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Civil Engineering '13

International Scientific Conference

Programme/Abstracts

Būvniecība '13

Starptautiskā zinātniskā konference

Programma/Kopsavilkumi

Jelgava 2013

LATVIA UNIVERSITY OF AGRICULTURE
FACULTY OF RURAL ENGINEERING
DEPARTMENT OF ARCHITECTURE AND BUILDING
DEPARTMENT OF STRUCTURAL ENGINEERING
DEPARTMENT OF LAND MANAGEMENT AND GEODESY
DEPARTMENT OF ENVIRONMENTAL ENGINEERING AND WATER
MANAGEMENT

LATVIJAS LAUKSAIMNIECĪBAS UNIVERSITĀTE
LAUKU INŽENIERU FAKULTĀTE
ARHITEKTŪRAS UN BŪVNIECĪBAS KATEDRA
BŪVKONSTRUKCIJU KATEDRA
ZEMES IERĪCĪBAS KATEDRA
VIDES UN ŪDENSŠAIMNIECĪBAS KATEDRA

CIVIL ENGINEERING '13
International scientific conference

ABSTRACTS

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Starptautiskā zinātniskā konference

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**International scientific conference “Civil engineering `13”,
Jelgava, 16-17 May, 2013**

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Conference “Civil engineering `13” programme

16 MAY / THURSDAY			
8.30 - 9.00		PARTICIPANTS REGISTRATION	
ROOM	TIME	OPEN SESSION	SPEAKER
HALL	9.05-9.10	RECTOR OF LATVIA UNIVERSITY OF AGRICULTURE, PROFESSOR OF FACULTY OF RURAL ENGINEERING	Juris Skujans
	9.10-9.15	MINISTRY OF ECONOMICS OF THE REPUBLIC OF LATVIA, STATE SECRETARY	Juris Puce
	9.15-9.20	RIGA TECHNICAL UNIVERSITY, DEAN, PROFESSOR OF FACULTY OF CIVIL ENGINEERING	Juris Smirnovs
	9.20-9.25	PROFESSOR EMERITUS OF CHALMERS UNIVERSITY OF TECHNOLOGY, SWEDEN	Ralejs Tepfers
	9.25-9.30	LATVIA UNIVERSITY OF AGRICULTURE, PROFESSOR OF FACULTY OF RURAL ENGINEERS	Janis Brauns

PARALELL SESSIONS - 16 MAY / THURSDAY

ROOM	TIME	PRESENTATION	AUTHORS
BUILDING AND RENOVATION	CHAIRMAN: Arturs Lesinskis, Nico Scholten		
	201	10.00 -10.20	INDIRECT EVAPORATIVE PRE-COOLED COMPRESSOR COOLING SYSTEM PERFORMANCE UNDER VARIOUS OUTDOOR AIR HUMIDITY CONDITIONS Arturs Brahmanis, Arturs Lesinskis
		10.20-10.40	CONSTRUCTION WASTE MANAGEMENT PROCESS IN LATVIA: PROBLEMS AND POSSIBLE SOLUTIONS Sandra Gusta, Gints Skenders
		10.40-11.00	CIVIL ENGINEERING WITH IN SUSTAINABILITY PERSPECTIVE IN LATVA Sandra Gusta, Kaspars Abramenko
		11.00-11.20	DESIGN OF FLOW AND HOLDING CAPACITY OF ESCAPE ROUTES IN BUILDINGS Peter H.E. van de Leur, Nico P.M. Scholten
		11.20-11.40	APPLICATION OF COMPUTER PROGRAMS IN THE CALCULATION OF WATER VAPOUR DIFFUSION FOR ROOF STRUCTURES Sandris Liepins, Arturs Lesinskis, Uldis Iljins
		11.40-12.00	NON-DESTRUCTIVE EVALUATION OF FIBER ORIENTATION IN FIBERCONCRETE PRISM Arturs Macanovskis, Vitalijs Zaharevskis, Andrejs Krasnikovs
	12.00-13.00 LUNCH TIME		
	CHAIRMAN: Arturs Lesinskis		
	201	13.00-13.20	CASE STUDY OF HEAT RECOVERY IN AIR HANDLING UNITS WITH HEAT EXCHANGERS FOR RESIDENTIAL APPLICATION IN LATVIA Gatis Plavenieks, Arturs Lesinskis
		13.20-13.40	NEED TO INNOVATE THE DUTCH BUILDING REGULATION Nico P.M. Scholten, Rob de Wildt, Ton.C.W.M. Vrouwenvelder
		13.40-14.00	EUROCODES AND STRUCTURAL SAFETY OF THE EXISTING BUILDINGS - CONSIDERING THE PUBLICATION OF THE DUTCH NEN 8700 Nico P.M. Scholten, Ton C.W.M. Vrouwenvelder
		14.00-14.20	PROBABILISM, THE WAY OUT FOR PERFORMANCE BASED BUILDING REGULATIONS Nico P.M. Scholten
		14.20-14.40	ENVIRONMENTAL PERFORMANCE REGULATIONS IN THE NETHERLANDS Nico P.M. Scholten, Harry A.L. van Ewijk

		14.40-15.00	NITROGEN BASED FIRE PREVENTION SYSTEM	Andris Steinerts, Aigars Bedritis, Iveta Vorza
	POSTER SESSION			
	201	15.00-15.10	NITROGEN BASED FIRE PREVENTION SYSTEM	Andris Steinerts, Aigars Bedritis, Iveta Vorza
		15.10-15.30	COFFEE BREAK	
LANDSCAPE ARCHITECTURE / LAND MANAGEMENT AND GEODESY	CHAIRMAN: Aija Ziemelniece			
	117	10.00 -10.20	THE IMPACT OF LEGISLATIVE RULES AND ECONOMIC DEVELOPMENT ON THE COASTAL LANDSCAPE IN LATVIA	Natalija Nitavska, Daiga Zigmunde
		10.20-10.40	REGIONAL STRUCTURE OF CULTURALLY-HISTORICAL LANDSCAPE OBJECTS AVAILABILITY IN LATGALE UPLAND AREA	Lilita Lazdane, Madara Markova, Aija Ziemelniece
		10.40-11.00	INTERACTION AREAS OF THE CULTURAL AND HISTORICAL TERRITORIES AND THE SOVIET PERIOD RESIDENTIAL AREAS	Una Ile, Silvija Rubene
		11.00-11.20	FLOODING AS A MEANS OF MILITARY DEFENCE: LANDSCAPE OF THE 20TH CENTURY FORTRESS WROCLAW	Lukasz Pardela
		11.20-11.40	LANDSCAPING OF SIBERIAN CITIES	Olga Pasko
		12.00-13.00	LUNCH TIME	
	CHAIRMAN: Velta Parsova			
	117	13.00-13.20	WATERMILLS AND SMALL-SCALE HYDROELECTRIC POWER PLANTS LANDSCAPES ASSESSED BY ASPECT OF AESTHETIC	Lilita Lazdane
		13.20-13.40	THE ROOF LANDSCAPES , THE HISTORIC CITY CENTRES AND CONTEXTUAL SEARCHES OF THE GREEN STRUCTURE	Aija Ziemelniece
		13.40-14.00	THE FIRST LATVIAN PRESIDENTIAL RESIDENCE FOR RIGA CASTLE GARDEN, A.ZEIDAKS GARDEN PROJECT IN 1923	Gundega Linare
		14.00-14.20	DISPLACEMENTS AT THE GNSS STATIONS	Diana Haritonova, Janis Balodis, Inese Janpaule, Madara Normand
		14.20-14.40	PRECISION OF LATVIA LEVELING NETWORK NODAL POINT HEIGHT	Armands Celms, Maigonis Kronbergs, Vita Cintina, Vivita Baumane
	POSTER SESSION			
	117	14.40-14.50	THE BENEFITS OF GREEN ROOFING FOR LATVIAN BUILDING ENVIRONMENT	Patricija Kara, Peteris Pastars
		14.50-15.10	COFFEE BREAK	
CONSTRUCTION AND MATERIALS	CHAIRMAN: Andris Steinerts			
	302	10.00 -10.20	MECHANICAL PROPERTIES OF LOW TEMPERATURE HYDRAULIC BINDERS	Bruno Kirulis, Janis Kreilis, Linda Krage, Inta Barbane, Inese Sidraba
		10.20-10.40	PROPERTIES AND COMPOSITION OF CONCRETE CONTAINING DIVERSE POZZOLANIC ADMIXTURES	Genady Shakhmenko, Diana Bajare, Inna Juhnevica, Nikolajs Toropovs, Janis Justs, Aljona Gabrene

CONSTRUCTION AND MATERIALS		10.40-11.00	EFFECT OF THERMAL TREATMENT ON PROPERTIES OF HIGH STRENGTH CONCRETE	Nikolajs Toropovs, Diana Bajare, Genadijs Shakhmenko, Aleksandrs Korjamins, Janis Justs	
		11.00-11.20	INFLUENCE OF POLYMERIC ADDITIVES ON THE PROPERTIES OF CONCRETE MANUFACTURED ON THE BASIS OF AGGREGATES PRODUCED FROM CRUSHED CONCRETE WASTE	Olga Finozenok, Ramune Zurauskiene, Rimvydas Zurauskas, Linas Mikulenas, Aleksandrs Korjamins, Genadijs Shakhmenko	
		11.20-11.40	THE ECONOMIC AND ENVIRONMENTAL BENEFITS FROM INCORPORATION OF COAL BOTTOM ASH IN CON CRETE	Girts Bumanis, Diana Bajare, Aleksandrs Korjamins	
		11.40-12.00	ANALYSIS OF SIMULATION MODELS OF PCM IN BUILDINGS UNDER LATVIA’S CLIMATE CONDITIONS	Janis Kazjonovs, Diana Bajare, Aleksandrs Korjamins, Ansis Ozolins, Andris Jakovics	
		12.00-13.00	LUNCH TIME		
	302	13.00-13.20	POSSIBILITIES OF CERAMIC MATERIALS IN PROVIDING ENERGY EFFICIENCY AND OPTIMAL MICROCLIMATE OF THE BUILDINGS	Sergejs Certoks, Janis Klavins, Andris Jakovics	
		13.20-13.40	HEAT INSULATION MATERIALS OF POROUS CERAMICS, USING PLANT FILLER	Aleksandrs Korjamins, Liga Upeniece, Diana Bajare	
		13.40-14.00	THERMAL CONDUCTIVITY OF WALLS INSULATED WITH NATURAL MATERIALS	Martti-Jann Miljan, Matis Miljan, Jaan Miljan	
		14.00-14.20	HIGH EFFICIENCY POROUS CERAMICS WITH CONTROLLABLE POROSITY	Aleksandrs Korjamins, Liga Upeniece, Diana Bajare	
		14.20-14.40	APPLICATION OF ULTRASONIC IMAGING TECHNIQUE AS STRUCTURAL HEALTH MONITORING TOOL FOR ASSESSMENT OF DEFECTS IN GLASS FIBER COMPOSITE STRUCTURES	Marija Masonkina, Kaspars Kalnins	
		14.40-15.00	COMPARISON OF ASPHALT CONCRETE PERFORMANCE USING CONVENTIONAL AND UNCONVENTIONAL AGGREGATE	Viktors Haritonovs, Martins Zaumanis, Guntis Brencis, Juris Smirnovs	
		15.00-15.20	INTERPRETATION OF ASPHALT MATERIAL DESIGN PARAMETERS	Atis Zarins, Viktors Haritonovs, Juris Smirnovs	
		15.20-15.40	DEVELOPMENT OF HIGH PERFORMANCE ASPHALT CONCRETE USING LOW QUALITY AGGREGATES	Viktors Haritonovs, Martins Zaumanis, Janis Tihonovs, Juris Smirnovs	
		15.40-16.00	UNCONFINED COMPRESSIVE STRENGTH PROPERTIES OF CEMENT STABILIZED PEAT	Peteris Skels, Kaspars Bondars, Aleksandrs Korjamins	
		16.00-16.20	COFFEE BREAK		
	POSTER SESSION				
	302	16.20-16.30	RHEOLOGICAL AND STRENGTH PERFORMANCE OF CEMENT PASTE WITH GROUND FLUORESCENT LAMP WASTE GLASS AND ASH	Patricija Kara	

		16.30-16.40	ACOUSTIC AND MECHANICAL PROPERTIES OF FOAM GYPSUM DECORATIVE CEILING PANELS	Raitis Brencis, Juris Skujans, Uldis Iljins
		16.40-16.50	CREEP BEHAVIOR OF HIGH PERFORMANCE FIBER REINFORCED CONCRETE (HPFRC)	Andina Sprince, Leonids Pakrastinsh, Aleksandrs Korjakins
		16.50-17.00	EFFECT OF ELEVATED TEMPERATURE ENVIRONMENT ON ULTRASONIC PULSE VELOCITY IN CURING CONCRETE	Uldis Lencis, Aigars Udris, Aleksandrs Korjakins
		17.00-17.20	COFFEE BREAK	
STRUCTURAL ENGINEERING	CHAIRMAN: Janis Kreilis			
	301	10.00 -10.20	BEHAVIOUR OF CABLE TRUSS WEB ELEMENTS OF PRESTRESSED SUSPENSION BRIDGE	Vadims Goremikins, Karlis Rocens, Dmitrijs Serdjuks, Raimonds Ozolins
		10.20-10.40	EFFICIENCY OF THERMAL DESIGN OF SHALLOW FOUNDATIONS	Guntis Andersons, Lilita Ozola
		10.40-11.00	FINITE ELEMENT ANALYSIS OF WEFT KNITTED COMPOSITES	Galina Harjkova, Vitalijs Lusis, Pavels Akishins, Andrejs Krasnikovs, Olga Kononova
		11.00-11.20	GFRP REBARS FOR CONCRETE CONSTRUCTIONS	Andrejs Kovalovs, Georgij Portnov, Vladimir Kulakov, Alexander Arnautov, Ellen Lackey
		11.20-11.40	MICROMECHANICS OF ELASTO-PLASTIC FIBER PULL OUT OF ELASTIC MATRIX	Angelina Galushchak, Vitalijs Lusis, Olga Kononova, Andrejs Krasnikovs
		11.40-12.00	OPTIMAL DESIGN OF VARIABLE STIFFNESS PLYWOOD- PLASTIC PLATE	Janis Sliseris, Girts Frolovs, Karlis Rocens
	POSTER SESSION			
		12.00-12.10	FOOTFALL INDUCED FORCES ON STAIRS	Liga Gaile, Ivars Radinsh
		12.10-13.00	LUNCH TIME	
	301	13.00-13.20	POLYMER FIBER PULL OUT EXPERIMENTAL INVESTIGATION	Vitalijs Lusis, Arturs Macanovskis, Andrejs Krasnikovs
		13.20-13.40	RESEARCH OF MATERIALS SUITABILITY FOR CRACK REPAIR IN REINFORCED CONCRETE STRUCTURES	Rytis Skominas, Vincas Gurskis, Algimantas Patasius
		13.40-14.00	STRENGTH OF LAYERED FIBERCONCRETE	Vitalijs Lusis, Angelina Galushchak, Arturs Machanovskis, Andrejs Krasnikovs
		14.00-14.20	TECHNOLOGY FOR FABRICATION OF CONCRETE SHELLS REINFORCED BY GLASS FIBERS	Vitalijs Lusis, Galina Harjkova, Arturs Machanovskis, Olga Kononova, Andrejs Krasnikovs
		14.20-14.40	EVALUATION OF GLASS IN DESIGN OF LOAD BEARING STRUCTURES	Liene Sable, Kaspars Kalnins
		14.40-15.00	COFFEE BREAK	
	301	15.00-15.20	ASSESMENT OF THE EFFECT OF BOUNDARY CONDITIONS ON CYLINDRICAL SHELL MODAL RESPONSES	Eduards Skukis, Olgerts Ozolins, Kaspars Kalnins

ENVIRONMENT AND ENVIRONMENTAL EFFECTS		15.20-15.40	INVESTIGATION OF WOOD BASED PANELS WITH PLYWOOD AND GFRP COMPOSITE COMPONENTS	Edgars Labans, Kaspars Kalnins
		15.40 -16.00	DETERMINATION OF SHRINKAGE STRESSES IN CONCRETE FLOOR COATINGS	Renno Reitsnik, Harri Lille, Alexander Ryabchikov, Kauni Kiviste
		16.00 -16.20	EVALUATION OF HIGHRISE BUILDING MODEL USING FUNDAMENTAL FREQUENCY MEASUREMENTS	Liga Gaile, Normunds Tirans, Jans Velicko
		16.20 -16.40	BUILDING CONSTRUCTIONS MADE OF PERFORATED METALLIC MATERIALS	Mihails Liscins, Viktors Mironovs, Irina Boiko
		16.40-17.00	INFLUENCE OF FIBRE AMOUNT ON SFRC PRE- AND POST-CRACK BEHAVIOUR	Ulvis Skadins, Janis Brauns
		17.00-17.20	COFFEE BREAK	
	CHAIRMAN: Reinis Ziemelnieks, Eriks Tilgalis			
	602	10.00 -10.20	COMPARISON OF MUNICIPAL SOLID WASTE CHARACTERISTICS AFTER SEPARATION BY STAR AND DRUM SCREEN SYSTEMS	Dace Arina, Ausma Orupe
		10.20-10.40	FORECAST FOR DRAINAGE RUNOFF AT DIFFERENT THICKNESS OF HUMUS SOIL LAYER	Otilija Miseckaite, Liudas Kincius
		10.40-11.00	PREPARATION OF COAL-WATER SLURRY USING A HIGH-SPEED MIXER-DISPERSER	Aleksandr Polyakov, Viktor Mironov, Andrej Shishkin, Janis Baroninsh
		11.00-11.20	GROUND TEMPERATURE REGIME IN THE COWSHED ENVIRONMENT	Dainius Ramukevicius, Petras Milius
		11.20-11.40	CALCULATION OF RAINWATER SEWAGE SYSTEMS	Eriks Tilgalis, Reinis Ziemelnieks, Marcis Sipols
		11.40-12.00	HIGH STRENGTH WASTEWATER TREATMENT PROCESS SIMULATION	Romans Neilands, Simona Larsson, Roberts Neilands, Boriss Gjunsburgs, Maris Bernats, Elina Strade
		12.00-12.20	PHOSPHORUS REMOVAL BY CA-FE OXIDE GRANULES IN A HORIZONTAL FREE FLOW FILTER	Egle Saaremaa, Martin Liira, Morten Poolakese, Toomas Tamm
		12.20-12.40	LIMIT DEFORMATIONS OF RETAINING WALLS IN LITHUANIAN HYDROSCHEMES	Raimondas Sadzevicius, Tatjana Sankauskiene, Feliksas Mikuckis
		13.00-14.00	LUNCH TIME	

17 MAY / FRIDAY			
ROOM	TIME	PRESENTATION	AUTHORS
CHAIRMAN: Sandra Gusta			
117	9.00-9.20	PLENARY SESSION	Anda Kursisa, Zane Sauka, Karlis Grinbergs, Krisjanis Kalnciems, Andris Vulans
	9.20-9.40	THE DEVELOPMENT OF ENERGY EFFICIENCY FOR INDUSTRIES IN LATVIA: LEGISLATION AND STATISTICS	Anda Kursisa, Laura Gleizde
	9.40 -10.00	ENERGY CONSUMPTION AND ITS REDUCTION POTENTIAL IN LATVIAN INDUSTRY SECTORS	Anda Kursisa, Laura Gleizde
	10.00 -10.20	INDUSTRIAL ENERGY EFFICIENCY CASE STUDIES IN LATVIA: 2010-2013	Artis Dzirkalis
	10.20-10.40	ENERGY AUDITING EXPERIENCE OF INDUSTRIAL ENTERPRISES IN LATVIA	Andris Vulans
	10.40-11.00	COFFEE BREAK	
	11.00-11.20	ENERGY AUDIT METHOD FOR INDUSTRIAL PLANTS	Karlis Grinbergs, Sandra Gusta
	11.20-11.40	ENERGY EFFICIENT ELECTRICITY USAGE	Karlis Grinbergs
	11.40-12.00	LIGHTING SOLUTIONS FOR INDUSTRIAL PLANTS	Andris Teraudkalns
	12.00-12.20	THE IMPACT OF HVAC REGULATION FOR ENERGY EFFICIENT LONG-TERM MAINTENANCE	Dmitrijs Ivancovs
	12.20-13.20	LUNCH TIME	
	13.20-13.40	HEAT RECOVERY FROM WARM WASTEWATER	Martins Zvigurs
	13.40-14.00	THE EXAMPLES OF AUTOMATIC CONTROLS FOR ENERGY EFFICIENT OPERATION OF HVAC SYSTEMS	Madars Zarins
	14.00-14.20	MODELS OF FINANCING FOR INDUSTRIAL ENERGY EFFICIENCY PROJECTS IN LATVIA AND EUROPE. AS CITADELE BANK.	Krisjanis Kalnciems, Maris Macijevskis
	14.20-14.40	ENERGY SAVING AND ESCO: LEGAL ASPECTS	Sandis Bertaitis
	14.40-15.00	SUSTAINABLE BUILDING POSSIBILITIES AND THE PRACTICE IN THE INDUSTRIAL SECTOR	Zane Sauka
	15.00-15.20	THE VISIONS FOR FUTURE	Laura Gleizde, Karlis Grinbergs
	15.20-16.00	COFFEE, GET-TOGETHER	
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I BUILDING AND RENOVATION

NON-DESTRUCTIVE EVALUATION OF FIBERS ORIENTATION IN FIBERCONCRETE PRISM

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Usually fibers are homogeneously distributed in concrete body having arbitrary spatial orientations. Macro crack propagation in mechanically loaded steel fiber reinforced concrete is characterized by fibers bridging the crack, providing resistance to its opening. Suppose about homogeneous distribution of spatially arbitrary oriented fibers in a volume is leading to homogeneous spatially arbitrary distributed fibers orientation on the surface of the crack. At the same time high experimental results scatter in fiberconcrete bending tests is experimentally observing, proving non-homogeneous fibers distribution in a volume and according to spatial orientations. The question of how to reduce experimental results scatter is very important. A number of test methods have been proposed, but all have significant problems associated with either the variability of the results and their application in structural design calculations. One possibility to solve this problem is to use fiberconcrete with internal oriented fibers structure. In this work fiberconcrete prisms with oriented (in each prism longitudinal direction) short steel fibers structure were elaborated (Lapsa et al., 2010). Precise amount of fibers was mixed with concrete and fresh fiberconcrete was placed into a mould. Two specially elaborated metallic combs were prepared, mould with fiberconcrete was placed on the shaking table and simultaneously fibers in the mould were combed. This operation was executed few times. Displacement between each comb two adjacent teeth was smaller than the length of a fiber, and was bigger than crossection's size of a bigger concrete aggregate largest linear size. Vibration was applied during the process. Fibers orientation results were controlled by X-ray pictures analysis. Prisms with oriented and chaotically (non-oriented) distributed fibers were tested by ultrasonic device, measuring ultra-sound waves velocity dependance on fibers orientation in the samples and fibers concentration. Ultra-sound waves velocity dependance on fibers orientation was experimentally obtained. After that all prisms were loaded by 4 point bendig and Load bearing – crack opening curves were obtained. Results were discussed.

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CONSTRUCTION WASTE MANAGEMENT PROCESS IN LATVIA: PROBLEMS AND POSSIBLE SOLUTIONS

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Overall Latvian Every year 600,000 to 700,000 tons of waste, about half of this amount is considered to be biodegradable municipal waste. The municipal solid waste management in their administrative area is the responsibility of municipalities.

Approximately 77% of Latvian household waste is disposed of in landfills or dumps, and every year the amount of waste disposed of increases. Besides increasing the amount of hazardous waste and hazardous waste in the most part consists of metal production waste. Currently, hazardous waste is temporarily stored in a specially equipped commercial and waste storage sites. However, improved hazardous waste collection and disposal, as well as the amount of recycled packaging.

Also, during the construction process creates a large amount of waste. The construction waste is referred to as waste from construction, renovation and demolition, as well as debris and damaged materials resulting from the construction process, or materials used in the construction site temporarily. Usually the construction waste from residential buildings containing concrete, wood, metal, plaster panels, oil, chemicals and roof trim materials. Construction waste a significant amount due to take a huge dump site. Usually construction of a cleaner material than demolition waste.

Construction waste can contain environment and human health hazardous substances. They can cause soil contamination. if improperly disposed of. Precipitation may result in contaminated groundwater. This paper addresses problems related to construction waste separation, storage, transportation and disposal. Look at the problems associated with waste management in Latvian context of sustainable construction.

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APPLICATION OF COMPUTER PROGRAMS IN THE CALCULATION OF WATER VAPOUR DIFFUSION FOR ROOF STRUCTURES

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For apartment buildings of standard designs built during the period from 1960 to 1989, roof constructions consist of hood panels, ineffective heat insulation, leveling layer and top waterproofing. Since 2009 there is available co-financing from the European Regional development fund for renovation of buildings. In the renovation projects for roof constructions there are provided improvements that meet today's requirements of quality and energy efficiency. Except for improved heat transmittance characteristics, for roof construction solutions in most cases there are not made detailed calculations of the liquid transport and diffusion processes in the internal layers of constructions. Paragraph 25 of the Latvian Construction Standard LBN 002-01 'Heat engineering of building envelopes' contains requirements for the moisture resistance of the construction in its warm and the cold side and imposes the use of Paragraph 31 of the Construction Standard which explains that for typical roof constructions with top waterproofing, a detailed calculation is to be carried out. Detailed calculations are carried out in accordance with two applicable ISO standards. In this research, there were used two computer programs of which 'Heat Engineering 2013' is based on the calculation method based on the Glaser theory, in turn, the other computer program named 'Wufi' is based on the newest findings regarding vapour diffusion and liquid transport in building materials. In the study there are compared the two software operating principles, application of the standardized methods of calculation for analysis of the standard roof construction composition for the year-round calculation months, finally, there are compared the results obtained and conclusions are made of the application of the two computer programs in calculations of the water vapour diffusion.

Key words: roof constructions, heat engineering, vapour resistance, computer programs

NEED TO INNOVATE THE DUTCH BUILDING REGULATION

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Increasing dissatisfaction with the regulatory burden, with the (municipal) system of quality assurance and the general loss of knowledge and experience on operational levels led to two Governmental Committees who presented in 2008 their conclusions and proposals. For instance private certification of the building permit procedure, and to concentrate the knowledge of municipalities in regional intermunicipal bodies. These proposals will however not change fundamentally the attitudes and behavior of the parties in the building process, owners and users of works. Experiments since show only increased costs and liability.

Also more fundamental questions were raised about quality assurance and responsibility in a market driven construction sector. Should the national building regulation set a minimum standard for all relevant aspects because of market imperfections? Or is self regulation feasible. And if so, will it be effective without supervision by an authority?

In 2011 three new studies were commissioned by the Government to address perceived problems. Two subjects were the economic effects of changed regulations, and the cost effectiveness of existing building regulations. The third integral study, executed by Foundation Expertcentre Regulations in Building (ERB) was based on the weaknesses in the knowledge circle of the building sector. It led to proposals to redefine responsibility and liability for all parties.

This study states that by an effort of yearly € 100 million, unnecessary costs up to € 1 billion can be avoided and a real quality push will take place in the building and real estate markets.

Keywords: arbitrage, building regulations, enforcement, system innovation,

DESIGN OF FLOW AND HOLDING CAPACITY OF ESCAPE ROUTES IN BUILDINGS

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A method was developed to dimension escape routes in a multi-storey building, controlling both the flow capacity of egress elements and the holding capacity of floor sections. The method is an extension of a current more traditional approach that requires the staircases in a building to provide sufficient holding capacity on each storey to accommodate all occupants of the storey. The width of stairs and doors is governed by the requirement that the building can be evacuated in 15 minutes. The existing method, mandatory in the Netherlands for office buildings, is unsuitable for high density occupancies such as assembly and education.

The new method recognizes the protection offered by smoke and fire compartments on the same floor as where the fire originated. It allows using these other compartments to hold occupants for a limited time before they can move into the staircases, thus making the method practicable for high occupant density buildings.

A side benefit of the new method is that it forces the designer to consider the likely exit routes taken by escaping groups depending on the location of a fire, not only in the originating fire compartment but in all other parts of the building as well. This is valid not only for the average distribution of occupants over the various parts of the building, but also for any other foreseeable distribution of occupants. The new method was published in 2011 as a Dutch Standard NEN 6089, and was introduced in a modified form in the Dutch Building Decree in April 2012.

The paper describes the method, and compares it to popular methods in current use worldwide. The authors argue that the new method overcomes some relevant limitations of the conventional methods, while remaining simple enough to be acceptable as a mandatory analysis for a building permit.

Key words: NEN 6089, escape routes, holding capacity

EUROCODES AND STRUCTURAL SAFETY OF THE EXISTING BUILDINGS – CONSIDERING THE PUBLICATION OF THE DUTCH NEN 8700

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Since 1992 there have been a number of proposals to renew calculation methods available to assess the structural safety of the existing buildings. But without operational results.

Upon publication of the Eurocodes NL decided to renew and to include them in the Dutch building regulations. The question was how.

It was decided to develop a new Dutch national standard: NEN 8700. That shows how, in conjunction with the 58 Eurocodes, an expert opinion can be assessed on the structural safety of an existing building. The Building Decree 2012 refers to this standard for load actions that have to be taken into account, the response of the structure and the required strength of structure, and references to the Eurocodes. The set up of the new standard is explained.

A building is classified as an existing building after it has been completed.

So the standard applies to all building stock, but the owner primarily must ensure that during the design working lifespan the legally required performance for newly built buildings remains satisfied except accidents.

The safety assessment of an existing building differs from that of a new one in ways that are elaborated:

- cost in relation to safety;
- safety in relation to the reference period;
- availability of the actual status data versus the design data.

Unlike the regulations that apply to new buildings the new standard includes for the judgement of the lower limit of safety of the existing structures (the moment that the use immediately has to cease):

- probability theory;
- harmonisation of the Eurocodes with safety of the existing building constructions on an arbitrary moment;
- acknowledgement of durable safety requirements other than a 1 year period;
- exclusion of requirements pertaining to the uncertainties that may arise during the theoretical design life;
- amendment of determination methods for the properties of the structural materials used;
- ability to review at any time the actual constructed situation.

The new standard also establishes the lowest limits of safety levels in the renovation, alteration or enlargement of an existing building.

Reliability and load factors are summarized extracted from the underlying TNO report.

Keywords: safety assessment, regulation, existing building, renovation, standard, Eurocodes, NEN 8700

PROBABILISM, THE WAY OUT FOR PERFORMANCE BASED BUILDING REGULATIONS

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Performance based regulations emerge increasingly. The actual situation in the Netherlands is described. We observe permanent obstruction of innovation and prescription of well known solutions because of lack of understanding. Bureaucracy and disasters force opponents and politicians to blame the complicated and scientific nature of modern democratic performance regulations. Political emphasis on reducing of the body of (technical) regulations however is counterproductive.

Expert opinion is that a decrease of regulatory-burden is possible by the improving regulatory methodology. Meanwhile probabilistic thinking is developing. We cannot live nor build without the risk of failure. The level of risk to be accepted is a subject of a political decision. Knowledge and understanding have to grow and be fostered by improving education. Eurocodes show quite some advance, “tight rope” calculations can be made. Application of probabilistic methods in other areas is still in its infancy or research stage. Regulation of emissions to ground, air and water have to be developed, but may not hinder re-use of building products. By applying performance based principles, using probabilistic methods adequately we could really advance. Management by accident is unholy. When disaster strikes, politicians and the regulators usually create a new host of rules to prevent recurrence. Acceptance according to probabilistics should be the issue.

Poor regulations, conflicts in practice, huge administrative burden and quite some destruction of capital are observed. We see blockades for the application of innovative technical and organisational solutions, and the use of unsatisfactory solutions that can be put to level only at great cost. Owner/user orientation ensures acceptance and proper application. Research and education should aim at tools to manage probabilistics in the industry.

Keywords: equivalent performance, probabilism, regulations

ENVIRONMENTAL PERFORMANCE REGULATIONS IN THE NETHERLANDS

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The Dutch Building Decree, as in force since April 2012, stipulated that by January 1st 2013 a calculation of sustainability performance for a dwelling or office building should be delivered at submission of the environment (building) permit.

The aim of this requirement is to encourage more conscientious decisions. Environmental and life cycle properties of materials chosen and design variants should so be enabled to be subject of consciousness. Furthermore the development of sustainable initiatives and innovation should be stimulated.

During the preparation of the Building Decree 2012 the so called "Determination Method Environmental Performance of Buildings and Infrastructural works in combination with the National Environmental Database" and the "Green Deal Environmental Performance Calculation" became available for application.

Precurring the publication of limit values for sustainability in the Building Decree, exercises are executed based on these methods and promoted by the Ministry and market parties.

The paper will elaborate on this development, the methods used and the results obtained.

Keywords: sustainability, regulations, environment, performance

CASE STUDY OF HEAT RECOVERY IN AIR HANDLING UNITS WITH HEAT EXCHANGERS FOR RESIDENTIAL APPLICATION IN LATVIA

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This paper presents a case study of energy efficiency of air handling units with cross flow heat exchanger for residential application in Latvia.

The paper will be summarizing measurements of configuration of air handling units with cross flow heat exchanger. The research carried out analytical studies analyzing for an optimum variant of the energy savings and optimization point of view according to SFP values, different filter classes and air volumes.

Results shows that based methods of air handling unit's optimization should be encouraged due to the potential of energy savings in Latvia residential area.

Reduction of energy consumption, improvement of energy efficiency and optimization of air handling units for residential area is important to address the improvement of indoor air quality.

Keywords: cross flow heat exchanger, SFP, energy efficiency.

INDIRECT EVAPORATIVE PRE-COOLED COMPRESSOR COOLING SYSTEM PERFORMANCE UNDER VARIOUS OUTDOOR AIR HUMIDITY CONDITIONS

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Present study is devoted to efficiency evaluation of combined indirect evaporative – compressor cooling system under various outdoor air humidity conditions of temperate climate. The investigated system is located in recently restored historical building, The Art Museum Riga Bourse, which was initially built in the middle of 19th century.

To preserve artifacts, the Museum is equipped with climate – control and building managements (BMS) systems. Cooling system consists of indirect adiabatic chiller with compressor, ventilation cooling coils and fan-coil units on separated loop.

Using data, acquired by BACnet BMS controllers and experimental data logging system, we have analyzed cooling plant operation efficiency dependence of outdoor air humidity for the period of two month. . Saved data has been exported as CSV files and imported in Matlab / Simulink software. Specific calculation software in Matlab is written for data analysis and graphical visualization. Some values of those parameters are shown in Fig. 1.

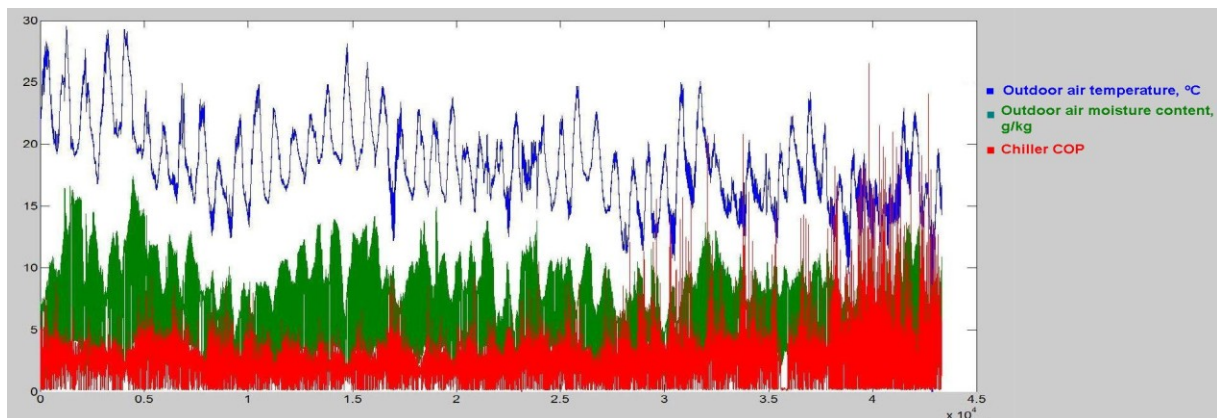


Figure 1. Outdoor air parameters and Chiller COP within two month

Information about electrical energy consumption, water consumption and produced cooling energy allows calculating chiller operation efficiency, and comparing it with other types of equipment. Collected data and analysis provides the basis for assessment of energy savings, what is very important to do next considerations for similar projects.

NITROGEN BASED FIRE PREVENTION SYSTEM

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In order to protect users of the public buildings and occupants of high-rise apartment buildings from fire disasters, according to the Latvian Building Code LBN 201-10 "Fire safety of buildings" requires installation of automatic fire protection systems. Most of these automatic fire-extinguishing systems react on smoke or elevation of temperature caused by broken fire. These systems do not prevent the fire, but react on the outbreak of fire. In addition, some of these systems, such as sprinkler system, most commonly used, cannot be used in rooms where they can cause damage to valuables to be protected from fire. In such areas automatic fire extinguishing systems on inert gas shall be installed, such as nitrogen system (IG-100) according to the European Standard EN 15004-8. Such system is running by refilling of inert gases, i.e. nitrogen in the volume to be protected. It activates only after the bracing of fire. It means that possibly some damage of premises or property could be caused before such system starts run, but it does not prevent bracing of fire.

Igor Kotlars has developed an original fire prevention system, which is based on creation of low oxygen content in atmosphere in the spaces to be protected [1, 2]. This fire prevention system consists of a nitrogen generator, system of sensors monitoring the space to be protected and nitrogen spray system. By sprinkling of nitrogen this system provides low oxygen atmosphere in the space to be protected. Area to be protected must be tightly closed, but not completely airtight. Nevertheless, the reduced oxygen concentration is in range of 10-15%, it responds to highlands atmosphere and it is not very dangerous to human beings. Therefore this system is recommended for application in premises such as archives, server rooms, museums etc. in the hours when there does not reside people.

No single European technical specifications for low oxygen (hypoxic) fire suppression system currently are available. Therefore standardization bodies of some European countries (UK, Switzerland) are working on such technical specifications. Also in Latvia there is an interest in implementation of hypoxic fire prevention system. Therefore at the end of 2012 Latvian Technical committee on standardization of fire safety LVS/STK 24 approved technical specification "Design and installation of hypoxia (Reduced oxygen) environment fire prevention equipment."

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USA Patent No.6560991 B1, Hyperbaric hypoxic fire escape and suppression systems for multilevel buildings;

Patent of Russian Federation No.2301095 C2, Предотвращающие пожар и ликвидирующие пожар системы и пригодные для дыхания огнегасящие составы с пониженным содержанием кислорода.

ASSESSMENT OF TIMELY EVACUATION OF BUILDINGS¹

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A method has been developed to dimension escape routes in a building, for introduction in the Dutch building regulations. The method overcomes the limitations of many conventional methods in current regulations, while remaining simple enough to be acceptable as a mandatory determination in the building permit process for most building. The new method was published in 2011 as a Dutch Standard NEN 6089.

The method works with both the flow capacity and the holding capacity of elements on the escape routes, concentrating on the critical factor, the vertical movement in staircases. It connects the elements by introducing limits to the time that people may be forced to wait before they can enter a protected staircase. It further draws value from the introduction of fire and usage scenarios: acceptable waiting times depend on the level of threat that the waiting space is subjected to in the scenario at hand, distinguishing:

- The smoke compartment where the fire originates
- Smoke compartments in which the evacuation process is influenced by the fire
- Smoke compartments in which the evacuation proceeds uninfluenced by the fire

The need for a clear and unequivocal method exists mostly in buildings with high occupancy density. Current Dutch regulations require that all occupants can find shelter on the same level in the protected staircases. That requirement does not pose serious problems in buildings with low occupancy density such as office buildings, but it gets extremely burdensome if the building (or parts thereof) caters high occupancy densities, as is the case in theaters, exposition halls, retail. In those cases it becomes economically unacceptable to accommodate quite large surface areas inside staircases only for evacuation in case of fire. That can be avoided by allowing temporary safety to be found in neighboring (smoke or fire) compartments, such that the holding capacity of the staircase itself can remain limited. This requires a check of the whole escape route for bottlenecks that could prohibit occupants from leaving in a short enough time the area directly threatened by fire and smoke. The current regulatory method requires only that the building can be evacuated in 15 minutes (larger times allowed with increasing level of protection of staircases). This requirement is still present in the new method for the ‘degenerative’ cases where there is no fire in the building, and all escape routes are available.

The new method implements this concept in as simple and robust a way as could be assembled. It makes use of conventional concepts of flow capacity of elements (doors, pathways, stairs) and holding capacity of floor surfaces and stairway steps. Walking distances and speeds of horizontal and vertical movement play no role, as their relevance is mainly restricted to cases with very low occupancy densities – not the focal point of the method.

The horizontal parts of escape routes on the floors, leading from the occupancies to the staircases, are omitted from the calculations, from the consideration that in most cases the bottlenecks are the staircases and the adjacent spaces.

¹ Paper was presented at SFPE 9th International conference in Hong Kong, 2012

Acceptance criteria for evacuation time, waiting time and several boundary conditions are the result of consensus discussions within the standards committee.

At publication, the standard was accompanied by software that does the calculations for the simpler cases. The software reports the results in a format suitable to serve as proof of acceptability in the building permit procedure.

The full paper compares NEN 6089 to existing methods in use in various countries' regulations, as well as the models based on tracking individuals, such as Building EXODUS, STEPS and others.

The paper presents practical examples of using the method, describing the efforts required to prepare and perform the necessary calculations, and describing the enhanced insight the results offer in the building's architectural bottlenecks to evacuation.

The paper discusses known limitations, such as situations where extremely fast fire growth is expected, buildings with bottlenecks on the floors, staircases stopping halfway and combining with others; also some potential future enhancements and extensions are discussed.

Keywords: evacuation, exodus, fire safety engineering FSE, steps

ASSESSMENT CRITERIA FOR EXISTING STRUCTURES²

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The Eurocodes are in the EU accepted as the official rules for structural design of new structures in most Member States. Also for the existing stock Eurocodes (renovation and disapproval of safety) will be a suitable starting point for the assessment as these codes are expected to be based on the best and most recent knowledge available. However, it would be uneconomical to require all existing buildings and civil engineering works like bridges and renovations of them to comply fully with these new codes. Already without the introduction of a set of new codes, the assessment of existing structures differs from the design situation. This paper describes the main differences with respect to the relevant reliability requirements and develops a set of partial factors that could be used in those cases.

Keywords: reliability, existing structures, partial factors

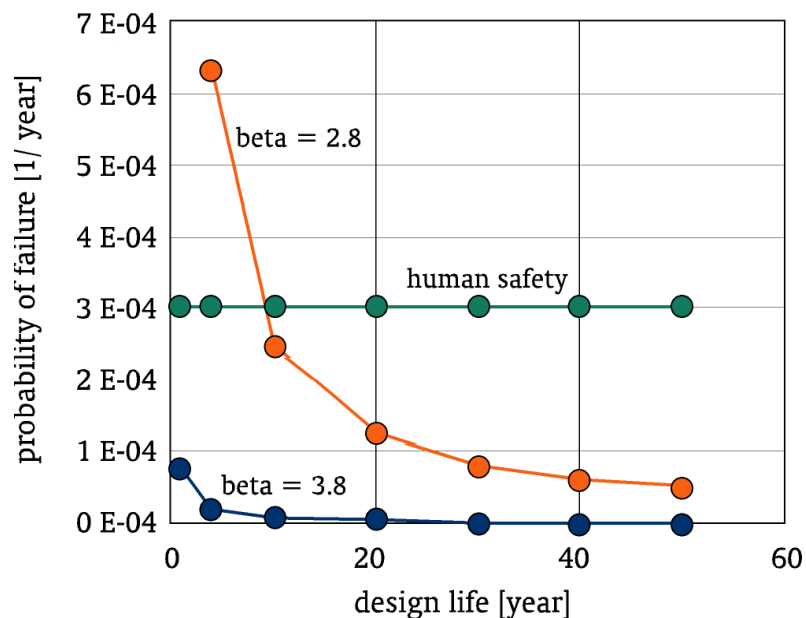


Figure 1. Annual failure probability as a function of the design working life (new structures)

² Paper is published in journal „Structural Engineering International”, 2010 (1), pp 62 - 65

ENERGY AUDITING METHOD FOR INDUSTRIAL PLANTS

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Overview

Different studies have shown that there are opportunities for significant energy efficiency improvements for industrial sector. Many of which are cost effective. These energy conservation options are general and also niche specific.

Owners or managers of industrial parks and factories are not always aware of possibilities for energy efficiency improvements. Energy audit is the first step to conduct energy audit in order to discover possibilities of energy savings prioritize projects and track progress after investments.

Industrial energy audit is a process that makes it possible to save energy and raw materials.

Industrial energy audit consists of 5 steps:

1. Introduction with the factory. Task – obtaining information about products manufactured, about the system itself and condition of building envelope and overall equipment wear.
2. Workflow and energy scheme. Creating schematic drawing of the process happening in the factory thus understanding the energy flow.
3. Collecting data of manufacturing process. The most time consuming task. This task must be done together with employees of the company in order to acquire the best possible viewpoint.
4. Benchmarking. Comparing obtained data with data from similar companies across Latvia or Europe.
5. Defining the problem and creating plan of action.

Background

Significance of energy audits for industrial plants can be emphasized by three main points:

- Possibility of significant financial savings;
- Improvement of manufacturing process quality and thus improving competitiveness through decreased energy consumption per one production unit;
- Improvement of working conditions and increased productivity.

Content

This paper provides guidelines for energy auditors, plant or industrial park owners and managers regarding the main elements for preparing for an energy audit, measuring energy use, analyzing bills, benchmarking, analyzing energy usage patterns, identifying potential energy efficiency opportunities, conducting cost-benefit analysis and preparing energy audit reports.

II LANDSCAPE ARCHITECTURE

INTERACTION AREAS OF THE CULTURAL AND HISTORICAL TERRITORIES AND THE SOVIET PERIOD RESIDENTIAL AREAS

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One of the base units of the urban structure is its residential areas; therefore, a great attention is paid to the development and housing improvement in these territories in the urban development strategic and operative planning documents. The residential area is a populated environment of an appropriate size which has its own maintenance, identity, character that follows its type of housing, physical borders and the sense of community between the landscape and the residents (Treija et al., 2003). On sharply developing the processes of industrialization in the period of 60'–80's in Riga and in other cities of Latvia there was built the chain of new industrially-made type residential and industrial building complexes, they attracted to the state the large workers contingent from the other USSR states. This impressive constructing process in the post-war Soviet period disrupted the historical planning principles and the urban scale. Rapidly deteriorating, this apartment market causes social, economic and technical problems, as well as issues that concern their maintenance (Asaris et al., 1996; Briņķis et al., 2001). Consequently, based on the historical material, a research is carried out, and the areas of interaction between the cultural and historical and the soviet period residential area territories are analyzed. The analysis is performed on the visual structure of the landscape in the urban territory, as an example - the Old Town territory of Jelgava City, St. Anna's Evangelical Lutheran Church, and the soviet period residential area located between these two objects. In the defined territory, several elements of the visual landscape structure were analysed, including compositional and aesthetic aspects, and viewpoint evaluation in the urban context. Consequently, the aim of this research – to obtain the record of the most valuable, aesthetically most qualitative elements in the defined research territory by practically applying the visual landscape structure analysis, thus, obtaining characterization of the interaction areas of cultural and historical territory and the soviet period residential areas, which would reveal important aspects for further preservation and enhancement of these areas.

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THE IMPACT OF LEGISLATIVE RULES AND ECONOMIC DEVELOPMENT ON THE COASTAL LANDSCAPE IN LATVIA

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For years the coastal area of the Baltic Sea and the Gulf of Riga has seemed appealing for people as a permanent living place, recreational space, and a biologically and archaeologically diverse landscape. Meanwhile, this part of Latvia is politically and strategically important, as it is the state border and the door to the international zone. The coastal landscape is multifarious. At the moment 45 per cent from the total length of the coastline are special areas of conservation. There are 7 towns and more than 20 inhabited territories with direct access to the sea. The development of the coastal landscape in Latvia was affected by various factors during different periods of time; the economic development and legislative rules are among them. The aim of this paper is to study and analyse how these factors have influenced the identity of the coastal landscape, identify spatial, functional and visual changes as well as inter-relationships between the factors and changes in the landscape. The impact of legislative rules and economic development during three historical periods on the coastal landscape in Latvia is analysed within this study. Those are: the soviet period, regaining of Latvia's independence as a period of transition, and nowadays. The selected objects of the study - Ainaži, Saulkrasti, Kolka, Liepāja - are of different scales and with individual historical development. In order to study the impact of legislative rules and economical development on spatial, functional and visual changes in the coastal landscape, cartographical materials from different periods of time, historical photographs and images, development plans, legislative rules and statistical data are used. During the soviet period, the main area of the coastal territory, which at that time was the border of the Soviet Union, was defined as a closed zone. The primary results of the study showed that the territory status, enforced during this period, and strictly restricted utilization possibilities stimulated the degradation process and encouraged people to leave the territory. Local citizens with their particular culture and traditional management methods were forced out of the territory, historical buildings and infrastructure were destroyed to create new military buildings and infrastructure. On the one hand, these heavy restrictions destroyed the local cultural environment established by the citizens, which are an integral part of the cultural landscape and the identity of the historic landscape. On the other hand, the nature was left undisturbed to develop in its own way thus stimulating the high biological diversity of the coastal territory which can be observed nowadays. Later on, with the fall of the Soviet Union and the withdrawal of troops, the coastal area became freely accessible. Yet, the new legislation was not prepared for such a heavy anthropogenic load characteristic of the period. The military territories were left without management and degraded the landscape. The free territories were built up chaotically and intensively used for recreation. New landscape elements appeared which significantly affected the historic identity of the coastal landscape. However, nowadays by developing and improving normative documents at all planning levels, a new sustainable approach to the coastal management is forming, taking into consideration all of its resources and values. Finally, the conclusion of the study is that both heavy restrictions and rapid yet unclearly defined development are in contradiction to the landscape, thus irreversibly change the

identity of the coastal landscape as well as the spatial, visual and functional aspects. Taking all this into consideration, when planning the coastal landscape and improving the legislative rules in future, it is important to establish a vision of sustainable development, take actions at the regional as well as national level, and identify the priorities at the local level emphasizing the identity of the landscape, cultural, archaeological and natural values.

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WATERMILLS AND SMALL-SCALE HYDROELECTRIC POWER PLANTS LANDSCAPES ASSESSED BY ASPECT OF AESTHETIC

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In Latvia the need for landscape assessment is important in territories with potential to tourism market or other public territories. Research in these particular territories by aspect of aesthetic is part of complex research of watermills and small-scale hydroelectric power plants landscapes in Latvia. This paper reflects landscape inventory matrix for research in field studies for landscape identification in local planning level (municipality level). Research included 42 territories from Latgale, Kurzeme and Vidzeme uplands distribution ranges. The results of research reflected aesthetical quality in researched landscapes according to previously developed criteria.

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REGIONAL STRUCTURE OF CULTURALLY-HISTORICAL LANDSCAPE OBJECTS AVAILABILITY IN LATGALE UPLAND AREA

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Church and small-scale hydropower site landscapes are an important cultural-historical part of the history of Latgale. Churches and locations of watermills can often be found in the landscape of nowadays Latgale. The importance, functionality and number of these sites have dynamically changed in the past. These changes are rooted in different historical periods, mainly involving a complete change of the ethnicity and socio-cultural field (Fjodorovs, 2009). Landscape is transformed around us with the aim to adjust it for our everyday needs. It defines arrangement, style and materials of the features, as it represents many eras of natural evolution and generations of human efforts (Yatsko, 1997). Usually, everyday landscapes are in danger because of their unprotected status. A church garden and landscape include different cultural-historical elements—fences, the crucifix, free standing bell tower and separate compositional plantings (Markova, 2012). As historical architecture structures, small-scale hydropower sites have been researched by different authors (Lazdāne, 2011; Raits, Virsnieks, 1944; Silķe, 2008; Tveins, 1985). In these historically active industrial areas, landscapes are changing nowadays. In this context, roads are one of the compositional elements; they influence not only the site availability but also forms visibility of the site. It is necessary to reconsider functionality of these landscapes. One of the key factors for a good cultural landscape development is availability (Jongman, 2002). In the research, there is used the cartographical method to show the landscape structure of the region by accessibility. In the research, there are included 14 areas of watermills and small-scale hydroelectric power plants (HPP) and 15 areas of churches (Figure 1). From Riga, we might get to these sites in approximately 2 or 3 hours.

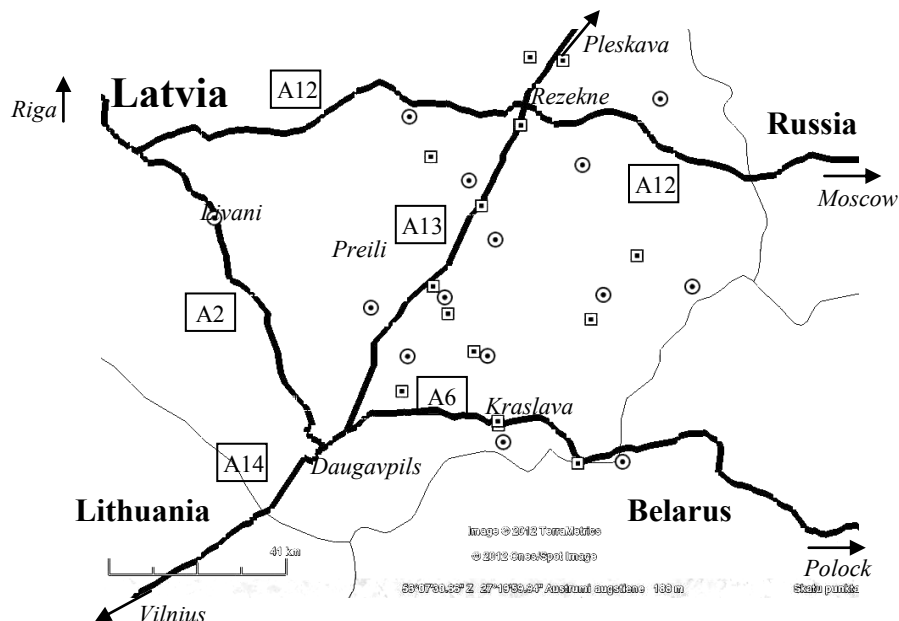


Figure 1. Objects placement in Latgele Upland area. (● - Hydropower objects, ■ -Churches)

The sites that are more difficult to reach have to be individual and varied in their cultural-historical and architectural meaning. On other hand, the accessibility of a destination clearly influences the attractiveness and potential for tourism and development (Banica, 2011). There are three scales of the tourism potential planning and we have to consider all of them (Gunn, 1994; Inskeep, 1994; Pearce, 1981; Formica 2000).

Responsibility for the site development varies depending on their transformation processes in the past. Church, watermill and small-scale HPP landscapes are part of the regional landscape identity, and, therefore, have to be taken into account as factors in local and countywide development plans. The key part in expanding of availability of these sites is the increase of the number of tourism trails.

Acknowledgement

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THE ROOF LANDSCAPES, THE HISTORIC CITY CENTRES AND CONTEXTUAL SEARCHES OF THE GREEN STRUCTURE

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The urban planning organises the space in which the life of human beings take place. Architecture is also a compromise between the man-created space and natural environment. Thus, as the attitude and requirements of the society towards architecture are changing, architecture on the whole changes. The dominant instrument in the architects work instead of empirical proof or theories is creativity as the main driving force.

The urban structure has been created over several centuries and shaped by different societies. It is built not only to meet the practical needs, but also the social and aesthetic requirements.

In the postwar years, streets of the Old Towns have lost several construction volumes so disrupting its continuous perception and harmony. Breaking of the building line that sometimes makes up even 3-4 buildings, provides an opportunity for appearing of a zone with extensive tree and shrub cover and over decades their crown has immensely widened that not only hides the adjacent historic building but also disrupts the architectural uniformity of the street building.

Density of the green structure veining and the areas in the historic building zone are growing every year, giving evidence that the cultural and historic heritage is slowly lost. With formation of breaking of the street building, there is lost the harmony and scale of the historic structure. Experience shows that, if instead of the dismantled building, there are carefully groomed a lawn and flower plantations, it means that within a few years the owner of the land is ready to start reconstruction of the historical construction volume.

The quality of the landscape is characterized by shapes of roofs and compliance of the used covers with the building's architectural style, duration of construction, color, placement of chimneys and technical equipment. Desiring to get more attic space of historic buildings, owners of buildings often choose solutions that create an uncharacteristic landscape to the historical building zone. Most often it refers to the construction of new roof patios, terraces or bays. Visually the aesthetic information volume is dependent on the ability to perceive and feel more or less the architectural shapes and exclusivity of the environment created by them.

Key words: urban structure, urban landscape, roof landscape, green plantation wedges, green structure, interdisciplinary dialogue.

THE BENEFITS OF GREEN ROOFS FOR LATVIAN BUILDING ENVIRONMENT

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Green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and mitigate the heat island effect. Modern green roofs, which are made of a system of manufactured layers deliberately placed over roofs to support growing medium and vegetation, are a relatively new phenomenon and used mostly in urbanized cities. However, green roofs or sod roofs in several countries have been for centuries. For example, traditionally, such earth structures were used for partially submerged food cellars and bomb shelters (Ferguson, 2012). The modern trend started when green roofs were developed in Germany in the 1960s, and has since spread to many countries. Today, it is estimated that about 10% of all German roofs have been “greened”. Green roofs are also becoming increasingly popular in the United States, although they are not as common as in Europe; however, one sees more and more architects opting for green roofs as an alternative to large flat roofs. A green roof is not only a pleasing aesthetic alternative, but it helps retain thermal energy and provides for better surface drainage for expansive roofed structures (Ferguson, 2012). Green or vegetated roof is not so traditional roof type for Latvian building environment. Mainly because of a lot of the ideas that it harms all structure, problems with leaking, problems with hydro isolation, too large weight and a lot of additional maintenance works and costs. And the greatest idea is that this roof type is totally unsuitable for local weather conditions when historically green roofs are widely used in Norway and also in Great Britain where weather conditions are much more harmful for greenery. These ideas mainly are coming from the fear to get into the situation with high risk to maintain the building with green roof and if that is cost approved. In present research is given review on green roofing worldwide and Latvia, compared different roof systems and described the benefits of green roof implementation.

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LANDSCAPING OF SIBERIAN CITIES

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The role of green space in the engineering landscaping is very high. They help an organization to undertake in the territory, the regulation of traffic and pedestrians treats the environment as well as the form of the artistic look. Ornamental plants are particularly important for Siberia, where the plants vegetate 5 months of the year. They enrich the environment with bright colors and a variety of forms, create a sense of celebration in the open air and significantly affect the attractiveness of the territory. We analyzed the system of green spaces in cities in Siberia, studied a group of plants that includes lawn grasses, annual and perennial flowering plants, ornamental shrubs and trees. In order to minimize costs, we have identified timing of flowering annuals in the seedling method of cultivation and sowing of seeds in the soil.

FLOODING AS A MEANS OF MILITARY DEFENCE: LANDSCAPE OF THE 20TH CENTURY FORTRESS WROCLAW

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The article presents the historical importance of the military flooding system around the city of Wrocław (Breslau) at the beginning of the 20th century. The research was carried out in the years 2010-2012 to investigate the elements of the former “barrages d'eau” (Dossier, 1920) of Fortress Wrocław (Festung Breslau), situated on the River Odra. The author of this paper focuses on the structures built along the following two Odra tributaries: the Widawa and the Ślęza. On 9 May 1889 a decision on the modernisation of the fortress was made (Entwicklung, Mkr 4605/2). From that moment on, the city was repeatedly renovated network in order to maintain its military effectiveness. To allow defensive flooding operations in the foreground areas in both sectors of the fortress, a number of hydrotechnical structures were erected. At the same time after the great flood of 1903, large earthworks were launched. The construction of weirs on the River Widawa coincided with the necessary expansion of the city's flood control system. Both, the fortress weirs and the canals with sluices, became an important part of the modernized system of the Wrocław Water Junction. This improvement was of major importance to the fortification of the fortress's right sector. However, Fortress Wrocław was never completed and during the Great War fortress weir's were never used for military purposes. Today the fortress weirs constitute a historical value as part of the hydrotechnical heritage.

Key words: military flooding, fortress landscape, festung Breslau

LAND MANAGEMENT AND GEODESY

EVALUATION OF THE INDICATORS OF CADASTRAL ASSESSMENT

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To justify the importance of the factors affecting the cadastral value, surveys were carried out, with the help of which opinions of different respondent groups were summarised. The interviewed respondent groups were real property specialists of municipalities and experts. The thematic blocks of the questions included in the questionnaires are based on the analysis are designed with the aim to clarify the quality of the indicators of cadastral assessment models, as well as their significance. The research summarises the survey findings about the correspondence and significance of the indicators of cadastral assessment models of land as evaluated by municipality specialists, as well as the assessment and solutions to actual problems are offered.

According to the assessment of the real property specialists of municipalities about the significance of the cadastral assessment model of building land, it can be concluded that the least significant indicator that does not affect the cadastral assessment of land is “social infrastructure”, but the most significant indicators are “purpose of use of building land”, “encumbrances”, “provision with engineering communications” and “geological situation”. These are significant indicators and they have to be taken into consideration when improving the cadastral assessment model of building land. The analysis of the survey findings allows concluding that the least significant indicator that partly affects the cadastral assessment of rural land, according to respondents’ assessment, is “types of land use”, but the most significant indicators are “agriculture use of the land qualitative assessment”, “qualitative assessment of forest land” and “encumbrances”. In this case all the selected indicators have received a significant recognition; therefore, these indicators should be taken into consideration when elaborating the cadastral assessment model of rural land.

Based on the findings of the municipality specialists’ survey and the research results, the indicators for the improvement of cadastral assessment models of building and rural land offered to the experts’ assessment are summarised and evaluated. In the research experts’ experience was also used, and to process the results, American scientist T. Saaty’s hierarchy analysis method was applied. Experts performed the assessment of the elaboration opportunities of the cadastral assessment models of rural land and building land with the algorithm of hierarchy analysis method developed by the author of research, using the information about the main indicators affecting the cadastral value of rural land and building land. To improve the cadastral assessment model of rural land the following criteria were selected for experts’ assessment: agriculture use of the land quality assessment; assessment of the quality of forest land; influence of the non-residential building; influence of the residential house; encumbrances; pollution; real property market. Experts have prioritised the offered indicators in the following order: agriculture use of the land quality assessment; pollution; assessment of the quality of forest land; real property market situation; influence of the non-residential building; influence of the residential house.

To improve the cadastral assessment model of building land experts were asked to assess the following criteria: purpose of use of the building land; encumbrances; pollution; supply with engineering communications; geological situation; level of social infrastructure; real property

market. Experts have prioritised the offered indicators in the following order: purpose of use of the building land; supply with engineering communications; encumbrances; geological situation; pollution; level of social infrastructure; real property market situation. Summarising the research results and experts' opinion about the opportunities for the improvement of cadastral assessment models of building land, it can be concluded that the assessment model should comprise correction coefficients that will characterise the existence of engineering communications, as well as geological conditions, alongside with the elaboration of the data storage system.

DISPLACEMENTS AT THE GNSS STATIONS

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The daily movements of EUPOS®-RIGA and LatPos permanent GNSS networks' stations have been studied. Reference stations from EUREF Permanent Network (EPN) have been used and Bernese GPS Software, Version 5.0, in both kinematic and static modes was applied. The standard data sets were taken from IGS data base.

The impact of solid Earth tides on the site coordinate changes has been studied as well.

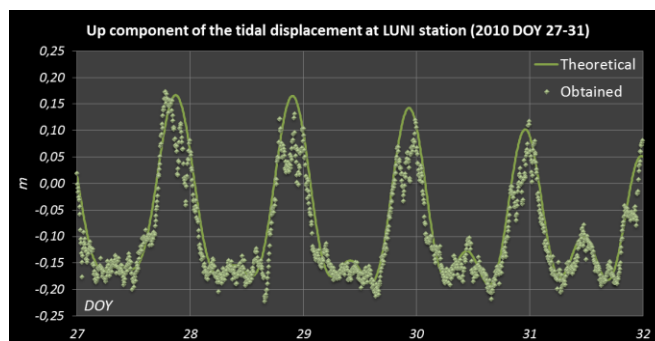


Figure 1. The solid Earth tide caused vertical displacements at LUNI station

The tide caused deformations of the Earth crust create vertical movement of the site with the maximum amplitude of 30 cm according to the theoretical estimates. The maximum value of the solid Earth tide caused vertical displacement obtained for the EUPOS®-RIGA stations is 34 cm for selected observation periods.

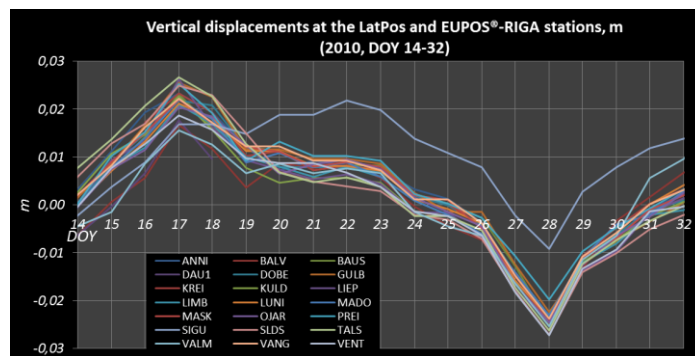


Figure 2. EUPOS®-RIGA and LatPos stations' height time series

The results of sites' height time series have shown some coherence between extreme values of the vertical displacements at the Latvian GNSS stations and distribution of solid tidal wave. As well as dissimilar height values at some LatPos stations could be distinguished.

PRECISION OF LATVIA LEVELING NETWORK NODAL POINT HEIGHT

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First order leveling network is a decisive factor for development of national height system. Therefore leveling must be carried out with the highest possible accuracy.

This research deals with Latvia I class leveling network nodal points accuracy. For this research The Latvian Geospatial Information Agency's data about performed leveling from the year 2000 to year 2010 were used.

The aim of research is to provide the accuracy assessment of the most topical leveling data. The standard deviation of each leveling network node point, in relation to starting points, chosen in different parts of the country, are defined. (Fig.1)

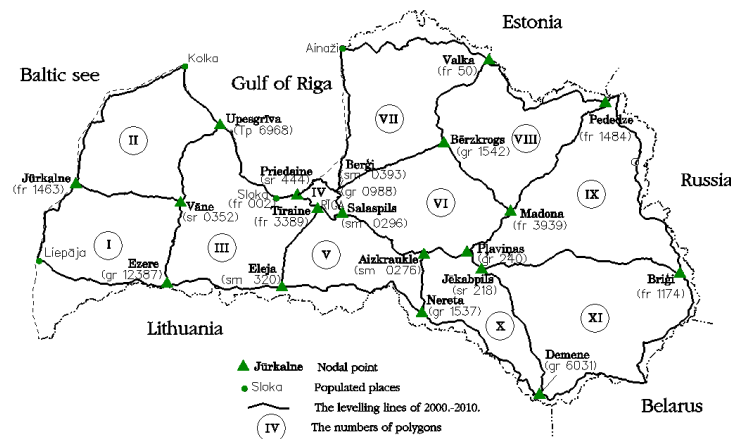


Figure 1. Scheme of first order leveling network

In Latvia territory the core leveling network was created from year 1929 to year 1939. Leveling network was unsystematic re-leveled in last century's 60's and 70's. Only for the 1929 – 1939 leveling, the farthest placed nodal point standard deviation, in relation to the central part of the leveling network, has been calculated (wall mark Sm304 in Zasulauks). Standard deviation in west direction is less than 5 mm and east direction – less than 6 mm.

For practical use of the leveling network, is important to know the height of the points and their accuracy. According to MK rules Nr.879, the starting point were chosen century benchmark fr002 and the leveling network nodal points adjusted height standard deviation were determined. Furthest from the century benchmark fr002 is located fundamental benchmark 1174 in Zilupe, which height's standard deviation is 9,7 mm and fundamental benchmark 1463 in Jūrkalne, which height's standard deviation is 8,2 mm.

Considering the current leveling network standard deviation $S = 0,78 \text{ mm/km}$, that affect the accuracy of nodal points, to recognize the causes, further need to determine leveling systematic error and study it's influencing factors.

Leveling network point height accuracy may directly affect the lower classes leveling accuracy.

Nodal point height standard deviation is required for calculations of the geoid model latest versions.

III CONSTRUCTION AND MATERIALS

ANALYSIS OF SIMULATION MODELS OF PCM IN BUILDINGS UNDER LATVIA'S CLIMATE CONDITIONS

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Demand for higher thermal comfort and climate changes have brought new challenges for designers of cooling systems, because of increased usage of air conditioning in building environment, resulting in higher electricity demand and CO₂ emissions. Today the thermal energy storage plays an important role in building energy conservation, which can be achieved by the incorporation of PCM into building envelope. PCM incorporated in plaster absorb redundant heat, which leads to improved thermal inertia of the building, lower and shifted in time temperature peaks.

This paper studies an innovative plaster for indoor use that incorporates phase change materials in its composition. Thermal and mechanical properties of the developed material are presented in the paper. Thermal simulations were performed to study the optimal distribution of this material inside the building. A simulation study using EnergyPlus was carried out on PCM plaster, investigating various fusion temperatures of the PCM during night and day in hot weather conditions. It was shown that use of PCMs has significant advantages for building applications, provided sufficient night ventilation is allowed.

In this paper, a mathematical model is provided also for the cross-section of the building's wall, including a moisture and heat transfer through the multi-layer construction and radiative and rain effects on exterior surface. A specialised program has been created for calculating transfer processes in buildings' walls, including PCM in construction, This approach is applied for analysis of PCM using efficiency in building structures.

This paper reviews how PCMs could be incorporated in building materials, particularly in passive applications.

APPLICATION OF ULTRASONIC IMAGING TECHNIQUE AS STRUCTURAL HEALTH MONITORING TOOL FOR ASSESSMENT OF DEFECTS IN GLASS FIBER COMPOSITE STRUCTURES

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Structural Health Monitoring (SHM) is health monitoring system which implements a damage detection and characterization strategy for engineering structures. It is widely used for rapid condition screening with aim to provide reliable information regarding the integrity of composite structures. Key elements of system functionalities include detection of unanticipated structural damage events, damage location identification and characterization through images, monitoring damage growth and enabling feedback action/alarm mechanism. SHM is extremely important and essential in various areas, including the aerospace, automotive, energy, civil and mechanical engineering. Fiberglass composite materials are widely used in high technology structures because of their performance in terms of high moduli, high corrosion and fatigue resistance, and low weight. Nevertheless the damage assessment by means of ply delamination causing stiffness and strength reduction is required by both industry and certification societies. In current research ultrasonic imaging technique is considered as the most efficient method employed for quality control and damage growth inspection by means of ultrasound B - and C - scans for visualization and direct estimation of the nature, structure and spatial distribution of the defects in GFRP structures. More than fifty GFRP samples have been produced with artificial damage, our impact caused damage for assessment study. A current research resulted in systemisation of damage and delamination identification means in glass fiber reinforced composite panels.

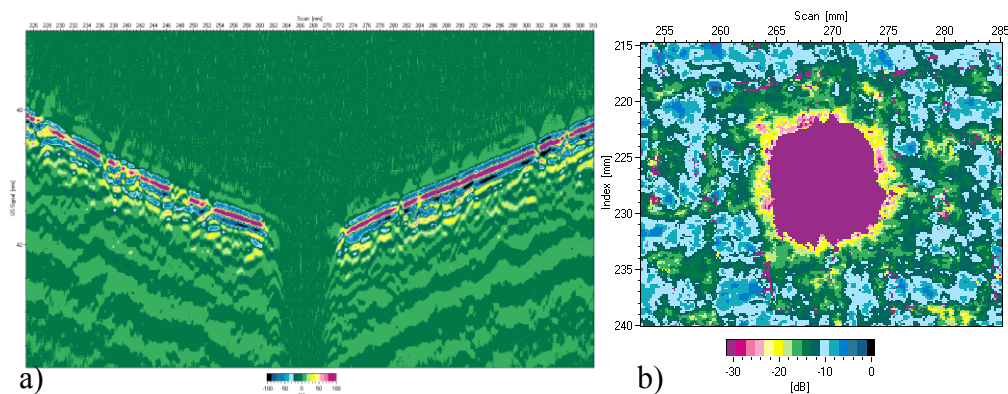


Figure 1. GFRP structures damages visualized by ultrasonic B – (a) and C – (b) scans

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CREEP BEHAVIOR OF HIGH PERFORMANCE FIBER REINFORCED CONCRETE (HPFRC)

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The challenge of present investigation is to evaluate the possibility of using micro- and nano-fillers as active additive in concrete composition for replacement of cement and elaborating a new concrete. This paper examines an experimental test results carried out with aim to evaluate the long-term deformations – creep of elaborated concrete composition. Two kind of fiber-reinforced high performance concrete mixes using those silica additives and cocktail of polyvinyl alcohol (PVA) fibers have been developed and prepared. The cubes and cylindrical specimens were prepared for each composition and tested. Cylindrical specimens were put into a creep lever test stand and subjected to a uniform compressive load kept constant over a long period in constant room temperature and level of moisture. This study was carried out on two different extreme cases of environment: the case with 100% moisture of specimens obtained by protecting to desiccation of this one and the case of air-dried specimens obtained by protecting to get moisten. The total creep strains are given in Fig.1.

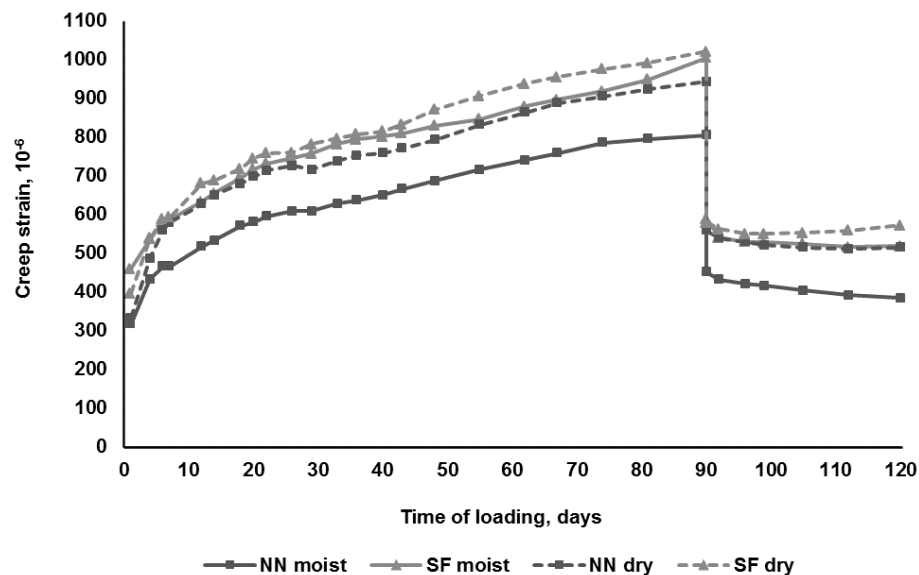


Figure 1. Creep strain of HPFRC at air-drying and moist conditions

The results of the experiments permit the prediction of long-term deformations of the concrete.

EFFECT OF ELEVATED TEMPERATURE ENVIRONMENT ON ULTRASONIC PULSE VELOCITY IN CURING CONCRETE

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Often there is necessity to determine the concrete strength parameters at an early age. This is related to the requirements of formworks dismantling and determination of load carrying capacity of reinforced concrete structures. For this propose, the most convenient is to use the material nondestructive testing methods. It is known that there is strong correlation between the mechanical and acoustic properties of concrete, however, the ultrasonic pulse velocity (UPV) is affected by many factors. The researches before show that the range of ambient temperature of +5...+30 °C does not have an influence on the UPV in concrete. However, in such cases there is discussed the concrete, which is sounded at the time when active phase of hydration process of the hydrated cement paste does not occur anymore. And namely, there is a big difference if the concrete is tested at an early age, or later in time of its exploitation. It is known that the shrinkage processes develop during the concrete hardening in increased ambient temperature, and, consequently, the cracks are appearing in upper layers of concrete. Since shrinkage processes on the UPV in concrete (especially in the upper layers of the material) has not previously been researched quite extensively, this paper points out the increased temperature (up to +30 °C) effect on the UPV in concrete if for sounding is used most often in practice applied ultrasonic test method — indirect transmission by using longitudinal waves.

The specimens specially made for this experiment were cured in different environments — under normal conditions or high temperature environment (dismantled or nondismantled). For some of concrete specimens curing conditions were simulated according to the situation in the construction sites during the summer. In order to determine the eventual impact of the shrinkage process on the UPV in the depth of concrete massive, specimens' upper layers were sawed off at different ages and different thicknesses. Ultrasonic measurements were carried out both before and after sawing. For the same concrete specimens the results of the UPV have been compared at the early age and about 3 years later.

In this research it is determined the differences of the results of UPV and compressive strength for the concrete specimens depending on the curing environment. Surface layer thickness, when at specific curing conditions shrinkage processes are no longer prevent the UPV in concrete, has been also established. It is defined the differences of the UPV in different faces of concrete specimens in relation to curing environment and to, whether or not these faces have previously been covered with formworks. For in different environment cured concrete specimens experimentally have determined the characteristics for UPV changes over a longer period of time.

EFFECT OF THERMAL TREATMENT ON PROPERTIES OF HIGH STRENGTH CONCRETE

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High Performance Concrete (HPC) and Ultra-High Performance Concrete (UHPC) are modern building materials with advanced mechanical properties and durability, compared to traditional concrete. Increase of mechanical properties allows to reduce cross-sections of construction elements, as result less raw materials are consumed.

Obtaining concrete with high mechanical strength is strongly related to low W/C ratio, superplasticizers and use of specific mixing and curing technologies. One of methods to influence properties of concrete is thermal treatment during hardening process. For traditional precast concrete elements steam treatment is well known, but in the case of specific modern materials like HPC and UHPC increase of mechanical properties can be achieved with thermal treatment at temperature over 100°C.

The effect of thermal treatment on concrete compressive strength was investigated for 50 mm cube samples. The heat treatment temperature varied from 50°C to 200°C with 50°C step. The samples were heated under the same conditions for each temperature level. Rate of temperature increase was 2°C per minute. The curing time at maximal temperature was 4 hours. Thermal treatment and compressive strength tests were carried at 3rd and 28th day. Tests were carried out on specimens cooled down gradually to room temperature after heating. Additional tests were made for water absorption and permeability, as well as scanning electron microscope imaging of fracture surfaces to analyse and compare microstructure of thermally treated and reference concrete samples.

The results have shown that despite the possible dehydration compressive strength of thermally treated HPC samples improved. Maximal compressive strength was achieved at 200°C. By heat treatment applied at the third day, compressive strength increased almost twice.

HIGH EFFICIENCY POROUS CERAMICS WITH CONTROLLABLE POROSITY

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Increasingly growing anxiety of society about global warming and interest about construction materials which are less harmful to the environment, promotes manufactures and scientists to think about the usage of more effective resources which are available and necessary for production, as well as to find possibilities and solutions for the decrease of primary energy resources depleting by producing ecological materials from local raw materials such as clay – what is the main raw material for production of ceramics materials and their products, as well as more widely distributed sediments which mainly form the upper part of Earth crust. Notwithstanding the distribution of clay, current usage amount of clay is similar to the second part of 50ties of the past century which is equal to the middle of 30ties.

Besides traditional ceramics materials, porous ceramics is also widely researched and it becomes more and more popular material in the world, thanks to its wide possibilities of usage in different technique and technology industries – from construction to mechanical engineering and even cosmic technique.

Chemically-mineral content, type of formation, thermal processing provisions, etc., of raw materials determines ceramics materials porosity characteristic.

Many of researchers investigated porous ceramics with efficient properties, in order to research factors which influence microstructure of porous ceramics, using polymer-material saturation with clay slicker and concluding how to produce porous ceramics. During the presented research porous ceramics was produced, by using polymer material which is saturated with clay slicker.

Obtaining of porous ceramics, using foam polyurethane pump as burnable filler, is promoted by the fact that current technology used for foam polyurethane producing allows to form preferable porous structures within wide ranges, with pore dimensions starting from some micrometers up to 2-3 millimeters.

Porous ceramics materials obtained within this research are breathing, it is thermostable material, resistance to thermal impacts, corrosion and are easy in processing.

HEAT INSULATION MATERIALS OF POROUS CERAMICS, USING PLANT FILLER

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Constantly growing energy prices and concerns about energy supply in the future, as well as requirement for gas emission producing greenhouse effect, directs us to search and realize activities allowing reduction of energy consumption and to reach higher energy efficiency level.

Heat insulation is one of such activities for energy efficiency improvement, by reducing energy consumption in construction field. New ecological heat insulation materials, which are made of local raw materials, can serve as alternative for heat insulation materials already existing in the market, using clay as binder in its production, but hemp and flax and shive are used as burnable fillers, thus obtaining material with necessary heat and acoustic insulation qualities, as well as fire-resistance and chemical stability in aggressive environment and providing development of industry in Latvia.

In order to reduce thermal conductivity of ceramic materials, it is necessary to increase its porosity what can be realized by the usage of gas forming additives, for examples, calcite and magnesite, but the second variant is to add burned out additives thus forming porous ceramics. Within this research, agricultural waste is used for the production of porous ceramics, which have not been sufficiently used for the production of construction materials with high added value in Latvia.

The aim of the work is developing of porous ceramics materials, using plant burnable filler with certain properties due to their resistance and density, based on world achievements, as well as the experimental investigations. In the present work the evaluation of practically obtaining material which could be used for heat insulation of buildings has been done.

The porous ceramics materials with burnable plant filler are developed in the present investigation. The dependences the mechanical and physical properties of porous ceramics are defined in according of the amount of filler and glass, amount and size of pore have been performed.

INFLUENCE OF HIGH-SHEAR MIXER AGITATOR TOOL TYPE ON THE PROPERTIES OF ULTRA-HIGH PERFORMANCE CONCRETE

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The main purpose of concrete mixing is homogenous distribution of different types of particles within the system. Failure in particle blending can result in poor concrete workability in the fresh state, low performance in hardened state and inefficient use of materials. In case of Ultra-High Performance Concrete (UHPC) mixing is even more difficult as system consists mainly of very fine particles with high surface area. Due to the low water-to-binder ratio, homogenous water and superplasticizer distribution is decisive to obtain good workability of mixture. Another problem is agglomerate formation of finest particles (e.g. silica fume). To overcome these problems high shear forces should be introduced in the mixture and more energy required.

In this study UHPC was produced in high-shear laboratory concrete mixer (Eirich) with capacity of 75 liters and possibility to record different mixing parameters (e.g. mix temperature, energy input, shaft torque, pan torque). Two agitating tools – pin-type and star-type agitator with different energy input potentials were used. Concrete properties in the fresh state (cone flow, L-box, air content) and hardened state (compressive strength) were determined.

INFLUENCE OF POLYMERIC ADDITIVES ON THE PROPERTIES OF THE CONCRETE MANUFACTURED ON THE BASIS OF AGGREGATES PRODUCED FROM CRUSHED CONCRETE WASTE

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Concrete is one of the oldest and widely employed materials. Buildings' demolition waste can be utilised for the production of the concrete with low and average strength. Since many researchers have analysed the influence of concrete waste on the properties of hardened cement concrete and have determined that the strength of such concrete decreases, and water absorption increases (Finoženok et al., 2011; Finoženok et al., 2010), during the research the experiment was carried out where polymeric additives improving concrete's properties were utilised in concrete production.

During the research the following materials were used: coarse aggregate – crushed concrete waste with particles' size 4–16 mm, density 2.4 g/cm³, and concrete's compressive strength till the crumbling – 25MPa; fine aggregate – natural sand of 0/1 mm fraction and crushed concrete waste with particles' size 0.125–4 mm, composite Portland limestone cement CEM II/A-L 42.5 N; water and various polymeric additives: vinyl acetate copolymer, copolymer from vinyl acetate and ethylene with mineral additives and protective colloid, copolymer from vinyl acetate and ethylene with higher vinylesters with mineral additives and protective colloid, synthetic copolymer with large molecular mass.

The following compositions of concrete mixtures were prepared: reference mixture K (where no additives were used in composition), and concrete mixtures E, V5, V7, R prepared by adding 1 % and 2 % (comparing to the cement mass) of the one of listed additives. During calculation of concrete composition, the selected slumping class of the concrete mixture was S1, and compressive strength class of the hardened concrete – C25/30.

As a summary of research results we can conclude that polymeric additives investigated reduce the compressive strength, however, density of the samples remains similar. These additives influence also water absorption parameter. Not only polymeric additive utilised influences this parameter but also the amount of polymeric additive. Values of structural characteristics of the samples depend on the additive added and on its amount. The calculated forecasted exploitation frost resistance of the samples increase due to the additives used.

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INTERNAL CURING OF HIGH PERFORMANCE CONCRETE BY SUPERABSORBENT POLYMERS

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Modern high and ultra-high performance concretes (HPC) and (UHPC) are demonstrating very good mechanical properties and durability, however these properties can be compromised by early age cracking caused by autogenous shrinkage. Autogenous shrinkage is defined as the bulk deformation of a closed, isothermal, cementitious material system not subjected to external forces (Jensen and Hansen 2001a) and its main driving force is accepted to be capillary pressure. In low water-to-cement ratio (w/c) systems, water-filled capillaries are emptied during the self-dessication. Consequently capillary pressure builds up and it can cause crack development in the concrete. Capillary pressure can be reduced if extra water is provided for concrete curing. In low w/c concretes, providing the water externally is not effective because of the very fine porosity and resulting low permeability, which does not allow the water to access the whole volume of the material. To overcome this limitation, internal curing with Superabsorbent polymers (SAP) has been proposed (Jensen and Hansen 2001b; Hansen 2002). SAP are covalently cross-linked hydrophilic polyelectrolytes with three dimensional structures, capable to absorb high amounts of liquid without dissolving and retain the liquid even under a certain pressure (Buchholz and Graham 1997). They are added in the dry state during mixing, whereupon they rapidly absorb part of the mixing water and form water-filled cavities (about 100-500 μm in diameter) in the fresh concrete (Hansen 2002; Mechtherine and Reinhardt 2012). To compensate for self-desiccation, the amount of water that will be absorbed by the SAP needs to be added to the mixing water (Jensen and Hansen 2001b). In this study two mixtures were prepared – reference mixture without SAP (w/c 0.27) and mixture with SAP addition and extra entrained water (w/c increased by 0.05). Concrete was mixed in a high shear mixer with the capacity of 75 liters. Corrugated plastic tube method was used to measure autogenous shrinkage.

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MECHANICAL PROPERTIES OF LOW TEMPERATURE HYDRAULIC BINDERS

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The local mineral deposits – clay and dolomite are widely used for production of building materials in Latvia. Investigations of new compositions and energy saving methods are today's topicality. One of the way is reducing of production expenses using lower firing temperature, and, in addition, providing desired strength characteristics required for building applications. It was detected (Lindina et.al., 2011), that the optimal burning temperature, giving the highest crushing strength was in the range 700-750°C. In addition, for assessing of new compositions the deformation and strength properties have to be analysed and taken into account.

It is known, that great part of architectural monuments in Latvia were built using low-temperature natural cement – dolomitic romancement as binder and now it's a time to start their restoration. As production of romancement has been stopped 60 years ago, it is urgent to develop the method, how to obtain low temperature binder of dolomite and clay similar to historic, developed from natural dolomitic marl – romancement.

At first, chemical composition as well the physical properties of hydraulic binders were investigated (Barbane et.al, 2012). In order to study mechanical properties, a range of uniaxial loading tests with samples were performed using loading equipment Instron 5985. For comparison ready-mixed calcitic romancement „Prompt” samples was tested previously. Analysis of the results shows a stable mechanical property values. The resulting binder mechanical parameters could be used for further improvement of the historic building restoration works.

The work was carried out in the frame of *ERDF Project „Elaboration of Innovative Low Temperature Composite Materials From Local Mineral Raw Materials”* (Nº 2010/0244/2DP/2.1.1.1.0/10/APIA/VIAA/152).

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MOISTURE AND TEMPERATURE INTERACTION EFFECT ON THE ULTRASONIC PULSE VELOCITY IN CONCRETE

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It is known that ultrasonic pulse velocity (UPV) in concrete is affected by raw material properties, curing and exploitation conditions, various physical factors etc. So far, all of them are usually analyzed separately. Each specific factor and the results of the researches of its impact, unfortunately, does not find the assurance that the measurement data are obtained in sufficiently correct manner, without considering this specific and other factors influence on the UPV in the form of interaction. This paper summarizes the information obtained from a number of researches by analyzing the mutual subordination of main physical factors, if it is tested the same concrete composition.

Carrying out the tests with ultrasonic devices it is found that the most significant influence on measuring results gives concrete moisture. Changes of its content largely determine the influence degree of the rest of the physical, mechanical etc. factors on the UPV in concrete. Aim of this research is to develop a methodology for obtaining the correct UPV data, if the testing of the concrete specimens is carrying out at different ages and at different moisture and temperature conditions.

In the curing process, as well as about 3 years of age concrete specimens were exposed to moisture changes, as well as to the impact of different temperatures (from -20 °C to +30 °C). Direct and indirect transmission methods were applied in this research to determine the ultrasonic longitudinal and surface waves pulse velocity. It has been shown that the moisture and temperature interaction effect on the UPV in concrete mainly depends on the hardening (curing) conditions and the phase of hydration process of the hydrated cement paste. In certain cases the direct and indirect transmission methods have shown the different results. The elaborated UPV measurement methodology includes a function that contains four arguments — the phase of hydration process of the hydrated cement paste (or concrete age), hardening (curing) condition, concrete moisture and ambient temperature.

POSSIBILITIES OF CERAMIC MATERIALS IN PROVIDING ENERGY EFFICIENCY AND OPTIMAL MICROCLIMATE OF THE BUILDINGS

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Introduction

During seeking for energy economy it is usually forgotten about comfortable environmental conditions and microclimate inside the building. Medical researches confirm that microclimate of the building has big influence on health. And in microclimate problems becomes as well important as energy efficiency questions.

Due to these reasons it is important to consider not only heat conductivity properties of the material, but also properties that influence microclimate of the building.

Comfort parameters

There are not much knowledge's and practical solutions how to achieve highest quality level of all following parameters at the same time:

1. Minimal energy consumption and maximal energy efficiency.
2. Comfort level of highest category.
3. Minimal consumption of building materials and applying of ventilation/ conditioning equipment.
4. Maximal usage of renewable energy sources and usage of local building material sources with lowest influence on environment during live cycle of building.

It is only possible to provide implementation of quality requirements by finding optimal balance between microclimate parameters and energy efficiency.

Solution

It is more difficult to achieve stabile thermal comfort parameters during increasing of thermal resistance of outer walls. The perspective solution could be implementation of constructions with relatively high density ($>100 \text{ kg/m}^2$), with micro and macrostructure providing necessary physical properties of walls, with reflexive properties of warm and humidity accumulation.

Properties of building materials influencing microclimate

As higher density would have the material as much energy would be absorbed in the material and slower would be change of temperature. By changing length, density and heat conductivity of the heat flow way it is possible to regulate dynamic of material surface temperature changes do not increasing warm losses. Warm resistance and microclimate stabilising properties of such hollow anisotropic materials depends on humidity transport and gas conductivity of material. Humidity transport mechanism of material could be divided in two big groups: 1. Humidity transport of capillary structure; 2. Humidity transport of cellular structure. Capillary structures are characterised by fast grow of humidity transport during achieving wetting level of capillars.

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PROPERTIES AND COMPOSITION OF CONCRETE CONTAINING DIVERSE POZZOLANIC ADMIXTURES

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Micro-sized particles are used in modern concrete technology as a part of multi-component cementitious systems. Adding micro-filler admixtures improves properties both of fresh and hardened concrete. The task of the study was to estimate locally available pozzolanic admixtures, taking into account their effect on properties and microstructure of concrete as well as economical benefits.

Following local and commercially available micro-fillers were used in this research: dolomite powder, microsilica, calcined local (illite) clay and calcined kaolinite clay. The first step of the study was initial testing of potential micro-fillers and creating their database: determining particle size distribution, particle morphology, specific surface and pozzolanic reactivity.

The second experimental part covered production of fine-grained mixes containing cement, micro-filler and quartz sand in order to avoid the effect of coarse aggregate. Samples were cured and tested at ages of 7, 28 and 50 days. Physical and mechanical properties, such as compressive strength and water absorption were tested. Mineral formation processes were investigated using X-Ray analysis and IR spectroscopy.

The best results (high compressive strength and low water absorption) were obtained for mixes based on silica fume and metakaolin. X-Ray analysis indicated crystalline minerals portlandite and hatrunite in mixes based in pure cement and cement-dolomite composition. Mineral larnite with small admixture of portlandite was detected in mixes with calcined clay and microsilica. Low content of portlandite in compositions based on silica fume and kaolin can be interpreted by pozzolanic reactions.

The summary of the results of this research are:

- One-component binding agent (CEM I 42.5 N in this case) does not create dense cement matrix;
- Multi-component cementitious systems allow to achieve high performance characteristics of concrete. The best results were obtained combining cement with reactive pozzolanic admixtures;

The main factors which determine the effectiveness of admixture are pozzolanic reactivity, particle grading and morphology. The most effective fillers in this research were silica fume and calcinated kaolinite clay. Results for dolomite fillers were the same as for inert fillers. Addition of local calcined illite clay improved tested concrete properties, consequently other locally available clay materials should be investigated as a potential pozzolanic materials in future more specifically.

ACOUSTIC AND MECHANICAL PROPERTIES OF FOAM GYPSUM DECORATIVE CEILING PANELS

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Material structure depends on its production technology and by varying this technology it is possible to obtain similar structures. Physical and mechanical properties depend on the material structure and relating that to the material thickness, it is possible to change the maximal sound absorption coefficient position in the range of frequency. The paper examines the development of foam gypsum sound absorption material production technology, in order to obtain materials with the rules of sound absorption coefficient at the same time fulfilling the strength requirements. The sound absorption coefficient was determined with a Ø40mm impedance tube and in a reverberation chamber according LVS EN ISO 354:2003. Flexural strength for beams was determined in a three-point bending test and for ceiling panels according LVS EN 14246:2006. The study of the results was acquired from a foam gypsum production technology that simultaneously executes the strength requirements and provides a Class B sound absorption material. It has been found that foam gypsum sound absorption material and mineral wool is similar to the behavior of the sound absorption coefficient and the thickness of the product, although these materials are different structures.

Key words: Foam gypsum, acoustic panels, sound absorption, ceiling panels

THE ECONOMIC AND ENVIRONMENTAL BENEFITS FROM INCORPORATION OF COAL BOTTOM ASH IN CONCRETE

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Coal is a fossil fuel and important natural resource and combustion of coal provides high energy production. Total coal production in 2011 was 7678 Mt and lignite production was 1041 Mt. Coal provide 30.3% of total world primary energy demand and 42 % from worlds electricity is produced from combustion coal. Coal production will continue to increase and in 2030ies 44 % from world's electricity will be produced from coal (Data courtesy). Coal combustion is provided in thermal power plants. A significant amount of coal ash is produced after burning coal and utilization of ash is an important issue in world. The sustainable utilization of coal ash could improve production efficiency, reduce production costs and avoid waste product disposal.

In this research coal combustion product – coal bottom ash was investigated for application as micro filler in conventional concrete production. Coal bottom ash was taken from local boiler house in Latvia and preliminary processing of coal bottom ash was done. Coal bottom ash was ground for 15, 30 and 45 minutes respectively. The grading analysis of obtained microfiller was done with standard sieves and grading curves were obtained. Scanning electron micrographs were obtained and energy-dispersive X-ray spectroscopy was performed.

In the current study, conventional concrete mixture with the cement amount of 350kg/m^3 and W/C 0.61 was chosen to integrate it with coal bottom ash as microfiller. The integration ratio of microfiller was chosen 10, 20, 30 and 40% by the mass of cement for each type of prepared coal bottom ashes. Reference concrete mixture consisted of 0% coal bottom ash. The concrete workability were kept constant for all mixtures and the chosen cone slump class was S4 (160-210mm). Fresh and hardened concrete properties were obtained. Compressive strength was determined at the age of 7, 14 and 28 days.

Processed coal bottom ash could be used as microfiller for conventional concrete production. Higher concrete strength class with the same amount of cement could bring economical benefit up to 3.6%. By incorporation of coal bottom ash in concrete environmental benefit could be achieved due to reduced cement consumption and effective disposal of coal bottom ash. The integration level of coal bottom ash could not exceed 30% by the mass of cement. At low rates incorporation (<20%) coal bottom ash provides the same W/C for concrete and fresh concrete density increases. Mechanical and physical properties of concrete can be improved by choosing appropriate amount of coal bottom ash microfiller.

THERMAL PROPERTIES OF SELF COMPACTING CONCRETE WITH REDUCED PORTLAND CEMENT VOLUME

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Within last decade most of research was carried out on utilization of waste glass in concrete as fine and coarse aggregates, mostly on mechanical properties of concrete, but only little research was carried out on the thermal properties of such concretes (Poutos et al., 2008). The thermal character of cement hydration reactions causes concrete to endure temperature changes during the first days after casting. In the present research glass cullet that has lower embodied energy and results in less CO₂ emissions into atmosphere than Portland cement is used in SCC. The influence of container (green, amber and flint bottles) glass powder ground to micro-scale particle size on the thermal properties of a hydrating SCC specimens was investigated. The hydration heat of concrete mixes was tested by following method: testing was done in the room with temperature (20 ± 2)°C, concrete mixes were cast in demountable 150x150x150 mm formworks made of plywood, afterwards a copper tube with thermocouple was placed in the centre of each test specimen in order to take measurements of temperature (thermocouple was connected to a data transmitting device), after formworks were placed into a plywood box with 50 mm insulation layer of polystyrene foam. The temperature at the centre of each concrete specimen was continuously monitored at least up to 120 h after production in the ambient environment of 20 ± 2 °C. The results showed that Portland cement substitution with glass cullet has significant influence on peak temperatures.

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COMPARISON OF ASPHALT CONCRETE PERFORMANCE USING CONVENTIONAL AND UNCONVENTIONAL AGGREGATE

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The study investigates use of dolomite sand waste as filler or/and sand material plus BOF steel slag as fine and coarse aggregate for design of high performance asphalt concrete. Both environmental and economic factors contribute to the growing need for the use of these materials in asphalt concrete pavements. This is particularly important for Latvia, where local crushed dolomite and sandstone does not fulfill the requirements for mineral aggregate in high and medium intensity asphalt pavements roads.

Annually 100 to 200 thousand tons of steel slag aggregates are produced in Latvia. However, it has not been used extensively in asphalt pavement despite of its high performance characteristics. Dolomite sand waste, which is byproduct of crushed dolomite production, is another widely available polydisperse by-product in Latvia. Its quantity has reached a million of tons and is rapidly increasing. This huge quantity of technological waste needs to be recycled with maximum efficiency.

Various combinations of steel slag, dolomite sand waste and conventional aggregates were used to develop AC 11 asphalt concrete mixtures. The mix properties tests include resistance to permanent deformations (wheel tracking test, dynamic creep test) and fatigue resistance. Laboratory test results showed that asphalt concrete mixtures containing steel slag and local limestone in coarse portion and dolomite sand waste in sand and filler portions had high resistance to plastic deformations and good resistance to fatigue failure.

INTERPRETATION OF ASPHALT MATERIAL DESIGN PARAMETERS

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Current situation in road design practice show that there exist inconsistency in using and defining some asphalt material parameters. Such inconsistency leads from fact of introducing EU standards for materials while design methods leaving unchanged.

In order to found possibilities adapt the correct modern test methods for asphalt material parameters such as deformation modulus used in road pavement design procedures, the research and theoretical basement analysis was performed. Current research fixes that after introducing of EU standards for road material requirements instead of former GOST, road engineers were faced with fact, that EU materials no more conforms with former design procedure. Some of them starts using other design methods different from previously used GOST based VSN (Russian) pavement design procedure. However both practices have not been covered with appropriate design parameters applicable for used procedures. Main source of inconsistency as fixed is non-compliance of defined road pavement materials with parameters used in design procedures and, for instance, defined on GOST basement. As result it leads to the improperly designed pavement structures and possibly can result in significant losses for national road industry.

This paper presents the interpretation of four point bending test results and possibility of acceptance for use them in still mostly used pavement design procedure -VSN. Four point bending tests were performed on AC11 asphalt mixture with conventional (dolomite, quartz sand) and non conventional (steel slag, dolomite sand) aggregates.

DEVELOPMENT OF HIGH PERFORMANCE ASPHALT CONCRETE USING LOW QUALITY AGGREGATES

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Dolomite is one of the most available sedimentary rocks in the territory of Latvia. Dolomite quarries contain about 1000 million tons of the material. However, according to Latvian Road Specifications 2012, this dolomite cannot be used for average and high intensity roads because of its low quality (mainly, LA index). Therefore, mostly imported magmatic rocks (granite, diabase, gabbro, basalt) or imported dolomite are used which makes asphalt expensive. However, practical experience shows that even with these high quality materials roads exhibit rutting, fatigue and thermal cracks. The aim of the paper is to develop a high performance asphalt concrete for base and binder courses with using only locally available aggregates. In order to achieve resistance against deformations at a high ambient temperature a hard grade binder was used. Workability, fatigue and thermal cracking resistance, as well as sufficient water resistance is achieved by low porosity (3-5%) and higher binder content compared with traditional asphalt. The design of the asphalt includes a combination of empirical and performance based tests, which in laboratory circumstances allow traffic and environmental loads to be simulated. High performance ACb 16 asphalt concrete has been created using local dolomite aggregate B20/30 penetration grade bitumen. The mixtures will be specified based on fundamental properties in accordance with EN 13108-1 standard

Key words: dolomite aggregate, asphalt concrete, permanent deformations, fatigue resistance

UNCONFINED COMPRESSIVE STRENGTH PROPERTIES OF CEMENT STABILIZED PEAT

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Peaty soil is considered as weak subgrade with poor bearing capacity and high compressibility. This study presents cement stabilization of peat to improve its engineering properties. Soil samples for laboratory experiments were collected in Riga District, Garkalne Country, near the road Riga-Pskov, in the place where the raised bog is formed by the peat up to 5 meter in thickness.

Unconfined compression tests were performed for stabilized peat specimens, cured in laboratory water soaked, to evaluate an increase in bearing capacity for three different Portland cement dosages- 200kg/m^3 , 250kg/m^3 and 300kg/m^3 , and three different surcharge rates-0kPa, 6kPa and 18kPa, in 7, 14 and 28 days. Surcharge rates were varied in order to evaluate the effect of stabilization in different depth and under additional axial loading during the process.

Laboratory tests showed that unconfined compressive strength, stiffness and so also compressibility of the peat were remarkably improved when mixed with cement. It was found that the effect of stabilization is strongly related to binder dosage, surcharge rate and curing time. The unconfined compression strength increase reached even 20 times comparing natural untreated and stabilized peat with 300kg/m^3 cement dosage and 18kPa surcharge after 28 days curing water soaked.

Key words: peat, cement stabilization, hydraulically bound mixtures, unconfined compressive strength

RHEOLOGICAL AND STRENGTH PERFORMANCE OF CEMENT PASTE WITH GROUND FLUORESCENT LAMP GLASS WASTE AND ASH

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Portland cement substitution with waste glass (special glass and container glass) in concrete has significant effect on performance characteristics of eco-concrete (Kara et al., 2012). The packing density of cementitious materials is an important property governing the rheological and strength performance of the cement paste. A higher packing density demands less water to fill the voids between the solid particles and at the same time water/cementitious materials ratio releases more excess water for increasing the flowability of cement paste. One of commonly used filler to increase packing density is condensed silica fume which is relatively high cost material. Therefore, in present study is investigated the usage of fluorescent lamp waste glass and ashes as fillers. An experimental program aiming to evaluate the effectiveness of ground fluorescent lamp waste glass and ash as filler in cement paste has been completed. Rheological properties and cube strength of cement paste samples containing different amounts of ground fluorescent lamp waste glass and ash were measured. The results showed that the substitution of cement at levels from 10% to 30% can significantly increase the workability of the cement paste without decreasing the properties of designed ready-mixed concrete.

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THERMAL CONDUCTIVITY OF WALLS INSULATED WITH NATURAL MATERIALS

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Using of natural renewable and recyclable materials enables us to construct a comfortable space to live in. The aim of this investigation was to research thermal transmittance and relative humidity of wall fragments with different structures and insulation. Tested wall fragments were built into window openings of an actual outside wall. All the materials used were natural: wood, lightweight clay blocks, reed and straw bales, loose hemp chips and reed. Walls were rendered with clay plaster. Thermal transmittance and relative humidity were measured in four different wall structures during two years. Sensors for measuring temperature and humidity were placed at several points, for one item between the insulation and clay plaster layers. On the basis of the research it may be concluded that it is possible to fulfil minimum energy performance requirements using natural insulation materials and based on the values of the observation period it can be concluded that there was no water condensation in the wall structure. Therefore there was no threat of biodegradation.

Key words: natural construction materials, insulation with loose reed and hemp chips, lightweight clay blocks, reed and straw bales, clay plaster, thermal transmittance, relative humidity

IV STRUCTURAL ENGINEERING

BEHAVIOUR OF CABLE TRUSS WEB ELEMENTS OF PRESTRESSED SUSPENSION BRIDGE

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A suspension bridge is the most suitable type for a long-span one due to the rational use of structural materials. Increased deformability, which is conditioned by the appearance of the elastic and kinematic displacements, is the major disadvantage of suspension bridges.

The prestressing can solve the problem of increased kinematic displacements under the action of non-symmetrical load (Goremikins et al., 2011). A prestressed suspension bridge with the span of 200 m was considered as an object of investigation. The cable truss with the cross web was considered as the main load carrying structure of prestressed suspension bridge (Fig. 1).

Topology optimization of cable truss web by 47 variable factors was realized with genetic algorithm (Goremikins et al., 2012) to find rational distribution of material in the cable truss space. It was stated, that the maximum total displacements are reduced up to 29.9% by using of cable truss with rational characteristics instead of single cable in the case of the worst situated load.

Cable truss web elements behaviours were analysed and it was shown, that some elements of the web are excluded from the work in some loading cases. It was stated, that removing of some elements of the web allows simplifying the web and minimizing displacements.

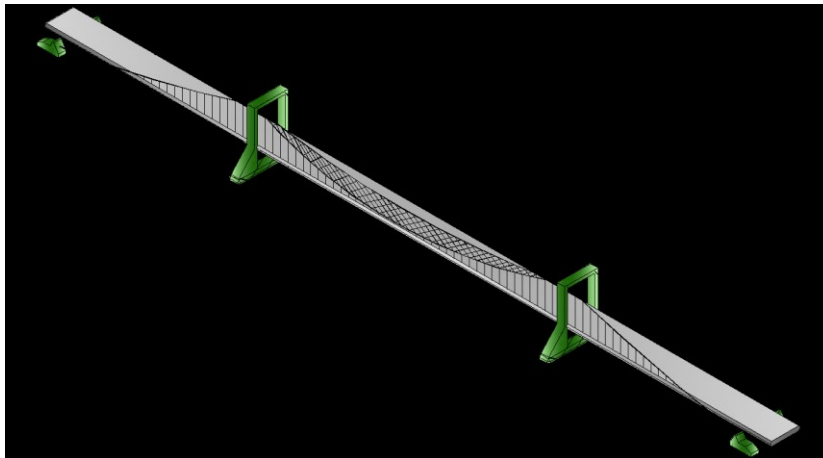


Figure 1. Prestressed suspension bridge with the cable truss as the main load carrying structure

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EFFICIENCY OF THERMAL DESIGN OF SHALLOW FOUNDATIONS

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The structural and thermal performance of building is influenced by freeze-transmitting through foundations in great extent. The risk of frost heave of foundations may be avoided in various ways. One is to have foundations deep enough so as to be below the frost penetration depth. Another possibility is to replace the frost-susceptible soil with non frost-susceptible material below the frost penetration depth before constructing the foundations. A third option is to set up the insulation so as to avoid frost penetrating below the foundations. The simplified procedures for the design of building foundations to avoid damage resulting from frost heave are given in standard LVS EN ISO 13793:2003. Yet these methods are new for construction practice in Latvia because of should be proved carefully taking into account local geological conditions.

The geotechnical specifications for Daugavpils region inspected testifies that the groundwater level rests 2 m below the depth at which fully frozen soil lies. For such conditions the Latvian code LBN 207-01 specifies that foundation depth should be not less than 1.45 m for undisturbed clayed soils and not less than 1.75 m for undisturbed sand soils. Correspondingly to insulation layer constructed the foundation depth may be reduced up to 0.4 m.

The current study contains the comparison of cost-effectiveness of foundation insulation methods presented in standard LVS EN ISO 13793:2003 with the design results obtained using Latvia code LBN 207-01 for columnar foundations of unheated building sized by 18×36 m in plan and insulated to reduce heat loss from the soil below the foundations so as to keep this soil unfrozen.

Some conclusions brought result in may be applicable for implementation and critical assessment of heated foundation methods:

- Cost effectiveness of heated foundations according LVS EN ISO 13793:2003 correlates closely with type of frost-heaven soil. For example, use of heated foundations in clayey gravel (clayey soils and clayey sand) leads to increase of soil volume to be excavated and filled back but concrete consumption for foundations decreases. In dust sand soils, if the required foundation depth is less than 0.8 m, both reductions are achieved in earth-moving and concrete consumption
- The decreased side area of foundations obtained applying the heat insulation leads to more safety of building as regard human errors in construction (if backfill is non-quality or material is off-grade- includes clay fraction)
- There is lack of tabulated data for Latvia region as regard design freezing index needed for design. The value of freezing index is defined as a 1 in n probability of being exceeded over a winter for the locality concerned, based on recorded meteorological data, and it is labour-consuming procedure to obtain the related value
- The thermal design may be recommended when groundwater level is high as using this method there is not needed the lowering of groundwater level during construction.

FINITE ELEMENT ANALYSIS OF WEFT KNITTED COMPOSITES

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Knitted fabric reinforced composites shows attractive properties - good impact resistance and high energy absorption, simultaneously high reinforcement deformability makes it possible to fit various complex preform shapes without forming folds (Miravete, 1999). At the same time, mechanical properties prediction for such composite materials still needs additional investigations.

In the present paper mechanical properties of knitted fiber reinforced polymer laminates are investigated numerically and experimentally. Unspecialized FEA software was used for composites material structural behavior simulation. Layered plates reinforced by knitted fabrics mechanical properties were studied numerically investigating material unit cell deformations under applied loads. This model was used in the tensile behavior simulation of epoxy matrix E-glass knitted fabric laminated composites. Numerical results comparison with performed experiments has shown the ability to predict the material properties with reasonable accuracy. Only material properties of constituent fiber and matrix as well as fabric geometric parameters are necessary for building the unit cell. Geometry of the material unit cell was described using Leaf and Glaskin formulas (Huang et al., 2001; Ramakrishna et al., 2000). Material tensile properties in two principal directions were investigated both experimentally and numerically. ANSYS commercial software was used for material unit cell modeling. The predicted properties were compared with the experimental results and with the data from previous analysis in SolidWorks program.

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GFRP REBARS FOR CONCRETE CONSTRUCTIONS

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The application of composite rebars instead of steel ones offers good corrosion resistance and durability. Composite rebars with different shape have been proposed (Kadioglu, 2005), but their influence on bond strength with concrete does not investigated in details.

The objective of this study is to investigate and compare the interfacial stresses arising between glass-fiber reinforced polymer (GFRP) composite rebar and concrete under axial loading. Rebars of three different cross-sections are considered: circular one and circular with two and four longitudinal ribs. The design analyses of the rebar configurations embedded in concrete are investigated by 3D finite element method (FEM) using ANSYS software. FEM results convergence was examined with different FE mesh sizes and comparing the calculated stresses. Influence of rib geometry on the operating stresses was also studied.

The results of interfacial stresses calculated are applied as a basis for estimation of the effectiveness of composite rebar configurations in concrete structures, which can provide good bond characteristics.

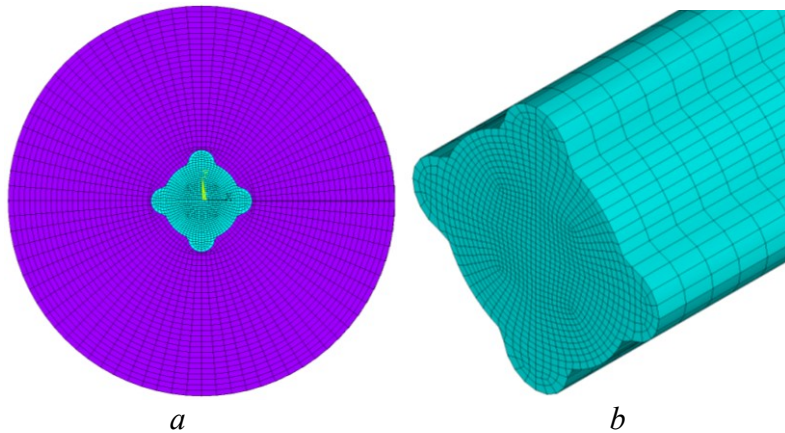


Figure 1. FE model of composite rebar with four ribs in concrete (a) and separate (b).

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INFLUENCE OF FIBRE AMOUNT ON *SFRC* PRE- AND POST-CRACK BEHAVIOUR

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Since 1960s when the studies on fibre reinforced cementitious composites (FRCC) where started, the research work in this field has developed very rapidly. Today there is a wide range of materials with different properties and applications that go under this classification. Although steel fibre reinforced concrete (SFRC) is a narrow part of this material family, it still have an important role in different structures both non-bearing and bearing ones.

Due to chaotic fibre dispersion in concrete matrix, which can be influenced by many factors, the prediction of SFRC structure behaviour is rather complicate. Nevertheless authors agree that the number and orientation of the fibres largely influence the properties of a SFRC member before and after cracking. From a mechanical point of view, there is an obvious interest in knowing the number of fibres crossing a given cracked section of a structural element (Martinie and Roussel 2011). Many researchers have proposed mathematical models based on assumption of homogeneous fibre dispersion (Krenchel, 1975; Stroeve and Hu, 2006), while others based on experimental data distinguish between total fibre amount and the number of fibres crossing crack plane (Barros et al, 2005). In other words, they have shown that there is a difference between theoretical and actual number of fibres, and it varies for different fibre volume fraction.

In this study experiments were performed with SFRC un-notched beams in four-point bending. After beam failure specimens were sawn in three different directions with the distance between cutting planes of 40 mm. Cut fibres were counted in each plane and the number of fibres per plane were compared with the number of fibres in the crack plane.

Study shows that not only the fibre amount by volume but also the number of fibres has a notable role in SFRC member behaviour. It also was confirmed that cracks tend to form in regions with smaller amount of fibres. Nevertheless, it was more explicit for specimens with higher fibre amount per volume. On the other hand, larger scatter of fibre number per plane (or unit area) was observed for those specimens with higher fibre volume fraction. Furthermore, the number of fibres in the least reinforced regions was almost the same for all specimens regardless of fibre volume fraction. Thus it can be assumed that the strength at the first crack and the residual strength of SFRC members is not increasing proportionally to total fibre amount per volume, although, it can be nearly true for fibre amount per section.

More experimental and analytical studies with different fibre volume fractions should be carried out to estimate the influence of the total fibre amount to the weakest section of a SFRC structural member.

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LOAD TRANSMISSION ON A HIGH STRENGTH COMPOSITE STRIP STRETCHED WITH WAVY-PROFILED GRIPS

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The problems of pretensioning and tensile testing of high strength strips are concerned with load transmission complexity by means of shear stresses, applied to a strip's surface. Depending on a grips design, these stresses are a friction or adhesive nature. Application of the grips with flat contact surfaces generates inevitably a high peak of shear stresses at the grips' entry, which is responsible for tensile stress concentration at near-surface layers of the strip and its premature failure (Portnov, 2008). Conception of the wavy-profiled grips for enhancing the strips or wire reliable fastening was proposed (e.g., Arnolt, E., 1952). However, stress distributions in such grips were not calculated and their optimum shape was not investigated.

Authors developed the technique for calculation of a FRP strip stress-strain state in such grips (Fig. 1). The geometrically nonlinear equations of bending a flexible strip are applied to calculate a stress state of a strip stretched inside a through slit, which is formed by the tight clocked grips (Usjukin, 1988). Geometry of the slit was assigned with equation:

$$\bar{y}(\bar{x}) = A \cdot \bar{x}^b \cdot \exp(-k(1-\bar{x})) \cdot \sin(\omega(1-\bar{x}) + a).$$

Mean stresses in the strip due to tension σ_x^t and totally with bending σ_x^Σ are shown in Fig. 2.

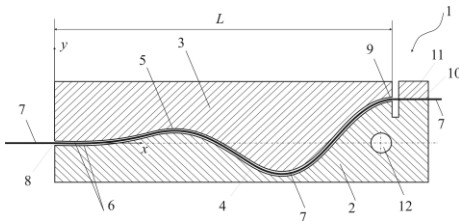


Figure 1. Device with wavy-profiled grips.

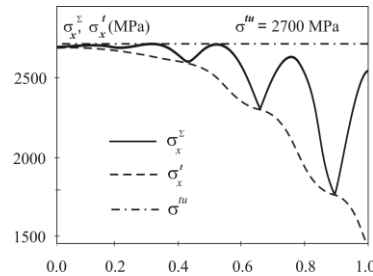


Figure 2. Distribution of tensile longitudinal stresses in the strip.

Thus, a smooth variation of the stresses may be realized both inside the strip and on its surface. Strip tension at the grips' end is two times less than maximum one and there is no problem to fasten safely the strip.

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MICROMECHANICS OF ELASTO-PLASTIC FIBER PULL OUT OF ELASTIC MATRIX

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It has been proven by many researchers that the overall behavior of concrete can be improved by the addition of fibers. In the present investigation numerical (FEM) modeling of elastically plastic single straight fiber pull-out of elastic matrix volume was realized. Comparison was done with steel fiber is pulling out of concrete matrix. Fiber pulling out micromechanics is governing the macro-crack opening process - fiberconcrete post cracking load bearing capacity is dependent on the each single fiber pull-out process.

Fiber is behaving elasto-plastically. Numerical modeling was performed using 3D FEM approach, which takes into account the non-linearity is presenting in physical model in combination with a finite element method (FEM). Straight shape fiber pulling out of concrete block in fiber direction was investigated in (Li et al., 1998; Mobasher et al., 1995). In our investigation numerical modeling was performed for straight shape fiber was embedded into elastic matrix under variable angle to applied pulling force and at variable depth.

Experimental data analysis shown that the pull-out process can be divided into three stages- a) fiber pull-out with perfect bond between fiber and concrete matrix; b) fiber pull-out with partial debond (cylindrical crack) between concrete matrix and fiber, started from concrete matrix surface; c) fully debonded fiber pull-out of concrete matrix. All above mentioned stages were investigated theoretically (using Solid Works and ANSYS software) and experimentally. Stress distribution acting across the fiber/matrix interface are obtained in each time step of simulation for further prediction of different shape fiber pull-out behavior (Krasnikovs et al. 2009; Krasnikovs et al. 2010).

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OPTIMAL DESIGN OF VARIABLE STIFFNESS PLYWOOD- PLASTIC PLATE

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Laminated plates and shells with variable stiffness have been intensively investigated during past two decades.

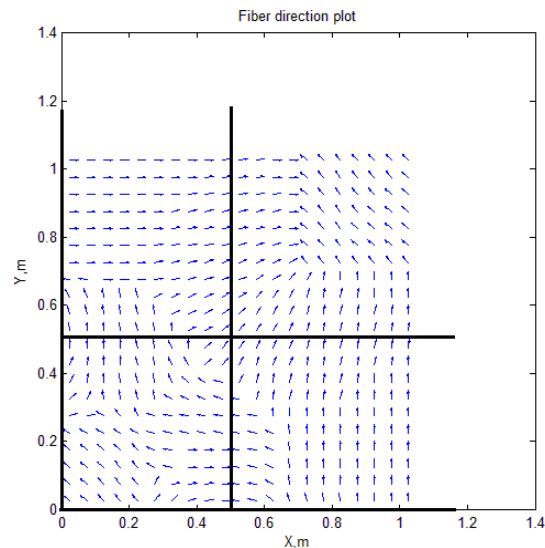
These kinds of structures are becoming more popular due to ability to achieve increased strength-to-mass and stiffness-to-mass ratios by tailoring material properties. The fiber steering machines are becoming more popular in manufacturing variable stiffness glass or carbon fiber plates.

An optimal variable stiffness plate could be obtained by optimization of fiber orientation angle (Keller 2010) or thickness optimization (Almeda and Awruch 2009). A lamina with the variable stiffness and curved fibers provide a great flexibility to achieve needed natural frequencies, mode shapes, vibration amplitudes and buckling load.

Flexural plates, like plywood, with variable stiffness are not investigated enough now. The optimization method for this type of structure should be specially created. Therefore there is proposed a new optimization method for plywood lamina optimization and provided some typical results.

The method was tested by optimizing single span and multispans plywood plates. A new kind of variable stiffness plywood and hybrid plywood-glass or carbon fiber multilayer composite plates with increased stiffness could be obtained by using proposed optimization method. The results show that increase of stiffness could be more than 20%, depending on boundary conditions.

Figure 1. Optimal fiber distribution for three span plate (shown one quarter due to symmetry)



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POLYMER FIBER PULL OUT EXPERIMENTAL INVESTIGATION

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Advanced polymer fibers are used in structural applications as micro reinforcement in composite materials with a concrete matrix. Comparing to other fibers such as steel, glass, carbon etc., polymer fibers behave visco-elastically or visco-elasto-plastically. Such fibers having moderate starting elastic modulus are characterized by relatively large elastic deformations and pronounced Poisson's effect during stretching. Concrete prisms with dimensions 10x10x40 cm were fabricated, having different amounts of 3 cm long and 0.75 mm in diameter polymer fibers. All prisms were tested under four point bending conditions and loading velocity $v=150$ N/s. An elaborated numerical fiberconcrete cracking model was exploited for prism load –deflection mechanical behavior prediction under four point bending conditions. Numerical results were compared with experimental data.

Key words: polymer fibers, concrete prisms, pull-out, four point bending

RESEARCH OF MATERIALS SUITABILITY FOR CRACKS REPAIR IN REINFORCED CONCRETE STRUCTURES

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Cracks are one of the biggest problems appearing in reinforced concrete. The reasons that cause the cracking of structures could be different: load impact, corrosion of reinforcement, unsteady settlement of framework, environmental effect etc. The cracks cause the decrease of the structure's durability and longevity. According to the research of A. C. Issa (2007) the cracks decrease the strength of concrete about 40 %. Therefore it is important to repair damaged structures.

There are two main repair strategies: cracks slushing and cracks injection (Thanoon et al, 2005), and according to the strategy different materials are used. So it is worth to compare these materials.

Research aim: to estimate the suitability of materials for cracks repair in reinforced concrete structures.

To estimate the materials suitability for cracks repair were used slant shear strength test (EN 12615). In research were used 3 cementic mortars (1st without additives, 2nd modified with expansive additive and 3rd modified with polymer additive) and 4 different polymer injection materials.

The results show that polymer injection materials A and B can restore the strength of concrete. The repair carried with modified cementic material (for modification used expansive additive and polymer additive) has the same effect (table 1).

Table 1
Strength of repaired concrete

Repaired concrete with	Strength loss, %
Not repaired concrete	100
Cementic mortar	87.8
Cementic mortar modified with expansive additive	100
Cementic mortar modified with polymer additive	100
Polymer injection material (A)	95.7
Polymer injection material (B)	100
Polymer injection material (C)	74.2
Polymer injection material (D)	90.1

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EN 12615:1999 Products and systems for the protection and repair of concrete structures - Test methods - Determination of slant shear strength.

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STRENGTH OF LAYERED FIBERCONCRETE

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In the work fiberconcrete prisms were created with non-homogeneous layered fibers distribution inside them. Fiberconcrete is important material for load bearing structural elements. Traditionally fibers are homogeneously dispersed in a concrete. At the same time in many situations fiberconcrete with homogeneously dispersed fibers is not optimal (majority of added fibers are not participating in loads bearing process). Is obvious, that is possible to create constructions with non-homogeneous fibers distribution in them, in different ways. (Krasnikovs et al., 2012; Krasnikovs et al., 2008; Li, 2003) Present research is devoted to one of them.

While fiberconcrete strength properties, in most of currently available design recommendations, are observed using inverse approach (approximating the experimentally obtained curve), it should be noted, that the direct modeling approach allows to perform economically optimal design of fiberconcrete structure and to obtain realistic characterization, for the actual fiber type, of fibers distribution and spatial orientations in structural element volume. In the present research three different types of layered prisms with the same fibers amount in them, were experimentally produced (four samples with dimensions 10x10x40cm were fabricated for each type as well as for reference, four prisms with homogeneously dispersed fibers were produced also). Prisms were tested under four point bending conditions till crack (in each prism) opening was reached 8mm. Simultaneously, prism cracking was simulated numerically, using elaborated numerical model for neutral axes location in the prism during crack growth and cracked beam load bearing capacity during crack growth and opening. Numerical modeling results were compared with experimentally obtained. Some conclusions about fracture process features were done.

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TECHNOLOGY FOR CONCRETE SHELLS FABRICATION REINFORCED BY GLASS FIBERS

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Fiberconcrete use leads itself to a variety of innovative designs as a result of its many desirable properties. Not only can it be cast in diverse shapes; but it thin –wall structural elements also possesses high compressive strength and stiffness. The promise of thinner and stronger elements, reduced weight and controlled cracking by simply adding fibres is an attractive feature of fibre-reinforced concrete.

Pneumatic mould use is an approach with a set of advantages among thin wall structural element fabrication technologies. In the reported work, on the flat surface of a non- inflated pneumatic mould was imposed and smoothed down (forming a thin layer) glass fiberconcrete mix. Before concrete binding, mould was inflated by air forming a moderate curvature shell. After that concrete was hardened, during concrete hardening air pressure in pneumatic mould was kept constant value. Then an air in the pneumatic mould was blown out and shell was demolded. Two variants were observed: a) shell is reinforced by uniformly distributed short glass fibers (concretes with three different fiber concentrations were investigated); b) shell is reinforced by weft knitted glass fiber textiles (were fabricated in the laboratory). Simultaneously flat material samples were fabricated and experimentally tested. Composite materials elastic moduli as well as tensile strength were obtained. With the goal to predict mechanical behavior of produced thin fiberconcrete shells detailed micromechanical investigation for single fiber and few fibers bundle pull-out micro-mechanics was performed numerically (using FEM modeling) and experimentally. Macro-crack opening structural model, based on data sets with information about single fiber and few fibers bundle pull-out micro-mechanics, (was elaborated earlier) was exploited predicting shell load bearing facility depending on opening of a crack in the loaded shell. Theoretical results were compared with the data obtained in experiments.

FOOTFALL INDUCED FORCES ON STAIRS

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To get a reliable dynamic performance of the modern flexible light-weight structures such as pedestrian bridges, flexible stairs, long span floors and even tall public observation towers it is important to check the structure's vibrations induced by human movement dynamic loads.

The paper gives some background information about recent advances determining the human induced dynamic forces and presents a convenient method in order to obtain the equivalent continuous walking force histories and therefore essential parameters (dynamic load factors and corresponding phase shifts) that can be used in the structural design. The imperfectness of individual footfall forcing functions and differences between continuous walking force histories among individuals is taken into account. There are analyzed the experimental data obtained by using inverse dynamic method (accelerometer technology) for walking load amplitude dependence on various pacing frequencies during the stair ascending or descending action.

The data in Fig. 1 and Fig. 2 that are obtained from the mean walking force history reveals differences between the stair ascending and descending process.

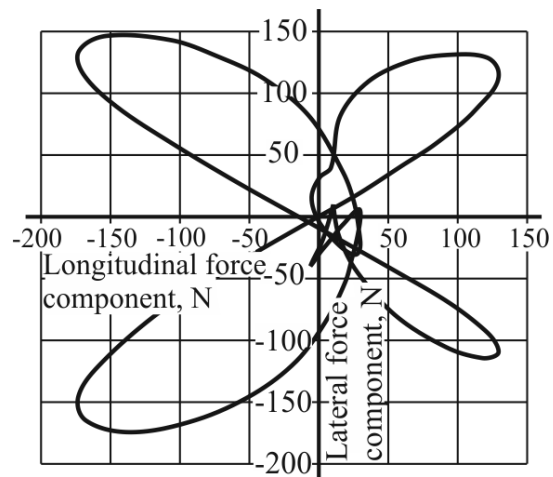
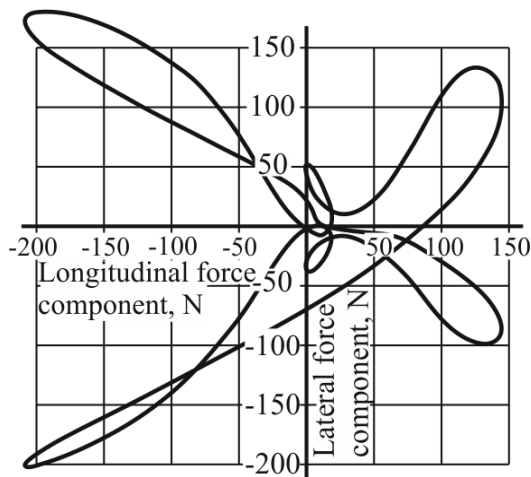


Figure 1. Path of the mean pedestrian force vector end point (ascending case at rate 2Hz)

Figure 2. Path of the mean pedestrian force vector end point (descending case at rate 2,15Hz)

To test the method there were obtained equivalent DLFs and their dependence on walking pace for all three force directions (the stair ascending and descending case): vertical, longitudinal and lateral. Results were compared with other researchers' findings that utilized the direct measurement technologies.

EVALUATION OF GLASS IN DESIGN OF LOAD BEARING STRUCTURES

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In 21st century the glass is not anymore considered just as a material for producing household goods, but becoming a material widely utilised load bearing structure as production quality has improved and building industry has progressed like never before. Main advantage of application of glass is its high mechanical strength, as well as high flexural module which are comparable with such materials as aluminium or high resistance concrete. At the same time glass is well known for its fragile and instantaneous collapse behaviour which does not encourage designers to sufficiently exploit glass material.

The most popular example of a load bearing structure made entirely from glass staircase landings. Current research aim is an assessment of existing design practice in contrary to physical experiments of single glass stair landing plate. In order to perform an optimisation task, a different kind of glass samples has been tested in 4-point bending using machine INSTRON 8802 (Fig.No.1) in order to extract the bending modulus. Bending test settings are corresponding to LVS EN 1288-3 standard requirements and based on similar research performed at Delft University of Technology, Netherlands.

Current research drawn a conclusion that by using finite element method it is possible accurately to simulate mechanical behaviour in 4-point bending with very high result correlation with differences less than 2%. Obtained glass Young's modulus are 70.0 ± 5 GPa which is equal with value found in literature. These results in particularly experimental ones clearly identified that in order to increase the maximum load it's a special attention should be paid to edge treatment level as well to glass modification by annealing process.

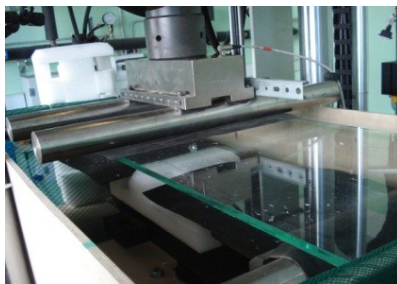


Fig.1. A glass sample tested in bending (INSTRON 8802)

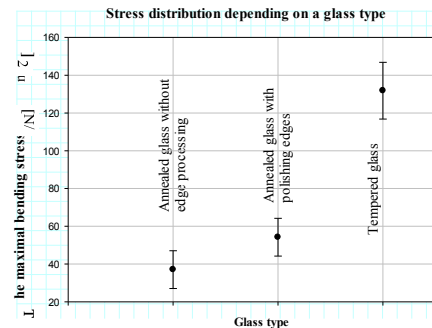


Fig.2. Strength versus glass treatment level

ASSESSMENT OF THE EFFECT OF BOUNDARY CONDITIONS ON CYLINDRICAL SHELL MODAL RESPONSES

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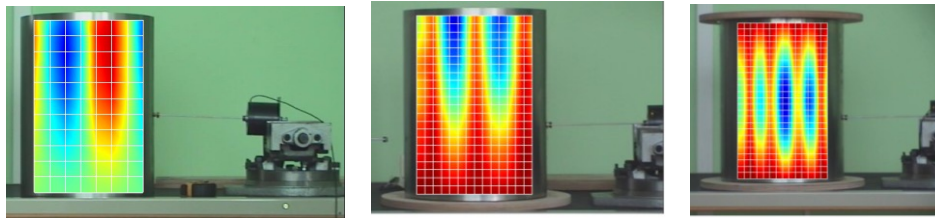
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Circular cylindrical shells made of stainless steel utilized in a variety of engineering structures which require high strength in combination with chemical resistance, for example, reservoirs, chimneys, offshore platforms, pipelines, silos or wind turbine towers. The structures should be designed against the tensile hoop stresses or tubular bending stresses (tower-type structures) often resulting in very thin shell walls which may imply the danger of a failure by instability due to compressive and/or shear forces known as shell buckling.

Dynamic behaviour of cylindrical shell structures is an important research topic since this is one of key elements for non destructive assessment of structural integrity.

Nevertheless, the modal analysis of circular cylindrical shells with general boundary conditions is rarely studied in the literature probably because of a lack of viable experimental verification. Moreover, the utilisation of existing solution procedures, which are often only customized for a specific set of different boundary conditions, can easily be inundated by the variety of possible boundary conditions encountered in practice.

A present research focusing on assessment of boundary condition effect on modal responses of circular cylindrical shells with outer diameter of OD300 and OD500 employing arbitrary boundary conditions.. A set of four cylinders per each given outer diameter with fixed thickness of 0.5 mm has been manufactured by plasma welding and tested by means of laser vibrometer (Polytech PSV400). Several boundary conditions has been applied during experimental set up as free/free, simply supported/free, pinned/simply supported and clamped/clamped in order to asses the robustness of modal responses. A numerical verification with FE code ANSYS has been given to demonstrate the accuracy and convergence of the current solutions. The modal characteristics and vibration responses of elastically supported shells are summarised and the effect of various restraining conditions over stiffness configurations has been discussed.



Keywords: Circular cylindrical shells; Modal response; Numerical techniques; Boundary conditions.

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INVESTIGATION OF WOOD BASED PANELS WITH PLYWOOD AND GFRP COMPOSITE COMPONENTS

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Plywood is extensively well known and widely employed building material, with ability to improve wood mechanical properties in planar direction. Veneers properties in longitudinal direction are close to glass fiber laminate stiffness that makes reasonable to combine these two materials for overall benefit in robust production of lightweight wood structure design for civil engineering and transport applications.

Moreover a current trend in plywood production suggests to replace the conventional formaldehyde adhesives with polymer based thermoplastic films. Such a shift in production could enable to reinforce a conventional plywood panel with thermoplastic glass fiber and *polyethylene/polypropylene* fabric composites. Such an approach offers an advantage of fast, one-shot manufacturing technology of complex parts by employing conventional hot press approach.

Current research aims to extend existing knowledge about weight reduction of wood based panels with plywood faces and glass fiber stiffeners (Fig.1), where experimental prototypes have been analyzed and optimized utilizing finite element code ANSYS and design of computer experiments. Initial study demonstrated that replacing homogeneous core of plywood boards with rib stiffened hollow core, it is possible to reach up to 45 % weight reduction by simply substitution massive core with plywood stiffener ribs and up to 65 % weight reduction with glass fiber stiffeners.

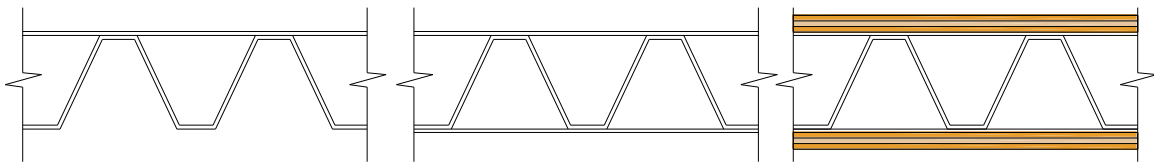


Fig. 1. Corrugated fiber reinforced core with plywood skins

The experimental investigation also revealed that plywood veneers could be successfully attached together with sheets of polyethylene/polypropylene film, which makes manufacturing process extremely versatile and reduce manufacturing foot print by using recycled PE/PP film material. Mechanical properties of unidirectional plywood bonded with PE film layer have also been determined as part of this study. The aim is to develop methodology and to verify experimentally the manufacturing process of combined wood and thermoplastic composite sandwich structures based on numerical simulation employing finite element method.

Keywords: wood based panels, thermoplastic composites, numerical modeling

DETERMINATION OF SHRINKAGE STRESSES IN CONCRETE FLOOR COATINGS

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Durability of concrete floors is nowadays a major problem in many industrial facilities. Particular attention is paid to the wear resistance of floors and therefore different surface hardeners are used to improve this property. There are situations where floor surface layer detaches from the substrate and so-called delamination takes place. The latter emerges from dense top surface and infiltrates water during the curing of concrete. Under the surface layer, air and water pockets are formed and when a load is applied the compacted floor surface layer detaches from the substrate. Surface hardeners and plain concrete are expected to have different shrinkages and should be taken into consideration as one of the reasons for arising of shrinkage stresses.

The aim of this study was to explore the shrinkage of different surface hardeners, to calculate shrinkage stresses and to compare them with shrinkage of concrete. Four series of experiments were carried out, each consisting of 12 specimens with dimensions 75×75×285 mm. The specimen was placed in the rig specially designed and manufactured for this study. The specimens were cast by adding water to the dry mixes of surface hardeners.

Determination of shrinkage was carried out by two methods: by length change measurements and by the semi-destructive hole-drilling method. The experimental procedure was carried out according to the standards (ASTM C490, 2008) and (ASTM E837-08, 2009), respectively. The hole-drilling method was used to compare the results measured by length change. It is one of the most widely used methods for determining residual and shrinkage stresses (ASTM E837-08, 2009). The modulus of elasticity was measured with strain gauges by the pressure test and the four-point bending test, because shrinkage stresses also depend on the modulus of elasticity of surface hardeners and plain concrete.

The results of the test showed that surface hardeners had higher shrinkage than plain concrete. The difference in shrinkage stresses becomes significant when a surface hardener is poured onto the hardened substrate.

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EVALUATION OF THE HIGHRISE BUILDING MODEL USING FUNDAMENTAL FREQUENCY MEASUREMENTS

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This paper proposes a potential method to evaluate degree of assumptions precision made during the finite element model construction. It is very important to precisely model the stiffness properties of the whole building in order to choose correct dimensions of the load bearing elements of the building. The finite element models of two 35 story high-rise buildings were verified with the real high-rise buildings structure using the experimental data. The two high-rise buildings' fundamental frequencies data was experimentally obtained during the different stages of the construction process. The data was compared with numerically calculated to evaluate the precision of the assumptions made during the FEM model creation process.

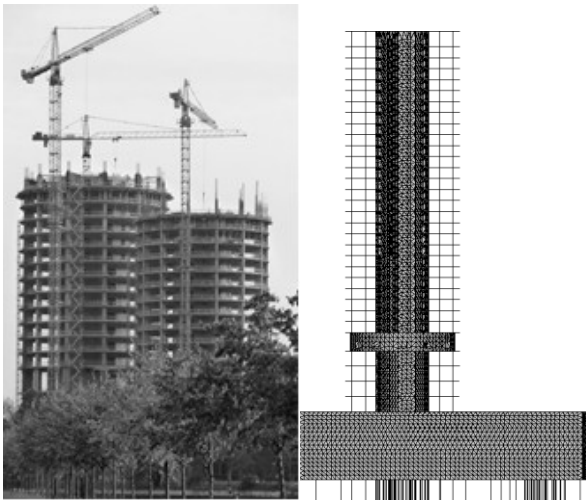


Figure 1. Multifunctional complex “Z-towers” construction process and FEM calculation model

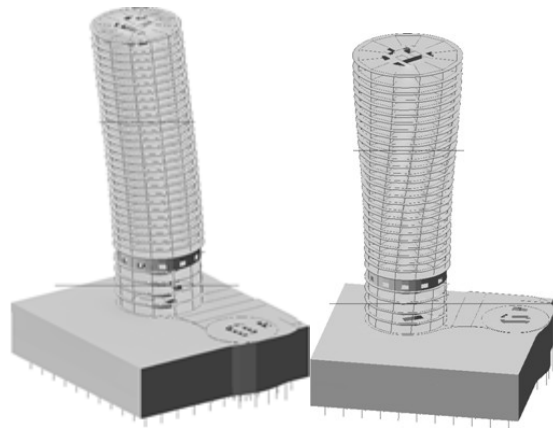


Figure 2. The FEM calculation model of the “O” tower; natural oscillations in the 1st (bending) and 3rd (torsional) modes

A simplified dynamic testing (when there is an aim to determine only the fundamental frequencies of the building) during the different stages of the load bearing structure's construction process creates the possibility to verify the existing calculation model's correspondence with the real structure's behavior. In this case if there arises a necessity the FEM model could be corrected at relatively early stage. And strengthening of the real structure can be performed before the building is finished so avoiding the extensive additional expenses. Such simplified calculation model evaluation is specifically applicable for high-rise buildings, tall towers and other similar line – like vertical structures.

PURIFICATION OF CONTAMINATED SOIL BY 'ORLANTE' PYROLYSIS PROCESS

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A contamination of soils by organic substances (oils, bitumens, petroleum spills etc.) is of importance for construction sites. The suggested approach developed by Italian-Latvian group offers an affordable recycling method for removal of contaminations from soil and ground materials by means of pyrolysis process (Lapkovskis, Mironovs, Zarins, & Codenotti, 2012)□. The purification of contaminated soil occurs when the material is heated (indirect) above 400-600 °C in a special kiln in the absence of oxygen. Thus the pyrolysis of organic substances occurs (Lapkovskis, 1999)□. The pyrolysis gas produced by the conversion of organic substances can be used as a fuel to drive the pyrolysis process. The following figures represent an overview of 'Orlante' pyrolysis process (Fig. 1.), and an internal view of pyrolysis reactor (kiln) (Fig. 2.). An average capacity of designed pyrolysis plant is 2-4 t/h.

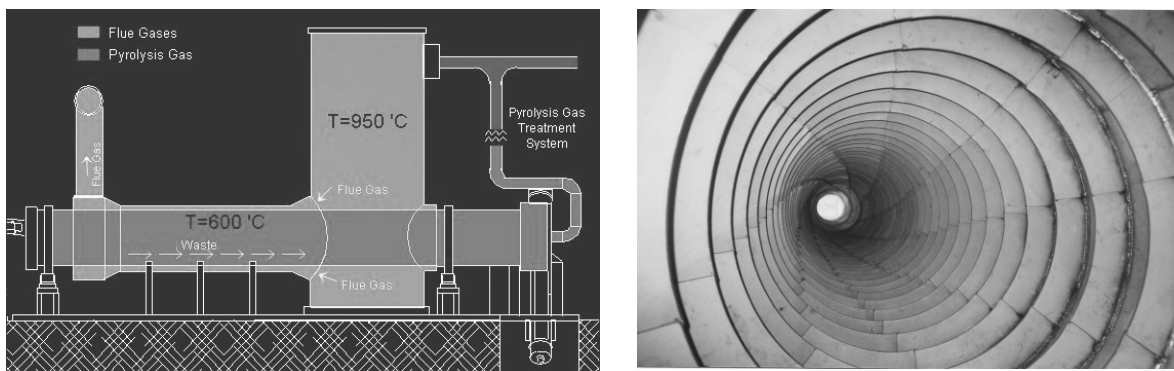


Figure 1. General principle of 'Orlante' pyrolysis process for soil decontamination. Figure 2. Internal view of pyrolysis kiln.

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BUILDING CONSTRUCTIONS MADE OF PERFORATED METALLIC MATERIALS

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The paper presents an analysis of perforated metal materials used in building construction. The information about main mechanical properties and geometrical characteristics is provided. Basic methods of modern manufacturing of perforated metallic plates and tapes are considered. Basic directions of the formation of building constructions from pre-profiled elements are provided too. New technological solutions for profiling of plates and tapes from perforated metals are proposed. Examples of the use of perforated metallic materials in building facades and other construction are given. Special attention is paid to the manufacturing of sandwich panels based on a honeycomb structure made of perforated metal tape. The estimation of the cost of production of perforated metallic materials is given.

Key words: metallic sheets and profiles, perforation, sandwich panels

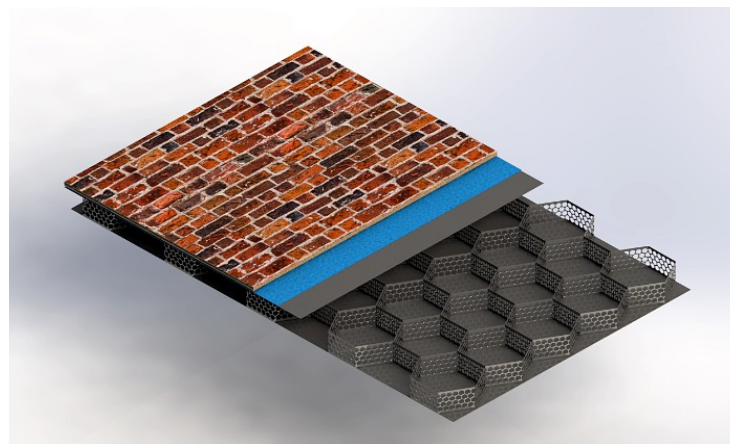


Figure 1. Sandwich panel based on perforated and profiled metal tape

POLYMER FIBER PULL OUT EXPERIMENTAL INVESTIGATION

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Advanced polymer fibers are used in structural applications as micro reinforcement in composite materials with concrete matrix. Comparing to another fibers (steel, glass, carbon etc.) polymer fibers are behaving visco-elastically or visco-elasto-plastically. Such fibers have relatively not high starting elastic modulus are characterized by relatively large elastic deformations and pronounced Poisson's effect during stretching. Concrete prisms 10x10x40cm were fabricated contained different amount of 3cm long 0,75mm in diameter polymer fibers. All prisms were tested under 4 point bending conditions and loading velocity $v = 150\text{N/s}$. First peak on the load – deflection curves corresponds to macro crack formation (in the weakest prism crosssection) and splitting the tensioned part of the bended prism crosssection. Beam midpoint vertical deflection is reaching tenth part of mm, fibers in material aren't loaded. After that fibers in crosssection start to stretch. Debonding is growing (bond is weak and each fiber Poisson contraction is high) reaching the length dependent on each particular fiber orientation to crack surface. All fibers bridging the crack are stretched (load is increasing- second peak on the curves). After that fibers start to rupture and its ends with friction are pulling out (curves after second peak). Relatively low polymer material Young modulus is leading to two peaks formation on the curves what wasn't recognized for materials with high modulus fibers. Single polymer fiber is embedded into elastic matrix and was subjected to external applied pulling load was numerically simulated. Numerical modeling was performed using 3D FEM approach. Relaxation effect was neglected and was supposed that fiber is deforming elastically. Experimental data analysis shown that the pull-out process can be divided into three stages- a) fiber pull-out with perfect bond between fiber and concrete matrix; b) fiber pull-out with partial debond (cylindrical crack) between concrete matrix and fiber, started from concrete matrix surface; c) fully debonded fiber pull-out of concrete matrix. Simultaneously simplified shear-lag analytical model (improving approach observed in Hutchinson et al., 1990) was elaborated and executed. Simulations results were compared with performed pull out experiments. Comparison was allowed to obtain numerical values for micromechanical process- friction coefficients on the fiber/matrix interface during fiber sliding motion with friction out of concrete matrix. The results of the numerical modeling were compared with experimental data and were discussed.

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V ENVIRONMENT AND ENVIRONMENTAL EFFECTS

COMPARISON OF MUNICIPAL SOLID WASTE CHARACTERISTICS AFTER SEPARATION BY STAR AND DRUM SCREEN SYSTEMS

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The research provides the results of experimental work in the waste mechanical pre-treatment in Latvia. The goal is to detect and to compare the main parameters of sorted waste parts after separation by star screen and drum screen systems. Samples were taken in three fractions - coarse, medium, fine from star screen system and coarse, fine, RDF from drum screen system. The parameters – upper, lower heating values, moisture, ash content, S, Cl, metals were determined. Results - the waste content of the fine fraction after star screen system pre-treatment has less additional material, than after drum screen system pre-treatment. The coarse fraction after star screen system pre-treatment contains high calorific power raw material for production of alternative energetic material. However this fraction needs an additional separation if drum screen system pre-treatment is used for it. The same is necessary for the medium fraction after star screen system pre-treatment.

The most part of waste in Baltic States is not sorted and is landfilled [1]. According to national statistics the total amount of disposed solid waste in 2010 was around 634.000 tons and the largest part of it - 94.3%, consisted of unsorted household refuse and similar waste material. The production of alternative fuels is one of the ways to reduce the waste amount for landfilling. The used method to reduce the organic waste disposal is pre-treatment of unsorted mass before its disposal. Automatically sorting by star screen and drum screen sorting lines were investigated as the pre-treatment method. Sorted waste quality as solid recovered fuel is depending on their content, humidity and other factors. The best solutions were detected for pre-sorted wastes contained small quantities of biodegradable waste and humidity. The mechanical pre-treatment of solid municipal waste was detected as perspective method for improving the sorting properties of waste.

Solid municipal waste landfill *Daibe* is the first waste mechanical pre-treatment centre in Latvia equipped with mechanical shredder, screener and metal separator. The screener (star screen) – model of Komptech Multistar L3-Flowerdisc – with screen sections: 0/10...25 mm; 10...25 /60...80 mm; >60...80 mm.

Sorting and reloading station of waste *Vibsteri* is equipped with mechanical shredder, screener, metal separator, manually sorting line and cutting mill. The screener (drum screen) – model of Technobalt DS-6000 – with screen: 60x60 mm.

Acknowledgement to the European Social Fund (ESF) agreement No: 2009/0180/1DP/1.1.2.1.2/09/IPIA/VIAA/017 for the doctoral research grant award to the first author.

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FORECAST FOR DRAINAGE RUNOFF AT DIFFERENT THICKNESS OF HUMUS SOIL LAYER

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Drainage runoff size and duration affect the humus layer thickness: in the control field, with natural humus content (up to 30 cm) frequency curve is steeper, and shorter than outside with the artificially thickened humus content (up to 50 cm).

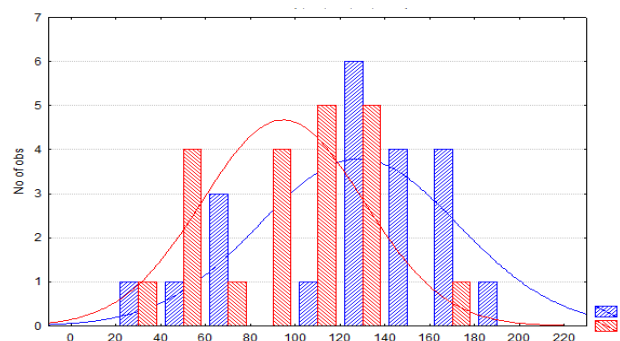


Figure 1. Runoff frequency curve

Analysing the drainage runoff during a twenty-year period between the annual values outside with the artificially thickened humus content (up to 50 cm) and in the control field, with natural humus content (up to 30 cm), a statistically significant difference ($p < 0.005$) was defined.

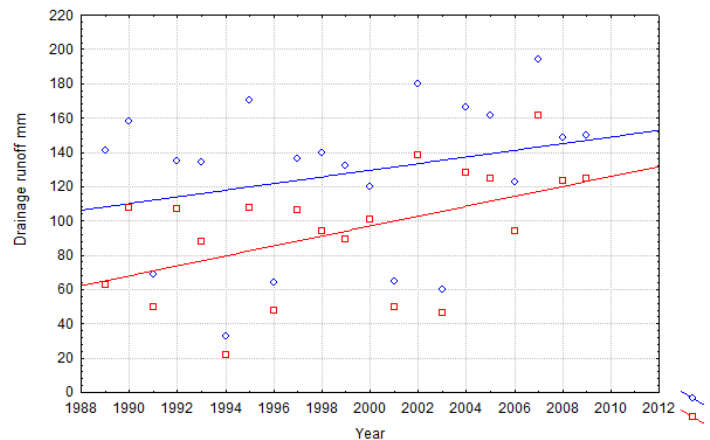


Figure 2. Annual runoff and the linear trend

In Figure 3 the predicted runoff is presented, in case the temperature will increase to 2°C (a) or 5°C (b), and the average annual rainfall increases 100mm.

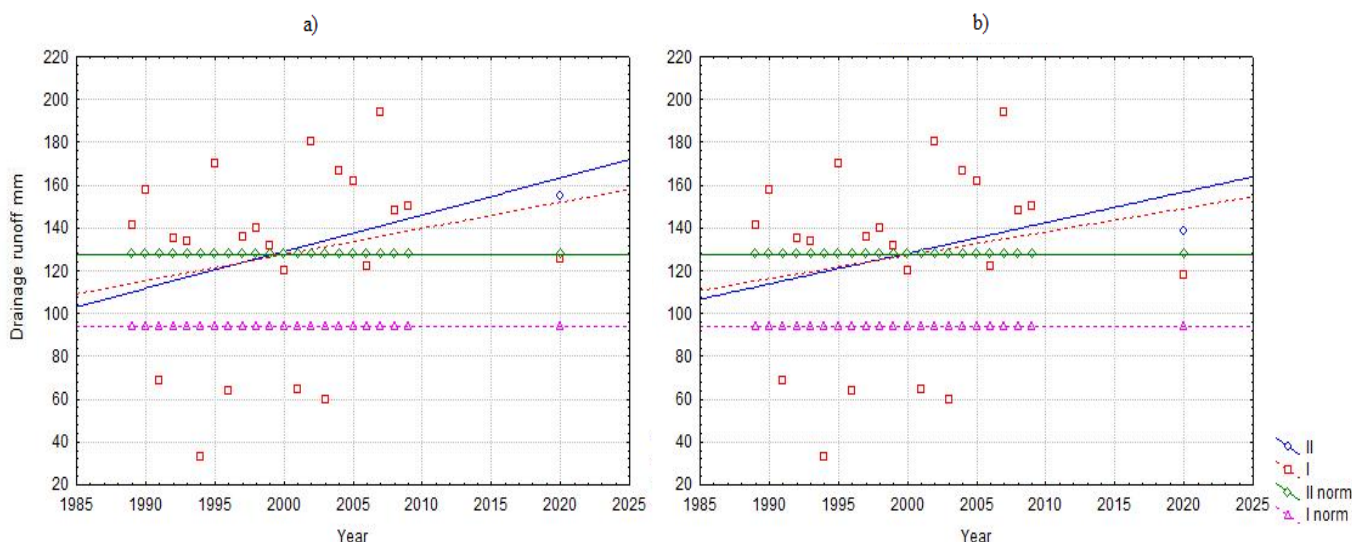


Figure 3. Predicted annual drainage runoff a) the temperature will increase to 2°C, b) the temperature will increase to 5°C

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GROUND TEMPERATURE REGIME IN THE COWSHED ENVIRONMENT

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The investigations of the ground temperature fixings in the cowshed building environment and under the building are presented in the article. Ground temperatures have been fixed on the surface and in various depths up to 2 metres. Ground surface and premise's air temperatures have been fixed inside the building. Three temperature fixing borings have been arranged inside the building and as many outside. The temperature has been fixed in 5 points and in various depths of every boring.

With the help of the ground temperature fixings in the premise of the cowshed building's animal resting-place, it has been determined that in winter time the temperature from the floor surface distributes from 20°C up to 14°C. It is influenced by outside and inside air temperature as well as by animal's heat removal to the ground surface. The more vivid ground temperature variation of the building environment is noticeable in the depth of up to 2 metres. The fixed ground temperatures in the boring (which is moved away from the building in 5 metres) showed that climate influences the temperature distribution most of all.

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HIGH STRENGTH WASTEWATER TREATMENT PROCESS SIMULATION

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Although researchers and engineers are continuously striving to enable quicker and more individualized wastewater treatment processes control solutions. The development of the process models is a long road with calibration and validation, and online data supply as they are dynamic systems, introduces another level of sophistication.

The existing mathematical wastewater treatment models gives a forecast for treatment results under various flow and pollutant circumstances, but results still are dissatisfied due to changeable dynamic of pollutants, which reflect to the treatment system directly.

The investigation was done for existing wastewater treatment plant with moving bed biofilm reactor (MBBR) process, which offers the specific advantages of biofilm system in treatment of high strength wastewater, which is unique adaptation of moving biofilm media.

The basic research was undertaken to analyze and verify a model that can be applied to this pharmaceutical factory wastewater treatment plant and similar for high strength wastewater treatment.

The future investigation is proposed to use of BW Controller which links to mathematical simulation model configuration and allows specification of range of process control features, such as O_2 , ORP, NH_4-N , commonly possible to employ in wastewater treatment systems. The online controller function introduces another way of understanding into wastewater treatment process management.

Keywords: Wastewater treatment, process simulation and control, biofilm.

LIMIT DEFORMATIONS OF RETAINING WALLS IN LITHUANIAN HYDROSCHEMES

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In accordance with Standard STR 2.05.04:2003 all deformations of hydraulic structures are divided in two groups: 1) main – deformations of whole structure and 2) local – deformations of joints, supports, etc. Retaining walls of the used hydraulic structures are under the influence of climatic conditions, water, soil pressure and other types of loads. Deformations appear because of the aggressive environment and the load influence. The aim of the work is to evaluate the limit deformation of retaining walls on hydroschemes.

The state of 14 reinforced concrete retaining walls of hydroschemes was evaluated during the scientific expedition in the period 2007–2012. Survey and commit of mainly deformations of retaining walls in hydroschemes in Kaunas, Marijampolė, Kėdainiai, Panevėžys, Šilutė districts.

Key words: retaining walls, limit deformation, hydroschemes.

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PHOSPHORUS REMOVAL BY CA-Fe OXIDE GRANULES IN A HORIZONTAL FREE FLOW FILTER

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Nutrient pollution causing eutrophication in many of our waterways is an important problem to be solved either reducing phosphorus losses in agriculture or increasing retention in streams and wetlands. Phosphorus (P) is one of the nutrients causing eutrophication. In agricultural drainage waters one possible solution is to reduce nutrient load with wetlands in combination with management applying suitable sorbents for phosphate removal, i.e. using so called active wetlands.

The aim of the present study was to test Ca-Fe oxide granules as a potential P sorbing material for phosphorus removal under laboratory and field conditions. Secondly, the aim was also to develop and to test filter system for free flow conditions.

Sachtofer PR Ca-Fe granules were selected for the experiment. The capacity of the granules to adsorb P was measured in the laboratory using batch experiments. With the highest inlet concentration 50 mgP l⁻¹ the removal per mass unit was 0,48 mgP g⁻¹. The kinetic absorption experiment was conducted for a period of 600 hours receiving the adsorption up to 1,28 mgP g⁻¹. The adsorption mechanism of phosphorus on to Ca-Fe oxide was described also by the Langmuir isotherm revealing extremely high adsorption capacity.

In addition to the laboratory tests, sorption of P to the Ca-Fe oxide granules was examined at a small- and full-scale field experiments in Rahinge ditch in southern Estonia. The water quality of Rahinge ditch was monitored over a two year. The total phosphorus and phosphate concentration ranged from 0,08-0,63 mg/l and 0,08-0,61 mgP/l, respectively, indicating a significant level of pollution.

The small scale field experiments was carried out in a 7,5 m long constructed flume with horizontal flow applying five different phosphorus concentrations ranging from 0,28 to 1,48 mgP l⁻¹. The experiments with horizontal flow over the flume bed covered with Sachtofer granules showed that phosphorus removal efficiency was 11-91%, depending on flow rate and contact time.

The full-scale field experiment showed that phosphorus removal efficiency was only 4-25%, depending on contact surface, contact time and biological processes in the ditch. It was found that the growth of algae on the surface of granules affected negatively on the retention processes.

Although complex laboratory methods and numerical models are available to estimate P retention, an understanding of P retention in the real conditions or/and at the process level is important, providing a valuable data for designing a filter systems capable effectively and long term to purify polluted waters.

PREPARATION OF COAL-WATER SLURRIES BY MEAN OF HIGH-SPEED MIXER-DISPERGATOR

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Is known, that water-coal slurry is used as fuel. Burning coal in a coal-water slurry has a number of economic, environmental and operational benefits compared to pulverized and especially bed firing. Creation of fine coal-water slurry by direct mixing is difficult. Weak wetting coal particle by water results of poor distribution of solid particles in the water. Dust waste formed during grinding of coal grade D in the production of coal briquettes can not be recycled in its entirety, for various reasons, and accumulate, creating a significant environmental problem. Thus a study to address the energy and environmental problems simultaneously.

The main way of mechanical dispersion of coal is wet milling in the rotating ball, rod or vibrating mills, various mixers, dispersers, such as a propeller mixer, rotary-pulsation apparatus, etc.[1]. Their drawback - the inability to get a fine suspension. To solve the problem in the present study was used method of preparing water-coal slurry by means a high speed mixer-disperser. The method is based on the dynamic effects of a liquid medium by multiple shock-wave, produced by dispergator parts elements. Due cavitation effect, called on the formation of bubbles in the liquid (cavities) by local reduction of pressure in the fluid. [2] In the zone of influence of the work item dispersing a liquid medium having multiple events simultaneously blow, ultrasonic vibration and cavitation. For experimental studies have proposed the construction of a high-speed multi-disc mixer-disperser. Considered design features and different geometric solutions work items mixer-disperser create optimal cavitation for coal-water slurry. Experimental studies were carried out on the waste coal dust obtained in Latvia. Obtained by processing disperser coal-water slurries segregational stability maintained for a long time (at least 2 weeks). This reduces the particle size of the solid phase was observed.

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CALCULATION OF RAINWATER SEWAGE SYSTEMS

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Rain intensity is highly variable, making it difficult to accurate calculation of runoff and the flow rate, that result in periodic flooding of streets and squares disturbing traffic and making material damages. Developed rainwater system calculation method capable of determining the rainfall maximum flow rates of different surfaces with different surface probability (1-200%) in the whole Latvian territory. Maximum stormwater flow rates determined according to the expression on basic A.Ziverts formula(1) that refreshed by R.Ziemelnieks on thesis work:

$$Q_{\max} = q \cdot k \cdot F \cdot \Psi \text{ [m}^3 \text{ s}^{-1}\text{]} \quad (1)$$

where: Q_{\max} - max 20 minutes rainfall flow rate, $\text{m}^3 \text{ s}^{-1}$;

q – runoff module $l \text{ (s} \cdot \text{ha)}^{-1}$ calculated using the formula E.Tilgalis;

k – the coefficient depending on the probability of calculation;

F – the surface run-off area to be calculated, ha;

Ψ – surface runoff coefficient (0,1-0,95% depending on the surface).

Gully between placing distance ridged edge of the road is determined by the following expression:

$$L = t \cdot v \cdot e \cdot \omega \cdot l \text{ [m]} \quad (2)$$

where: L - the distance between two adjacent intermediate gullies;

t - water flow by the time from gutter (by LBN 223-99 3-5 min);

v - water flow speed(m/s);

e - grates effectiveness of collect rain water;

ω - crossectional area of the water grates, m^2 .

Rainwater diversion gravity self-flow collector internal diameters calculated assuming full pipe filling and a minimum allowable internal pipe diameter of 250 mm (200 mm usually use for inside section nets) to calculate the minimum pipe slope (LBN 223-99), which will challenge self-cleaning process of the pipe systems using expression:

$$Q = \omega \cdot v, \text{ m}^3 \text{ s}^{-1} \quad (3)$$

$$I_{\min} = \tau (\rho g R)^{-1} \quad (4)$$

where: ω - cross sectional flow area, m^2 ;

v - flow speed, ms^{-1} ;

τ – flow traction, N m^{-2} ;

ρ – specific gravity of waste water, kg m^{-3} ;

g - acceleration of free fall m s^{-2} ;

R - filler of pipe hydraulic radius, m.

WASTEWATER TREATMENT EFFICIENCY IN CONSTRUCTED WETLAND IN TERVETE, LATVIA

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Constructed wetlands are widely used for the wastewater treatment in different climatic conditions. It is not very popular in Latvia to use traditionally constructed wetlands for treatment of the domestic wastewater. In order to promote assessment of the efficiency and sustainability of the different components of constructed wetlands several pilot projects started in Latvia since 2003. However, mistakes in the implementation of projects could be critical to accomplishing the goal of efficient water treatment in wetlands. One of the first implemented projects is subsurface flow wetland for treatment of domestic wastewater in Tērvete. Wastewater from baths, showers, sinks and WC's of rehabilitation centre "Tērvete" flows directly to septic tank with volume 30 m³ and after sedimentation is pumped to the sand filter with an area of 1200 m² vegetation cover on the surface. The treated effluent discharge is in the Tērvete River. The peak daily flow rate is 58 m³ per day.

To control the efficiency of the wastewater treatment, water samples were collected at the inlet and outlet of the constructed wetland. The sampling was performed occasionally; regular monitoring programme was not implemented. In terms of year 2004 - 2010 14 samples were analysed. The parameters analyzed included biochemical oxygen demand, chemical oxygen demand, suspended solids, phosphate phosphorus, nitrate nitrogen, ammonium nitrogen, nitrite nitrogen and pH. Wastewater analyses were performed in the Laboratory of Latvian Environment, Geology and Meteorology Centre according to the standard methods. For estimation of data series of the water quality parameters the mathematical data processing with the Wilcoxon test analysis is used.

DISUSED WATERWORKS OF LATVIAN RIVERS

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The Latvian government making new Cabinet of Minister rules, not used waterworks on the Latvian rivers, but at fact reconstruction of building management does not happen. Studied and incorporated into construction evaluation methods evaluated abandoned sluice threat to the environment. We have studied the potential unmanaged sluice monitoring and management issues and the necessary legislations.

Latvian territory for 800 years ago began building hydraulic structures to use water energy for mostly to process the grains. For hundreds of years, and tens of buildings during the operation of the building wear, a few crashes. Two world wars and socialist farming stop for practical use. Nowadays they are on standby regime to waiting construction activities. Structures are not managed by creating unpredictable accident risks for an example in mainly spring floods and after catastrophic rainfalls.

So far, Latvian virtually unmanaged made dams and hydraulic structures technical assessment of the situation. However, this is necessary. First of all, it is particularly important to identify abandoned hydraulic structures, which are subjected to accident risks the most. Unmanaged and abandoned sluice threat to the environment can be assessed by examining the construction of the technical state of nature. We can offer some construction of the recommendations for monitoring and control of old hydraulic structure buildings (HSB).

Former water mill sluice and construction Latvian economic development must be assessed as very significant technical and cultural heritage. Revival of the old mill buildings attractive option is to allow there to restore a small hydro-electric power plants, the documentation into the necessary action, conditions and responsibility for the management of HSB.

LEGIONELLA BACTERIA SPREAD IN CLOSED WATER SYSTEMS

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Legionella is one of the fresh waters normal flora bacteria. On the water taking the tank for hot water systems, these bacteria can be reached by passing through the city, village drinking water supply, preparation station. The water supply network is a favorable environment that encourages the growth of bacteria. Human infection most commonly occurs through inhalation of aerosols contaminated with legionella, which spreads in bathrooms with hot water vapor. Other sources have whirlpool baths, air conditioning and humidification systems etc. This bacterium causes legionellozi - a rare form of pneumonia, and Pontiac fever - a flu-like illness. The most ill travelers, hospital patients, the elderly and children, as this group of people the immune system has not had time to develop resistance to the flora or is weakened. The worldwide spread of disease depends on the geography of the country, building operating practices and other factors.

Legionella bacteria in the hot water supply systems in Latvia for last years are increase. This is due to the disease symptoms sound detection, identification methods improvement recorded in a single implementation and to distinguish this disease from other diseases with similar symptoms. More cases recorded in the Latvian capital of city - Riga, where the population density is higher, and it is well beyond the centralized water supply networks and a higher risk of developing Legionella bacteria. Since the likelihood of bacteria grow in hot water systems in each house, it is necessary to determine in detail why only some buildings there is a presence, what factors have intensified. Legionella is seen as the main drinking water pathogens in developed countries. This topic is one of the most studied problems in the water sector research, but few studies Latvian. In-depth research would be possible to explore a variety of water sources and systems to determine the presence of bacteria in hot water systems Latvian.

The study shall be required to use the classic methods and the Legionella bacteria detection contemporary - molecular detection method. This type of examination zoom in and confirm a more accurate study of the results of the reliability and value. The study aims are to present proposals for water suppliers, property managers, district heating companies, local governments and the public on the safe supply of water from the water source to the end user to avoid entering the Legionella bacteria in hot water systems.

The aim of research are:

- 1) Water resources quality assurance from the start of source till the end of user.
- 2) Drinking water development Latvian improvement in relation to the quality of the water supply from the water intake sources.
- 3) The water supply system of the current state of improvement and development nowadays.

Purpose - to examine various Latvian natural water bodies and drinking water in a closed system to determine the initial concentration of Legionella in cold drinking water system. In low temperature in hot water systems failures due to high concentrations of Legionella bacteria.

VI INDUSTRIAL ENERGY EFFICIENCY

DEVELOPMENT OF INDUSTRIAL ENERGY EFFICIENCY IN LATVIA, LEGISLATION AND STATISTICS FOR INDUSTRIES IN LATVIA: LEGISLATION AND STATISTICS

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Overview

This article analyzes the legislation of the Republic of Latvia and available statistical data about industrial energy efficiency. The European legislation in the sector of industrial energy efficiency is reviewed and compared to the Latvian legislation. LR and EU statistics is summarized, data of OECD countries in respect of energy consumption by industries and savings estimates are informatively reviewed. Latvian industrial energy efficiency scenarios are estimated based on EU and OECD studies. Recommendations include the need for a more detailed analysis of data on industrial energy consumption by sectors, strategic choice of a best available technology (BAT) development scenario; and the need for support measures in the SME sector.

Background

Energy efficiency legislation for industrial companies in EU and the Republic of Latvia
Statistical indicators in energy efficiency in EU, OECD and Latvia

Content

The analysis of European and Latvian legislation on energy efficiency in industries;
The analysis of statistical indicators in energy efficiency in countries of the European Union, OECD and the Republic of Latvia;
Review of development scenarios and recommendations.

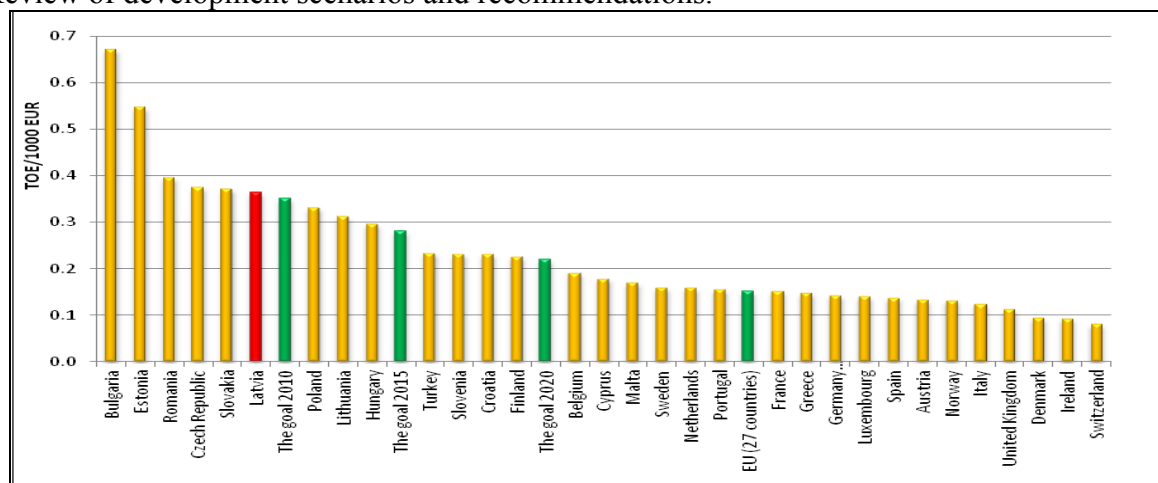


Table 1. Example of Energy Intensity per GDP (toe. vs 1000 Eur GDP, source Eurostat)

References

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

See all references in the full article.

THE ANALYSIS OF ENERGY USE AND REDUCTION POTENTIAL IN INDUSTRIES

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Overview

This paper presents status quo analysis of the situation in energy use in Latvia, by industrial fields, and potential for energy savings in future. As a background, the overview of energy use for industrial sectors is given, as well as the analysis of successful projects in specific industries. The future scenarios are given both for short-term and long term strategies. Recommendations set the roadmap to sustainable energy efficiency strategies.

Background

Overview about industrial energy consumption, given for major industries;
The methodology used for the survey;
The analysis of KPFI (Green Investment Scheme) projects.
The identification of Latvian enterprises with higher rate of energy consumption;
The number of large enterprises as a target group for the Energy Directive 2014.

Forecasts

The analysis of potential energy savings per industries, forecast of investments and CO₂ reduction;
Identification of main problems;
Proposal of action plan, the future scenarios and recommendations.

References

To be included in full scientific paper.

INDUSTRIAL ENERGY EFFICIENCY CASE STUDIES IN LATVIA: 2010-2013

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Overview

This paper presents methodology and case study about reduction of energy consumption in several operating industrial plants. The case studies are performed by use energy calculation tools, documentation and monitoring of project activities. The improvement scenarios and results are given based on calculations or monitoring results.

Background

Importance of energy saving in Industrial sector is characterized by two major aspects:
Large potential of reduction of energy consumption combining multiple engineering tools: improving building envelope and ventilation systems; heat recovery from ventilation systems and warm wastewater; improvement of electrical systems; change of user's behaviour; and other.

Improvement of indoor climate, both for employees and specific product lines.

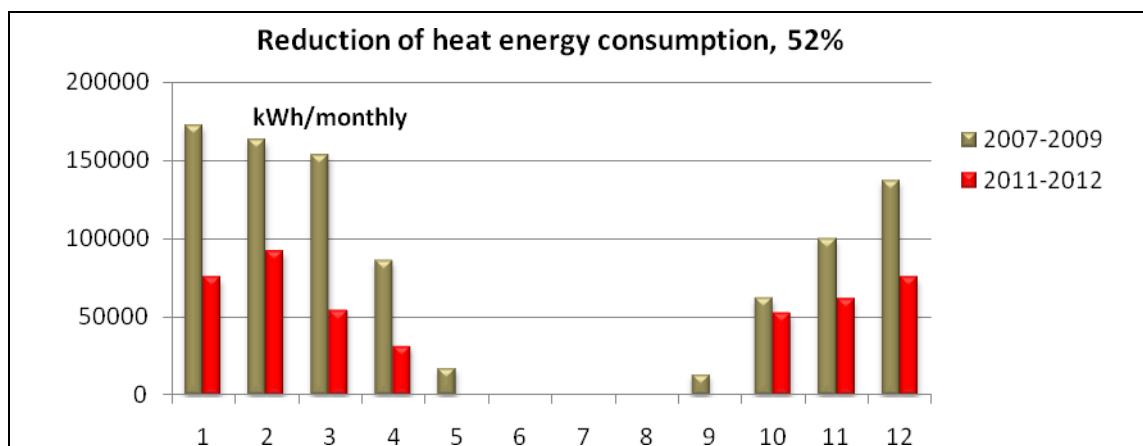
Content

Case analyses are performed, following the standardized calculation tools and methods:

The qualitative analysis of 'status quo' energy and indoor comfort, using full energy assessment method;

Improvement scenarios are calculated, including pay back analysis;

Monitoring data, photos and other evidences are collected and analysed.



Picture 1. Example of monitoring results.

ENERGY AUDITING EXPERIENCE OF INDUSTRIAL ENTERPRISES IN LATVIA

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Overview

In recent years even more activities towards improvement of energy efficiency of industrial buildings in Latvia have been performed. The energy audit for industrial buildings, comparing with the regular procedure of the energy audit for residential or public buildings, implies more complicated approach to analysis of energy consumption and prospective energy saving actions. The main cornerstone of this energy efficiency trend in manufacturing enterprises in Latvia is related with the access to EU structural funds. One of the main activities of this particular support programme is the performance of energy audits for industrial buildings in accordance with the report scheme being developed by the Ministry of Environmental Protection and Regional Development of the Republic of Latvia. Today the given report scheme is the sole official document in Latvia defining the evaluation scale of energy efficiency for industrial buildings. Taking into account the experience of the energy audits being recently performed for several industrial enterprises, it can be concluded, that the existing report scheme is not fully reflecting the actual balance of energy consumption and therefore it is not flexible when drafting the plan of prospective energy efficiency improvement measures. Both the content and form of the given report scheme derives from the energy audit methodology being used for residential and public buildings, thus, not covering the following aspects as the production and technology processes associated with industrial buildings.

Content

This paper provides the analysis of energy audit methodology and report schemes for existing industrial buildings, taking into account the amount of data output, prospective actions and grouping of various energy efficiency measures. It also describes the competence of reporting energy audits being performed for industrial buildings in Latvia within the framework of the state supported project for energy efficiency improvement. Proposals for improvements and supplements to be included in the energy audit methodology and report for industrial buildings have been made.

References

Canadian Environmental Agency (CEA) (2010) Realizing Potential of Energy Efficiency
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ENERGY AUDIT METHOD FOR INDUSTRIAL PLANTS

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Overview

Different studies have shown that there are opportunities for significant energy efficiency improvements for industrial sector. Many of which are cost effective. These energy conservation options are general and also niche specific. Energy audit is the first step to in order to discover possibilities of energy savings prioritize projects and track progress after investments.

Industrial energy audit consists of 5 steps:

Introduction with the factory. Task – obtaining information about products manufactured, about the system itself and condition of building envelope and overall equipment wear.

Workflow and energy scheme. Creating schematic drawing of the process happening in the factory thus understanding the energy flow.

Collecting data of manufacturing process. The most time consuming task. This task must be done together with employees of the company in order to acquire the best possible viewpoint.

Benchmarking. Comparing obtained data with data from similar companies across Latvia or Europe.

Defining the problem and creating plan of action.

Background

Significance of energy audits for industrial plants can be emphasized by three main points:

Possibility of significant financial savings;

Improvement of manufacturing process quality and thus improving competitiveness through decreased energy consumption per one production unit;

Improvement of working conditions and increased productivity.

Content

This paper provides guidelines for energy auditors, plant or industrial park owners and managers regarding the main elements for preparing for an energy audit, measuring energy use, analyzing bills, benchmarking, analyzing energy usage patterns, identifying potential energy efficiency opportunities, conducting cost-benefit analysis and preparing energy audit reports.

References

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All of information sources are included in full paper.

ENERGY EFFICIENT ELECTRICITY USAGE AND LIGHTING SOLUTIONS FOR INDUSTRIAL PLANTS

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Overview

In recent years, there is a growing interest about energy efficiency and conserving environment in general. The study aims to evaluate industrial plant energy usage patterns and possibility of improvement. Technologies that are used in industrial plants are old and there is space for improvements. Lighting systems are inefficient and isn't meeting today's standards. New methods of energy management and usage habits are needed.

Industrial energy auditing method attempts to resolve differences among various auditing approaches. There are three main issues that have caused problems with performance monitoring of energy audit results and measures taken in the past.

Standardization: Standard performance metrics provide a consistent basis for comparing energy performance among buildings;

Versatility: The analysis is customized to the facility boundaries, energy configuration, goals and budget of analysis that apply to a given project;

Economy of Effort: The data collection is carefully matched to the goals of the analysis and the study questions to avoid the common mistakes of too few or too many data.

Each procedure in this series should be done according to a standardized protocol that helps to quantify performance metrics.

Manufacturing and construction industries are the third largest energy consumer in Latvia after household and transport branches. Energy consumption in manufacturing and construction industries in 2007, 2008, 2009, and 2010 years were as following 16.6%, 16.4%, 16.2% and 18.3% of total energy consumption in Latvia. Energy efficiency measures are usually applied in order to maintain or increase competitiveness in given industry

Content

Conventional electricity distribution systems are very complicated and extensive, but almost entirely passive, with little inter-communication and very limited control ability. Only the biggest consumers have commercial electricity monitoring systems either by voltage or by drawn current. The interaction between consumer loads and power system itself is very poor.

The focus on improving the efficiency of electric lighting has the potential to be one of the most significant short-term initiatives to decrease power consumption and CO₂ emissions.

References

Canadian Environmental Agency (CEA) (2010) Realizing Potential of Energy Efficiency

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Ekonomikas Ministrija (EM) (2011) Latvijas enerģētika skaitļos, Latvian Energy in Figures

All of information sources are included in full paper.

SUSTAINABLE BUILDING POSSIBILITIES AND THE PRACTICE IN THE INDUSTRIAL SECTOR

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Overview

The presentation will first provide a general overview of sustainability in the building sector including the importance of decision-making and cooperation during the concept/ design/ building/ operation phases. It will also give an overview of sustainable building certification systems and possibilities in Latvia. As a second step, the presentation will shift the focus to the industrial sector and will discuss the sustainability on the basis of case studies.

Background

The importance of achieving sustainability in the building sector cannot be exaggerated due to the sector's large influence on the energy, material and other resource consumption throughout Europe and the rest of the world. Sustainability certification systems are one of (many possible) motivators towards sustainable building practices. To reach a sustainable result, timely decision-making and cooperation among all of the parties involved is an essential factor.

Content

- General overview – sustainability concept and it's components;
- Role of timely decision-making and communication;
- Sustainable building certification systems and possibilities in Latvia;
- Sustainable building case studies – industrial sector.

MODELS OF FINANCING FOR INDUSTRIAL ENERGY EFFICIENCY PROJECTS IN LATVIA AND EUROPE

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Overview

This paper will focus on case studies of existing financing solutions for energy efficiency projects in industrial plants in Latvia as well as on praxis of application of different third party financing schemes (mainly EPCs (Energy Performance Contracts) used by ESCOs (Energy Service Companies)) throughout the European Union (EU) countries. The paper will propose adaptation scenarios for the use of EPCs to finance energy efficiency projects in industrial plants in Latvia.

Background

During last 10 years costs of fossil fuels in Latvia have tripled. Thus many manufacturing companies have been motivated to seek for solutions how to deal with growing energy pricing. Additionally the availability of state grants for complex energy efficiency solutions in industrial plants have motivated many leading industrial companies to develop and implement different energy saving measures. On other hand, many industrial companies lack free capital to be able to finance large scale energy efficiency projects themselves. Therefore there has been growing need for adapting worldwide known third party financing solutions like the EPC.

Content

The first part of paper will focus on description and analysis of existing financial solutions for industrial energy efficiency – bank financing products, state grants and state issued warranties. The second part of the paper will review the praxis of application of third party financing tools, especially the EPCs in various countries of the EU. The final part of the paper will discuss the possible scenarios of development of third party financing tools for industrial energy efficiency projects in Latvia.

ENERGY CONSUMPTION AND ITS REDUCTION POTENTIAL IN LATVIAN INDUSTRY SECTORS

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Overview

This article compares the distribution of energy consumers by industry sectors in Latvia. The analyses of manufacturers that have received state support within the Climate Change Finance Instrument (CCFI) programme are examined by their industry sectors. The planned savings structure is compared to statistical indicators of OECD countries, European Union and Latvia. The distribution of planned measures by types of energy efficiency is examined, savings are compared. Article provides an example of planned and achieved results of two companies based on the monitoring data at the disposal of the authors. A more detailed statistics by sectors, surveys of companies that have not received state support and ETS companies are required.

Background

The identification of Latvian enterprises with higher rate of energy consumption;
Overview about industrial energy consumption, given for major industries;
The analysis of CCFI (Climate Change Finance Instrument) projects;
The analysis of EU and OECD statistics.

Content

Structure of energy consumption in Latvia and sectoral breakdown of companies receiving CCFI support;
Analysis of energy saving by types of energy and industry sectors;
Comparison with EU and OECD statistics; industrial building age factor;
CCFI energy saving analysis: percentage and measures; two study cases;
Conclusions and recommendations.

References

Altmann M, Michalski J, Brenninkmeijer A, Tisserand P.(2010), European Parliament: Overview of Energy Efficiency measures of European industry. [online] [accessed on 24.01.2013.]
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See all references in the full article.

ENERGY EFFICIENT ELECTRICITY USAGE AND LIGHTING SOLUTIONS FOR INDUSTRIAL PLANTS

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Overview

In recent years, there is a growing interest about energy efficiency and conserving environment in general. The study aims to evaluate industrial plant energy usage patterns and possibility of improvement. Existing electrical systems at factories are inefficient judging by today's standards. Technologies that are used in industrial plants are old and there is space for improvements. Lighting systems are inefficient and isn't meeting today's standards. New methods of energy management and usage habits are needed.

Topic is divided in two main parts with subsections:

1. Efficient energy usage and distribution:

- Electricity distribution system including transformers, switches and contacts
- Motors and drives
- Fans and blowers for manufacturing process
- Pumps and related systems
- Compressors and compressed air
- HVAC systems and chillers
- Refrigeration and cooling towers
- Suitable and efficient lighting systems

2. Energy efficient lighting

- Lighting for increased productivity
- Lighting energy efficiency
- Comparison of lighting elements

Content

Studies have been carried out to determine the energy usage patterns and lighting conditions of industrial plants. Based on the analysis list of recommendations for increasing energy efficiency and improving working environment has been made.