typology is presented, reviewing typical housing types, quantities and structure of building materials used.

Keywords: C&D waste management, building life cycle, reuse, recycle

RHEOLOGICAL PARAMETERS OF 100% RECYCLED HALF-WARM ASPHALT MIXTURES

Petr Kucera

Josef Zak

Czech Technical University in Prague, Faculty of Civil Engineering, **Czech Republic**

ABSTRACT

Since 1960s several railway administrations have utilized asphalt mixtures instead of conventional granular subballast in selected tracks or track sections. Gained experiences have shown that asphalt layers provide a good support for ballast bed, distribute load equally to subgrade and due to their impermeability protect subgrade from rain water penetration. However, production of conventional asphalt mixtures demands high amounts of energy and natural materials, particularly bitumen and aggregates. Production of asphalt mixtures at lower temperatures can significantly decrease energy consumption of the process. A possible way to preserve resources of natural materials is utilization of high percentages of recycled asphalt pavement material in production of asphalt mixtures. This study is focused on investigation of 100% recycled half-warm asphalt mixtures. Development of a new approach to design subballast layers made of these mixtures is proposed. The design approach employs deformation modulus as the main criterion for assessment of bearing capacity of subballast layers. To evaluate the effect of subballast, made of recycled asphalt mixtures, on the bearing capacity of railway track bed it is necessary to gather enough data including deformation modulus on formation surface, subballast thickness and resulting deformation modulus on subballast surface. The data can be gathered by measurements on real structures, measurements on physical models or by numerical modeling. For the purpose of this study, the latter approach was chosen. First steps to establish a corresponding material model were carried out. The creep compliances were calculated from direct compression test as the dimensionless physical parameter of recycled asphalt mixtures. The effect of several stress levels is presented and the linear-viscoelastic boundaries are assessed. The measured creep compliances were fitted with the Kelvin-Voight model.

Keywords: recycled, asphalt mixture, subballast, creep, linear viscoelasticity

SELF MANAGING BUILDINGS

Dr. Mircea Păstrav¹

Cornelia Baeră¹

Dr. Henriette Szilagyi¹

¹ National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development “URBAN-INCERC”, Cluj-Napoca Branch, **Romania**

ABSTRACT

The concept of smart or green or eco-friendly building is usually referring to the energy efficiency of the buildings dealing with the passive or active measures to achieve zero energy consumption. The attention is focused on the reducing the loss of heat, the efficiency of lighting and other types of energy consumption in buildings.

The proposed concept of self managing buildings is focused on the new design and detailing of the building structures, and advanced materials rather than on the insulation materials or the building equipment.

This new concept is based on experimental studies on the behavior under seismic type loadings of a different kind of reinforced concrete frame structure as well as on the special characteristics of advanced cement-based grouts used as self-healing materials.

The reinforced concrete frame structure is made out of precast elements assembled by non-adherent partial post-tensioning. The detailing of the column-girder joints, called modified special hybrid joint, consist of two different type of horizontal reinforcement which go through the beams ends and the column and in the interfaces gaps a high resistance grout is used. The former type of reinforcement is made of strands, used also for the general structural assembly by post tensioning, and is located in the centroid of the beams. The latter consist of ductile steel bars, located at the beam top and bottom ends, having the role of bending moment transfer and also of energy dissipation, mainly due to their plastic behavior under extreme loadings. As for the interface grout the innovative solution is the use a high resistance fiber reinforced self-healing cementitious compounds.

The paper emphasizes the auto-balancing structural behavior of the new RC frame structures with modified hybrid joints, as well as the self-healing grout properties which determine the closure of the remaining micro cracks after a seismic type or other accidental loading as well as the sustainable aspects of the use of such structures.

Keywords: modified special hybrid joint, seismic type test, self-healing advanced cementitious compound

SOLUTION OF THE RISING DAMP IN THE CHURCH IN GEMERSKÝ JABLONEC

Assoc. Prof. Anna Sedláková¹

Assist. Prof. Ladislav Ťažký¹

¹ Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Moisture is a major source of damage in historic solid masonry. Rising damp is a well-known phenomenon around the world and occurs when groundwater flows into the base of a construction and is allowed to rise through the pore structure. From practical experience it is known that many factors may play a role regarding permeability problems in masonry. The amount of possible causes of moisture problems in historic masonry underlines the complexity of this phenomenon. Evaporation is an important factor in rising damp. The surface of an affected wall contains moisture that has risen from the ground and this moisture is then subject to evaporation. The factors controlling evaporation include: temperature, humidity, air movement and surface condition (the masonry been painted). [1,3,5,6]

The most cost-effective way of preventing damp problems in buildings, including those resulting in damp masonry at the foot of walls, is to minimize moisture sources and provide adequate passive moisture sinks to dissipate any penetrative moisture so as to make the system fail-safe. Traditional and more effective detail is to use a ventilated and drained 'dry area' around the foot of the wall. Alternatively, a perforated plastic land drain can be laid to falls in a trench lined with geo-textile and back filled with 'beach cobbles' or large diameter hard core. [1,7,8]

Keywords: rising damp, sub-floor ventilation, drainage, historical building, masonry

**STRENGTH DEVELOPMENT OF FIBER REINFORCED SELF-
COMPACTING CONCRETE (RFSCC): TEMPERATURE EFFECT ON
MECHANICAL PROPERTIES**

Safi B¹ and Saidi M¹

¹ Research Unit: Materials, Processes and Environment (UR/MPE), Boumerdes University, Algeria

ABSTRACT

The strength development of Fiber Reinforced Self-Compacting Concrete (FRSCC) was investigated in this work. The variable is the heat curing at different temperatures (20°C and 60°C) applied at 7 and 14 days of curing of concretes studied. Two temperatures 20 and 60 °C were applied to samples with intermediate levels (depending on the drying method applied to precast concrete) for 18 hours in total. In this study, a Portland cement (CEMII), limestone fillers were used in the binders of FRSCC and the steel fibers are also used as reinforcement for concrete. The results show that the compressive strength to 14 days of concretes studied, increases with heating (60 °C) compared to that measured at 20 °C. Also, values of compressive strength of FRSCC at 14 days that are best to those obtained without 28 days curing treatment. Indeed, the compressive strength values of treated concretes (14journs) obtained are 15% and 25% respectively obtained for fibers reinforced self-compacting concretes made with 1.5% of steel fibers.

Keywords: Fibers reinforced self-compacting concrete, steel fibers, compressive strength, flexural strength, temperature.

STRUCTURE AND ROLE OF ADDITIVES IN BITUMEN ADHESION TO NATURAL AGGREGATES

Senior Lecturer Ph.D. Judele Loredana¹,

Professor Ph.D. Marinela Barbuta¹

Senior Lecturer Ph.D. Daniel Lepadatu¹

**¹Gh. Asachi" Technical University of Iași, Faculty of Civil Engineering and Building Services,
Romania**

ABSTRACT

The road works at getting hot bituminous mixtures and not only an important requirement of bitumen is to wet better natural aggregates. In order to ensure a stable connection between aggregate and bitumen are used increasingly more frequently in the addition (doping) of bitumen, i.e. bitumen mass addition of small amounts of additive (0.1-0.5%). Although the percentage of additive is small, laboratory tests show that adhesiveness increases substantially after introduction. The adhesion is one of the complex phenomena that occur at the contact bitumen - aggregate, some physical or physico-chemical phenomena (aggregate surface texture and porosity, bitumen viscosity, interfacial tension) and other chemical (mineralogical nature of the aggregates and the chemical composition of bitumen) . Typical adhesion is defined as the ability to cover a binder with an aggregate to disperse upon contact with water or traffic aggressions. Bitumen is a natural or artificial fluid of semi-solid consistency - dark color of brown to black, consisting of complex mixtures of organic substances with colloidal structure. The paper presents two of the additives with which I worked, their structure, how they act bitumen and some of the results obtained for adhesion (using both pure bitumen and bitumen additives). It should be binding to the aggregated particles or between particles and the surface of the existing connection. Although the incidence of premature rupture attributable to adhesion is relatively rare, substantial costs to breakdowns may occur at the time.

Keywords: additives, adhesiveness, aggregate, bitumen

STUDY OF STRENGTHENED REINFORCED CONCRETE SHORT CORBEL BY EXTERNALLY BONDED CARBON FIBRES FABRICS

Dr. Ivelina Ivanova¹,

Dr. Jules Assih¹,

Prof. Alex Li¹,

Prof. Dimitar Dontchev²

¹ University de Reims Champagne-Ardenne, Reims, **France**

² University de Technologie Chimique et de Métallurgie Sofia, **Bulgarie**

ABSTRACT

The present paper investigates experimentally the mechanical behavior of reinforced concrete corbels strengthened with carbon fibers fabrics, including the local and global strain distribution, load-carrying capacity and mode of failure. The effect of fibers fabrics configuration and some geometrical and structural parameters are studied experimentally and analyzed: the number of layers and the thickness of carbon fiber fabrics, the type of strengthening, and the orientation of the fibers in carbon fibers fabrics (unidirectional, bidirectional). As such as, effect of the type of strengthened reinforced concrete corbels directly on either sides or wrapping by externally bonded the carbon fiber fabrics.

A preliminary study to found the number of layers necessary for optimal and effective strengthening is realized. Then, we compare usefully unstrengthened and strengthened reinforced concrete short corbels subjected to monotonic loading to failure. Cracking of corbels are described and different failure modes are observed. The testing shows better results for the unidirectional fibers as well as by wrapped strengthening.

The extensometer technique based on electrical strain gauge is used to study the local behavior of the structure. This technique allows to measure the strain of steel, carbon fabrics and concrete. The effect of the same parameters on local behavior of the strengthening structure is examined.

The ultimate load and strain of the specimens are compared to the reference corbel. The cracking mechanisms and the mode of failure under static loading are presented and analyzed. The results show an increase of more than 82% of the load carrying capacity of the corbels and improving their rigidity of the third.

Keywords: strengthening, short corbel, reinforced concrete, mechanical behavior, composite materials;

SUSTAINABILITY OF CONSTRUCTION FROM PERSPECTIVE OF APPLICATIONS TECHNOLOGIES FOR GREEN BUILDINGS

Prof. Ing. Mária Kozlovská, PhD.¹

Ing. Marek Krajňák¹

Assoc. Prof. Ing. Renáta Bašková, PhD.¹

Ing. Alena Tážiková, PhD.¹

¹Institute of Civil Engineering Technology and Management, Faculty of Civil Engineering, Technical University of Košice, **Slovakia**

ABSTRACT

A worldwide trend in terms of sustainability is the construction of green buildings. Green buildings are efficient in resource using (energetic, natural and social) and environmentally friendly throughout their life cycle (selection of land and project, construction process, the operation of the building, reconstruction or liquidation). Sustainability of buildings is currently investigated by a number of evaluation systems that reflect their design, technical, technological and material solutions. In one of the first green building in Slovakia "EcoPoint Kosice Office Center", which obtained pre-certificate "Seal of the sustainable construction (DGNB)" in the category of silver, was used a number of "green technologies". This paper presents the process of building certification under the LEED and selected structural-technical solutions that support the principles of sustainability. Combining geothermal wells connected to a heat pump with reinforced Concrete Core Activation (CCA) of ceilings is created highly effective way of surface heating and cooling of buildings. Contribution points out that although the use of new green technologies raises several unexplored risks, ultimately form the necessary framework to meet the requirements of sustainability.

Keywords: sustainable development, green technologies, concrete core activation, building certification, reinforced concrete structures

SUSTAINABLE PAVEMENTS: INFLUENCE OF THE SAW-CUTTING METHOD ON THE PERFORMANCE OF JPCP

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Section Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, the election of concrete as material for pavements is limited when only the construction costs are considered in the analysis. There is a continuing development of technology in order to reduce the costs of concrete pavements while maintaining the good performance and durability. Early-Entry Saw-Cutting (EESC) consists of a shallow cut (up to 30 mm depth) that allows a faster construction of Jointed Plain Concrete Pavements (JPCPs) because the joints can be cut just 3-5 hours after concrete placement. In addition, EESC is useful to avoid repair costs for random cracking because it relieves internal concrete stresses. Although EESC has become more accepted, especially in U.S.A, there are some concerns regarding to its influence on the JPCP performance. The objective of this paper is to evaluate the influence of the saw-cutting method on the JPCP performance. For that, a modelling of the activation of transverse joints and their crack width value is made. The modelling takes into account the cut depths of the EESC and the conventional saw-cutting method when they are applied to traditional and short slab JPCPs. In addition, the Load Transfer Efficiency (LTE), related with the crack width, and representative for the JPCP performance is estimated using the experimental verification of the finite-element software EverFE. Finally, practical experiences of JPCP projects in similar conditions as assumed in the modelling are considered in the evaluation, including fibre-reinforced concrete (FRC). It was concluded that EESC is effective to avoid random cracking but special measures need to be taken to evade higher stresses in the JPCPs that are not considered in the design and will negatively influence the JPCP performance. In short slabs, for the analysed conditions, a Relative Joint Depth (RJD) $\leq 25\%$ results in LTE $\leq 52\%$ and uncracked joints, therefore longer slabs than the designed ones. In traditional JPCPs a RJD $\leq 25\%$ results in a very low LTE ($\leq 30\%$).

Keywords: Sustainable, Pavements, Concrete, Saw-Cutting.

SUSTAINABLE PAVEMENTS: UNSEALED JOINTS IN JOINTED PLAIN CONCRETE PAVEMENTS

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Section Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, concrete as material for pavements is hardly chosen when only the construction costs are considered in the analysis. The use of Jointed Plain Concrete Pavements (JPCPs) with unsealed joints not only yields the savings of sealing the joints, but also the ones for keeping them sealed. The total savings for not sealing the joints can reach 45% in 10 years. The objective of the present paper is to determine the conditions where it is feasible to use unsealed joints in JPCPs. For that, the technical basis of the unsealed joints are taken into account, together with the experiences of these kind of joints in different scenarios, for instance: JPCP applications for streets, bus corridors, highways, low volume roads and industrial yards; different times in service and climatic conditions. The necessary conditions to use unsealed joints in JPCPs are narrow saw-cuts (not more than 3 mm wide) and a base/soil layer with limited fines content. The applications where it is feasible to use unsealed joints are streets, low volume roads, industrial JPCPs (warehouses) and any JPCP application where the seals are not maintained. For JPCPs with higher traffic demands, as highways and bus corridors, the feasibility of JPCPs with unsealed joints will depend on the traffic and the weather. There are bus corridors with good performance in climate without excessive rainfall. Although there is not consensus about the performance of unsealed joints under heavy traffic and very demanding climates, there are unsealed joints in these conditions with excellent results.

Keywords: Sustainable, Pavements, Concrete, Unsealed Joints.

SUSTAINABLE PAVEMENTS: AN ANALYSIS OF THE CRACKS WIDTH IN JOINTED PLAIN CONCRETE PAVEMENTS WITH SHORT SLABS

Assist. Prof. - PhD Candidate Mauricio Pradena¹

Assoc. Prof. Lambert Houben²

¹ Civil Engineering Department, Universidad de Concepción, **Chile** – Road Engineering, Delft University of Technology, **the Netherlands**

² Section Road Engineering, Delft University of Technology, **the Netherlands**

ABSTRACT

A technical, economic and environmental analysis over the road life cycle shows that concrete pavements are a sustainable paving alternative. However, the election of concrete as material for pavements is limited when only the construction costs are considered in the analysis. Because of the load configuration and the curling reduction, the Jointed Plain Concrete Pavements (JPCPs) with short slabs allow less thickness and therefore less construction costs (savings up to 30%). The objective of the present paper is to analyze the crack width under the joints of JPCPs with short slabs and the implications of these values for the performance of the pavement. For that, a comparison of the magnitude of the crack width is made with the traditional JPCP, using a model developed by the authors, field data of cracks width and Load Transfer Efficiency (LTE), and taking into account practical experiences of JPCPs with short slabs. For the analyzed conditions a reduction of 40% of the average cracks width of the JPCP with short slabs in comparison with the value of the traditional JPCP was found. This means better aggregate interlock, then higher LTE and less deterioration of the pavement, which is in agreement with the good performance that JPCPs with short slabs have shown in U.S. and Chile

Keywords: Sustainable; Pavements, Concrete; Crack Width.

THE AGGREGATE INFLUENCE ON THE PHYSICAL AND MECHANICAL PROPERTIES OF THE CONCRETES FOR USE AS GAMMA RADIATION SHIELDING

Prof. PhD. Maria Gheorghe¹,
Assoc. Prof. PhD. Nastasia Saca¹,
Assoc. Prof. PhD. Lidia Radu¹
PhD Adriana Moanta² ,
PhD Viorel Fugaru³

1: Technical University of Civil Engineering, Research Center of Inorganic Waste Valorization in Building Materials, **Romania.**

2: CEPROCIM SA **Romania.**

3: The National Institute of R&D for Physics and Nuclear Engineering Horia Hulubei **Romania**

ABSTRACT

This paper presents an experimental study on physical and mechanical properties of the concretes prepared with different type of cements and aggregates. The reference concretes carried out with river aggregate and with two type of cement namely ordinary Portland cement and composite Portland cement with 20% Ba compounds addition. The high-density concretes have been prepared with ordinary Portland cement and high density aggregates as hematite and mineral steril with barite from barite rock processing.

The concrete gamma linear attenuation coefficients were tested for γ -rays energy of 0.37 MeV (Ir-192), 0.663 MeV (Cs-137) and 1.25 MeV (Co-60). The concrete density, ultrasonic wave velocity and compression strengths were tested too. The fresh and hardened concrete properties were considerably influenced of the water/cement ratio and of fine particles/coarse aggregate volume ratios. The high concretes density significantly favored the attenuation of gamma rays energy.

Keywords: high density aggregate, heavy concrete, gamma linear attenuation coefficients

**THE ENVIRONMENTAL, ENERGY PERFORMANCE EVALUATION OF THE
REAL WOODEN HOUSE AND THE COMPARISON OF ITS LOCATION IN
THE DIFFERENT CLIMATIC CONDITIONS**

Ing. Silvia Baďurová, PhD.¹

Ing. Radoslav Ponechal, PhD.²

¹Research Centre, University of Žilina, **Slovakia**

²Faculty of Civil Engineering, University of Žilina, **Slovakia**

ABSTRACT

This paper deals with an evaluation of an existing wooden panel house in the passive standard and its comparison with the alternative material composition (porous concrete masonry house). The criteria for the evaluation are the energy performance (according to EU standards and norms), the size of the usable area and the environmental impact (according to OI3 methodology). Furthermore, this paper assesses a potential benefit for the energy savings in heating (or cooling) based on the change of the locations (changing of the climate dates). These comparisons are based on the numerical simulation which is calibrated from in situ measurements.

Keywords: passive house, energy efficiency, eco indicator OI3, natural materials, energy simulation

**THE FORMATION OF THE MICROSTRUCTURE OF THE MULTISILICON
GROWN FROM REFINED METALLURGICAL SILICON**

Dr. Svetlana Peshcherova

Dr. Liudmila Pavlova

Assoc. Prof. Dr. Aleksander Nepomnyaschikh

Vinogradov Institute of Geochemistry, Siberian Branch, Russian Academy of Sciences, **Russia**

ABSTRACT

Distribution of impurities in multisilicon, grown from metallurgical silicon by the Bridgmen-Stockbarger method has been studied using electron probe microanalysis. It has been found that most of the impurities occur as primary and secondary microinclusions. Primary microinclusions are large (1-100 micron) intermetallic agglomerates formed in the melt from primary microinclusions of metallurgical grade silicon. Secondary microinclusions are smaller (to 1 micron) and contain not more than three metal elements.

Keywords: Multicrystalline silicon, impurities, electron probe microanalysis

THE GREEN CONSTRUCTION TECHNOLOGIES FROM SAFETY AND HEALTH POINT OF VIEW

Ing. Zuzana Struková, PhD.

Prof. Ing. Mária Kozlovská, PhD.

Technical University of Košice, Faculty of Civil Engineering, **Slovakia**

ABSTRACT

The Europe 2020 strategy sets target for reducing the greenhouse gas emissions is contributing mainly to the development of renewable energy technologies and activities to support energy efficiency, particularly in construction industry, as one of the sectors most directly linked to green or green economic activities. The assessment of the occupational hazards and risks that might be associated with new green technologies and related jobs is now becoming part of many discussions. The paper deals with the initiative of the European Agency for Safety and Health at Work aimed at examination of the potential safety and health risks associated with the technologies being used in the development of “green jobs” that are becoming an important part of the construction labor workforce. Moreover, the occupational safety and health implications and scope for emergent risks in green construction technologies are discussed in the paper. The increasing drive towards green buildings is leading to innovative design and construction processes and the use of alternative materials and so development and greater implementation of new technologies. New work situations connected with new technologies, substances and work processes connected with the design and construction of buildings that have potential to reduce energy use may result in some emergent safety and health risks. Consideration should be given to the safety and health of those who build and maintain those designs and the mentioned risks should demand some approaches to ensure high level of occupational safety and health.

Keywords: green construction, green technology, sustainable construction, new technology, green job, safety and health

THE ISSUE OF BUILDING ENVELOPE OF MODULAR STRUCTURES

Ing. Barbora Hrubá

Ing. Marcela Cerniková

Ing. Nada Zdrážilová

Prof. Ing. Darja Kubecková, Ph.D.

VŠB – TU Ostrava, Faculty of civil engineering, **Czech Republic**

ABSTRACT

Building envelopes must request very stringent thermal insulation requirements. All in connection with the implementation of the regulation of the European Parliament and Council 2010/31/EU of the energy performance of buildings into law 318/2012 Sb., of energy management, which changes the law 406/2000 of energy management. This paper deals with the issue of modular structures. Modular structures also called residential containers have many prerequisites for creating quality living. It is possible to assemble objects of almost any floor plan and elevation dimensions from these residential containers. In terms of the impact on the internal environment of these buildings it is difficult to solve thermal bridges and thermal bonds, which are one of the most important factors in the possible formation of mold on the inner surface of the structure.

Keywords: Building envelope, modular structure, thermal insulation, thermal bridges

THE PROPERTIES OF BASALT ROCKS OF GEORGIAN DEPOSITS AND THE FIBERS OBTAINED FROM THEM

Prof. Nikoloz Chikhradze^{1,2},

Prof. Guram Abashidze²,

Ms. Sc. George Pkhaladze²,

Eng. Davit Tsverava

¹ Georgian Technical University, **Georgia**

² LEPL G. Tsulukidze mining Institute **Georgia**

ABSTRACT

With the advent of 21-st century the intensive investigations carried out all over the world for preparation of technical purpose fibers of new type. Among them is basalt fiber which may be considered as an alternative of glass fiber. Basalt fiber is distinguished from glass one by improved physical-mechanical characteristics, especially by elasticity module, enhanced heat resistance and stability against various aggressive media. Taking into consideration the fact that the technology of preparation of basalt fiber is not much different from the technology of preparation of glass fiber and their cost is the same order, the technologies of preparation of the products from basalt fiber occupy a highly important place in advanced industrially developed countries.

There are large resources of basalt raw material in Georgia. In presented work the characteristics of basalt rocks of three deposits (Marneuli, Tetrtskaro, Bolnisi) are given as well as such properties of obtained melt as viscosity and crystallization ability, the conditions of fiber formation, fiber physical-chemical and mechanical characteristics, including short-term resistance and long-term strength at tension.

THERMAL ANALYSIS OF PERFORMANCE OF THE BUILDING ENVELOPE

Ing. Denisa Donova¹

Ing. Veronika Kucerikova¹

Ing. Nada Zdrazilova¹

¹ VSB – Technical University of Ostrava, Faculty of Civil Engineering, **The Czech Republic**

ABSTRACT

The aim of this paper is to evaluate performance of a light wooden structure in terms of the temperatures in the structure. The evaluation is done with respect to the type of the building envelope. Specifically there is a comparison of the structure with ventilated air gap and the structure without ventilated air gap. To evaluate the performance of structures there are used experimental data which are measured in the experimental passive house. Then the paper focuses on comparing of the real performance of the structures with generated numerical models.

Keywords: thermal analysis, building envelope, experimental passive house

which is used as a vocational training center MSDK. The facade of this building is partially solved with ventilated air gap and partly without ventilated air gap, see Figure 1.



Fig. 1: Object of Vocational training center MSDK

CONSTRUCTIONS OF PASSIVE TIMBER BUILDING

The peripheral wall of this experimental passive house is designed as a lightweight wooden construction. The construction is diffuse open. As supporting elements there were used beams Steico based on wood which are positioned axially at a distance of 600 mm. The structure is insulated by wood-fiber boards Steico.

Detailed section of both structures is shown in Figure 2. From this figure it is obvious that the structures differ in terms of compositions of the external insulation. While in case of the structure without the ventilated air gap is on the external side of structure used thermal insulation in a total thickness of 140 mm, for the construction with ventilated air gap, the thickness of insulation is reduced to 100 mm. Then there follows up the ventilated air gap. Thermal resistance of structures, in the axis between the beams, is then 12.3 (m².K)/W for the construction without air gap and 11.3 (m².K)/W for a ventilated design. Thermal resistance of the structure with ventilated air gap is almost 10% lower than in a case of non-ventilated construction.

MONITORING OF THERMAL – TECHNICAL CHARACTERISTICS

Since the building became operational there are monitored heat and humidity characteristics of the external walls in 8 locations. In the cross-section of structure there are disposed sensors for measuring temperature on the inner and outer side of the construction and 3 sensors are located inside the structure to measure temperature and humidity inside of this structure. Placement of the sensors inside the design is shown in Figure 2. In addition to these parameters, in this object there are also measured parameters of the internal and external environment using spatial sensors. Thanks to this

it can be comprehensively evaluated the structural behavior in response to the conditions that are in the vicinity of construction (on the internal and external side).

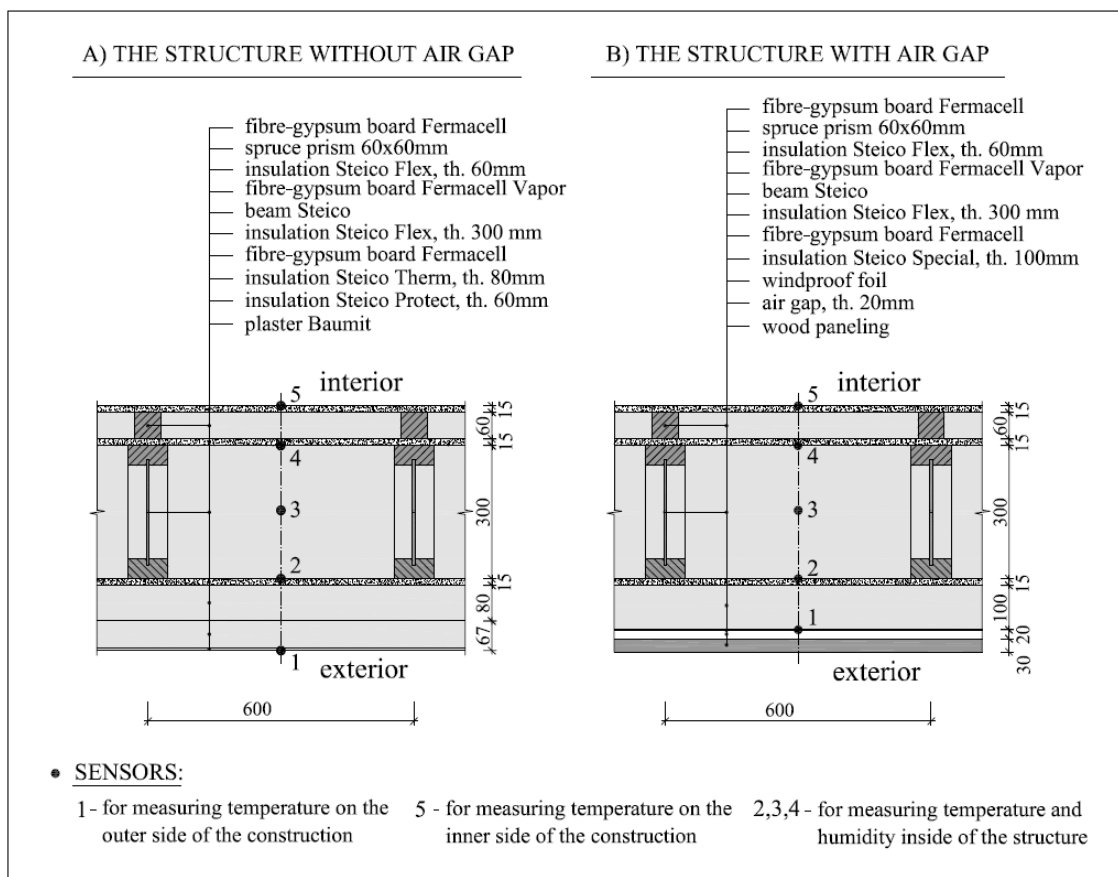


Fig. 2: Constructions composition and placement of the sensors

ASSESSED DATA

For the purpose of this paper there was used data obtained in measurements in two areas of the building envelope - from the south side of the building where there is facade without ventilated air gap and on the east side of the building where is the facade with air gap. In both cases, there were chosen places on the axis between the Steico beams, it means outside the thermal bridge. These two places were chosen because of similar internal boundary conditions inside the rooms where the sensors are placed. Due to the minimal differences in indoor air temperatures it is possible to compare the behaviour of these structures from the heat - technical view. For evaluation of construction design there was chosen data measured during the January 2014, when the temperature dropped below 0°C during a few days consistently. Measured values of temperatures in the structures are shown in Figures 3 and 4.

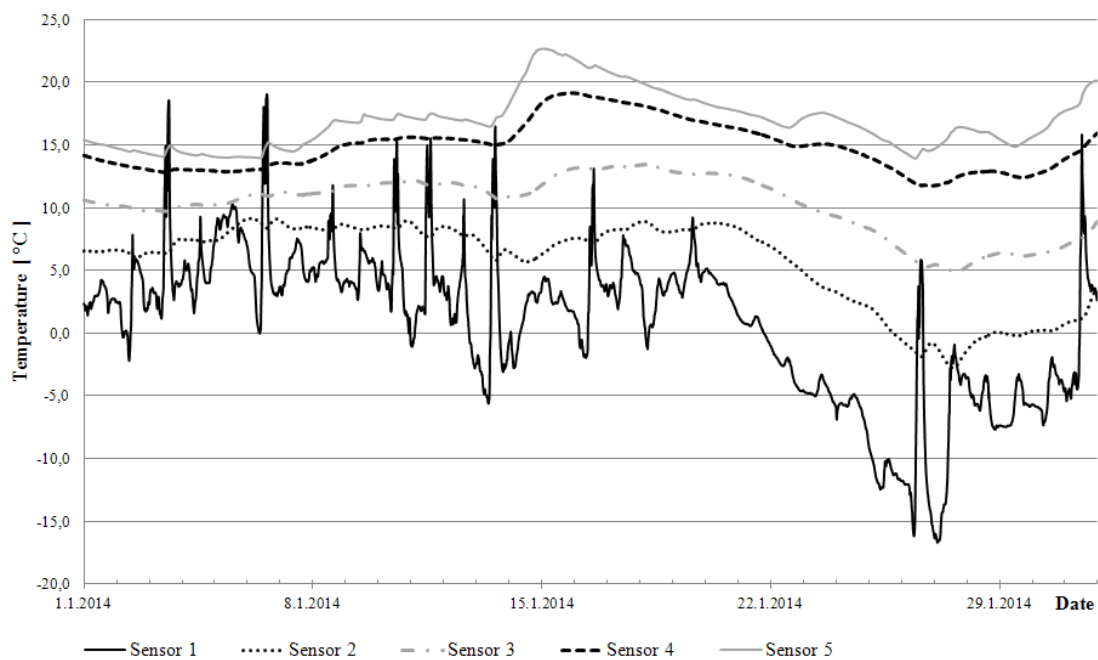


Fig. 3: Temperatures in the facade without ventilated air gap during January 2014

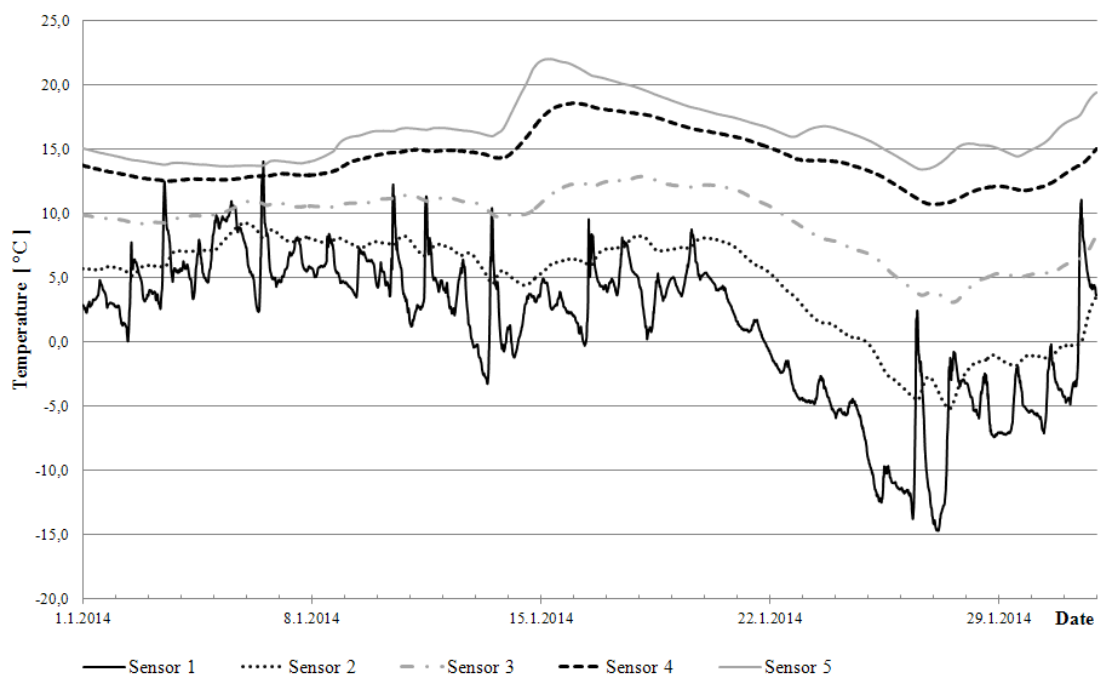


Fig. 4: Temperatures in the facade with ventilated air gap during January 2014

TEMPERETURES ON THE EXTERIOR SIDE OF CONSTRUCTION

In the case of external wall without an air gap, it is clear that the surface of structure is exposed to large temperature differences. These are caused by changes of outside air temperature and also by sunlight, which has an influence on the facade during the day. This thermal stress of the external surface of structure is inappropriate in the terms of the wear of used material and its thermal expansion. It is eliminated in the case of construction with ventilated air gap. Temperature curves of the exterior surface of structures are shown in figure 5. Here, in addition to course of temperatures it is also shows the temperature difference between these temperatures for both structure compositions. There was calculated the difference between the temperature on the external side of these structures - with ventilated air gap and without the air space. Values are mostly at around 0.5 ° C. It means that the temperature on the external surface behind the ventilated air gap is precisely higher by this value than in the case of a direct action of the external temperature on the exterior surface of the structure without the air gap. Conversely, in the case of direct sunlight on facade, when temperature in the ventilated air gap is significantly lower than in the case of the structure without the ventilated air gap.

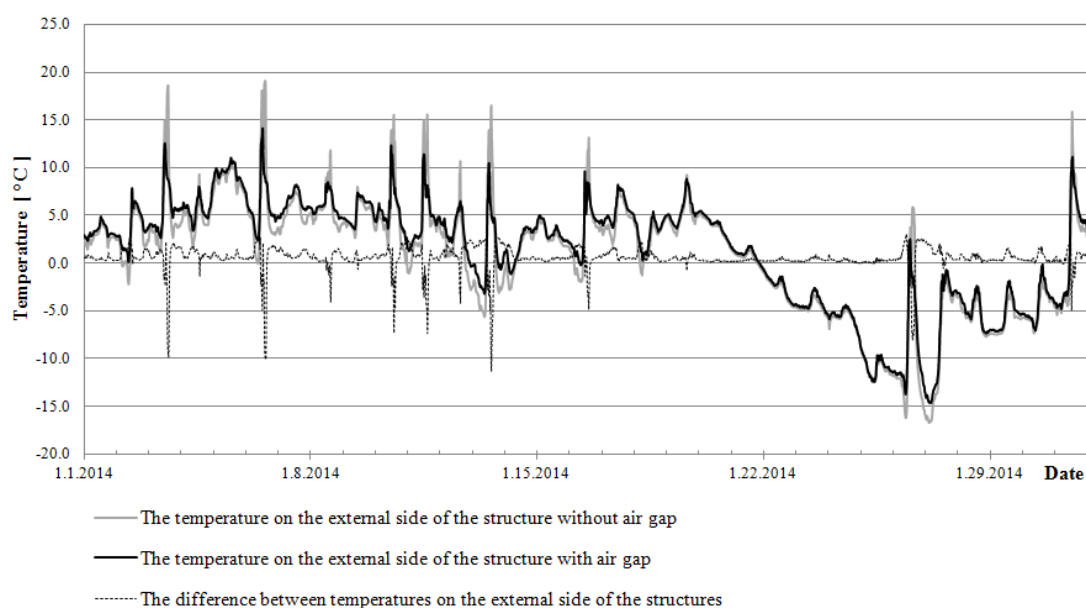


Fig. 5: Temperature curves on the external side of the structures

COURSE OF TEMPERATURE INSIDE THE STRUCTURE

For temperature inside the structures there were evaluated differences in temperature between the structures assessed at the same point in the structure construction. Positive values indicate that the temperature in the structure without ventilated air gap is higher than in the construction with air gap. From Figure 6 it is obvious that these differences are mainly higher inside the structure closer to its exterior surface. Closer to the interior of the structure the difference in temperature gradually decreases. This is evident at lower outdoor air temperatures, ie. from 22nd to 28th January 2014. From this it follows that the thermal insulating ability of construction with ventilated air gap is

lower than in the case of construction without ventilated air gap. This is of course due to the insulation of the outer surface of each structure, the construction of ventilated air gap is isolated in a smaller thickness and its thermal resistance is therefore lower. Furthermore, from Figure 6 it is clear that the difference between the temperature inside the structure at the point closer to the outer surface decreases with increase in outside air temperature.

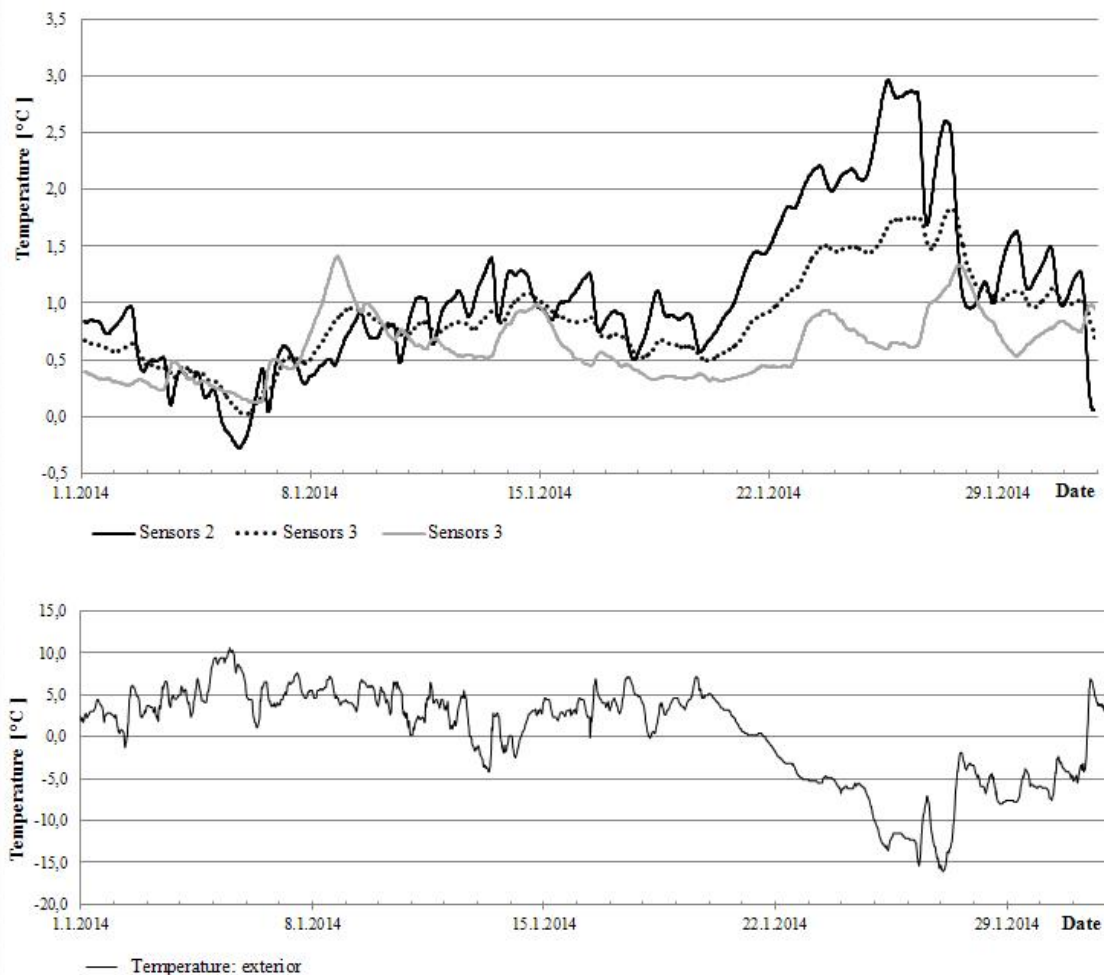


Fig. 6: Waveforms of temperature differences between the structures at given points – depending on the boundary conditions of external environment

TEMPERETURES ON THE INTERIOR SIDE OF CONSTRUCTION

For temperatures on the inner surface structure it was observed the difference between the temperature of the internal air in the room and the temperature on the inner surface of the structure. Differences between these temperatures for both types of construction are shown in Figure 7. It is obvious that the difference of these temperatures in the case of construction with ventilated façade is in average 0.6 ° C higher than for facade without the vented air gap. It means that the heat-insulating ability of structure with ventilated air gap is slightly lower than in the case of the structure without the air gap. However, it is necessary to emphasize the difference between the heat resistance

of structures where for construction with ventilated air gap it is almost 10% lower than for structure without it. Obvious differences in temperature increases of the internal air and the inner surface temperature that are caused by solar gains are also interesting.

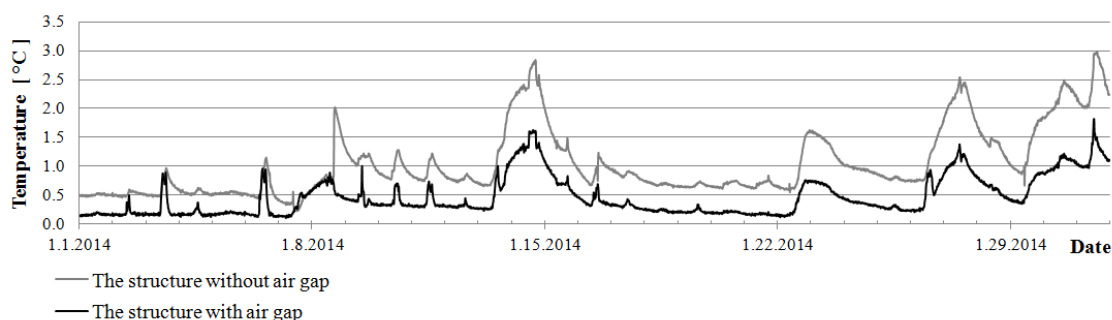


Fig. 7: Waveforms of differences between temperatures of the interior air and the inner surface temperature of construction

COMPARISON OF MEASUREMENT RESULTS WITH NUMERICAL MODEL

The results of experimental measurements were compared with the results of numerical calculation (like in [4]). It was performed using Area 2011 software, where it was modeled 2D temperature array. Stationary boundary conditions were modeled for the design boundary conditions in winter, according to CSN 73 0540, therefore the design temperature of outdoor air in Ostrava is $-15\text{ }^{\circ}\text{C}$ and the design temperature of indoor air for residential buildings is $20\text{ }^{\circ}\text{C}$. Thermal resistance on the inner side of the structure for calculation of temperature field is $0.25\text{ (m}^2\text{K)}/\text{W}$, on the outside of the structure if construction is unventilated it is $0.04\text{ (m}^2\text{K)}/\text{W}$ and for ventilated construction $0.13\text{ (m}^2\text{K)}/\text{W}$.

It was found that the difference in internal surface temperatures is for this boundary conditions about $0.65\text{ }^{\circ}\text{C}$. This is consistent with the results of measurements where the difference of internal surface temperatures during the reference period was mostly just $0.6\text{ }^{\circ}\text{C}$. The results are shown in Figure 8.

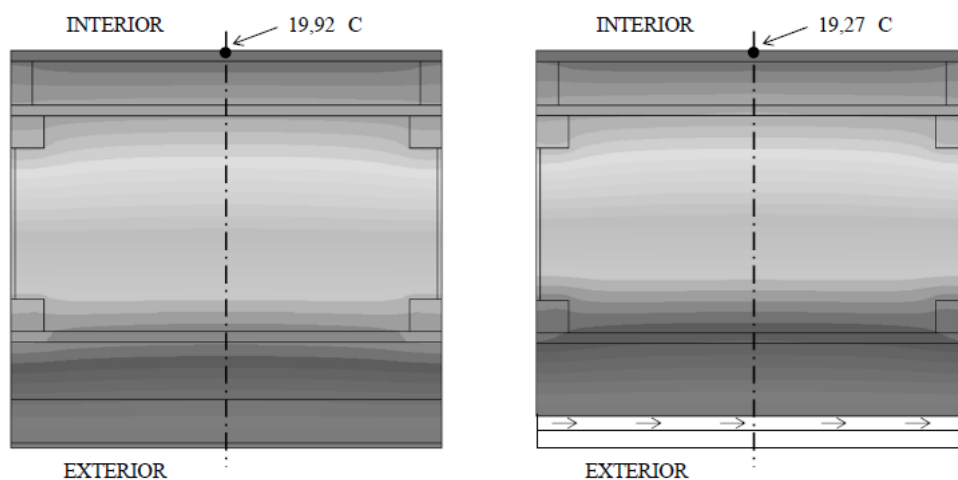


Fig. 8: Results of the numerical model

CONCLUSION

It was found that construction with ventilated air gap has insignificantly worse heat - insulating characteristics than the structure without this air gap. This is, of course, due to the thermal resistance of the construction, which is almost 10% lower than in the case of construction without an air gap, which insulated used thicker layer of thermal insulation. Furthermore, it was performed a comparison of differences between internal surface temperatures specified by numerical calculation with actual measured data, which practically correspond to the numerical model.

Acknowledgment

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REFERENCES

- [1] LAHUTA, Hynek & Iveta SKOTNICOVA. *Dynamic thermal performance of building structures in experimental lightweight timber-frame passive house*. In: SGEM 2013: Albena, Bulgaria, 2013-06-20, pp 403-410. ISBN 978-619710506-3. ISSN 13142704. DOI: 10.5593/SGEM2013/BF6/S26.008.
- [2] SKOTNICOVA, Iveta, Zdenek GALDA, Petra TYMOVA & Lenka LAUSOVA. *Experimental measurements and numerical simulations of dynamic thermal performance of external timber frame wall*. In: *Advanced Materials Research*, vol. 899, pp 988-99, 2014. DOI: 10.4028/www.scientific.net/AMR.899.126.
- [3] KUCEROVA, Lucie, Marcela CERNIKOVA & Barbora HRUBA. *Thermal technical assessment of selected constructions of wooden houses*. In: *ICMEMSCE 2013: Beijing, China*, vol. 470, pp. 988-991. ISBN 978-303785961-2. ISSN 16609336. DOI: 10.4028/www.scientific.net/AMM.470.988.
- [4] KUCEROVA, Lucie, Marcela CERNIKOVA & Barbora HRUBA. *Thermal properties of wooden buildings in relation to computer software*. In: *Advanced Materials Research*, vol. 899, pp 193-196, 2014. DOI: 10.4028/www.scientific.net/AMR.899.193.
- [5] PASEK, Jan & Daniela BOSOVA. *Impact of facade colouring on temperature and light conditions of buildings, housing estates, and environment*. In: *Advanced Materials Research*, vol. 899, pp 135-138, 2014. DOI: 10.4028/www.scientific.net/AMR.899.135.
- [6] PATANIA, Francesco, Antonio GAGLIANO, Francesco NOCERA, A. FERLITO & A. GALES. *Thermofluid – dynamic analysis of ventilated facades*. In: *Energy and Buildings*, vol. 42, pp 1148-1155, 2010. ISSN:03787788. DOI: 10.1016/j.enbuild.2010.02.006.
- [7] SUAREZ, Christian, Patrice JOUBERT, Jose L. MOLINA & Francisco Jose SANCHEZ. *Heat transfer and mass flow correlations for ventilated facades*. In: *Energy and Buildings*, vol. 43, pp 3696-3703, 2010. ISSN:03787788. DOI: 10.1016/j.enbuild.2011.10.002.

THERMAL BRIDGES HYGROTHERMAL PERFORMANCE IN BUILDING ENVELOPES SUBMITTED TO ENERGY REHABILITATION

Assistant Researcher, PhD Eng. Adrian Iacob

Senior Researcher 3rd rank, PhD Phys. Monica Lilioara Cherecheş

National Institute for Research and Development in Construction, Urban Planning and Sustainable Territorial Development “URBAN-INCERC”, Jassy Branch, **Romania**

ABSTRACT

The necessity of adopting a responsible attitude when using resources is rendered in all areas concerning energy through specific regulations derived from the general expressions of the principles of sustainable development. Buildings hold a major position in resource consumption, and if for the construction stage the materials investment is foreknowledge, the expense in controlling the indoor climate over a building's life cycle is for certain indefinable. For each type of building envelope, minimum insulation levels are required in national building codes, with a scope extent from new projects to the existing stock that undergoes processes for thermal improvement. This paper reviews several alternatives in hygrothermal upgrading of enclosure elements with reinforced concrete structural walls or frames, in order to lay out good building practice for minimizing thermal bridges effects. By performing numerical simulations of heat and mass transfer in specific constructive details, for Jassy typical climate, comparisons between hygrothermal performance of mineral wool and renewable natural materials are drawn.

Keywords: sustainable development, energy performance, heat and mass transfer, thermal bridges, numerical simulation.

**TYPICAL RENOVATION MEASURES OF BRICK HOUSES
FROM 1970 - 1990**

Pavel Oravec

Brno University of Technology, Faculty of Civil Engineering, Brno, **Czech Republic**

ABSTRACT

In the Czech Republic the construction of family houses by self-support of actual investors with the minimum of contractor participation is common. Since 1970's most houses have been built from molded bricks with concrete ceilings and reinforcing rims, covered by a wooden roof. The case study analyzes the typical range of reconstruction measures, which the specified houses are undergoing at present. The common denominator of the construction impacts are measures aimed at reducing the amount of energy needed to heat buildings. Are processes, technologies and investments of this type adequate? The part of this paper is also a test of the air tightness of the building and a measurement of the thermal insulation of the structures in the original condition and after the reconstruction.

Keywords: family house renovation, insulation of a construction, airtightness

VALORIZATION OF MINERAL WASTE WITH HEAVY METALS CONTENT INTO SILICATE MATRIX

Prof. PhD. Maria Gheorghe,

Assoc. Prof. PhD. Nastasia Saca,

Assoc. Prof. PhD. Lidia Radu

Technical University of Civil Engineering, Research Center of Inorganic Waste Valorization in Building Materials, **Romania**

ABSTRACT

Article presents a study concerning the embedding of some mineral waste with heavy metal content (electroplating sludge) into solidification/stabilisation (s/s) vitreous/vitroc ceramic matrix of glass products type and into cementitious matrix of concrete products type. The leaching tests showed that the obtained materials of vitreous, vitroc ceramic type and of hydraulic matrix type (based on Portland cement – PC and granulated blast-furnace slag - GBS) present no risk to the environment contamination. Also, the mechanical strengths of cementitious matrix and concretes are influenced of the Portland cement/granulated slag ratio, waste/cement ratio and water/cement ratio. The 28 days-compressive strengths of matrix with CP/GBS ratio from 80/20 to 20/80 varied from 80 MPa to 40 MPa. The cementitious matrix with GBS content more than 40/60 and with higher waste/cement ratio of 3/10 and 4/10 developed the lowest 28 days-compressive strengths due to a high content of Zn and Cu.

Keywords: waste, valorisation, vitreous, cementitious matrix, leaching, heavy metals

VEGETATIVE SLOPED ROOF ALTERNATIVE SOLUTIONS

Ing. Stanislav Tóth, PhD.¹

Ing. Arch. Zuzana Poórová ²

Doc. Ing. Zuzana Vranayová, PhD.³

^{1,2,3} Civil Engineering Faculty, Technical University of Košice, **Slovakia**

ABSTRACT

Roof construction with substrate and vegetation layer raises quality parameters of artificial environment, raises quality parameters of the building and its internal comfort. It also raises qualitative index of the vegetative roof construction in compare with roof construction without substrate and vegetation layer. Vegetation layer on roof construction has an ecological aspect for the entire building that cannot be overlooked. Green roofs are also both architecturally and visually appealing forms of roof construction. It allows creating new volumes, new architectural surfaces that depend on design of the construction and aesthetical possibilities of the vegetative roof. Solving details and sloped vegetative roof structures directly affects reliability of the roof in term of damp proof course and building thermal physics. Construction design of the details and all roof structures intervene applied building physics. With its theoretical and experimental rules it must eliminate ineligible water penetration, but it must respect the request of designed vegetation. This paper deals with vegetative roofs advantages, mentions its mostly ecological contributions and its related roofs design specifics and structure solutions.

Keywords: current state, designed state, double-wall roof, single-wall roofs, thermal transmittance, triple-wall roof, relative humidity, structure solutions