

## STRESZCZENIA

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### ANALYSIS OF CABLE DOME UNDER VARIOUS INITIAL CONDITIONS

The paper focuses on the numerical analysis of Levy cable dome under two various initial conditions. Experimental device of cable dome is equipped with 7×7 wire ropes with diameter  $\phi$  6 mm. Nevertheless, it is completely changed for 1×19 wire ropes single strand with diameter  $\phi$  4 mm. The interchange could lead to creation of more adaptive structure for further static and dynamic analyses. Furthermore, it is essential to stress out that force gauges will improve accordingly.

**Keywords:** cable dome, active member, stiffness, tensegrity

*Przesłano do redakcji: 24.09.2017 r.*

*Przyjęto do druku: 31.03.2018 r.*

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### SYNTHESIS OF KAOLIN-BASED ZEOLITE Y AND ITS APPLICATION FOR ADSORPTION OF TWO CARBONYL COMPOUND GASES

The aim of the study was to synthesize zeolite Y based on natural clay mineral and to determine its potential for adsorption of carbonyl compounds. The synthesis route consisted of four steps: thermal activation of kaolin into metakaolin; aging of reaction mixtures at ambient temperature; crystallization of the reaction mixture; washing and drying of the final product. The reaction mixture consisted of metakaolin silica gel (SiO<sub>2</sub>), sodium chloride (NaCl) and sodium hydroxide (NaOH). All substrates were used at an intended molar ratio. The physicochemical properties of the synthesized adsorbent were attained through the advanced instrumental analysis. The adsorption of acetone and methyl ethyl ketone (MEK) on synthesized zeolite as well as on four commercially available adsorbents and three natural materials was examined in a dedicated home-made installation. The results showed, that the synthesized zeolite Y has the highest affinity for acetone over other adsorbents, while its affinity for MEK is only a little lower than AC.

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Additionally, adsorption isotherms of acetone and MEK on zeolite Y were measured on a gravimetric balance. Experimental binding isotherms were fitted by a non-linear regression to five empirical equations. In both acetone and MEK cases, the best results of statistical tests were obtained for the Marczewski-Jaroniec model.

**Keywords:** adsorption, acetone, methyl ethyl ketone, Y zeolites

*Przesłano do redakcji: 10.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## SHARP-CRESTED WEIR HEAD LOSSES INVESTIGATION

The work is devoted to the rectangular sharp-crested weir calculation methods improvement. This can be realized by using mathematical model developed on energy and momentum conservation principles. In order to get energy conservation equation within sharp-crested weir we have to know weir head losses. This article presents theoretical and experimental investigations of the sharp-crested weir head losses. The height of the weir plate  $p_w$  and weir head  $H$  are estimated as main operating factors that determine hydraulic weir outbound parameters: threshold depth  $h$  and the specific weir flow  $q$ . The flow moving over sharp-crested weir suffers sudden vertical contraction and transforms from the uniform flow to a jet. Mentioned above, causes sharp-crested weir head losses. To determine these losses, we propose to use Hind's formula that describes similar contraction losses in the channel. Experimental investigations proved Hind's formula application adequacy to evaluate these losses. Sharp-crested weir energy conservation equation that includes head losses is determined. Graphs set out in the article disclose the influence of the main operating factors and their ratio on the relative head losses.

**Keywords:** flow energy, total head, head losses, nappe, jet flow

*Przesłano do redakcji: 24.03.2017 r.*

*Przyjęto do druku: 25.09.2018 r.*

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## EVALUATION OF THERMAL COMFORT OF THE CITY'S PUBLIC SPACES BY THE USE OF NUMERICAL SIMULATIONS

Decision making by those who play a key role in urban transformation can be supported by computer techniques. 3D-4D spatial simulations provide reliable information on the impact of spatial development changes on urban composition, microclimatic conditions and thermal comfort. Comprehensive approach to the subject of spatial changes during revitalization activities can

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contribute to guarantee high quality of life for people in urbanized areas, especially within public spaces. However, the current activities do not take into account microclimate issues, due to higher costs. As a result, an aim of this work was to evaluate microclimatic conditions and thermal sensation of people occupying two public spaces, i.e. Old Marketplace and Urban Square, which have been identified as priority areas in the process of city revitalization (Lodz). Results of studies may be presented to the local authorities to enrich analytical part of the urban development study, thus to enable appropriate decisions to be taken on land conversion.

Conducted studies have shown that microclimate of areas is strongly dependent on spatial planning method. Greater diversity of meteorological parameters, i.e. temperature and relative humidity of air is observed in the Old Marketplace. In both areas there are microclimatic conditions described as uncomfortable. In order to guarantee appropriate thermal conditions for users, it is necessary to implement changes in their structure. The authors proposed potential planning strategies aimed to alleviate the discomfort related to human presence in both public spaces.

**Keywords:** CFD simulator, urban environment, revitalization, comfort

*Przesłano do redakcji: 04.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## **WATER MANAGEMENT OF “SMART” BUILDINGS AND CITIES**

Now is the time to take our future more seriously and start providing solutions for tomorrow's world. The new notion or significant specification of the term “*BLUE to GREEN*” infrastructures in buildings in the modern information age is the expression of the sustainable development of a „smart city“ society and beyond. We introduce our experimental platforms representing different types of green roofs, green and water walls as possible solutions. These experimental sites in the University Campus were created on the basis of research dealing with green roofs and their retention qualities, as well as green walls and their impact on the microclimate and the possibility of using rain and gray water that could be filtrated through the media of these structures.

The paper describes the world-wide conditions on the basis of which this issue is up to date and addressed. The outputs from the individual measurements will be related to water cycle issues, green walls and roofs constructions.

**Keywords:** green roof, green wall, water cycle, water management

*Przesłano do redakcji: 24.03.2017 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## **MONITORING VERTICAL DISPLACEMENTS OF AN ENGINEERING OBJECT WITH MASONRY WALLS**

The paper presents a method for conducting measurements and processing the results that makes it possible to determine the vertical displacements of measurement and control network points stabilized outside and inside a building in which changes in the form of scratches and cracks on the external and internal walls were noticed. These changes were so disturbing that a number of technical opinions were issued on the technical condition of the building, the ground and water conditions as well as the location of other buildings in relation to that object. The measurement methodology is generally known, but the problem of correctly defining a reference system and estimating the values of vertical displacements still remains to be solved. Moreover, the paper presents the characteristics of the object subjected to research, its technical condition in 2006 and in 2015 as well as an analysis of the impact of a heating duct on the behaviour of the building.

**Keywords:** vertical displacements, geodesic monitoring, engineering object

*Przesłano do redakcji: 17.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## **MORET-SUR-LOING – CULTURAL HERITAGE, ITS VALUE AND PROTECTION**

This article concerns the historic town of Moret-Sur-Loing in the context of preservation and revalorisation, which are connected to its sustainable development. It is one of many examples, besides e.g. Heppenheim, Lorsch, Weinheim and Provins, of small European historic towns which can suitably use their cultural potential for their multidirectional development. The town of Moret-Sur-Loing is located to the south of Paris, in the Île-de-France region, in the department of Seine and Marne. The cultural landscape of Moret comprises mainly historic buildings with the magnificent Notre Dame church and numerous small-town houses, defensive walls with gates and a donjon, as well as the urban layout. Bridges are also important elements of the cultural landscape, particularly Le pont et l'Eglise which, together with the medieval defensive ramparts, creates a unique panorama. Although the historic heritage of the town is related to its past, it also has a great impact on the urban development. Protecting their culture, tradition, historic architecture and urban design, the inhabitants and the authorities in Moret-Sur-Loing spare no effort to maintain the former climate of a medieval town. They are aware that for the sustainable development of the town to progress properly, they ought to preserve their heritage, revalorise it and allow it to survive for next generations. The article contains the characteristics of the cultural landscape of the town of Moret in the context of its protection and preservation for future generations, which constitutes an important factor of sustainable development. The town will certainly set a valuable example for other, also Polish, small historic towns.

**Keywords:** France, town, history, cultural heritage, architecture, urban design

*Przesłano do redakcji: 18.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE ANALYSIS OF THE SOLAR POWER PLANT PERFORMANCE IN TEMPERATE CLIMATE

Due to gradual depletion of fossil fuels resources and emission of harmful chemicals accompanying the combustion process, the interest in alternative energy sources still increases. Among many kinds of alternative sources, solar radiation is very special because of its wide availability and large technical potential. Photovoltaic systems providing the electric energy are used in many countries. The most important part of photovoltaic system is a module, which parameters (e.g. efficiency, rated power, temperature coefficients of power and efficiency, short circuit current, open circuit voltage) are determined in laboratory tests under Standard Test Conditions (STC: 25°C, 1,000 W/m<sup>2</sup>, air mass 1.5). However, in real outdoor conditions the modules exhibit lower efficiency since local climate influences their performance and different external factors generate energy losses in the whole system. The aim of this work is the performance analysis of a solar power plant connected to the grid, which total rated power is 2.985 MW and it works in temperate climate in eastern Poland. Insolation in the location was estimated according to Solargis data and the role of the modules tilt angle, of which the value is non-typical for the considered location was studied. The tilt angle smaller than optimal angle allows increasing the amount of the solar radiation collected in the summer period. The electric energy production based on the inverters data in 2016 and 2017 as well as yearly yield are presented. The results are compared to data coming from other solar power plants, also located at high latitude.

**Keywords:** photovoltaics, grid connected solar plant, photovoltaic performance, inclination angle, tilt angle

*Przesłano do redakcji: 18.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## IMPACT OF GLASS AND CERAMIC WASTE ON SELECTED PROPERTIES OF MATERIALS WITH A CEMENT

The article presents the impact of selected waste materials (usable ceramics, sanitary ceramics, CRT glass cullet) on the physical and mechanical properties of cement-based materials (cement mortars). The samples of cement mortars made were 10, 20 and 30% addition of waste material. Physical and mechanical properties of modified cement mortars were compared with standard mortar. The highest compressive strength obtained mortar with the addition of usable and sanitary ceramics in the amount of 30%. The mortar was also characterized by the lowest decreases in compressive strength after frost resistance tests. The use of 30% sanitary ceramics resulted a compressive strength drop of 3.5% compared to 18% for the standard mortar. The absorptivity of all samples differed slightly.

**Keywords:** cement mortars, mechanical properties, utilitarian ceramics, sanitary ceramics, CRT glass

*Przesłano do redakcji: 26.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE ANALYSIS OF ROAD BUILDING TECHNOLOGY WITH A DATA NORMALIZATION METHOD

The paper presents a data normalization method for processing the data that makes it possible to choose the road building technology. There are two technologies for road construction, a flexible one and a rigid one, and both of them have their advantages and disadvantages. The main advantage of rigid pavement lays on the fact that it doesn't require higher financial expenditures within 30 years of exploitation (provided that necessary pavement maintenance treatments are carried out). In the case of flexible pavement it is necessary to mill the wear off layer of the road already after 9 years. It leads to the question: which of these technologies should be chosen, which one is better? The problem of the choice of technology for road building still remains to be unresolved.

The work hereby carries on the analysis concerning a comparison of the technologies for road building; the flexible pavement and the rigid pavement. Based on the analysis carried out using the data normalization method it was found that the achieved values of synthetic coefficient for flexible and rigid pavements are close to each other which may indicate that both technologies are comparable within the sectors taken for analyses in relation to accepted technological-technical and usability features.

**Keywords:** road, pavement, choice, data normalization method

*Przesłano do redakcji: 17.02.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE USE OF A HEAT PUMP AND SOLAR ENERGY IN THE HEAT DEMAND

The article presents the energy performance of a heat pump. The coefficient of performance was taken into account, which is the ratio of the heating energy obtained to the supplied electrical energy necessary for the compressor operation. The focus was on the issue of operating costs of using heat pumps. These costs are mainly influenced by two factors. Firstly, energy performance and the purchase price of electricity. The second factor is investment costs. Heat gains from solar energy were characterized. The value of the solar radiation transmission coefficient for the double glazing was assumed ( $TR = 0.7$ ). Solar gains were shown in January for windows on the eastern and western facades. The analysis covered the seasonal heat demand for heating. The studies and calculations took into account the occurring heat losses and heat gains from the sun and internal sources with their utilization rate. Particular attention was paid to the fact that the peak power of heating appliances can be calculated by knowing the value of the annual energy demand for heating a building that takes into account the most severe external conditions prevailing in a given climate zone, i.e. the minimum outside temperature.

**Keywords:** heat pump, solar energy, Coefficient of Performance COP, energy performance, heat losses and gains, heat power, heat source, heating, heating appliances, temperature, investment costs, heat demand

*Przesłano do redakcji: 12.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE EFFECT OF POZZOLANS ADDITION ON CEMENT MORTARS

The addition of microsilica was widely used in concretes and mortars since the second half of the 20th century (in high and very high strength concretes). Silica fume consists of very fine spherical particles. This additive, thanks to its properties, fills the space between cement particles and aggregates which affects: porosity, watertightness, shrinkage reduction and increased strength. The microsilica has pozzolanic properties and reacts with calcium hydroxide and gradually forms a uniform and continuous contact phase C-S-H (calcium-silicat hydrate). The interfacial zone between cement paste and aggregate has been considered as a zone of weakness. Zeolite is a material lesser known in civil engineering which can be used as an alternative to microsilica. The article presents the investigation of the physical properties of mortars containing these two types of pozzolan. In mixes pozzolan additives at 0 to 20 percent by mass of portland cement are used. Testing of such properties of fresh mortar as workability and air content was carried out. The properties of hardened mortar such as strength, water absorption, frost resistance and capillary suction were also determined.

**Keywords:** cement mortars, microsilica, zeolite, physical properties, freeze-thaw resistance, capillary suction

*Przesłano do redakcji: 18.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## RISK ANALYSIS ON SCAFFOLDINGS EXPOSED TO NOISE

The article presents the results of environmental tests performed on scaffolding that were focused mainly on the sound level. The parameters on which we base our analysis are the value of daily noise exposure level and peak sound levels on scaffolding. The noise that affects construction workers on scaffolding, may increase the risk of accidents. We present the results of measurements for twenty two scaffolds in five cities. The analyses carried out confirmed the qualitatively expected dependencies but they allowed us to quantify the impact of the noise on which construction workers on the scaffolding are exposed. The noise occurs continuously throughout the day and can cause faster fatigue, thereby it can increase the risk of accidents in noisy work environment.

**Keywords:** environmental studies, noise, scaffolding, sound level

*Przesłano do redakcji: 24.02.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## MONITORING OF HISTORICAL LAND USE CHANGES CAUSED BY UNDERGROUND MINING IN MIEDZIANKA TOWN, BASED ON A WEBGIS TOOL AND INSAR OBSERVATIONS

The article presents land surface changes caused by historical mining of metal ores on in the country town of Miedzianka in Lower Silesia, Poland. From the 19<sup>th</sup> until the middle of 20<sup>th</sup> century, mining in Miedzianka was in depression. Due to long-term and widespread mining activity, the town almost completely disappeared. The scale of the devastating effects of the mining appeared on the surface of the land, which led to the decision to abandon Miedzianka. Despite the damage the local authority made efforts to renew regional tourism. Unfortunately, it is impossible to carry out revitalization without recognizing the current threat of post-mining excavations. Therefore, the authors focused on analyzing collected archival documentation to understand the mining processes that have occurred and may still be occurring under the surface. The archival maps presented in the article have been indicated land use changes from 1886 to 1951. The current situation display WMS layer from Geoportal website. The collected materials allowed the spatiotemporal changes that occurred in Miedzianka to be presented. Additionally, the information base has been enriched with InSAR results for monitoring terrain deformation. The observations demonstrate that the biggest changes have taken place before 1936. In addition, current urban development constitute less than 25% of historical buildings. Analysis of InSAR method indicate that the research area require more accurate technique, because of the occurrence of large number of agricultural and forest areas.

**Keywords:** revitalization, historical mining impact, urban development, WebGIS tool, InSAR technique

*Przesłano do redakcji: 28.02.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE VALIDITY OF THE BDOT10k DATABASE ON THE EXAMPLE OF THE TOWN OF TARNOBRZEG

Up to date issue of cartographic studies is a complex problem. The content of the BDOT10k database is particularly important from the user's point of view, which should be updated on a current basis. The authors carry out an analysis of the database's validity along with the assessment of changes in spatial topography based on available non-standard topographical studies and an

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orthophotomap. The research was carried out in the town of Tarnobrzeg, which due to its specificity (a town with high dynamics of development) allows for a clear picture of the essence of the problem.

**Keywords:** Tarnobrzeg, BDOT10k, topographic maps, urban structure, development of the city

*Przesłano do redakcji: 17.01.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE COMPLEX OF ST. FLORIAN AND ST. CATHERINE CHURCH IN GOŁĄB AS A UNIQUE EXAMPLE OF MILITARY ART OF LUBLIN VOIVODESHIP

With the development of the civilization and the need to ensure safety for the next generation and cultural material, it became more and more vital to provide defence in case of danger. That is why, the character of residential space and historical architecture was influenced by the conflicts, which had various forms. Aside from the buildings, which were fulfilling visible and explicitly defined military function like e.g. fortresses or defence walls, there were also others that have been subjected to the process of incastellation to respond to the needs of the society. Giving the defensive character to the buildings that had originally completely different purpose, especially religious, had been developed since the Roman times. Military art was purely functional at the beginning. Later it was intertwined with decorations and other architectonic elements that were occurring e.g. in churches and conventual complexes. The aim of this article is to analyse the expression of the late Renaissance architecture with the elements of military art (*ars militaris*) in the discussed church, the Loreto Chapel and the wall, which together constitute the religious complex of St. Florian and St. Catherine in Gołąb in Lublin Voivodeship. Referring to functional and architectural-construction solutions of the subject of our research, the author discusses the topic of giving defensive character to religious buildings while keeping their functional layout, decorativeness and rich architectural expression typical for the architecture of the Lublin Renaissance.

**Keywords:** defensive architecture, church, the Loreto Chapel, the Renaissance, the Lublin Renaissance, Mannerism, military art (*ars militaris*), Jan Zaor, Piotr Likkel

*Przesłano do redakcji: 25.02.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## ANALYSIS OF THE AIR FLOW IN SELECTED BUILDINGS

Airflow properties are most apparent adjacent to the surface of the building, because there take place any reactions between liquid and solid object. Air exchange rate is associated with air flow through a building by natural – through small openings and cracks in the structure. Due to leakages in the building construction, opening and closing of windows, the air in the building shifts. The value of air exchange rate is hard to predict and depend of several variables – wind speed, difference between outside and inside temperatures, the quality of the building construction. The paper analyzed the air flow in selected buildings and quantified the value of air pressure differences and the air exchange rate with the emphasis on specification of aerodynamic coefficients.

**Keywords:** air flow, aerodynamic coefficients, wind speed, air exchange rate

*Przesłano do redakcji: 24.03.2017 r.*

*Przyjęto do druku: 31.03.2018 r.*

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## THE INFLUENCE OF THE ENVIRONMENT ON OBJECTS OF HISTORICAL VALUE

The result of the environment's influence on objects of historical value is the ongoing process of their deterioration. The main cause for the deterioration process is the flow of heat and moisture which also brings salinary solutions. The correct diagnosis on the causes of adverse effects affecting buildings of historical value serves as the basis for further activity which can result in protecting an object of value against further deterioration. Dampness issues which occur in buildings are usually caused by the lack of proper anti-dampness insulation and an incorrect micro-climate inside (temperature and air humidity outside). In order to evaluate the influence of a micro-climate on dampness processes, the selected buildings of historical value had air temperature and relative air humidity monitors installed, each having the capacity for continuous data retrieval. Every month, examinations of wall dampness are being carried out using a PWM-3 hygrometer.

Based on the measurements from the first two months, initial conclusions were drawn. Deeper analyses and the conclusions stemming from these will be drawn after the entire cycle of measurement ends at the end of 2018 (after one, full year of measurements).

**Keywords:** buildings of historical value, partition microclimate, humidity measurements, wall dampness measurement, microclimate measurement

*Przesłano do redakcji: 28.03.2018 r.*

*Przyjęto do druku: 31.03.2018 r.*

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