

### **Uncertainty in the early phase of a municipal building refurbishment project-A case study in Finland**

Municipal building refurbishment projects are carried out under conditions of high uncertainty and complexity, which often result in unsatisfying outcomes. In this research, a case study approach is used to provide a holistic presentation of the sources of uncertainties in the early phase of a municipal school refurbishment project in Finland. The study also explores how these sources are treated in the case project. It is considered that the uncertainty in the case study originated from three key sources: from the project due to the characteristics of existing buildings; from the organization due to the separately operating municipal units; from the municipal environment due to the municipal policy, and decision-making process. This study shows that more emphasis should be laid on the sources of uncertainty in the early phases of a municipal building refurbishment project for reaching proper decisions. In addition, the study presents suggestions for improving the municipal process.

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Contributors: Uotila, U., Saari, A., Junnonen, J. M.

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### **People's current mobility costs and willingness to pay for Mobility as a Service offerings**

Mobility as a Service (MaaS) is a concept that is based on the idea of providing customers with comprehensive mobility services by seamlessly combining various modes of transport. The scientific research on this theme has increased considerably over the last few years, but very little research has so far been conducted on people's willingness to pay for new MaaS services. This study presents the results of a survey (representative sample size 6,000, number of respondents 1,176, response rate 19.6%) conducted in Finland regarding people's willingness to pay for MaaS offerings. The study also estimates the current mobility costs of the respondents and relates their willingness to pay for MaaS to their mobility costs. Analysis includes also a linear regression model of willingness to pay for MaaS. As a result of the study, it was found that 43% of the respondents would be willing to adopt a mobility package, assuming it could cover all mobility needs of the respondent. For such a mobility package, the respondents were willing to pay approximately €140 on average, while their relative willingness to pay was an average of approximately 64% of their current mobility costs. However, it should be noted that due to the limitations of the study, the results are mostly indicative and further research is called for to grasp the multifaceted qualitative elements related to willingness to pay for MaaS. This study shows some significant variation between user groups in the respondents' willingness to pay relative to their estimated mobility costs, as well as their absolute willingness to pay. The variation maybe due to the fact that MaaS is still largely unknown as a concept and the challenge that the mobility package which fulfils individual needs differs from person to person. According to the results, MaaS should lower the mobility costs for users in order to be financially attractive.

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Contributors: Liljamo, T., Liimatainen, H., Pöllänen, M., Utriainen, R.

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### Hot-box measurements to investigate the internal convection of highly insulated loose-fill insulation roof structures

The purpose of this study was to investigate how internal convection in loose-fill insulations affects the insulation properties of highly insulated roof structures. This study consists of laboratory measurements of roof structures insulated by two different blown-in insulations. The measurements are repeated with two temperature differences and air velocities for 300 mm and 600 mm thick insulation layers both with and without trusses, making a total of 24 case studies. The measurements were conducted with equipment using the calibrated hot-box method. The results of the tests show that internal convection can reduce insulation capacity significantly, especially with low-density loose-fill insulations, such as blown-in glass wool. A critical evaluation should be performed as to whether international standards and national building regulations take internal convection into account adequately. According to this study, 5 should be used as a critical modified Rayleigh number for horizontal roof structures with an open upper surface when used insulation material is loose-fill glass wool or wood fibre insulation as in this study.

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### Heat protective properties of enclosure structure from thin-wall profiles with foamed concrete

Receiving the qualitative, energy efficient and economic building is the main tendency in the civil engineering. One of the leading places is occupied by technology of frame-panel construction with use of new non-autoclaved, monolithic foamed concrete technology producing on a building site. On the example of the real samples there were determined the heat-shielding properties of foamed concrete in a condition of setting process and after attainment of strength with a practical and theoretical methods. The results were obtained for a non-autoclaved monolithic foamed concrete wall fragment (lightweight steel concrete structure - LSCS) for the areas with and without rigid reinforcement with steel thin-wall profiles (lightweight gauge steel structure - LGSS). Influence of the thermal bypass on cold-resisting properties of enclosure

structures with technology "Intech LB" is revealed. On the basis of the received results, modernization of a design for improvement of its thermotechnical characteristics is made.

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Contributors: Rybakov, V. A., Ananeva, I. A., Pichugin, E. D., Garifullin, M.

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#### Utilizing mixed-mineralogy ferroan magnesite tailings as the source of magnesium oxide in magnesium potassium phosphate cement

A mixed-mineralogy talc mine tailing (MT) fraction consisting of 80% ferroan magnesite ( $MgCO_3$ ) was studied for utilization as the source of magnesium oxide (MgO) in magnesium potassium phosphate cement (MKPC). The effects of calcination temperature of this low-grade magnesite on the composition, BET surface area and phosphate reactivity of the resulting magnesia powder were studied. The 4-point flexural strength of resulting MKPC was measured for all calcined raw material fractions that produced a solid. Based on the strength measurement results, the optimal range for calcination resided between 700 °C and 1150 °C, which is drastically lower than commonly recommended for finer magnesia sources in MKPCs. Accelerated reactivity assessment showed that phosphate reactivity behavior could not be entirely predicted by BET surface area. The presence of impurity silicates and high iron content in all the constituent minerals was posed as the reason for densification and loss of reactivity at higher calcination temperatures.

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Organisations: Materials Science and Environmental Engineering, Research group: Ceramic materials, Geological Survey of Finland, VTT Technical Research Centre of Finland

Contributors: Ismailov, A., Merilaita, N., Solismaa, S., Karhu, M., Levänen, E.

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#### **Modeling of hygrothermal behavior for green facade's concrete wall exposed to nordic climate using artificial intelligence and global sensitivity analysis**

Green facades are one of the most promising natural-based solutions for buildings. Notwithstanding, in regions with varying weather such as the northern hemisphere, these can be counterproductive for the structures due to humidity retention. For these reasons, this work presents the development of an Artificial Neural Network (ANN) model to estimate the hygrothermal behavior inside a concrete wall protected by a second foliage skin. The database used for model formation was obtained through measurements made in an Accelerated Weathering Laboratory (AWL) to emulate the Nordic climatic conditions for a typical year. The ANN-hygrothermal model was trained in function of the parameters: environment relative humidity, ambient temperature, microclimate's relative humidity, microclimate's temperature, and the separation distance between the vegetation and the wall. The statistical results of the model demonstrated successful adaptability and great generalization capacity for both internal temperature ( $R^2 = 99.98\%$  for training and  $R^2 = 99.95\%$  for testing) and internal humidity ( $R^2 = 99.16\%$  for training and  $R^2 = 99.17\%$  for testing). Additionally, a sensitivity analysis was implemented, showing that the most influential variable in the estimation of both hygrothermal parameters is the ambient temperature and that the separation distance has a significant impact on the humidity produced inside the wall. Finally, the presented computational approach can be implemented in non-invasive monitoring systems or as a complementary tool in studies of concrete degradation due to humidity.

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Organisations: Research group: Virtual Building Technologies, Architecture, Autonomous University of Yucatan

Contributors: May Tzuc, O., Rodríguez Gamboa, O., Aguilar Rosel, R., Che Poot, M., Edelman, H., Jiménez Torres, M., Bassam, A.

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#### **Impacts of multiple refurbishment strategies on hygrothermal behaviour of basement walls**

The refurbishment of existing buildings to provide thermal performance comparable to new design standards can be achieved using multiple design strategies. Although high structural thermal resistance is usually considered to be of high importance, hygrothermal conditions must be taken into account. They can significantly prolong the life of the building and avoid biological growth inside the structure as well as the indoor environment. In this study, three structures from different decades are compared from the point of view of thermal insulation performance, structural drying and mould growth, which was assessed using the Finnish mould growth model. Special interest is given to structural details that are subjected to humid conditions and details characterised by a thermal bridge, where vapour condensation can occur. The numerical computation provides a risk assessment tool for the structural elements in terms of hygrothermal performance and structural health implications.

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Contributors: Fedorik, F., Heiskanen, R., Laukkarinen, A., Vinha, J.

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### Recycling lithium mine tailings in the production of low temperature (700–900°C) ceramics: Effect of ladle slag and sodium compounds on the processing and final properties

This paper deals with the valorization of quartz and felspar rich lithium mine tailings (QFS) in the development of construction materials. Ladle slag was used as green strength increasing agent. Sodium hydroxide and carbonate were used as fluxing agents to allow sintering at 700–900 °C. Of these, sodium hydroxide was found to be the more efficient. The sintered ceramics were characterized by X-ray diffraction, scanning electron microscopy, compressive test, water absorption, apparent density and dilatometry; the results were found to comply with ASTM C62-99 specifications for building brick, and interesting for a sustainable use of resources.

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Contributors: Lemougna, P. N., Yliniemi, J., Ismailov, A., Levänen, E., Tanskanen, P., Kinnunen, P., Roning, J., Illikainen, M.

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### Variation of CPTu-based transformation models for undrained shear strength of Finnish clays

The determination of a design soil property may include multiple sources of uncertainty. One of the sources originates from transformation model used to evaluate soil parameters when they are not measured directly. This study focuses on the transformation uncertainty related to three different transformation models used in evaluation of undrained shear

strength from CPTu borings. The used correlation models are common models found in literature and calibrated at Tampere University. The CPTu data used in this study was taken from Knuuti and Länsivaara [2019. Variation of Measured CPTu Data. ISGSR], and it consisted of four different soft clay sites in Finland. The transformation uncertainty was calculated for each transformation model at each site. Moreover, every CPTu boring was analysed separately. The results showed that the transformation uncertainty was lowest for models based on the net cone resistance ( $COV = 0.033-0.084$ ) and pore pressure ( $COV = 0.024-0.085$ ). For the third model, the uncertainty was little higher as it included more uncertainty in the initial parameters. This suggests that the transformation models based on net cone resistance ( $q_{NET}$ ) and pore pressure ( $u_2$ ) could be more suitable for practice.

#### General information

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Contributors: Knuuti, M., Länsivaara, T.  
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ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Safety, Risk, Reliability and Quality, Geotechnical Engineering and Engineering Geology, Geology  
Keywords: coefficient of variation, correlation models, CPTu, reliability, statistics, undrained shear strength  
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Source ID: 85074297150  
Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

#### Behaviour of riveted stringer-to-floorbeam connections in cyclic load tests to failure

Structural connections in bridges supporting directly the railway track have cumulated large amount of load cycles from passing trains. The connections were not originally designed for fatigue and some of them have found to be in poor condition by inspection. To study their structural behaviour under large number of repeated load cycles, five 85year old stringer-to-floorbeam connections from a decommissioned railway bridge were loaded in laboratory. Each connection had four angle plates connecting stringer webs to floorbeams and two connection plates connecting stringer top flanges together. During the load tests, the connection plate maximum stress ranged from 60MPa to 150MPa. It was estimated that the peak stresses under traffic were in the range of 40–60MPa. Despite large stresses in load tests and long active use under traffic, only three connections failed after 0.5–1.6 million load cycles. Two connection tests were run out after 2.4 and 2.6 million cycles. By measuring strains and displacements continuously during testing it was seen that failures occurred gradually as components fractured slowly during tens of thousands of cycles. Any of the connection failures was not complete and the connections showed substantial residual bending stiffness and capacity after failure. Load tests showed that even if connection is seen to be in poor condition and close to its theoretical fatigue life, it still might function safely for hundreds of thousands of stress cycles if stress redistribution between connection components is possible and connection is monitored for major fractures.

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Contributors: Tulonen, J., Siitonen, T., Laaksonen, A.  
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INT=CENG,"Siitonen, Tuomo"

Research output: Contribution to journal > Article > Scientific > peer-review

### **Parametric study on temperature distribution of square hollow section joints**

The resistance of a steel joint is one of the most crucial elements of a structure under fire conditions. The aim of the study was to investigate the temperature distribution within the square hollow section (SHS) joints with different geometric parameters under fire conditions. The commercial finite element (FE) software, Abaqus/Standard CAE, was used to simulate the behaviour of the SHS joints. Extensive numerical research was conducted on different joint types (T-, Y-, and K-joints) to examine the influence of the joint configuration on the temperature distribution within the joint. To provide reliable observations, a model was validated against the experimental results. The FE simulation results were compared to the predictions of Eurocode equations. The FE simulation results showed that the simulated temperatures are different from the temperatures determined using the Eurocode method. The  $\beta$  parameter was found to have hardly any influence on the temperature distribution within the joint area, whereas different joint configurations strongly influence the distribution.

### **General information**

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Contributors: Bączkiewicz, J., Pajunen, S., Malaska, M., Heinisuo, M.

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### **Assessing population vulnerability towards summer energy poverty: Case studies of Madrid and London**

Climate change is expected to increase the frequency and duration of hot weather and its associated adverse health effects. In dense urban areas, these phenomena will be exacerbated by the Urban Heat Island (UHI) effect and indoor overheating. This paper assesses population exposure and vulnerability to high summer temperatures by exploring the geospatial connection between the UHI, housing energy efficiency and overheating risk, and social vulnerability indicators, such as income and the elderly population. Focusing on Madrid and London, two European cities with strong UHIs but contrasting drivers of indoor heat risk, the spatial distribution of selected indicators were analysed by means of Geographical Information Systems, and areas with the highest vulnerability towards summer energy poverty were identified. It was found that while 'hot and vulnerable' areas are present in both Madrid and London, there are significant differences in climate, socioeconomic distribution and housing between the two cities. In warmer climates such as Madrid, energy poverty—traditionally defined by wintertime heating—requires its definition to be broadened to include summertime cooling needs; in the context of climate change and urban warming trends, this may soon also be the case in northern cities such as London.

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### Initial axial stiffness of welded RHS T joints

Recently, CIDECT (International Committee for the Development and Study of Tubular Structures) has proposed the component method as a unified approach for the design of many types of connections, including welded tubular joints. Although CIDECT provides clear and simple equations for the resistance of welded tubular joints, the design of initial stiffness remains complicated and includes a number of uncertainties. This paper analyzes the theoretical approach for the initial axial stiffness of rectangular hollow section T joints. The validation against experimental data has shown that the component method considerably overestimates the stiffness of T joints. The paper develops new equations for the stiffness of the components "chord face in bending" and "chord side walls in compression". The equations are based on simplified mechanical models, employing finite element analyses to calculate the parameters for which analytical solutions are found extremely complicated. In addition, the article numerically investigates the effect of chord axial stresses on the axial stiffness of joints and proposes a corresponding chord stress function.

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Contributors: Garifullin, M., Bronzova, M., Pajunen, S., Mela, K., Heinisuo, M.  
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Keywords: Axial stiffness, Component method, Initial stiffness, Rectangular hollow section, Tubular joint  
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### **A life cycle assessment of two residential buildings using two different LCA database-software combinations: Recognizing uniformities and inconsistencies**

Traditionally, the emissions embodied in construction materials have not been considered important; however, they are becoming crucial due to the short time-frame in which the emissions should be reduced. Moreover, evaluating the environmental burden of construction materials has proven problematic and the reliability of the reported impact estimates is questionable. More reliable information from the construction sector is thus urgently needed to back and guide decision-making. Currently, the building sector environmental impact assessments predominantly employ commercial software with environmental impact databases and report results without knowledge about the impact of the software/database choice on the results. In this study, estimates for the embodied environmental impacts of residential construction from the two most widely used life cycle assessment (LCA) database-software combinations, ecoinvent with SimaPro software and GaBi, are compared to recognize the uniformities and inconsistencies. The impacts caused by two residential buildings of different types, a concrete-element multi-story residential building and a detached wooden house, both located in Finland, were assessed, including all building systems with a high level of detail. Based on the ReCiPe Midpoint method, fifteen impact categories were estimated and compared. The results confirm that the tool choice significantly affects the outcome. For the whole building, the difference is significant, around 15%, even in the most widely assessed category of Climate Change, and yields results that lean in different directions for the two cases. In the others, the estimates are entirely different, 40% or more in the majority of the categories and up to several thousand percentages of difference. The main conclusion is that extensive work is still urgently needed to improve the reliability of LCA tools in the building sector in order to provide reliable and trustworthy information for policy-making.

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### **Evaluating retrofit options in a historical city center: Relevance of bio-based insulation and the need to consider complex urban form in decision-making**

Historical dwellings make up a significant fraction of the French building stock and require substantial retrofitting to reduce their energy consumption and improve their thermal comfort. In the city center of Cahors, France, the old medieval dwellings are considered as valuable cultural heritage and internal insulation is often the only insulation technique that can be used when the architectural value of the exterior façade is to be preserved. However, internal insulation may have an impact upon the hygrothermal performance of the wall, leading to lowered drying capacity, with possible interstitial condensation and mold growth. Hygrothermal models may be used to assess the risk of failure, but the accuracy of the results depends on how reliable the input data is, including external boundary conditions, which may vary significantly in

dense medieval cities such as Cahors. In this study, a Geographical Information System model of Cahors is used to develop EnergyPlus models of individual dwellings. The boundary conditions output by these models are, in turn, used to model the hygrothermal performance of façades with different internal insulations, using the hygrothermal tool Delphin. The Delphin outputs are then analyzed with the VTT model, a mold growth assessment model. Results highlight a quantitative correlation between some urban morphology characteristics and the hygrothermal performance of refurbished walls, with some configurations raising the risk of damage patterns. We find that bio-based insulation presents a better hygrothermal performance than mineral wool in most of the configurations.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Toulouse, INP, LAAS-CNRS, University College London

Contributors: Claude, S., Ginestet, S., Bonhomme, M., Escadeillas, G., Taylor, J., Marincioni, V., Korolija, I., Altamirano, H.

Number of pages: 9

Pages: 196-204

Publication date: 1 Jan 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy and Buildings

Volume: 182

ISSN (Print): 0378-7788

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ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

DOIs:

10.1016/j.enbuild.2018.10.026

URLs:

<http://www.scopus.com/inward/record.url?scp=85055886229&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85055886229

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Remote diagnostics application software for remote handling equipment**

The ITER Remote Handling Control System (RHCS) controllers provide measurement and diagnostics data about the remote handling equipment and tools they control. This paper presents the Remote Diagnostics Application (RDA) software for the analysis and archiving of the RHCS diagnostics data. The RDA provides a basic set of diagnostics tools, including trends, spectra, histograms, scatter plots, cross-correlation plots, as well as archiving and retrieval of history data. The ITER RH operators can extend diagnostics capabilities for specific RH equipment needs by incorporating custom diagnostics functions. To facilitate customization, RDA implements an architecture with three nested levels: the RDA Framework, its Diagnostics Workbenches and their Diagnostics Primitives. The RDA Framework has a user interface that can load one or several special diagnostics cases implemented as custom Diagnostics Workbenches with custom or default Diagnostics Primitives, such as rules, analysis functions and filters. As a result, the RDA features a diagnostics framework to execute complex and dedicated diagnostics and prognostics for the RH experts to monitor performance data, to run diagnostics tests and rules on equipment systems and to analyse historical data. The RDA helps the RH operators reduce downtime of the Remote Handling systems by exposing failure conditions and maintenance needs.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Automation Technology and Mechanical Engineering, VTT Technical Research Centre of Finland, Fusion For Energy (F4E)

Contributors: Alanen, J., Ruiz Morales, E., Muhammad, A., Saarinen, H., Minkkinen, J.

Publication date: 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Fusion Engineering and Design

ISSN (Print): 0920-3796

Ratings:

Scopus rating (2019): CiteScore 2.7 SJR 0.558 SNIP 1.049

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Nuclear Energy and Engineering, Materials Science(all), Mechanical Engineering

Keywords: Control system, Diagnostics, Prognostics, Remote handling, Software

DOIs:

10.1016/j.fusengdes.2019.01.125

#### **Bibliographical note**

EXT="Saarinen, Hannu"

Source: Scopus

Source ID: 85060619368

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Modelling the stressed skin effect by using shell elements with meta-material model**

It is a well-known fact that the so-called stressed skin design results in ca. 10-20 % mass and cost savings in a typical steel hall structures. The potential of this design method is however, too often disregarded due to e.g. rather complex and limited existing design rules and instructions. In this paper, a method for determination of generalized elastic parameters is proposed, so that the stressed skin can be modelled in the general finite element software using existing elements and material parameters. With the proposed method, structural designer can take advantage of the stressed skin design in the context of basic design tools as Autodesk Robot or RFEM.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Sorvimo Optimointipalvelut Oy

Contributors: Pajunen, S., Hautala, J., Heinisuo, M.

Number of pages: 10

Pages: 20-29

Publication date: 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Magazine of Civil Engineering

Volume: 86

Issue number: 2

ISSN (Print): 2071-4726

Ratings:

Scopus rating (2019): CiteScore 3.7 SJR 0.598 SNIP 2.176

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Corrugated sheet, Diaphragm, Stressed skin

Electronic versions:

03-1

DOIs:

10.18720/MCE.86.3

URLs:

<http://urn.fi/URN:NBN:fi:tty-201909022051>

#### **Bibliographical note**

EXT="Heinisuo, M."

Source: Scopus

Source ID: 85068566348

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Behavior of capacitive humidity sensors in monitoring the drying of concrete walls**

This research examines the behavior of capacitive humidity sensors in monitoring the drying of concrete walls in continuous measurements in laboratory conditions. Tests are carried out using continuous measuring of moisture with different capacitive sensors in concrete structures varied with three different types of thermal insulation materials. Sensors are sealed in plastic tubes that were preinstalled into the casting molds. Three borehole measurements are carried out as reference during the research. Results show differences in performance between the examined humidity sensors from two different manufacturers. The main difference is related to stability as sensors from the other manufacturer prove to be more prone to error. The study affirms that measuring humidity in concrete is challenging even when using high-quality humidity sensors.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Vinha, J., Raunima, T.  
Number of pages: 6  
Publication date: 2019  
Peer-reviewed: Yes

### Publication information

Journal: MATEC Web of Conferences  
Volume: 282  
Article number: 02053  
ISSN (Print): 2274-7214  
Ratings:  
Scopus rating (2019): CiteScore 0.8 SJR 0.166 SNIP 0.714  
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ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
matecconf\_cesbp2019\_02053  
DOIs:  
10.1051/matecconf/201928202053  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-201912126820>

### Bibliographical note

INT=ceng,"Raunima, Tuomas"  
Research output: Contribution to journal > Conference article > Scientific > peer-review

### Calculation method to determine capillary properties of building materials with automatic free water intake test

The water absorption coefficient and capillary saturation water content are common building physical material properties. This paper presents a calculation method to determine these values with an automated free water intake test arrangement. Buoyancy affects weighing results in the automatic measurement and it is recommended to take these factors into account when deriving the real water intake of a specimen. A new mathematical method is presented and trial experiments have been conducted. The method is proven to work with the polymer modified plaster, concrete, autoclaved aerated concrete and lightweight aggregate concrete, which represent materials from both extremes of capillary activity. The functionality and advantages of the test arrangement for both low and high suction materials are presented.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Vinha, J.  
Number of pages: 6  
Publication date: 2019  
Peer-reviewed: Yes

### Publication information

Journal: MATEC Web of Conferences  
Volume: 282  
Article number: 02037  
ISSN (Print): 2274-7214  
Ratings:  
Scopus rating (2019): CiteScore 0.8 SJR 0.166 SNIP 0.714  
Original language: English  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
matecconf\_cesbp2019\_02037  
DOIs:  
10.1051/matecconf/201928202037  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-201912126839>  
Research output: Contribution to journal > Conference article > Scientific > peer-review

### **Comparison between calculated and billed building energy consumption values of schools and daycare centers**

In many countries, building regulations set requirements for energy efficiency, which must be fulfilled in order to have a building permit. Because the actual building does not yet exist, the calculations are done in the early design phase with approximate input data. This paper presents results from dynamic whole-building simulations and compares the results to monthly calculation results, billed energy consumption and to a small number of central building energy efficiency parameters. According to the results, using a more sophisticated calculation tool does not necessarily improve the accuracy of the calculation results, if the capabilities of the tool are not properly utilised. Although there was a clear difference between the calculated and billed values, lower calculated energy consumption did correlate with lower billed values. Besides the need for extra effort to ensure accurate input data in general, input values related to infiltration and ventilation should be evaluated especially carefully.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Ruusala, A., Laukkarinen, A., Vinha, J.  
Number of pages: 6  
Publication date: 2019  
Peer-reviewed: Yes

#### **Publication information**

Journal: MATEC Web of Conferences  
Volume: 282  
Article number: 02085  
ISSN (Print): 2274-7214  
Ratings:  
Scopus rating (2019): CiteScore 0.8 SJR 0.166 SNIP 0.714  
Original language: English  
ASJC Scopus subject areas: Civil and Structural Engineering  
Keywords: building energy consumption, simulation, Building physics, calculated building energy consumption, billed building energy consumption  
Electronic versions:  
matecconf\_cesbp2019\_02085  
DOIs:  
10.1051/matecconf/201928202085  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202001091135>  
Research output: Contribution to journal > Conference article > Scientific > peer-review

### **Thermal and moisture properties of calcium silicate insulation boards**

The purpose of this research was to determine thermal and moisture properties of calcium silicate insulation boards available on the Finnish market. Ruggedness testing and test arrangement development were done related to the pressure plate test, which was used to measure desorption isotherms in capillary range. Four calcium silicate and one calcium hydroxide board were examined. The determined material properties are water vapour permeability, water absorption coefficient, capillary saturation water content, moisture sorption isotherm in hygroscopic and capillary range, thermal conductivity and specific heat capacity. Ruggedness tests and development were done to the pressure plate measurement method. Capacitance needles were tested as a method to evaluate the state of equilibrium and different vacuum saturation methods were tested.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Tuominen, O., Vainio, M., Ruuska, T., Vinha, J.  
Number of pages: 7  
Publication date: 2019  
Peer-reviewed: Yes

#### **Publication information**

Journal: MATEC Web of Conferences  
Volume: 282  
Article number: 02065  
ISSN (Print): 2274-7214

Ratings:

Scopus rating (2019): CiteScore 0.8 SJR 0.166 SNIP 0.714

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Electronic versions:

mateconf\_cesbp2019\_02065

DOIs:

10.1051/mateconf/201928202065

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001091153>

#### **Bibliographical note**

INT=ceng,"Tuominen, Olli"

INT=ceng,"Vainio, Maarit"

Research output: Contribution to journal > Conference article > Scientific > peer-review

#### **Moment-rotation behavior of welded tubular high strength steel T joint**

Based on recent studies, high strength steels (HSS) can be efficiently used in civil engineering, reducing the consumption of material and CO<sub>2</sub> emissions. The present Eurocode contains the reduction coefficients (0.8 and 0.9 depending on the steel grade) for high strength steel joints. These reduction factors lead to the excessive consumption of material, making the usage of HSS for construction not as economically viable as it might be. The scope of this paper is to present experimental results dealing with the welded in-plane moment-loaded HSS joints. Twenty tests on square hollow section T joints were performed to observe their moment-rotation relationship, studying the following parameters: (1) bending resistance, (2) rotational stiffness, (3) ductility. The results show that the reduction factors are needed only for butt-welded joints, as well as for joints with small fillet welds and made of steel grades higher than S500. The required ductility was achieved by all specimens, even when using welds smaller than full-strength fillet welds. In addition, it was shown experimentally that fillet welds considerably increase the resistance and stiffness of joints.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, HAMK University of Applied Sciences

Contributors: Havula, J., Garifullin, M., Heinisuo, M., Mela, K., Pajunen, S.

Number of pages: 15

Pages: 523-537

Publication date: 1 Oct 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Engineering Structures

Volume: 172

ISSN (Print): 0141-0296

Ratings:

Scopus rating (2018): CiteScore 5 SJR 1.628 SNIP 2.123

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Ductility, High strength steel, In-plane moment-load, Moment resistance, Reduction coefficient, Rotational stiffness, Welded tubular T joint

Electronic versions:

Moment-rotation behavior of welded tubular high strength steel T joint. Embargo ended: 20/06/20

DOIs:

10.1016/j.engstruct.2018.06.029

URLs:

<http://urn.fi/URN:NBN:fi:ty-201908211987>. Embargo ended: 20/06/20

#### **Bibliographical note**

EXT="Havula, Jarmo"

Source: Scopus

Source ID: 85048742638

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Condensation at the exterior surface of windows**

New energy efficient windows have a higher risk for outdoor air vapour condensing to their exterior surface, when compared to older windows with lower thermal resistance. This external condensation can reduce visibility through the

window, decrease owner satisfaction and affect the behaviour of window buyers and sellers. The purpose of this study was to analyse the impact of window U-value and other factors on the occurrence of external condensation. A combined heat and moisture transfer model was created and used for the calculations. According to the results, the duration and amount of external condensation are projected to increase in the future due to lower window U-values and climate change. Exterior surface emissivity, external shadings and building location had a big impact on the amount of yearly condensation hours, while window orientation and solar absorption coefficient had a smaller impact. There was also an interesting power-law-type correlation between yearly condensation hours and the median effective thickness of the condensation layer. The results help window manufacturers and building designers make more accurate decisions in their future work.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering  
Contributors: Laukkarinen, A., Kero, P., Vinha, J.  
Number of pages: 10  
Pages: 592-601  
Publication date: 1 Sep 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Building Engineering  
Volume: 19  
ISSN (Print): 2352-7102  
Ratings:  
Scopus rating (2018): CiteScore 3.6 SJR 0.682 SNIP 1.569  
Original language: English  
ASJC Scopus subject areas: Building and Construction, Architecture , Civil and Structural Engineering, Safety, Risk, Reliability and Quality  
Keywords: Building physics, Condensation, Energy efficiency, Heat transfer, Moisture transfer, Windows  
Electronic versions:  
Laukkarinen et al 2018 Condensation at the - Accepted manuscript. Embargo ended: 1/09/20  
DOIs:  
10.1016/j.jobe.2018.06.014  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201807312043>. Embargo ended: 1/09/20  
Source: Scopus  
Source ID: 85049334016  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Radon, fungal spores and MVOCs reduction in crawl space house: A case study and crawl space development by hygrothermal modelling

In this case study was to investigate how ventilation of the crawl space will influence on concentrations of radon, fungal spores and MVOCs in the crawl space and indoors of detached house. The crawl space pressurisation by exhaust air from indoors was successful to prevent the convective flow of radon from the soil, but it increased microbial growth in the crawl space. After installation of the supply and exhaust ventilation in the crawl-space and in the living space, the concentrations of fungal spores in the crawl space and also entry of radon and MVOCs into a house decreased. A microbiologically safe crawl space was determined with hygrothermal simulation utilizing the Finnish Mould Growth Model and a two year examination period. The optional structures of the crawl space being depressurised with exhaust ventilation included an open base uncovered ground and various air-sealed closed structures. When mould growth of building materials was at medium resistant sensitivity class, mould was not observed during different air change rates in any of the examined structures. Open base uncovered gravel ground is a functional solution of a crawl space, only when there are no organic materials. The air-sealed ground structure is recommended build with concrete + insulation and when air exchange rate (ach) varied from 0.2 to 1 h<sup>-1</sup>. A concrete ground in the crawl space having ach from 0.2 to 0.6 h<sup>-1</sup> is also very effective. XPS insulation and plastic sheet covered ground are not recommendable due to their high mould index.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, Ramboll Finland Ltd., Ita-Suomen yliopisto  
Contributors: Kesikuru, T., Salo, J., Huttunen, P., Kokotti, H., Hyttinen, M., Halonen, R., Vinha, J.  
Number of pages: 10  
Pages: 1-10  
Publication date: 15 Jun 2018  
Peer-reviewed: Yes

### Publication information

Journal: Building and Environment

Volume: 138

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2018): CiteScore 8.1 SJR 1.879 SNIP 2.241

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: Air change, Crawl space, Ground covers, Modelling, Mould growth, Radon

Electronic versions:

Keskikuru - Radon, fungal spores and MVOCs reduction in crawl space house - A case study and crawl space development by hygrothermal modellin. Embargo ended: 15/06/20

DOIs:

10.1016/j.buildenv.2018.04.026

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186059>. Embargo ended: 15/06/20

### Bibliographical note

INT=rak,"Salo, J."

Source: Scopus

Source ID: 85046008041

Research output: Contribution to journal > Article > Scientific > peer-review

### Investigating the kinetics and biofuel properties of *Alstonia congensis* and *Ceiba pentandra* via torrefaction

*Alstonia congensis* (Ahun) and *Ceiba pentandra* (Araba) were chosen as representations of tropical wood in this study. The use of untreated wood for energy recovery could lead to a high loss in efficiency. One way of circumventing this in a developing country such as Nigeria is by exposing the fuel materials to a pre-treatment, such as torrefaction, prior to deployment. Attempts were made to improve the combustion properties of these resources and also to investigate their torrefaction kinetics. Derivations of kinetic parameters using Coats-Redfern method were discontinued due to inconsistent results. A non-linear regression method was then employed and the results compared to the average value obtained by the FWO method, which was considered more viable than the Coats-Redfern method. The kinetic parameters ( $E_a$ ,  $A$  and  $n$ ) derived by the regression method are 134.45 kJ/mol,  $1.83E+13 \text{ min}^{-1}$  and 2.15, respectively, for Araba and 143.38 kJ/mol,  $1.90E+10 \text{ min}^{-1}$  and 2.28, respectively, for Ahun. The thermal behaviour of the samples showed that a lower mass yield resulted in a lower energy yield, while the heating values increased with the temperature of torrefaction. The results obtained in this study affirm the possibility of obtaining an optimum conversion of these resources for energy recovery.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy, University of Borås, Laboratory of Chemistry and Bioengineering

Contributors: Oluoti, K., Doddapaneni, T. R. K., Richards, T.

Number of pages: 8

Pages: 134-141

Publication date: 1 May 2018

Peer-reviewed: Yes

### Publication information

Journal: Energy

Volume: 150

ISSN (Print): 0360-5442

Ratings:

Scopus rating (2018): CiteScore 8.5 SJR 2.048 SNIP 1.842

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Pollution, Energy(all), Mechanical Engineering, Industrial and Manufacturing Engineering, Electrical and Electronic Engineering

Keywords: *Alstonia congensis*, *Ceiba pentandra*, Energy densification, Kinetic parameters, Mini-grid, Torrefaction

DOIs:

10.1016/j.energy.2018.02.086

Source: Scopus

Source ID: 85042679330

Research output: Contribution to journal > Article > Scientific > peer-review



### **An approach to combining related notifications in large-scale building management systems with a rehabilitation facility case study**

ICT advances have enabled the incorporation of multiple devices that monitor various aspects of the environment into building management (BM) systems. The data from these devices is used to detect multiple abnormal situations, which require the awareness of system users and/or timely response. However, the number of abnormal situations is usually large, and delivering all of the associated notifications is overwhelming for users, rather than helping them to interpret the ongoing status of the environment. This work proposes a novel approach for combining ongoing notifications in the monitoring systems by their types, priorities, locations, and receivers. The approach is based on formal classification of possible alarms and runtime analysis of ongoing notifications with the aim of reducing repeating information pieces delivered as part of multiple notifications. The paper provides details of combination principles of notifications and applies them to real data from a rehabilitation facility. The results show a reduction in the users' information load of approximately 42% of the peak number of ongoing notifications. It is expected that the proposed approach will improve situation awareness in the managed facilities – enabling better and faster decisions on the ongoing status of the environment.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Automation and Hydraulic Engineering, FAST Lab.  
Contributors: Evchina, Y., Martinez Lastra, J. L.  
Number of pages: 11  
Pages: 106-116  
Publication date: 31 Mar 2018  
Peer-reviewed: Yes  
Early online date: 14 Dec 2017

#### **Publication information**

Journal: Automation in Construction  
Volume: 87  
ISSN (Print): 0926-5805  
Ratings:  
Scopus rating (2018): CiteScore 7.9 SJR 1.408 SNIP 2.662  
Original language: English  
ASJC Scopus subject areas: Control and Systems Engineering, Civil and Structural Engineering, Building and Construction  
Keywords: Alarm classification, Alarm design, Alarm management, Building management systems, Notification management  
DOIs:  
10.1016/j.autcon.2017.12.020  
URLs:  
[https://ac.els-cdn.com/S0926580517306805/1-s2.0-S0926580517306805-main.pdf?\\_tid=ec5c28ec-0039-4c26-abb3-4efdb15a680c&acdnat=1522915523\\_31e63dd4966a67b5647f2d26b3a56cf9](https://ac.els-cdn.com/S0926580517306805/1-s2.0-S0926580517306805-main.pdf?_tid=ec5c28ec-0039-4c26-abb3-4efdb15a680c&acdnat=1522915523_31e63dd4966a67b5647f2d26b3a56cf9)  
Source: Scopus  
Source ID: 85037985629  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Characterization of elastic constants of anisotropic composites in compression using digital image correlation**

Experimental determination of elastic constants of anisotropic composite laminates in all orthogonal directions is generally a complex process. In this paper a simple direct technique to determine a broad set of elastic moduli is presented based on compression testing of a prism sample. Digital image correlation is used to measure the full-field deformations that allow the determination of Young's moduli and all six Poisson's ratios for the three orthogonal directions based on a single sample. Finite element model is used in evaluation of the effect of friction on the measured properties. In addition to quantitative characterization of the material properties, local strain mapping is used in qualitative evaluation of the sample structures.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Materials Science, Research group: Plastics and Elastomer Technology, Valmet Technologies Oy  
Contributors: Orell, O., Vuorinen, J., Jokinen, J., Kettunen, H., Hytönen, P., Turunen, J., Kanerva, M.  
Number of pages: 10  
Pages: 176-185  
Publication date: 2018  
Peer-reviewed: Yes

Early online date: 7 Nov 2017

### Publication information

Journal: Composite Structures

Volume: 185

ISSN (Print): 0263-8223

Ratings:

Scopus rating (2018): CiteScore 7.9 SJR 1.967 SNIP 2.099

Original language: English

ASJC Scopus subject areas: Ceramics and Composites, Civil and Structural Engineering

Keywords: Digital image correlation, Elastic constants, Laminates, Microstructural analysis

Electronic versions:

Orell\_manusc\_post\_print\_embedded\_figures. Embargo ended: 7/11/19

DOIs:

10.1016/j.compstruct.2017.11.008

URLs:

<http://urn.fi/URN:NBN:fi:ty-201803051331>. Embargo ended: 7/11/19

Source: Scopus

Source ID: 85033434793

Research output: Contribution to journal › Article › Scientific › peer-review

### Utilizing the innovation potential of suppliers in construction projects

**Purpose** – The manufacturers of construction components and materials are the suppliers in construction projects, and represent a significant portion of their value. However, their knowledge is not used sufficiently when it comes to construction innovation. This research paper focuses on the suppliers' innovation potential in construction projects. The purpose of this paper is to identify practices for enhancing the contractor-supplier relationship and using the suppliers' innovation potential in construction projects. **Design/methodology/approach** – A qualitative exploratory research strategy is used in the context of construction projects. In total, 18 interviews were conducted with contractors to discover the experiences and practices related to the contractor-supplier relationship and construction innovation. **Findings** – The contractors perceive that the suppliers have innovation potential, and that they are often a source of construction innovation. The findings reveal business- and project-level practices for enhancing the contractor-supplier relationship and for overcoming barriers that hinder the suppliers' innovation potential. **Research limitations/implications** – The research conducted for this paper is limited to the contractors' perspectives based on construction projects in one country. Further research is encouraged to verify the success of identified practices and cover the perspectives of the suppliers, clients and designers. **Originality/value** – Limited research and attention is directed toward the role of the suppliers in projects within the construction industry. This paper offers important information about the part that both the suppliers and the contractors play in construction innovation and its facilitation.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Industrial and Information Management

Contributors: Sariola, R.

Publication date: 2018

Peer-reviewed: Yes

Early online date: 20 Jan 2018

### Publication information

Journal: Construction Innovation

Volume: 18

Issue number: 2

ISSN (Print): 1471-4175

Ratings:

Scopus rating (2018): CiteScore 3.5 SJR 0.707 SNIP 0.791

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Computer Science(all), Civil and Structural Engineering, Architecture, Building and Construction

Keywords: Construction innovation, Construction management, Construction projects, Contractor-supplier relationship, Procurement, Supply chain management

DOIs:

10.1108/CI-06-2017-0050

Source: Scopus

Source ID: 85040725863

Research output: Contribution to journal › Article › Scientific › peer-review

### **Techno-economic evaluation of integrating torrefaction with anaerobic digestion**

In recent days, the interest on torrefaction is increasing owing to its ability to improve biomass properties to a level of competing with coal. However, its techno-economic feasibility still need to be optimized. Integrating torrefaction with other thermochemical and biochemical processes could be a feasible option to improve the performance of the torrefaction process. In that regard, this study evaluates the techno-economic feasibility of integrating the torrefaction with anaerobic digestion (AD). In addition, new process configurations were studied to identify the possible heat energy recovery options. Technical feasibility was tested through mass and energy balance at each process unit. The economic indicators such as net present value (€), minimum selling price and internal rate on return (%) were used to evaluate the economic performance. At 10 t/h of torrefied biomass pellets production capacity, the estimated bio-methane production from AD was 369 m<sup>3</sup>/h. The economic evaluation shows that the minimum selling price of the torrefied biomass to reach the breakeven could be reduced from 199 €/t for standalone torrefaction to 185 €/t in case of torrefaction integrated with AD. The sensitivity analysis shows that feedstock and total capital investment were the most sensitive input parameters. This study shows that integrating the torrefaction with AD has better technical and economic feasibility than standalone torrefaction.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Chemistry and Bioengineering, Research group: Bio- and Circular Economy

Contributors: Doddapaneni, T. R. K. C., Praveenkumar, R., Tolvanen, H., Rintala, J., Kontinen, J.

Number of pages: 13

Pages: 272-284

Publication date: 2018

Peer-reviewed: Yes

Early online date: Jan 2018

#### **Publication information**

Journal: Applied Energy

Volume: 213

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2018): CiteScore 14.3 SJR 3.455 SNIP 2.649

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Energy(all), Mechanical Engineering, Management, Monitoring, Policy and Law

Keywords: Energy recovery, Minimum selling price, Process integration, Techno-economic analysis, Torrefaction – anaerobic digestion, Torrefied pellets

DOIs:

10.1016/j.apenergy.2018.01.045

Source: Scopus

Source ID: 85041461877

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Cold-formed RHS T joints with initial geometrical imperfections**

Generally, numerical simulations of structures are carried out in such a way as to most accurately repeat their real behavior. The current rules for finite element modeling of tubular joints oblige scientists and engineers to construct their numerical models considering initial imperfections. However, not all joints are sensitive to initial imperfections. Often consideration of initial imperfections brings no reasonable improvements in the accuracy of results, but severely complicates numerical simulations. In such cases, the effect of geometrical imperfections can be effectively replaced by a simple theoretical equation or neglected entirely. This paper evaluates the effect of initial geometrical imperfections on the structural behavior of cold-formed rectangular hollow section T joints. Imperfections are simulated using the conventional approach for thin-walled structures, applying corresponding buckling modes to the perfect geometry. The paper analyzes several buckling modes and their combinations to identify the most rational technique for simulation of imperfections under in-plane bending and axial loading. Based on the obtained results, parametric studies are conducted to investigate the effect of initial imperfections on joints with various geometry and material properties. The results demonstrate that initial imperfections reduce the resistance and initial stiffness of joints. However, the observed effect has been found sufficiently small to be safely ignored in computational analyses.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, St. Petersburg State Polytechnical University

Contributors: Garifullin, M., Bronzova, M. K., Heinisuo, M., Mela, K., Pajunen, S.

Number of pages: 14  
Pages: 81-94  
Publication date: 2018  
Peer-reviewed: Yes

#### **Publication information**

Journal: Magazine of Civil Engineering  
Volume: 80  
Issue number: 4  
ISSN (Print): 2071-4726  
Ratings:

Scopus rating (2018): CiteScore 2.7 SJR 1.062 SNIP 2.509

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Finite element analysis, Hollow section joint, Imperfection, Initial stiffness, Resistance

Electronic versions:

cold-formed\_rhs\_t\_joints

DOIs:

10.18720/MCE.80.8

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910033677>

Source: Scopus

Source ID: 85051540096

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Core Project Team As a Management Entity for Construction Projects**

The complexity of constructed facilities and the high degree of specialisation in design and construction generates very fragmented working environment for the construction project. Construction project organisations are built up from the units of organisations and they have arranged rules and procedures about how practicalities are to be done. A current perception of construction management is widely built around power, authority, and task orientation. This is resulting from the traditional focus of the construction industry on the technical and managerial features of construction projects.

Organisations of construction projects vary substantially in their structure and this structure has considerable consequences to outcomes. Therefore, project management professionals continuously seek and establish new organisational and management structures and linkages to facilitate imperative cooperation between people and project partners. New understanding and amendments are broadening the content of construction project management and have provided new insights for successful construction operations. This paper is based on research according to this continuum by having focus on the appearances of management entity of a new kind, its significance and roles as a part of construction project management. The paper sought to summarize this literature and the survey study by focusing on the project management entity "core project team", later "core team". Drawing from this inclusive, the phenomenon of core team, the authors approach the field through six attributes, which have been selected to describe the new way for organising project management.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Digitalization in the real estate and construction sector

Contributors: Keinänen, M., Kähkönen, K.

Number of pages: 10

Pages: 208-217

Publication date: 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: In\_bo: Ricerche e progetti per il territorio, la città e l'architettura. Construction Management

Volume: 9

Issue number: 13

ISSN (Print): 2036-1602

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Core project team, Core team, Construction management, Construction project, Construction teams

Electronic versions:

Core Project Team As a Management Entity for Construction Projects

URLs:

[https://in\\_bo.unibo.it/issue/view/751/showToc](https://in_bo.unibo.it/issue/view/751/showToc)

### **Initial in-plane rotational stiffness of welded RHS T joints with axial force in main member**

In the frame analysis, the local analysis model of the joint must follow the behavior of the joint. When completing the elastic global analysis, the initial rotational stiffness of the joints should be known to obtain the reliable moment distribution between the members of the frame. This paper evaluates the existing calculation approach for the initial rotational stiffness of welded rectangular hollow section T joints. Validation with the experiments shows that the current calculation approach significantly underestimates their initial rotational stiffness. Based on the existing experimental data, the paper proposes the improvement for determining the initial stiffness. The second part of the article investigates the effect of the axial force in the main member on the initial rotational stiffness of the joint. The conducted numerical study on square hollow section T joints shows that the reduction of their initial stiffness can reach 50%, when the main member experiences the normal stresses close to yielding. Using the curve fitting approach, the paper proposes and validates a corresponding chord stress function, similar to the existing ones for the moment resistance.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Metal and Light-wight structures, St. Petersburg State Polytechnical University, HAMK University of Applied Sciences

Contributors: Garifullin, M., Pajunen, S., Mela, K., Heinisuo, M., Havula, J.

Number of pages: 10

Pages: 353-362

Publication date: 1 Dec 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Constructional Steel Research

Volume: 139

ISSN (Print): 0143-974X

Ratings:

Scopus rating (2017): CiteScore 4.2 SJR 1.892 SNIP 2.282

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanics of Materials, Metals and Alloys

Keywords: Chord stress function, In-plane moment load, Rotational stiffness, Welded tubular T joint

Electronic versions:

Initial rotational stiffness of RHS joints with axial force in main member. Embargo ended: 10/10/19

DOIs:

10.1016/j.jcsr.2017.09.033

URLs:

<http://urn.fi/URN:NBN:fi:tty-201908262017>. Embargo ended: 10/10/19

Source: Scopus

Source ID: 85030871269

Research output: Contribution to journal › Article › Scientific › peer-review

### **The effect of steel grade on weight and cost of warren-type welded tubular trusses**

The effect of steel grade on the weight and cost of Warren-type welded tubular roof trusses was investigated. For an unbiased comparison, best truss designs were obtained through optimisation. The steel strength investigated ranged from S355 to S960. Costs were calculated based on the features of the trusses. The starting point was the exact geometry of the truss, from which a finite-element model was derived. This approach allowed the resistance and other requirements of design standards of both members and joints to be included as constraints in the optimisation problem. The design variables were the truss height, the locations of joints, the gap width at the joints and the member sections, from a catalogue of cold-formed square tubes. Eurocode 3 requirements were applied. The results of the comparison imply a significant saving in weight when using high-strength steel (HSS), by as much as 50% for S960. The cost reduction was smaller, but still about 20%, for a hybrid solution of S700/S355 for the higher of two investigated load values. It is hoped the results will motivate the use and further investigations of HSSs in building products.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Metal and Light-wight structures

Contributors: Tiainen, T., Mela, K., Jokinen, T., Heinisuo, M.

Number of pages: 19

Pages: 855-873  
Publication date: 1 Nov 2017  
Peer-reviewed: Yes

#### **Publication information**

Journal: Proceedings of the Institution of Civil Engineers: Structures and Buildings

Volume: 170

Issue number: 11

Article number: 1600112

ISSN (Print): 0965-0911

Ratings:

Scopus rating (2017): CiteScore 2.4 SJR 0.41 SNIP 0.676

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Buildings, structures & design, Design methods & aids, Steel structures

DOIs:

10.1680/jstbu.16.00112

Source: Scopus

Source ID: 85032028489

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Relationships among Civil Engineering Students' Approaches to Learning, Perceptions of the Teaching-Learning Environment, and Study Success**

This study examines the relationship among civil engineering students' approaches to learning, their perceptions of the teaching-learning environment, and their study success. The aim was to identify civil engineering students' approaches to learning and how their approaches to learning are related to their perceptions of the learning-teaching environment and their study success. The data of the study consist of the students' answers to a questionnaire (n=215) and their study success data (n=204), which were gathered from their university's study register. The study success data consist of the cumulative study credits and weighted averages of their course grades. The students were classified into four clusters according to their approaches to learning. Differences in their perceptions of the teaching-learning environment and study success between the clusters were statistically significant. Students who belonged to clusters that emphasized the deep approach to learning experienced their teaching-learning environment more positively than did other students. Students who belonged to clusters emphasizing organized studying earned more credits and higher marks in their studies than did other students.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Digitalization in the real estate and construction sector, Industrial and Information Management, University of Helsinki

Contributors: Salmisto, A., Postareff, L., Nokelainen, P.

Publication date: 1 Oct 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Professional Issues in Engineering Education and Practice

Volume: 143

Issue number: 4

Article number: 04017010

ISSN (Print): 1052-3928

Ratings:

Scopus rating (2017): CiteScore 2.3 SJR 0.456 SNIP 1.301

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Industrial relations, Strategy and Management

Keywords: Approaches to learning, Engineering education, Study success, Teaching-learning environment

DOIs:

10.1061/(ASCE)EI.1943-5541.0000343

Source: Scopus

Source ID: 85023205638

Research output: Contribution to journal > Article > Scientific > peer-review

#### **A generic method to optimize a redundant serial robotic manipulator's structure**

In this paper, an optimization method for a redundant serial robotic manipulator's structure is proposed in order to improve their performance. Optimization was considered in terms of kinematics using the proposed objective function and the non-linear Levenberg-Marquardt algorithm for multi-variate optimization. Range limits of the joints, bounds of the design

parameters, and a constrained workspace are enforced in the proposed method. A desired manipulator can be optimized to cover the required task points using dimensional synthesis. This approach effectively optimizes the link lengths of the manipulator and minimizes the position and orientation errors of the tool center point. A commercial heavy-duty hydraulic, underground tunneling manipulator was used to demonstrate the capability of the proposed optimization method. The obtained results encourage the use of the proposed optimization method in automated construction applications, such as underground tunneling, where the confined environment and the required task add challenges in the design of task-based robotic manipulators.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Research group: Mobile manipulation, Sandvik Mining and Construction Oy

Contributors: Kivelä, T., Mattila, J., Puura, J.

Number of pages: 8

Pages: 172-179

Publication date: 1 Sep 2017

Peer-reviewed: Yes

#### Publication information

Journal: Automation in Construction

Volume: 81

ISSN (Print): 0926-5805

Ratings:

Scopus rating (2017): CiteScore 8.2 SJR 1.613 SNIP 2.594

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Civil and Structural Engineering, Building and Construction

Keywords: Computer-aided design, Constraint, Optimization, Redundant, Robotic, Serial manipulator, Synthesis, Workspace

DOIs:

10.1016/j.autcon.2017.06.006

Source: Scopus

Source ID: 85020881925

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

#### Carbon dioxide permeability of building materials and their impact on bedroom ventilation need

This research determined the carbon dioxide permeabilities of different materials and cellulose-insulated wall structures without a vapour barrier as well as the CO<sub>2</sub> balance of bedroom air. Material tests have indicated that the CO<sub>2</sub> permeabilities of building materials correlate closely with their water vapour permeabilities. Thus, the more permeable the external wall structures are, the bigger their impact on the CO<sub>2</sub> content of indoor air. Yet, higher permeability allows more water vapour to pass through the structures, which make them more at-risk for condensation and mould growth. Some calculations on the CO<sub>2</sub> balance of bedroom air were also made which indicated that the need of ventilation is not reduced by the use of gas permeable structures.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Niemelä, T., Vinha, J., Lindberg, R., Ruuska, T., Laukkarinen, A.

Number of pages: 10

Pages: 99-108

Publication date: 1 Jul 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Building Engineering

Volume: 12

ISSN (Print): 2352-7102

Ratings:

Scopus rating (2017): CiteScore 2.5 SJR 0.753 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Architecture, Civil and Structural Engineering, Building and Construction, Safety, Risk, Reliability and Quality, Mechanics of Materials

Keywords: Building materials, Carbon dioxide, Material properties, Material testing, Permeability

Electronic versions:

Authors\_accepted\_manuscript\_1\_s2.0\_S2352710216303825\_main. Embargo ended: 1/07/19

DOIs:

10.1016/j.jobe.2017.05.009

URLs:

<http://urn.fi/URN:NBN:fi:tty-201706051583>. Embargo ended: 1/07/19

#### **Bibliographical note**

INT=rak,"Niemelä, Timo"

Source: Scopus

Source ID: 85019363463

Research output: Contribution to journal > Article > Scientific > peer-review

#### **The effect of matrix type on ageing of thick vinyl ester glass-fibre-reinforced laminates**

In this research, glass fibre reinforced composite laminate samples were manufactured with filament winding technique using four different vinyl ester resin systems to study ageing. The manufactured laminate samples were conditioned in an environmental cabinet (70°C, 95 RH%), water immersion (95°C), and in sulphuric acid solution immersion under pressure (5% H<sub>2</sub>SO<sub>4</sub>, 95°C, 15bar). After 6 and 12months of conditioning, the samples were tensile tested and the results were compared with the initial values. Regardless of the matrix type, conditioning in the environmental cabinet resulted in the lowest weight gain and least decrease in tensile properties: the decrease in the tensile strength values was 10-25% after 12months' conditioning depending on the vinyl ester used. The water immersion was more detrimental to the samples than the 5% H<sub>2</sub>SO<sub>4</sub> immersion causing the highest weight gain and the greatest decrease in tensile strength (up to 65%). However, when comparing the tensile performance, it was noted that the highest weight gain did not inevitably correlate with the strongest ageing effect. In water immersion, the ultimate strength deteriorates faster than the proof stress level leading to a decreasing damage tolerance of the vinyl-ester composite laminates.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Research group: Plastics and Elastomer Technology, Aalto University, Outotec Research Center

Contributors: Sarlin, E., Sironen, R., Pärnänen, T., Lindgren, M., Kanerva, M., Vuorinen, J.

Pages: 840–850

Publication date: 15 May 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Composite Structures

Volume: 168

ISSN (Print): 0263-8223

Ratings:

Scopus rating (2017): CiteScore 6.8 SJR 1.905 SNIP 1.951

Original language: English

ASJC Scopus subject areas: Ceramics and Composites, Civil and Structural Engineering

Keywords: Ageing, GFRP, Tensile properties, Vinyl ester

Electronic versions:

COST\_2017\_84\_Manuscript\_revised. Embargo ended: 15/02/19

DOIs:

10.1016/j.compstruct.2017.02.086

URLs:

<http://urn.fi/URN:NBN:fi:tty-201801311180>. Embargo ended: 15/02/19

#### **Bibliographical note**

INT=mol,"Sironen, Reija"

EXT="Lindgren, Mari"

Source: Scopus

Source ID: 85014165625

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Output power variation of different PV array configurations during irradiance transitions caused by moving clouds**

This paper presents a study of the output power variation of different photovoltaic (PV) array configurations during irradiance transitions caused by moving clouds. The study was based on velocity and other characteristics of roughly 27,000 irradiance transitions identified in measured irradiance data and conducted using a mathematical model of irradiance transitions and an experimentally verified simulation model of a PV module. The studied electrical PV array



configurations were series-parallel, total-cross-tied and multi-string. The different PV array orientations and layouts (physical shapes) of the configurations were also studied. The average rate of change of the power of these studied PV array configurations during the irradiance transitions was around 3%/s and the maximum instantaneous rates of change of the power were around 75%/s. Half of the time during the studied transitions, the rate of change in the power was over 1.2%/s, and most of the time during the transitions, it exceeded typical PV power ramp rate limits set by grid operators. The average rate of change of PV array power decreased with an increasing maximum array dimension and it was observed to be the largest when the shorter dimension of the array was parallel to the dominant movement direction of the shadow edges. The results of this study are relevant especially in terms of PV array design, maximum power point tracking algorithm development and energy storage systems sizing.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Energy Engineering, Research area: Power engineering

Contributors: Lappalainen, K., Valkealahti, S.

Number of pages: 9

Pages: 902-910

Publication date: 15 Mar 2017

Peer-reviewed: Yes

#### Publication information

Journal: Applied Energy

Volume: 190

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2017): CiteScore 12.9 SJR 3.162 SNIP 2.79

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Energy(all)

Keywords: Irradiance transition, Partial shading, Photovoltaic power generation, Power variation, PV array

DOIs:

10.1016/j.apenergy.2017.01.013

URLs:

<http://www.scopus.com/inward/record.url?scp=85009223592&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85009223592

Research output: Contribution to journal > Article > Scientific > peer-review

#### Effect of energy measures on the values of energy efficiency indicators in Finnish daycare and school buildings

The potential for cost-effective energy efficiency improvements is very large. However, major impacts from energy efficiency improvements can take decades to be fully realised. In addition, today the building sector is requested to define strategies and decide which energy retrofit actions to undertake in their existing building stock. Since building users are very often encouraged to save energy based on measured energy consumption, it is essential to know that the indicator used to assess energy efficiency is really guiding the building use towards sustainability. This study examines how energy measures reflect energy efficiency indicators and how they can be combined so that the result is user-driven and reflects the reality of the building operational phase energy efficiency better. This study shows that energy efficiency can be measured by using alternative indicators and confirms that different indicators make a different impact on results showing efficiency. In the studied cases savings in energy consumption can be achieved by investing in technical measures or operating the building automation system based on actual occupancy. Results indicated that the size of the effect of energy measures is roughly similar in a case of alternative indicators of energy efficiency.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Civil Engineering, Aalto University, VTT Technical Research Centre of Finland

Contributors: Sekki, T., Airaksinen, M., Saari, A.

Number of pages: 9

Pages: 124-132

Publication date: 15 Mar 2017

Peer-reviewed: Yes

#### Publication information

Journal: Energy and Buildings

Volume: 139

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2017): CiteScore 7.8 SJR 2.061 SNIP 2.131

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Daycare centres, Energy efficient indicators, Energy savings, Schools

DOIs:

10.1016/j.enbuild.2017.01.005

Source: Scopus

Source ID: 85009126496

Research output: Contribution to journal › Article › Scientific › peer-review

### **Overheating in English dwellings: comparing modelled and monitored large-scale datasets**

Monitoring and modelling studies of the indoor environment indicate that there are often discrepancies between simulation results and measurements. The availability of large monitoring datasets of domestic buildings allows for more rigorous validation of the performance of building simulation models derived from limited building information, backed by statistical significance tests and goodness-of-fit metrics. These datasets also offer the opportunity to test modelling assumptions. This paper investigates the performance of domestic housing models using EnergyPlus software to predict maximum daily indoor temperatures over the summer of 2011. Monitored maximum daily indoor temperatures from the English Housing Survey's (EHS) Energy Follow-Up Survey (EFUS) for 823 nationally representative dwellings are compared against predictions made by EnergyPlus simulations. Due to lack of information on the characteristics of individual dwellings, the models struggle to predict maximum temperatures in individual dwellings and performance was worse on days when the outdoor maximum temperatures were high. This research indicates that unknown factors such as building characteristics, occupant behaviour and local environment makes the validation of models for individual dwellings a challenging task. The models did, however, provide an improved estimate of temperature exposure when aggregated over dwellings within a particular region.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, London School of Hygiene and Tropical Medicine

Contributors: Symonds, P., Taylor, J., Mavrogianni, A., Davies, M., Shrubsole, C., Hamilton, I., Chalabi, Z.

Number of pages: 14

Pages: 195-208

Publication date: 17 Feb 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Building Research and Information

Volume: 45

Issue number: 1-2

ISSN (Print): 0961-3218

Ratings:

Scopus rating (2017): CiteScore 5.6 SJR 1.141 SNIP 1.797

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: building information modelling (BIM), building performance, EnergyPlus, housing stock, occupant behaviour, overheating, simulation, validation

DOIs:

10.1080/09613218.2016.1224675

URLs:

<http://www.scopus.com/inward/record.url?scp=84988432242&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84988432242

Research output: Contribution to journal › Article › Scientific › peer-review

### **The corrosion rate in reinforced concrete facades exposed to outdoor environment**

Outdoor concrete structures such as concrete facade panels and balcony frame panels are subjected to various environmental actions causing reinforcement corrosion problems. Long-term field measurement data on reinforcement corrosion in carbonated concrete on these structures was utilized in the creation of a corrosion rate regression model combining weather parameters such as temperature, relative humidity, wind-driven rain and solar radiation to corrosion rate. A versatile model capable of predicting the effect of varying environmental actions on the corrosion rates of carbonation induced corrosion was produced. Wind-driven rain was found to have the greatest impact on corrosion rate in tandem with the micro climate surrounding the building. Due to changes in air temperature, air relative humidity as well as in the amount of wind-driven rain and solar radiation, the corrosion rate on concrete facades and balconies is constantly changing. Despite the high seasonal and yearly variation, the average level of the modelled corrosion rate was quite

steady on a longer 30-year perspective. This information is substantial for the long term service life design of concrete structures.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Research group: Building Physics, Research area: Structural Engineering, Finnish Meteorological Institute

Contributors: Köliö, A., Pakkala, T. A., Hohti, H., Laukkarinen, A., Lahdensivu, J., Mattila, J., Pentti, M.

Publication date: Feb 2017

Peer-reviewed: Yes

Early online date: 10 Aug 2016

### Publication information

Journal: Materials and Structures

Volume: 50

Issue number: 23

ISSN (Print): 1359-5997

Ratings:

Scopus rating (2017): CiteScore 4.4 SJR 1.383 SNIP 1.713

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Materials Science(all), Mechanics of Materials

Keywords: Carbonation, Concrete, Corrosion, Field measurement, Modelling, Reinforcement, Service life design

DOIs:

10.1617/s11527-016-0920-7

Source: Scopus

Source ID: 84981736636

Research output: Contribution to journal > Article > Scientific > peer-review

### Designers' performance evaluation in construction projects

**Purpose** - In a construction project, "participants' satisfaction" is one of the main dimensions used for measuring the successfulness of a project. Designers perform a major role in attaining the project goals and managing project complexity during production. The purpose of this paper is to examine the designers' performance as evaluated by the main participants: the client, the project consultant/manager and the main contractor, and to identify the main success factors of designer performance using the participants' evaluation. The study also aims to examine how the economic size of a project affects the project participants' assessment of the designer's performance. It is assumed that as the size of a project increases, so does the complexity of the project, which will affect the scope of work and demands on the designers' operational performance for the specific project level. **Design/methodology/approach** - The Finnish project evaluation and benchmark database was used in this study as empirical data. The quantitative data consists of surveys on the project level and are based on a multi-dimensional standard evaluation wherein the main participants evaluate each other's performances. The client, project consultant and main contractor evaluated the designer's performance. The data of the study consisted of a total of 892 evaluations. ANOVA analysis was used to examine the differences between the project participants' assessments based upon the different economic sizes of the projects. **Findings** - Contractors were satisfied with the designers' performance in small projects, whereas the client and the project consultant/manager rated the designers' performance most successful in large projects. This result may be due to small projects are typically simple and less complex, in which case design solutions are generally well-defined. Nonetheless, the participants' level of satisfaction follows the same factors. The main problems in the designers' performance were related to the design content: the flawlessness and comprehensiveness, as well as the compatibility and consistency of designs. These factors were emphasized particularly in the client's low satisfaction of the designer's performance. However, project participants were satisfied with the collaboration with designers; however, room for improvement could be found in internal communication and collaboration within the design teams. The findings illustrated that the assessment of the success rate of a project was party-specific, which was clearly affected by the size of the project, as large projects appeared to be more complex than smaller ones. **Practical implications** - The findings suggested that there is a need to develop project-specific practices in managing multidisciplinary design teams. Additionally, particularly in large projects, designers should focus more on solving problems and design requirements occurring at the construction site. However, this should be implemented in such a way that this does not interfere with the design activities conducted with the client and project management. While client satisfaction is low in the small projects, designers should focus more on customer-oriented methods to serve client needs better. **Originality/value** - In construction project management studies, there is a need to measure the importance that various participants assign to different success factors. Since project success factors depend on project type, a more project-specific approach is suggested to identify the main parameters for measuring project success. This study provides a holistic approach of the designers' performance, which contributes to the theory of project success and designers' performance improvement.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Research group: Responsible Construction, Aalto University  
Contributors: Kärnä, S., Junnonen, J. M.  
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Pages: 154-169  
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Original language: English

ASJC Scopus subject areas: Architecture , Civil and Structural Engineering, Building and Construction, Business, Management and Accounting(all)

Keywords: Critical success factors, Customer satisfaction, Design management, Performance measures, Project management, Project participants satisfaction

DOIs:

10.1108/ECAM-06-2015-0101

URLs:

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Source: Scopus

Source ID: 85009354387

Research output: Contribution to journal › Article › Scientific › peer-review

#### Multicriteria selection in concept design of a divertor remote maintenance port in the EU DEMO reactor using an AHP participative approach

The work behind this paper took place in the Eurofusion remote maintenance system project (WPRM) for the EU Demonstration Fusion Power Reactor (DEMO). Following ITER, the aim of DEMO is to demonstrate the capability of generating several hundreds of MW of net electricity by 2050. The main objective of this paper was the study of the most efficient design of the maintenance port for replacing the divertor cassettes in a Remote Handling (RH) point of view. In DEMO overall design, one important consideration is the availability and short down time operations. The inclination of the divertor port has a very important impact on all the RH tasks such as the design of the divertor mover, the divertor locking systems and the end effectors. The current reference scenario of the EU DEMO foresees a 45° inclined port for the remote maintenance (RM) of the divertor in the lower part of the reactor. Nevertheless, in the optic of the systems engineering (SE) approach, in early concept design phase, all possible configurations shall be taken into account. Even the solutions which seem not feasible at all need to be investigated, because they could lead to new and innovative engineering proposals. The different solutions were compared using an approach based on the Analytic Hierarchy Process (AHP). The technique is a multi-criteria decision making approach in which the factors that are important in making a decision are arranged in a hierarchic structure. The results of these studies show how the application of the AHP improved and focused the selection on the concept which is closer to the requirements arose from technical meetings with the experts of the RH field.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, ENEA/CREATE/Università Degli Studi Napoli Federico II, VTT Technical Research Centre of Finland, ENEA Brasimone

Contributors: Carfora, D., Gironimo, G. D., Esposito, G., Huhtala, K., Määttä, T., Mäkinen, H., Miccichè, G., Mozzillo, R.

Number of pages: 8

Pages: 324-331

Publication date: 15 Nov 2016

Peer-reviewed: Yes

#### Publication information

Journal: Fusion Engineering and Design

Volume: 112

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Ratings:

Scopus rating (2016): CiteScore 2.3 SJR 0.579 SNIP 1.022

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Materials Science(all), Nuclear Energy and Engineering, Mechanical Engineering

Keywords: AHP, Concept design, DEMO, Remote handling, Systems engineering

DOIs:

10.1016/j.fusengdes.2016.08.023

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<http://www.scopus.com/inward/record.url?scp=84994060921&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84994060921

Research output: Contribution to journal > Article > Scientific > peer-review

### **Instrumentation and fe analysis of a large-span culvert built under a railway, in Finland**

Large span soil-steel culverts are rarely used in Finland as vehicular underpasses. The large span and low soil cover height together with high traffic loads place high demands on the construction of culvert backfills. Traffic-induced stress changes and the fatigue resistance of the plates play a major role in the endurance of a culvert. According to design calculations, the most critical section of the culvert is the crown. For this reason, the focus of this project is on the assessment of the structural behaviour and performance of the crown area. The structural performance of the culvert was verified by monitoring stress changes and deformations under live railway traffic, which proved the suitability of the multi-plated culvert built under a railway. As the project had only one constructed and monitored culvert, the monitoring results were used to construct an FE model to examine the effect of backfill variation on the culvert's structural behaviour.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Track Structures, Research group: Concrete and Bridge Structures

Contributors: Asp, O., Laaksonen, A.

Number of pages: 8

Pages: 357-364

Publication date: 3 Nov 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Structural Engineering International: Journal of the International Association for Bridge and Structural Engineering

Volume: 26

Issue number: 4

ISSN (Print): 1016-8664

Ratings:

Scopus rating (2016): CiteScore 1.3 SJR 0.342 SNIP 0.682

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Culvert, railway bridge, instrumentation, monitoring, live loads

DOIs:

10.2749/101686616X14555429843807

URLs:

<http://www.ingentaconnect.com/content/iabse/sei/2016/00000026/00000004/art00009>

Research output: Contribution to journal > Article > Scientific > peer-review

### **Consideration of energy consumption, energy costs, and space occupancy in Finnish daycare centres and school buildings**

The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of all energy. Failure to encourage energy-efficiency and low-carbon in new builds or retrofitting will lock countries into the disadvantages of poor performing buildings for decades. The journey towards low-carbon and energy efficient buildings starts with good design, commissioning and measuring. The share of energy costs can be up to 50% of all maintenance costs [7] in Finland. In the studied buildings the average costs were 39% for daycare centres and 45% for schools. Since the share of energy costs is remarkable in maintenance, it is important to find out the most concrete indicators to measure energy efficiency in practice. This study explores ways in which building usage and occupancy influences the energy cost in Finnish daycare centres and school buildings. This study shows that energy costs vary a lot between different energy efficiency indicators, i.e. there is great variation in energy costs regardless of the building age and when child or student density varies. Results indicated that actual use of space is profiled in the operational phase where the energy costs variation is remarkable.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Civil Engineering, Aalto University, VTT Technical Research Centre of Finland  
Contributors: Sekki, T., Andelin, M., Airaksinen, M., Saari, A.  
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Publication date: 1 Oct 2016  
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Scopus rating (2016): CiteScore 6.6 SJR 2.055 SNIP 1.969

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Daycare centres, Energy consumption, Energy costs, Occupation, Schools

DOIs:

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Source: Scopus

Source ID: 84982834048

Research output: Contribution to journal > Article > Scientific > peer-review

#### Stress relaxation in tempered glass caused by heat soak testing

Heat soak testing of tempered glass is a thermal process required after the tempering process itself to bring glasses of commercial soda-lime-silica-glass to failure that are contaminated with nickel sulphide inclusions, diameter 50 nm to 500 nm typically. Thus, the tests avoid a so-called "spontaneous" breakage of the glass in building elements at ambient temperatures months or years later. According to industry standards, the duration of the tests typically differs between 1 h and 4 h at temperatures of  $290 \pm 10$  °C. Although this temperature is well below the transformation temperature of commercial soda-lime-silica glass, it causes stress relaxation in tempered glass and the fracture pattern of the glass changes accordingly, especially thin glasses are affected. Based on the Tool-Narayanaswamy-Model, this paper comprises the theoretical background of the stress-relaxation-process and the results of a parameter study for its most influential technical parameters. Results are compared to photoelastic measurements of temper stresses and fracture patterns of tempered glass before and after a heat treatment similar to heat soak testing.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Mechanical Engineering and Industrial Systems, Technical University Darmstadt, Danmarks Tekniske Universitet, DTU Informatik, University of Sydney  
Contributors: Schneider, J., Hilcken, J., Aronen, A., Karvinen, R., Olesen, J. F., Nielsen, J.  
Number of pages: 8  
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ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Fracture pattern, Heat soak test, Photoelastic measurements, Stress relaxation, Tempered glass, Tool-Narayanaswamy-Model

DOIs:

10.1016/j.engstruct.2016.04.024

Source: Scopus

Source ID: 84969753418

Research output: Contribution to journal > Article > Scientific > peer-review

### **Energy saving and indoor climate effects of an added glazed facade to a brick wall building: Case study**

This study is focused on the energy saving and indoor climate analysis of the renovation of a 1930's brick-walled building in the moderately cold climatic conditions of Malmö in southern Sweden. Three facades of the building were glassed in and the ventilation system was renewed. The purpose of this study was to investigate the effect the added glazing would have on the building's energy demand and indoor climate. Measurements were taken on site and were used as the input for computational studies performed with the help of IDA Indoor Climate and Energy software (IDA-ICE). The study showed that the heating energy demand was reduced after the glazing installation by between 5.6% and 25.3%. In addition, the mean annual temperature difference between the cavity space and the outside air was from 5.2 °C to 11.4 °C higher, depending on the design. A number of different design options were explored for the winter and also summer case-studies, as it was apparent that adding glazing decreased the level of comfort in the building's indoor environment in summer time. This problem could be solved by increasing the cavity air flow or adding new solar shading to the front or back of the glazing.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Service Life Engineering of Structures, Department of Civil Engineering, Lunds Universitet / Lunds Tekniska Högskola

Contributors: Hilliaho, K., Nordquist, B., Wallentèn, P., Hamid, A. A., Lahdensivu, J.

Number of pages: 17

Pages: 246-262

Publication date: 1 Sep 2016

Peer-reviewed: Yes

#### **Publication information**

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ISSN (Print): 2352-7102

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Scopus rating (2016): CiteScore 1.2 SJR 0.571 SNIP 1.069

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Mechanics of Materials, Safety, Risk, Reliability and Quality , Building and Construction, Architecture

Keywords: Added glazing, Building energy simulation, Energy saving effects, Field monitoring, IDA-ICE, Indoor climate

DOIs:

10.1016/j.jobe.2016.07.004

Source: Scopus

Source ID: 84978795756

Research output: Contribution to journal > Article > Scientific > peer-review

### **Effects of strain rate and confining pressure on the compressive behavior of Kuru granite**

Understanding the influence of hydrostatic pressure and loading rate on the strength and fracture behavior of rocks is very important for the development of deep drilling technology. This paper presents a systematic study on the mechanical properties and behavior of Kuru Gray granite at confining pressures up to 225 MPa and at strain rates of  $10^{-6} \text{ s}^{-1}$  and  $600 \text{ s}^{-1}$ . The low strain rate compression tests were carried out with a servo-controlled hydraulic testing machine with a radial confining chamber, and the dynamic tests with a special split Hopkinson pressure bar device with axial and radial confining pressure chambers. The results show that the rock strength increases significantly with strain rate and confining pressure. At confinements below 20 MPa, the strength of the material increases faster at the higher strain rate, but at confinements higher than this, the effect of confining pressure is stronger at the lower strain rate. The strain rate sensitivity increases when even a small confining pressure is applied. However, the rate sensitivity remains rather constant when the confining pressure is increased above 10 MPa. The parameters of the Hoek-Brown model and an alternative power-law model were calibrated for low and high rate data. Also, the fracture behavior of the rock was found to be strongly dependent on strain rate and confining pressure. At the low strain rate, the samples fail by axial splitting in the unconfined tests, whereas the dynamic unconfined tests result in a complete pulverization of the samples. At high confining pressures the fracture behavior is shear fracture for both studied strain rates.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Materials Characterization, School of Aeronautics and Astronautics and Materials Engineering, Purdue University, Department of Geology and Mineral Resources Engineering, Norwegian Univ. of Sci. and Technol., Materials and Chemistry, SINTEF

Contributors: Hokka, M., Black, J., Tkalich, D., Fourmeau, M., Kane, A., Hoang, N. H., Li, C. C., Chen, W. W., Kuokkala, V.

Number of pages: 11  
Pages: 183-193  
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Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Impact Engineering  
Volume: 91  
ISSN (Print): 0734-743X  
Ratings:

Scopus rating (2016): CiteScore 5.4 SJR 1.515 SNIP 2.221

Original language: English

ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Civil and Structural Engineering,

Aerospace Engineering, Automotive Engineering, Ocean Engineering, Safety, Risk, Reliability and Quality

Keywords: Confining pressure, Granite rock, High strain rate, Split Hopkinson pressure bar, Triaxial loading

DOIs:

10.1016/j.ijimpeng.2016.01.010

Source: Scopus

Source ID: 84957603545

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Energy saving in working hydraulics of long booms in heavy working vehicles**

Hybridization of heavy off-highway working vehicles brings considerable energy savings in the form of a downsized internal combustion engine (ICE) by means of reduced no-load losses. In this paper, a novel energy saving opportunity in working hydraulics at the end of long booms of working vehicles is proposed. In traditional off-highway working vehicles, the working hydraulics is supplied through pipes, hoses, and valves by a hydraulic pump located near the main engine. A significant amount of energy is lost in long pipelines and hoses as well as in valve throttles. A new topology is introduced to supply the power along the long boom; the power for a hydraulic actuator is supplied by an integrated electro-hydraulic energy converter (IEHEC), which is located at the boom end. The electrical energy to the converter is supplied through electrical cables, which have negligible losses compared with a conventional fluid power supply with long pipelines. The converter transforms the electrical energy into hydraulic energy at the end of the boom, and may also recover energy for additional energy savings.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Powertrain design, Research group: Fluid power automation in mobile machines, Lappeenranta University of Technology, VTT Technical Research Centre of Finland

Contributors: Immonen, P., Ponomarev, P., Åman, R., Ahola, V., Uusi-Heikkilä, J., Laurila, L., Handroos, H., Niemelä, M., Pyrhönen, J., Huhtala, K.

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Peer-reviewed: Yes

#### **Publication information**

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ISSN (Print): 0926-5805

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Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Civil and Structural Engineering, Building and Construction

Keywords: Energy efficiency, Hybrid vehicles, Off-highway heavy working vehicles

DOIs:

10.1016/j.autcon.2015.12.015

Source: Scopus

Source ID: 84959532162

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Mapping indoor overheating and air pollution risk modification across Great Britain: A modelling study**

Housing has long been thought to play a significant role in population exposure to environmental hazards such as high temperatures and air pollution. However, there is sparse data describing how housing may modify heat and air pollution



exposure such that housing's role in poor health and mortality from these hazards may be estimated. This paper describes the development of individual-address level indoor overheating and air pollution risk modifiers for Great Britain, for use alongside historical weather, outdoor air pollution, population socio-economic data, and mortality data in a large-scale epidemiological investigation. A geographically-referenced housing stock database was developed using the Homes Energy Efficiency Database (HEED) and the English Housing Survey (EHS). Simulations of unique combinations of building, fabric, occupation, and environment were run using a modelling framework developed for EnergyPlus 8.0, estimating indoor temperature metrics, indoor/outdoor ratio of pollution from outdoor sources, and indoor air pollution from multiple indoor sources. Results were compiled, matched back to individual properties in HEED, and mapped using Geographical Information Systems (GIS). Results indicate urban areas had higher numbers of buildings prone to overheating, reduced levels indoor air pollution from outdoor sources, and higher air pollution from indoor sources relative to rural areas, driven largely by variations in building types. The results provide the first national-scale quantitative estimate of heat and indoor air pollution modification by dwellings, aggregated at levels suitable for inclusion in health analysis.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, University of Oxford, University of Nottingham

Contributors: Taylor, J., Davies, M., Mavrogianni, A., Shrubsole, C., Hamilton, I., Das, P., Jones, B., Oikonomou, E., Biddulph, P.

Number of pages: 12

Pages: 1-12

Publication date: 1 Apr 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Building and Environment

Volume: 99

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2016): CiteScore 7.1 SJR 1.998 SNIP 2.227

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: Building physics, Building stock modelling, IAQ, Overheating

DOIs:

10.1016/j.buildenv.2016.01.010

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Source: Scopus

Source ID: 84955098873

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Pre-use phase LCA of a multi-story residential building: Can greenhouse gas emissions be used as a more general environmental performance indicator?**

Both the construction and use of buildings cause significant environmental pressures. The greenhouse gas (GHG) emissions imposed by buildings have been studied rather extensively, but less is known about other impacts. Still, climate change is only one harmful impact driven by buildings. Furthermore, no studies exist about how the other impacts are correlated with GHG emissions in the building context, and thus to what extent GHGs could be utilized as a more general environmental performance indicator. This paper fills these gaps by presenting a life cycle assessment of the pre-use phase of a modern concrete-element residential building with a very comprehensive life cycle inventory (LCI). The focus of the study is on the comparison of the accumulation of different environmental impacts relative to GHGs. The accumulation is analyzed from two perspectives common to building LCAs: building systems and different construction materials. The ReCiPe midpoint assessment method is utilized to reach wide impact category coverage. The study shows how GHGs act as a relatively good indicator for eight impact categories, but not for the others. The study also depicts that a very high coverage in the LCI must be reached to capture the majority of the different impacts. Many materials and building systems are considered non-relevant and are often excluded from building LCAs, which are in fact of great importance in many impact categories.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Iceland, Aalto University

Contributors: Heinonen, J., Säynäjoki, A., Junnonen, J. M., Pöyry, A., Junnila, S.

Number of pages: 10

Pages: 116-125  
Publication date: 1 Jan 2016  
Peer-reviewed: Yes

#### **Publication information**

Journal: Building and Environment

Volume: 95

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2016): CiteScore 7.1 SJR 1.998 SNIP 2.227

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: Building, Construction, Embodied emissions, Environmental impact, LCA, Life cycle assessment, ReCiPe  
DOIs:

10.1016/j.buildenv.2015.09.006

Source: Scopus

Source ID: 84941915948

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Effects of added glazing on Balcony indoor temperatures: Field measurements**

In this study the temperatures on 22 balconies (17 glazed) and adjacent flats were monitored with an aim to determine the key factors affecting the ability of a glazed balcony to warm up and remain warm without a heater. Considered were glazed balconies in different locations, the amount of glazing and building heat loss, the tightness of balcony vertical structures, and balcony ability to capture solar radiation. Temperature monitoring showed that over a year the air temperature of both glazed and unglazed balconies remained almost without an exception above the outdoor air temperature. On average, the temperatures of unglazed balconies were 2.0 °C and those of glazed balconies 5.0 °C higher than the outdoor air temperature. The three key factors affecting the glazed balcony temperatures seemed to be the level of air leakage in the balcony vertical structures, the balcony's ability to capture solar radiation, and the heat gain from an adjacent flat, in that order. The air tightness of the glazing was the most crucial factor, since it affected the results all the year round. Solar radiation was important from spring to autumn and heat gain in midwinter.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Research group: Building Physics

Contributors: Hilliäho, K., Köliö, A., Pakkala, T., Lahdensivu, J., Vinha, J.

Number of pages: 15

Pages: 458-472

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Energy and Buildings

Volume: 128

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2016): CiteScore 6.6 SJR 2.055 SNIP 1.969

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Balcony glazing, Balcony temperatures, Field monitoring, Prefabricated building, Temperature monitoring  
Electronic versions:

Hilliäho - Effects of added glazing on Balcony indoor temperatures- Field measurements. Embargo ended: 11/07/18  
DOIs:

10.1016/j.enbuild.2016.07.025

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911216141>. Embargo ended: 11/07/18

Source: Scopus

Source ID: 84978370516

Research output: Contribution to journal › Article › Scientific › peer-review

### **Surrogate modeling for initial rotational stiffness of welded tubular joints**

Recently, buildings and structures erected in Russia and abroad have to comply with stringent economic requirements. Buildings should not only be reliable and safe, have a beautiful architectural design, but also meet the criteria of rationality and energy efficiency. In practice, this usually means the need for additional comparative analysis in order to determine the optimal solution to the engineering task. Usually such an analysis is time-consuming and requires huge computational efforts. In this regard, surrogate modeling can be an effective tool for solving such problems. This article provides a brief description of surrogate models and the basic techniques of their construction, describes the construction process of a surrogate model to calculate initial rotational stiffness of welded RHS joints made of high strength steel (HSS).

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Metal and Light-wight structures, Peter the Great St. Petersburg Polytechnic University, Peter Great St Petersburg Polytech Univ

Contributors: Garifullin, M. R., Barabash, A. V., Naumova, E. A., Zhuvak, O. V., Jokinen, T., Heinisuo, M.

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Peer-reviewed: Yes

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Journal: Magazine of Civil Engineering

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Issue number: 3

ISSN (Print): 2071-4726

Ratings:

Scopus rating (2016): CiteScore 1 SJR 0.236 SNIP 0.772

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Finite element analysis, Kriging, Plane bending, Square hollow section, Surrogate modeling

Electronic versions:

Surrogate modeling for initial rotational stiffness of welded tubular joints

DOIs:

10.5862/MCE.63.4

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#### **Bibliographical note**

EXT="Garifullin, M. R."

Source: Scopus

Source ID: 84994045052

Research output: Contribution to journal › Article › Scientific › peer-review

### **Improving the thermal performance of concrete-sandwich envelopes in relation to the moisture behaviour of building structures in boreal conditions**

The excellent thermal performance and low cost of concrete-sandwich walls have made them widely applied in residential buildings. However, their standard composition may require additional insulation in boreal and arctic climates, where improvements in thermal insulation are achieved mainly by applying additional insulation layers on the envelope surface. Although thick insulation will substantially improve the heat capacity of a structure, elevated temperatures and entrapped humidity can lead to favourable conditions for the initiation of mould growth. The present study simulates the thermal performance of a model house wall structure in relation to increased mould growth risk. The results indicate that added insulation may have a negative impact not only on the structure and material properties of structural elements, but also on the environmental health and comfort of residents. Furthermore, climate conditions are shown to be a significant factor in identifying an optimal insulation design based on thermal performance and structural health.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu, Structural Engineering and Construction Technology, Ita-Suomen yliopisto

Contributors: Fedorik, F., Malaska, M., Hannila, R., Haapala, A.

Number of pages: 8

Pages: 226-233

Publication date: 15 Nov 2015

Peer-reviewed: Yes

### Publication information

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Ratings:

Scopus rating (2015): CiteScore 6 SJR 2.04 SNIP 2.185

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Concrete sandwich, Energy efficiency, Heat and mass transfer, Mould growth, Renovation building, Structural health

DOIs:

10.1016/j.enbuild.2015.08.020

Source: Scopus

Source ID: 84953403315

Research output: Contribution to journal › Article › Scientific › peer-review

### Airtightness of residential buildings in Finland

Single-family buildings and apartments in multi-family apartment buildings have been studied in Finland in two large-scale studies between the years 2002 and 2009. This paper is based on the measurements of airtightness of 170 single-family detached houses and 56 apartments by fan pressurisation method at 50 Pa. The mean air change rate of 10 autoclaved aerated concrete block, 10 shuttering concrete block, 10 concrete element, 10 brick masonry, 10 lightweight aggregate concrete block, 100 timber-framed, and 20 log single-family houses was 1.5 h<sup>-1</sup>, 1.6 h<sup>-1</sup>, 2.6 h<sup>-1</sup>, 2.8 h<sup>-1</sup>, 3.2 h<sup>-1</sup>, 3.9 h<sup>-1</sup> and 6.0 h<sup>-1</sup>, respectively. In concrete-built multi-storey houses, in which the intermediate floor was cast on site, the mean n<sub>50</sub>-value of 23 apartments was 0.7 h<sup>-1</sup>. The mean n<sub>50</sub>-value of 20 apartments in multi-storey houses built from concrete elements was 1.6 h<sup>-1</sup>. 16 apartments in timber-framed multi-storey houses had a mean n<sub>50</sub>-value 2.9 h<sup>-1</sup>. Factors like construction method and insulation material (polyurethane insulation) in timber-framed houses, seam insulation material in log houses and ceiling structure in heavyweight buildings among others were found to have an effect on the average values of air change rates. The mean values of airtightness do not satisfy the recommended level of airtightness in Finland. Most important result, however, is that good airtightness of individual houses was reached within all house groups regardless of the choice of structure, storeys, ventilation system or technology of construction.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University, Department of Civil and Structural Engineering

Contributors: Vinha, J., Manelius, E., Korpi, M., Salminen, K., Kurnitski, J., Kiviste, M., Laukkarinen, A.

Number of pages: 13

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Publication date: 1 Nov 2015

Peer-reviewed: Yes

### Publication information

Journal: Building and Environment

Volume: 93

Issue number: P2

ISSN (Print): 0360-1323

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Scopus rating (2015): CiteScore 6.9 SJR 2.067 SNIP 2.498

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Environmental Engineering, Geography, Planning and Development, Building and Construction

Keywords: Air change rate, Air leakage, Airtightness, Residential buildings

Electronic versions:

Kiviste - Airtightness of residential buildings in Finland. Embargo ended: 11/06/17

DOIs:

10.1016/j.buildenv.2015.06.011

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911216158>. Embargo ended: 11/06/17

URLs:

<http://www.scopus.com/inward/record.url?scp=84938085676&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84938085676

Research output: Contribution to journal > Article > Scientific > peer-review

### **Assessing uncertainty in housing stock infiltration rates and associated heat loss: English and UK case studies**

Strategies to reduce domestic heating loads by minimizing the infiltration of cold air through adventitious openings located in the thermal envelopes of houses are highlighted by the building codes of many countries. Consequent reductions of energy demand and CO<sub>2</sub>e emission are often unquantified by empirical evidence. Instead, a mean heating season infiltration rate is commonly inferred from an air leakage rate using a simple ratio scaled to account for the physical and environmental properties of a dwelling. The scaling does not take account of the permeability of party walls in conjoined dwellings and so cannot differentiate between the infiltration of unconditioned ambient air that requires heating, and conditioned air from adjacent dwellings that does not. A stochastic method is presented that applies a theoretical model of adventitious infiltration to predict distributions of mean infiltration rates and the associated total heat loss in any stock of dwellings during heating hours. The method is applied to the English and UK housing stocks and provides probability distribution functions of stock infiltration rates and total heat loss during the heating season for two extremes of party wall permeability. The distributions predict that up to 79% of the current English stock could require additional purpose-provided ventilation to limit negative health consequences. National models predict that fewer dwellings are under-ventilated. The distributions are also used to predict that infiltration is responsible for 3-5% of total UK energy demand, 11-15% of UK housing stock energy demand, and 10-14% of UK housing stock carbon emissions.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Nottingham, University of Oxford, London School of Hygiene and Tropical Medicine, University College London

Contributors: Jones, B., Das, P., Chalabi, Z., Davies, M., Hamilton, I., Lowe, R., Mavrogianni, A., Robinson, D., Taylor, J.

Number of pages: 13

Pages: 644-656

Publication date: 1 Oct 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Building and Environment

Volume: 92

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2015): CiteScore 6.9 SJR 2.067 SNIP 2.498

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: DOMVENT, Leakage, Model, Monte Carlo, Permeability, Ventilation

DOIs:

[10.1016/j.buildenv.2015.05.033](https://doi.org/10.1016/j.buildenv.2015.05.033)

URLs:

<http://www.scopus.com/inward/record.url?scp=84934989246&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84934989246

Research output: Contribution to journal > Article > Scientific > peer-review

### **Impact of building usage and occupancy on energy consumption in Finnish daycare and school buildings**

The facility strategy of the City of Espoo emphasises improvements in the energy efficiency and efficient use of buildings. The design phase of a building is crucial and when the building is in operation, it is crucial to use control systems correctly. Further, in order to encourage relevant efficiency efforts, it is essential to know how to measure energy efficiency in the building operation phase. This requires an understanding of the correlation between building occupancy, space efficiency and energy efficiency. Energy efficiency is typically measured as energy consumption per unit of area kWh/m<sup>2</sup> per annum. The specific energy consumption is an effective way to measure the technical properties of a building and to guide its design but it neglects issues related to building occupancy and space efficiency. This paper explores ways in which building usage and occupancy influences the measured energy consumption in Finnish daycare centres and school buildings. The study adopts existing energy efficiency indicators and introduces a new indicator for building energy efficiency which takes into account both space and occupancy efficiency.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), VTT Technical Research Centre of Finland, Aalto University, School of Engineering, Aalto University

Contributors: Sekki, T., Airaksinen, M., Saari, A.

Number of pages: 11

Pages: 247-257

Publication date: 18 Aug 2015

Peer-reviewed: Yes

### Publication information

Journal: Energy and Buildings

Volume: 105

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2015): CiteScore 6 SJR 2.04 SNIP 2.185

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Building usage, Daycare centres, Energy efficiency indicators, Measured energy consumption, Schools  
DOIs:

10.1016/j.enbuild.2015.07.036

URLs:

<http://www.scopus.com/inward/record.url?scp=84939449749&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939449749

Research output: Contribution to journal > Article > Scientific > peer-review

### Analysis of thermo-active pile structures and their performance under groundwater flow conditions

Geothermal heat pump systems (GHPs) are economically efficient and renewable environmentally friendly energy production systems in which the ground acts as a heat source in winter and a heat sink in summer. New methods have been developed to increase the economic efficiency of GHPs, including using pile foundations as dual-purpose structures in energy production and load transfer from building to ground. The performance of such energy pile foundations in cold climate regions was assessed numerically in this study by considering groundwater flow effects and short-term imbalanced seasonal thermal loadings. The structural behaviour of frictional pile foundations was also analysed using soil elasto-plastic behaviour and assuming non-linear sliding contact at the pile-soil interface. The results indicated that using energy pile foundations under medium groundwater flow (around 1.65E - 8 m/s), the productivity of system is improved by around 20% compared with a saturated conditions with no groundwater flow. They also indicated that no sliding occurred between the frictional pile shaft and the surrounding soil. However, the stresses in the frictional pile shaft decreased significantly in comparison with the end-bearing conditions. Moreover, there was a significant increase in the mobilised shaft friction at the pile-soil interface, particularly in summer mode.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu

Contributors: Gashti, E. H. N., Malaska, M., Kujala, K.

Number of pages: 8

Pages: 1-8

Publication date: 11 Aug 2015

Peer-reviewed: Yes

### Publication information

Journal: Energy and Buildings

Volume: 105

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2015): CiteScore 6 SJR 2.04 SNIP 2.185

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Energy pile foundations, Geothermal energy, Groundwater flow, Nordic countries, Structural behaviour, Thermo-active infrastructures  
DOIs:

10.1016/j.enbuild.2015.07.026

Source: Scopus

Source ID: 84938855851

Research output: Contribution to journal > Article > Scientific > peer-review

### **Divertor remote handling for DEMO: Concept design and preliminary FMECA studies**

The paper describes a concept design of a remote handling (RH) system for replacing divertor cassettes and cooling pipes in future DEMO fusion power plant. In DEMO reactor design important considerations are the reactor availability and reliable maintenance operations. The proposed divertor mover is a hydraulic telescopic boom driven from the transportation cask through the maintenance tunnel of the reactor. The boom is divided in three sections and it is driving an end-effector in order to perform the scheduled operations of maintenance inside the vacuum vessel. Two alternative designs of the end effector to grip and manipulate the divertor cassette are presented in this work. Both concepts are hydraulically actuated, based on ITER previous studies. The divertor cassette end-effector consists of a lifting arm linked to the divertor mover, a tilting plate, a cantilever arm and a hook-plate. Taking advantage of the ITER RH background and experience, the proposed hydraulic RH system is compared with the rack and pinion system currently designed for ITER and is an object of simulations at Divertor Test Platform (DTP2) in VTT's Labs of Tampere, Finland. Pros and cons will be put in evidence.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, Field robotics for efficient work sites (FIRE), VTT Technical Research Centre of Finland, ENEA/CREATE/Università Degli Studi Napoli Federico II

Contributors: Carfora, D., Di Gironimo, G., Järvenpää, J., Huhtala, K., Määttä, T., Siuko, M.

Number of pages: 5

Pages: 1437-1441

Publication date: 9 Jul 2015

Peer-reviewed: Yes

### **Publication information**

Journal: Fusion Engineering and Design

Volume: 98-99

ISSN (Print): 0920-3796

Ratings:

Scopus rating (2015): CiteScore 2.1 SJR 0.682 SNIP 1.472

Original language: English

ASJC Scopus subject areas: Nuclear Energy and Engineering, Materials Science(all), Civil and Structural Engineering, Mechanical Engineering

Keywords: Concept design, DEMO, Divertor, Hydraulic telescopic boom, Remote handling

DOIs:

10.1016/j.fusengdes.2015.06.056

URLs:

<http://www.scopus.com/inward/record.url?scp=84942553949&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Siuko, M."

Source: Scopus

Source ID: 84942553949

Research output: Contribution to journal > Article > Scientific > peer-review

### **Role and nature of systemic innovations in construction and real estate sector**

**Purpose** - The paper aims to clarify the role of systemic innovations and the subsequent profound change these can have on the construction and real estate sectors. Systemic innovation as a concept has an inherent capability for viewing factors, actors and conditions as a system or several systems. This has a direct relevance in construction and real estate sector where operations are composed of temporary and continual networks of stakeholders and where the end products can be understood as systems. **Design/methodology/approach** - The paper builds additional viewpoints and interpretations on some recently completed research where sector wide innovation aspects and challenges have been studied. Two doctoral dissertations supervised by the author and an action research effort where innovative cellular building products were developed and implemented are presented. **Findings** - The paper provides insights about systemic innovations in the construction and real estate sectors. It presents research topics that explain further what is required for having successful systemic innovations. **Research limitations/implications** - This is a synthesis paper. The presented viewpoints and interpretations can be used as starting points for research, development and innovation actions. **Practical implications** - The paper presents starting points for companies and other service providers targeting new innovative products which have systemic implications. **Originality/value** - This paper explains the need and challenges of systemic innovations in the

construction and real estate sectors.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Digitalization in the real estate and construction sector, Research group: Capacity Development of Water and Environmental Services CADWES, Research group: Real estate development, Life Cycle Effectiveness of the Built Environment (LCE@BE)

Contributors: Kähkönen, K.

Number of pages: 4

Pages: 130-133

Publication date: 7 Apr 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Construction Innovation: Information, Process, Management

Volume: 15

Issue number: 2

ISSN (Print): 1471-4175

Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.443 SNIP 0.76

Original language: English

ASJC Scopus subject areas: Computer Science(all), Control and Systems Engineering, Civil and Structural Engineering, Building and Construction, Architecture

Keywords: Cellular building products, Construction sector, Industry transformation, Innovation, Real estate, Systemic innovation

DOIs:

10.1108/CI-12-2014-0055

URLs:

<http://www.scopus.com/inward/record.url?scp=84928793747&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928793747

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Understanding fundamental and practical ingredients of construction project data management**

**Purpose** - This paper and research behind it aim to explain key elements behind construction project data management by looking at actual operations. The construction project management is heavily built around document control and relating events such as change orders, submittals, transmittals and requests for information. These functionalities are usually forming the core of electronic data/document management systems (EDMS), and more recently solutions based on Building Information Modelling (BIM) technologies. A growing share of buildings construction projects are designed and documented by using BIM applications. BIM applications can form spatially organised access to project data and documents which, if widely applied, can change the world of EDMS solutions. **Design/methodology/approach** - This paper presents results of a research effort where the use of EDMS was studied in 15 building construction case projects. The research focus was on EDMS structure, usage of EDMS in each case project and EDMS use models. **Findings** - The gained results explain content and characteristics of current practice. It is considered that useful knowledge can be learned from the present used of EDMS in building construction projects. This understanding can help our sector to move towards more advanced solutions. **Research limitations/implications** - The obtained research data are a certain kind of building development projects. These were renovation and change projects of existing buildings. **Originality/value** - Although the main stream of research has been technology-driven, the research behind this paper is targeting for new knowledge over the characteristics of EDMS use.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Digitalization in the real estate and construction sector, Research group: Capacity Development of Water and Environmental Services CADWES, Research group: Real estate development, Life Cycle Effectiveness of the Built Environment (LCE@BE)

Contributors: Kähkönen, K., Rannisto, J.

Number of pages: 17

Pages: 7-23

Publication date: 5 Jan 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Construction Innovation: Information, Process, Management



Volume: 15  
Issue number: 1  
ISSN (Print): 1471-4175  
Ratings:

Scopus rating (2015): CiteScore 1.9 SJR 0.443 SNIP 0.76

Original language: English

ASJC Scopus subject areas: Computer Science(all), Control and Systems Engineering, Civil and Structural Engineering, Building and Construction, Architecture

Keywords: Construction management Information systems/management, IT building design and construction, Planning and management, Project management, Team working

DOIs:

10.1108/CI-04-2014-0026

URLs:

<http://www.scopus.com/inward/record.url?scp=84921340330&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84921340330

Research output: Contribution to journal › Article › Scientific › peer-review

### **Measured energy consumption of educational buildings in a Finnish city**

This study measures energy consumption in existing educational buildings. The study provides an overall picture of energy consumption and assesses the factors that are used in evaluating measured energy. The studied buildings are day care centres, schools and university buildings located in southern Finland. The energy efficiency requirements in Finnish building regulations have become significantly stricter in recent years. This study shows that in different educational building type, the newer buildings consume less heating. However, such a clear correlation not found for electricity consumption. In the day care centres and school buildings studied, the primary heating consumption as a function of the age of the buildings has a decreasing trend. In turn, the primary electricity consumption has a slightly rising trend. However, in different building types, the primary heating and electricity consumption varied significantly between the buildings e.g. in day care centres variation was 83%, in schools 84% and in university buildings 76%. This study shows that even though Finnish climate is cold the primary electricity consumption is higher than primary heating in educational buildings constructed in the 2000s. This means that in the design phase, there is a need to find ways to influence the electricity consumption in particular.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), VTT Technical Research Centre of Finland, Aalto University

Contributors: Sekki, T., Airaksinen, M., Saari, A.

Number of pages: 11

Pages: 105-115

Publication date: 1 Jan 2015

Peer-reviewed: Yes

### **Publication information**

Journal: Energy and Buildings

Volume: 87

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2015): CiteScore 6 SJR 2.04 SNIP 2.185

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Educational buildings, Energy consumption, Measured energy, Primary energy consumption

DOIs:

10.1016/j.enbuild.2014.11.032

URLs:

<http://www.scopus.com/inward/record.url?scp=84911913165&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911913165

Research output: Contribution to journal › Article › Scientific › peer-review

### **The assessment of constructability: BIM cases**

The constructability appraisal methods developed so far are based on evaluating and analysing the major design components and systems of an entire building, such as structural systems, materials and production techniques. At first,

this paper discusses the current practice of constructability assessment used in Finland and next it introduces an experimental constructability assessment method (ECAM) using building information models (BIM) as a source of constructability information. Interviews of design and construction professionals were used to explore the current practice of constructability assessment. An experimental assessment methodology was developed and tested in case projects. According to the interviews, the main assessment method used was the inspection of drawings, and constructability was assessed occasionally during the design development stage and more systematically at the very end of the detailed design stage with varying professional participants in meetings. Using ECAM in the project level a constructability score of a building and building type can be analysed. When using ECAM on the level of structural elements a constructability score of elements can be measured. These scores incorporate information for the development of constructability. In Finland, the development of a systematic review process of constructability will be needed. The constructability assessment methodology suggested in the article is experimental and is to be developed and tested further before using it reliably in building projects. The assessment combining visual and analytical approach will change present methods for assessing constructability.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University

Contributors: Tauriainen, M. K., Puttonen, J. A., Saari, A. J.

Number of pages: 17

Pages: 51-67

Publication date: 1 Jan 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Information Technology in Construction

Volume: 20

ISSN (Print): 1403-6835

Ratings:

Scopus rating (2015): CiteScore 2.6 SJR 0.398 SNIP 1.129

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Computer Science Applications

Keywords: Analyses, Assessment, BIM, Buildability, Constructability, Modelling, Quantitative

URLs:

<http://www.scopus.com/inward/record.url?scp=84921652278&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84921652278

Research output: Contribution to journal › Article › Scientific › peer-review

### Debonding and impact damage in stainless steel fibre metal laminates prior to metal fracture

An experimental drop-weight impact investigation was performed for stainless steel fibre metal laminates (FMLs) containing carbon-fibre and glass-fibre-reinforced epoxy layers. The purpose was to study the dependence of metal-composite debonding on the metal's surface morphology, as well as the interaction between debonding and internal damage caused to a composite. Three different steel surface morphologies were studied for the steel-carbon FMLs. Force-contact time and deflection profile measuring, as well as ultrasonic scanning and scanning electron microscopy imaging, were used for impact damage evaluation. Debonding was found to proceed either at the metal and adhesive film interface or cohesively inside the adhesive film. The steel's surface condition did not significantly influence impact response. The research also revealed that debonding between the lower metal sheet and composite part proceeded as mixed mode (I/II) fracture. Debonding was connected to the composite damages by several shear cracks located in the uppermost composite layer.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Engineering materials science and solutions (EMASS), Department of Applied Mechanics, Aalto University

Contributors: Pärnänen, T., Kanerva, M., Sarlin, E., Saarela, O.

Number of pages: 10

Pages: 777-786

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Composite Structures

Volume: 119

ISSN (Print): 0263-8223

Ratings:

Scopus rating (2015): CiteScore 5.6 SJR 2.157 SNIP 2.235

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Ceramics and Composites

Keywords: Debonding, Fibre metal laminates, Fracture, Impact, Interface

DOIs:

10.1016/j.compstruct.2014.09.056

URLs:

<http://www.scopus.com/inward/record.url?scp=84908303091&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

siirretään 2015<br/>Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2015-01-13<br/>Publisher name: Elsevier

EXT="Kanerva, M."

Source: researchoutputwizard

Source ID: 25

Research output: Contribution to journal > Article > Scientific > peer-review

### Experimental study on the behavior of wear resistant steels under high velocity single particle impacts

High velocity solid particle erosion may cause severe damage and high wear rates in materials used for wear protection. An experimental work on the behavior of wear resistant steels, including three high-strength martensitic alloys and a carbide-reinforced metal matrix composite, was performed in high rate single impact conditions. Characterization of the mechanical behavior of the materials at high strain rates was conducted using the Hopkinson Split Bar technique to identify the effects of strain rate on strain hardening and the prevailing failure mechanisms. The high velocity impact experiments using spherical projectiles were carried out at various impact angles and projectile velocities. The effects of impact energy and impact angle were studied and discussed. Wear was analyzed as volume loss from the surface, but it was also presented in a more precise way by taking into account the actual energy spent on the plastic deformation and wear. In-situ high speed photography and post impact characterization of the impact craters were used to reveal the prevailing failure and wear mechanisms. Depending on the impact angle and impact energy, different wear mechanisms of plastic deformation, cutting, shear banding and fracture were identified. The martensitic steels exhibited adiabatic shear banding in the microstructure at high strain rates and impact velocities, which may accelerate the wear. The carbide reinforced steel was found susceptible to catastrophic fracturing especially at high impact angles.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Materials Characterization, Computational Science X (CompX), Engineering materials science and solutions (EMASS), VTT Technical Research Centre of Finland, Ruukki Metals Inc.

Contributors: Lindroos, M., Apostol, M., Kuokkala, V. T., Laukkanen, A., Valtonen, K., Holmberg, K., Oja, O.

Number of pages: 14

Pages: 114-127

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Impact Engineering

Volume: 78

ISSN (Print): 0734-743X

Ratings:

Scopus rating (2015): CiteScore 4.9 SJR 1.697 SNIP 2.926

Original language: English

ASJC Scopus subject areas: Mechanical Engineering, Mechanics of Materials, Civil and Structural Engineering, Aerospace Engineering, Automotive Engineering, Ocean Engineering, Safety, Risk, Reliability and Quality

Keywords: Adiabatic shear band, High strain rate, High strength steel, Impact wear

Electronic versions:

Experimental study on the behavior of wear resistant steels under high velocity single particle impacts. Embargo ended:

26/12/16

DOIs:

10.1016/j.ijimpeng.2014.12.002

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606134241> . Embargo ended: 26/12/16

### **Bibliographical note**

EXT="Oja, Olli"

Source: Scopus

Source ID: 84920738236

Research output: Contribution to journal › Article › Scientific › peer-review

### **Evaluation of thermo-mechanical behaviour of composite energy piles during heating/cooling operations**

Energy pile foundations can function as dual-purpose structures, i.e. as supports to transfer loads from building to ground and as energy production systems. Use of ground heat exchangers (GHE) for energy production in energy piles can result in temperature variations in the pile shaft, in turn affecting the thermo-mechanical behaviour of pile in structural and geotechnical terms. Despite large numbers of energy piles now being installed, there is still little reliable information and experience about the thermo-mechanical behaviour of these structures under different thermal loadings. This study calculated the structural and geotechnical resistance of a composite energy pile foundation fitted with GHEs using numerical finite element simulations. Pile and surrounding soil were assumed to behave within a linear thermo-elastic range, assuming perfect contact at the soil-pile interface. The results showed that when the pile is used for cooling the building, the pile shaft is in expansion mode and additional compressive stresses are generated in the pile shaft. These stresses are typically around 20% of the ultimate compressive strength of typical concrete (30. MPa). Consequently, it is recommended that in a design context, the structural bearing capacity of energy piles needs to be reduced due to the additional thermal stresses. The results also showed that when end-bearing piles were used, the temperature-induced mobilised shaft friction did not have a significant effect on the geotechnical failure of these piles.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu

Contributors: Hassani Nezhad Gashti, E., Malaska, M., Kujala, K.

Number of pages: 11

Pages: 363-373

Publication date: 15 Sep 2014

Peer-reviewed: Yes

### **Publication information**

Journal: Engineering Structures

Volume: 75

ISSN (Print): 0141-0296

Ratings:

Scopus rating (2014): CiteScore 3.5 SJR 1.701 SNIP 2.483

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Composite structure, Foundation engineering, Geo-thermal energy, Infrastructure, Soil-structure interaction, Structural modelling

DOIs:

10.1016/j.engstruct.2014.06.018

Source: Scopus

Source ID: 84903551102

Research output: Contribution to journal › Article › Scientific › peer-review

### **Commissioning for nearly zero-energy building projects**

**Purpose** - This article aims to reveal the benefits and opportunities that commissioning procedure has to offer for nearly zero-energy building (nZEB) projects. Another goal is to sculpture the commissioning process and, especially, commissioning consultant's tasks to fit nZEB projects.

**Design/methodology/approach** - The idea was to incorporate the literature from two fields: commissioning and nZEB, and find out if commissioning would fit nZEB projects. Challenges offered by nZEB technology were pointed out and the solutions offered to these problems by commissioning were established. Expert interviews were used to test the findings.

**Findings** - Commissioning was found valuable for complex nZEB projects and even worthwhile investing to in simple nZEB projects. Quality assurance is a huge task when the change to nZEB construction happens in 2020 and commissioning can be a valuable tool to prevent large-scale quality problems. A number of additions were made to the example commissioning process used in Finland today.

**Originality/value** - This article gives evidence for economical usability of commissioning procedure in nZEB projects and reason to start investigating the possibility to attach commissioning as a mandatory procedure to all nZEB projects.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University  
Contributors: Kantola, M., Saari, A.  
Number of pages: 13  
Pages: 370-382  
Publication date: 1 Jul 2014  
Peer-reviewed: Yes

#### Publication information

Journal: Construction Innovation: Information, Process, Management

Volume: 14

Issue number: 3

ISSN (Print): 1471-4175

Ratings:

Scopus rating (2014): CiteScore 1.8 SJR 0.544 SNIP 0.936

Original language: English

ASJC Scopus subject areas: Computer Science(all), Control and Systems Engineering, Civil and Structural Engineering, Building and Construction, Architecture

Keywords: Green buildings, Quality management, Sustainability

DOIs:

10.1108/CI-06-2013-0031

URLs:

<http://www.scopus.com/inward/record.url?scp=84907101373&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84907101373

Research output: Contribution to journal › Article › Scientific › peer-review

#### Stretching risk management standards: Multi-organizational perspectives

**Purpose:** Standard frameworks for project risk management (RM) are currently mostly focussed on single-firm organizations, whereas in practice, construction project RM involves multiple organizations. The purpose of this paper is to identify and systematically maps practical processes that bridge the gap between single-organizational RM standards and multi-organizational RM (MORM) needs. **Design/methodology/approach:** This case study covers three large construction management (CM) projects in Finland. The 35 interviews with project owners, project management consultants, design groups, and contractors identify the participants' positions on RM roles, integration within organizations, and further development requests. **Findings:** Most (16 of 21) of the identified RM practices are multi-organizational; i.e. they involve two or more organizations. Compared to single-organizational standards, MORM practices involve less emphasis on detailed risk analysis processes but highlight both participant selection and managing collaborative performance. **Research limitations/implications:** The research results are attached to Finnish CM projects but may be applicable to other types of collaboration-based construction projects, such as alliances and public-private partnerships. The efficiency of the MORM model requires further evaluation in future research. **Practical implications:** A model for MORM is a systematic presentation of the research results. The model provides guidance for efficiently setting up MORM processes and for refining multi-organizational research. **Originality value:** The multi-organizational interfaces of RM processes are mainly overlooked in the current literature, standards, and frameworks. This research provides a rare explication of parallel MORM processes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Aalto University

Contributors: Lehtiranta, L., Junnonen, J. M.

Number of pages: 18

Pages: 128-145

Publication date: 1 Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: BUILT ENVIRONMENT PROJECT AND ASSET MANAGEMENT

Volume: 4

Issue number: 2

ISSN (Print): 2044-124X

Ratings:

Scopus rating (2014): CiteScore 0.8 SJR 0.246 SNIP 0.541

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Management Science and Operations Research

Keywords: Collaboration, Complexity, Multi-disciplinary, Multi-organization, Organization, Project management, Project teams, Risk management, Standard

DOIs:

10.1108/BEPAM-06-2013-0019

Source: Scopus

Source ID: 84898938713

Research output: Contribution to journal › Article › Scientific › peer-review

### **The impact of occupancy patterns, occupant-controlled ventilation and shading on indoor overheating risk in domestic environments**

It is widely recognised that a major source of uncertainty in building performance simulation relates to occupancy and behavioural assumptions. This paper aims to assess the relative impact of lifestyle patterns, occupant-controlled window opening and shading use on indoor overheating risk levels in dwellings. The indoor thermal environment of a set of broadly representative archetypes of the London housing stock was simulated using dynamic thermal modelling. Two lifestyle patterns and four scenarios of window opening and shading use schedules were combined with multiple other varying parameters (building geometry and orientation, insulation levels, level of overshadowing by adjacent buildings), leading to a total of 27,648 modelled dwelling variants. It was found that the rankings obtained for dwellings occupied by a family with children at school and dwellings occupied by pensioners were broadly similar for all combinations of behaviour and the majority of overheating metrics. Lower ranking correlations were, however, observed between simple temperature-dependent window opening scenarios and a more sophisticated scenario of combined shading and night ventilation. This is an indication that shading and/or night cooling could modify indoor overheating risk significantly. The findings of the study add to a growing body of literature suggesting that the way inhabitants occupy and operate a building has a measurable impact on thermal discomfort and potentially the health risks associated with their exposure to high indoor temperatures. This should be taken into consideration in the design of retrofit interventions and public health strategies aiming to minimise such risks.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, London School of Hygiene and Tropical Medicine, University of Nottingham

Contributors: Mavrogianni, A., Davies, M., Taylor, J., Chalabi, Z., Biddulph, P., Oikonomou, E., Das, P., Jones, B.

Number of pages: 16

Pages: 183-198

Publication date: 1 Jan 2014

Peer-reviewed: Yes

#### **Publication information**

Journal: Building and Environment

Volume: 78

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2014): CiteScore 6.3 SJR 1.887 SNIP 2.751

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: Behaviour, Dwellings, Overheating, Shading, Simulation, Ventilation

DOIs:

10.1016/j.buildenv.2014.04.008

URLs:

<http://www.scopus.com/inward/record.url?scp=84901007060&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84901007060

Research output: Contribution to journal › Article › Scientific › peer-review

### **The relative importance of input weather data for indoor overheating risk assessment in dwellings**

The risk of overheating in UK dwellings is predicted to increase due to anthropogenic climate change and local urban climate modification leading to an increased urban heat island effect. Dwelling geometry characteristics such as orientation, aspect, and glazing, and building fabric characteristics such as thermal mass and resistance can influence the risk of overheating. The majority of simulation-based studies have focused on identifying the importance of building characteristics on overheating risk using a small number of weather files, or focus solely on the impact of external temperatures rather than a full set of climatic variables. This study examines the overheating risk in London dwelling archetypes when simulated under different UK climates, both in the present and under 'hot future' conditions, with the objective of identifying whether the conclusions drawn from location-specific studies can be generically applied to different cities. Simulations were carried out using the dynamic thermal simulation tool EnergyPlus using 3456 dwelling variants and six different Design Summer Year (DSY) climate files from locations within the UK. In addition, a 2050 Medium Emissions scenario weather file was used to model a particularly hot summer in all locations. The results indicate that weather files can influence the ranking of relative overheating risk between dwelling types, with significant variations in the

relative ranking between London, Scotland and the North of England, and the rest of England. These results show that studies examining the overheating risk across the UK need to consider the variability of building performance under regional weather conditions.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, London School of Hygiene and Tropical Medicine, University of Nottingham

Contributors: Taylor, J., Davies, M., Mavrogianni, A., Chalabi, Z., Biddulph, P., Oikonomou, E., Das, P., Jones, B.

Number of pages: 11

Pages: 81-91

Publication date: 1 Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: Building and Environment

Volume: 76

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2014): CiteScore 6.3 SJR 1.887 SNIP 2.751

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: EnergyPlus, Kendalls Tau, Overheating, Weather files

DOIs:

10.1016/j.buildenv.2014.03.010

URLs:

<http://www.scopus.com/inward/record.url?scp=84897417588&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84897417588

Research output: Contribution to journal > Article > Scientific > peer-review

#### Using probabilistic sampling-based sensitivity analyses for indoor air quality modelling

We develop a probabilistic framework for modelling indoor air quality in housing stocks, selecting appropriate sensitivity analyses to understand indoor air quality determinants, and constructing a reliable metamodel from the most relevant determinants to allow quick assessments of future intervention scenarios. The replicated Latin Hypercube sampling method is shown to be efficient at propagating variations between model input and output variables. A comparison of a range of sample-based sensitivity methods shows that an initial visual assessment can help to select appropriate sensitivity analyses, as they test for different types of relations (i.e. linear, monotonic, and non-monotonic). An advantage of linear regression methods is that the total output can be apportioned to various input variables. The advantage of tests with correlation coefficients is that the associated p-values can be used to assess whether input variables are significant. An artificial neural network constructed from a reduced set of input variables selected at a 5% level of significance is able to accurately predict indoor air quality. In the application of the framework to the modelling of winter indoor air quality in single-storey flats in England, the drivers for internally- and externally-generated PM<sub>2.5</sub> are found to be different, therefore allowing interventions that reduce both concentrations simultaneously. Principal determinants for externally-generated PM<sub>2.5</sub> are the internal deposition rate of PM<sub>2.5</sub>, weather-corrected volumetric infiltration rate, and ambient concentration of PM<sub>2.5</sub>, while for PM<sub>2.5</sub> produced by gas cooking, they are the kitchen window opening area, generation rate of PM<sub>2.5</sub>, and indoor temperature.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University College London, University of Nottingham, London School of Hygiene and Tropical Medicine

Contributors: Das, P., Shrubsole, C., Jones, B., Hamilton, I., Chalabi, Z., Davies, M., Mavrogianni, A., Taylor, J.

Number of pages: 12

Pages: 171-182

Publication date: 1 Jan 2014

Peer-reviewed: Yes

#### Publication information

Journal: Building and Environment

Volume: 78

ISSN (Print): 0360-1323

Ratings:

Scopus rating (2014): CiteScore 6.3 SJR 1.887 SNIP 2.751

Original language: English

ASJC Scopus subject areas: Environmental Engineering, Civil and Structural Engineering, Geography, Planning and Development, Building and Construction

Keywords: Housing stock, Indoor air quality, Metamodel, Probabilistic sampling, Sensitivity analysis

DOIs:

10.1016/j.buildenv.2014.04.017

URLs:

<http://www.scopus.com/inward/record.url?scp=84901003154&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84901003154

Research output: Contribution to journal > Article > Scientific > peer-review

### **Passive wireless antenna sensor for strain and crack sensing - Electromagnetic modeling, simulation, and testing**

This research investigates a passive wireless antenna sensor designed for strain and crack sensing. When the antenna experiences deformation, the antenna shape changes, causing a shift in the electromagnetic resonance frequency of the antenna. A radio frequency identification (RFID) chip is adopted for antenna signal modulation, so that a wireless reader can easily distinguish the backscattered sensor signal from unwanted environmental reflections. The RFID chip captures its operating power from an interrogation electromagnetic wave emitted by the reader, which allows the antenna sensor to be passive (battery-free). This paper first reports the latest simulation results on radiation patterns, surface current density, and electromagnetic field distribution. The simulation results are followed with experimental results on the strain and crack sensing performance of the antenna sensor. Tensile tests show that the wireless antenna sensor can detect small strain changes lower than  $20 \mu\epsilon$ , and can perform well at large strains higher than  $10\,000 \mu\epsilon$ . With a high-gain reader antenna, the wireless interrogation distance can be increased up to 2.1 m. Furthermore, an array of antenna sensors is capable of measuring the strain distribution in close proximity. During emulated crack and fatigue crack tests, the antenna sensor is able to detect the growth of a small crack.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering, Virginia Tech

Contributors: Yi, X., Cho, C., Cooper, J., Wang, Y., Tentzeris, M. M., Leon, R. T.

Publication date: Aug 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Smart Materials and Structures

Volume: 22

Issue number: 8

Article number: 085009

ISSN (Print): 0964-1726

Ratings:

Scopus rating (2013): CiteScore 4.4 SJR 1.006 SNIP 1.93

Original language: English

ASJC Scopus subject areas: Signal Processing, Atomic and Molecular Physics, and Optics, Civil and Structural Engineering, Materials Science(all), Condensed Matter Physics, Mechanics of Materials, Electrical and Electronic Engineering

DOIs:

10.1088/0964-1726/22/8/085009

URLs:

<http://www.scopus.com/inward/record.url?scp=84881172175&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84881172175

Research output: Contribution to journal > Article > Scientific > peer-review

### **Implementation of a direct procedure for critical point computations using preconditioned iterative solvers**

Computation of critical points on an equilibrium path requires the solution of a non-linear eigenvalue problem. These critical points could be either bifurcation or limit points. When the external load is parametrized by a single parameter, the non-linear stability eigenvalue problem consists of solving the equilibrium equations along the criticality condition. Several techniques exist for solution of such a system. Their algorithmic treatment is usually focused for direct linear solvers and thus use the block elimination strategy. In this paper special emphasis is given for a strategy which can be used also with iterative linear solvers. Comparison to the block elimination strategy with direct linear solvers is given. Due to the non-uniqueness of the critical eigenmode a normalizing condition is required. In addition, for bifurcation points, the Jacobian matrix of the augmented system is singular at the critical point and additional stabilization is required in order to maintain the quadratic convergence of the Newton's method. Depending on the normalizing condition, convergence to a critical



point with negative load parameter value can happen. The form of the normalizing equation is critically discussed. Due to the slenderness of the buckling sensitive structures the resulting matrices are ill-conditioned and a good preconditioner is mandatory for efficient solution. © 2012 Civil-Comp Ltd. and Elsevier Ltd. All rights reserved.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mechanics and Design, Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE), Academy of Sciences of the Czech Republic, Institute of Computer Science of the Academy of Sciences of the Czech Republic, Department of Civil and Structural Engineering, Aalto University

Contributors: Kouhia, R., Tůma, M., Mäkinen, J., Fedoroff, A., Marjamäki, H.

Number of pages: 8

Pages: 110-117

Publication date: Oct 2012

Peer-reviewed: Yes

#### Publication information

Journal: Computers & Structures

Volume: 108-109

ISSN (Print): 0045-7949

Ratings:

Scopus rating (2012): CiteScore 3.8 SJR 1.354 SNIP 2.226

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Civil and Structural Engineering, Mechanical Engineering, Modelling and Simulation, Materials Science(all)

Keywords: Critical points, Equilibrium equations, Non-linear eigenvalue problem, Preconditioned iterations

DOIs:

10.1016/j.compstruc.2012.02.009

URLs:

<http://www.scopus.com/inward/record.url?scp=84865782578&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

/kir12<br/>Contribution: organisation=mec,FACT1=1<br/>Publisher name: Elsevier

Source: researchoutputwizard

Source ID: 4554

Research output: Contribution to journal > Article > Scientific > peer-review

#### Financial viability of energy-efficiency measures in a new detached house design in Finland

This study analyses alternative energy-saving design concepts for a typical new detached house design in Finland. The impact of these design concepts on the construction costs and on the total delivered energy needs of the building were calculated, and the financial viability of the different concepts analysed. Different thermal insulation and airtightness properties of the building envelope and different ventilation's heat recovery efficiency assumptions were tested in the analysis work. Other variations modelled included the heating mode: direct electrical floor heating, or floor heating via an air or ground source heat pump. Among these alternatives, the estimated annual consumption of purchased energy for running the household varied extensively, in the range 57-182kWh/net floor m<sup>2</sup>. With the real interest rate set at 3%, the payback period was shortest for the air source heat pumps (9years). When a heat pump was installed in a house with higher energy consumption, the payback period was 7years, and if it was installed in the 'ultra low-energy' house designs, the payback period was over 13years. Investment to thick thermal insulation of envelope was unattractive in Finland. The results of this study can be generalized to similar climates and techno-economic environments.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Aalto University, School of Engineering, Department of Energy Technology, Department of Structural Design, Tallinn University of Technology, Finnish Innovative Fund

Contributors: Saari, A., Kalamees, T., Jokisalo, J., Michelsson, R., Alanne, K., Kurnitski, J.

Number of pages: 8

Pages: 76-83

Publication date: Apr 2012

Peer-reviewed: Yes

#### Publication information

Journal: Applied Energy

Volume: 92

ISSN (Print): 0306-2619

Ratings:

Scopus rating (2012): CiteScore 8.1 SJR 2.778 SNIP 3.075

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Energy(all)

Keywords: Building simulations, Detached house, Energy efficiency, Financial viability, New construction

DOIs:

10.1016/j.apenergy.2011.10.029

URLs:

<http://www.scopus.com/inward/record.url?scp=82155186761&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

INT=rak,"Kalamees, Targo"

Source: Scopus

Source ID: 82155186761

Research output: Contribution to journal › Article › Scientific › peer-review

### **Cost optimal and nearly zero (nZEB) energy performance calculations for residential buildings with REHVA definition for nZEB national implementation**

This study determined cost optimal and nearly zero energy building (nZEB) energy performance levels following the REHVA definition and energy calculation methodology for nZEB national implementation. Cost optimal performance levels - meaning the energy performance leading to minimum life cycle cost - were calculated with net present value method according to the cost optimal draft regulation. The seven-step procedure was developed to conduct cost optimal and nZEB energy performance levels calculations in systematic and robust scientific fashion. It was shown that cost optimal primary energy use can be calculated with limited number of energy simulations as only four construction concepts were simulated and cost calculated. The procedure includes the specification of building envelope components based on specific heat loss coefficient and systems calculation with post processing of energy simulation results, without the need to use iterative approach or optimization algorithm. Model calculations were conducted for Estonian reference detached house to analyse the difference between the cost optimal and nZEB energy performance levels. Cost optimal energy performance level of Estonian reference detached house was 110 kW h/(m<sup>2</sup> a) primary energy including all energy use with domestic appliances and it was significantly lower than the current minimum requirement of 180 kW h/(m<sup>2</sup> a).

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Sitra, the Finnish Innovation Fund, Aalto University, Tallinn University of Technology, Equa Simulation Finland Oy, Hevac O

Contributors: Kurnitski, J., Saari, A., Kalamees, T., Vuolle, M., Niemelä, J., Tark, T.

Number of pages: 10

Pages: 3279-3288

Publication date: Nov 2011

Peer-reviewed: Yes

### **Publication information**

Journal: Energy and Buildings

Volume: 43

Issue number: 11

ISSN (Print): 0378-7788

Ratings:

Scopus rating (2011): CiteScore 3.8 SJR 1.476 SNIP 2.558

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Mechanical Engineering, Electrical and Electronic Engineering

Keywords: Cost optimal, Energy performance, EPBD recast, Global cost, Nearly zero energy buildings, nZEB, REHVA nZEB technical definition

DOIs:

10.1016/j.enbuild.2011.08.033

URLs:

<http://www.scopus.com/inward/record.url?scp=80053300759&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80053300759

Research output: Contribution to journal › Article › Scientific › peer-review

### **Briefing: Initial findings from the urba project**

This briefing describes the research project The Future Concepts of Urban Housing (Urba), which was initiated in 2007 to develop new ideas, concepts and cooperative practices for Urban housing in the Helsinki metropolitan area. The area suffers from Urban sprawl, soaring prices and a lack of feasible and attractive housing alternatives as a result of the narrow and inflexible housing market. Moreover, the housing sector suffers from a lack of cooperation. Urba is a multi-disciplinary research project that brings together a wide range of stakeholders and actors in the housing sector. The first phase of the project has produced an initial selection of promising Urban housing concepts that will serve as the basis for the development phase. The development phase is structured in the form of a collective learning and invention process that involves a wide group of participants from the housing sector.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Institute of Society and Space (SOCIS), Aalto University, Centre for Urban and Regional Studies

Contributors: Krokfors, K., Ilmonen, M., Kangasoja, J., Lehtonen, H., Mälkki, M., Mäntysalo, R., Norvasuo, M., Nupponen, T., Puustinen, S.

Number of pages: 3

Pages: 15-17

Publication date: Mar 2011

Peer-reviewed: Yes

### **Publication information**

Journal: PROCEEDINGS OF THE ICE: URBAN DESIGN AND PLANNING

Volume: 164

Issue number: 1

ISSN (Print): 1755-0793

Ratings:

Scopus rating (2011): CiteScore 1.1 SJR 0.153 SNIP 0.488

Original language: English

ASJC Scopus subject areas: Geography, Planning and Development, Urban Studies, Civil and Structural Engineering

DOIs:

10.1680/udap.2011.164.1.15

URLs:

<http://www.scopus.com/inward/record.url?scp=79951962584&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79951962584

Research output: Contribution to journal › Article › Scientific › peer-review

### **Precision refurbishment of buildings: A façade refurbishment case study**

Purpose - The purpose of this paper is to develop a systematic refurbishment design procedure that allows precision refurbishment and thus enables the preservation of existing structures and their component parts.

Design/methodology/approach - The participatory research method was chosen and was used to develop and test a precision refurbishment procedure. This involved preparing the programming and design documents of an ongoing refurbishment project in cooperation with the designer. The actual refurbishment work was carried out using the documents developed in the study. Findings - The principal finding was that a thorough, objective analysis of the condition and functioning of the structures in question is essential for determining a precision refurbishment procedure of the type presented here. With the refurbishment design incorporated into the contract, including precise product specifications and drawings, the client will be in a strong position in relation to the contractor during the actual refurbishment process. The way in which the product specifications were presented in the refurbishment specification allows systematic and precise depiction of the content and focus of the refurbishment. At the same time, the level of detail in the product specifications can be easily "regulated". Originality/value - The paper offers a tested systematic method for drawing up precise and unambiguous refurbishment designs for building refurbishment projects.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Aalto University

Contributors: Saari, A.

Number of pages: 12

Pages: 108-119

Publication date: 2008

Peer-reviewed: Yes

### **Publication information**

Journal: STRUCTURAL SURVEY

Volume: 26  
Issue number: 2  
ISSN (Print): 0263-080X  
Ratings:

Scopus rating (2008): SJR 0.163 SNIP 0.43

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Building specifications, Buildings, Cost effectiveness, Integrated cost and schedule control, Process planning  
DOIs:

10.1108/02630800810883049

URLs:

<http://www.scopus.com/inward/record.url?scp=44449151584&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 44449151584

Research output: Contribution to journal › Article › Scientific › peer-review

### **Computational design concept analysis: A Nordic comparison of four apartment buildings**

**Purpose** - The purpose of this paper is to present a systematic procedure to analyse the cost-effectiveness of design concepts in residential construction, at the same time profiling differences in design concepts between four Nordic countries. **Design/methodology/approach** - The research methodology is computational. The study involved a comparison of design concepts and computational construction costs in a Swedish, Norwegian, Danish, and a Finnish apartment house built by Nordic subsidiaries of a larger international construction corporation. A reference value (type-of-space cost calculation) and a cost estimate relating to the design concept (conceptual cost estimate) were calculated for each project using the Finnish method of calculation. The results of the calculated construction costs were compared. **Findings** - The construction costs of the Swedish and Danish design concepts were high in comparison with the Finnish reference values. In both cases, the high construction costs were the result of low space efficiency and large window surface-areas. The design concepts of the Norwegian and Finnish projects were cost-efficient. **Originality/value** - The paper offers a systematic way to analyse design concepts in residential construction and profiles the differences in design concepts between four Nordic countries from the point-of-view of cost-effectiveness.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Aalto University

Contributors: Saari, A.

Number of pages: 9

Pages: 29-37

Publication date: 2008

Peer-reviewed: Yes

### **Publication information**

Journal: STRUCTURAL SURVEY

Volume: 26

Issue number: 1

ISSN (Print): 0263-080X

Ratings:

Scopus rating (2008): SJR 0.163 SNIP 0.43

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Denmark, Design management, Finland, Housing, Norway, Sweden

DOIs:

10.1108/02630800810857426

URLs:

<http://www.scopus.com/inward/record.url?scp=41749086704&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 41749086704

Research output: Contribution to journal › Article › Scientific › peer-review

### **Strategy formation in construction firms**

The aim of the present paper was to examine strategy formation in construction firms. Strategic thinking has become increasingly important because the environment of construction has changed dramatically in recent years. An organizational strategy is the result of a formation process over time and an organization uses strategy when dealing with a changing environment. Therefore, strategies are formed in an iterative process of social interactions involving various activities. The basic unit of analysis strategy must be a distinct business and corporate entity. Corporate strategy should

grow out of a deep understanding of how construction firms prosper in individual business areas, i.e. 'the parenting advantage'. Parenting advantage is a criterion for guiding corporate strategy formation. Business strategy is formed by accepted common thinking and on the basis of business strategy in general. Business strategy and competitive advantage is based on the competencies and resources of firms.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Research group: Responsible Construction, Helsinki University of Technology  
Contributors: Junnonen, J. M.  
Number of pages: 8  
Pages: 107-114  
Publication date: 1 Feb 1998  
Peer-reviewed: Yes

#### Publication information

Journal: ENGINEERING, CONSTRUCTION AND ARCHITECTURAL MANAGEMENT  
Volume: 5  
Issue number: 2  
ISSN (Print): 0969-9988  
Original language: English  
ASJC Scopus subject areas: Architecture , Civil and Structural Engineering, Building and Construction, Business, Management and Accounting(all)  
Keywords: Business strategy, Construction firm, Corporate strategy, Formation  
DOIs:  
10.1108/eb021065  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84992969917&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84992969917  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Nano-structured optical fibers made of glass-ceramics, and phase separated and metallic particle-containing glasses

For years, scientists have been looking for different techniques to make glasses perfect: fully amorphous and ideally homogeneous. Meanwhile, recent advances in the development of particle-containing glasses (PCG), defined in this paper as glass-ceramics, glasses doped with metallic nanoparticles, and phase-separated glasses show that these "imperfect" glasses can result in better optical materials if particles of desired chemistry, size, and shape are present in the glass. It has been shown that PCGs can be used for the fabrication of nanostructured fibers—a novel class of media for fiber optics. These unique optical fibers are able to outperform their traditional glass counterparts in terms of available emission spectral range, quantum efficiency, non-linear properties, fabricated sensors sensitivity, and other parameters. Being rather special, nanostructured fibers require new, unconventional solutions on the materials used, fabrication, and characterization techniques, limiting the use of these novel materials. This work overviews practical aspects and progress in the fabrication and characterization methods of the particle-containing glasses with particular attention to nanostructured fibers made of these materials. A review of the recent achievements shows that current technologies allow producing high-optical quality PCG-fibers of different types, and the unique optical properties of these nanostructured fibers make them prospective for applications in lasers, optical communications, medicine, lighting, and other areas of science and industry.

#### General information

Publication status: Published  
MoE publication type: A2 Review article in a scientific journal  
Organisations: Physics, Research group: Photonics Glasses, Université Côte d'Azur, Ecole Centrale de Nantes, PSL Research University  
Contributors: Veber, A., Lu, Z., Vermillac, M., Pigeonneau, F., Blanc, W., Petit, L.  
Number of pages: 29  
Publication date: 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Fibers  
Volume: 7  
Issue number: 12  
ISSN (Print): 2079-6439  
Ratings:  
Scopus rating (2019): CiteScore 2.7 SJR 0.442 SNIP 1.036

Original language: English

ASJC Scopus subject areas: Ceramics and Composites, Civil and Structural Engineering, Biomaterials, Mechanics of Materials

Keywords: Fabrication, Glass, Glass-ceramics, Metallic nanoparticles, Optical fibers, Optical properties, Phase-separation

Electronic versions:

fibers-07-00105-v2

DOIs:

10.3390/fib7120105

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001171373>

Source: Scopus

Source ID: 85076893292

Research output: Contribution to journal > Review Article > Scientific > peer-review

### Urban social housing resilience to excess summer heat

The potential levels of exposure to indoor overheating in an urban environment are assessed for vulnerable social housing residents. Particular focus is given to the synergistic effects between summertime ventilation behaviour, indoor temperature and air pollutant concentration in relation to energy retrofit and climate change. Three different types of social housing are investigated (1900s' low-rise, 1950s' mid-rise and 1960s' high-rise). The case study dwellings are located in Central London and occupied by vulnerable individuals (elderly and/or people suffering from ill-health or mobility impairment). Indoor temperature monitoring suggests that occupants are already exposed to some degree of overheating; the highest levels of overheating occur in 1960s' high-rise tower blocks. The thermal and airflow performance simulation of a mid-floor flat in the 1960s' block under the current and projected future climate indicates that improved natural ventilation strategies may reduce overheating risk to a certain extent, with night cooling and shading being slightly more effective than all-day rapid ventilation. However, their potential may be limited in future due to high external temperatures and the undesired ingress of outdoor pollutants. This highlights the need for the development of combined strategies aiming to achieve both indoor thermal comfort and air quality.

### General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: University College London, London Borough of Islington Council

Contributors: Mavrogianni, A., Taylor, J., Davies, M., Thoua, C., Kolm-Murray, J.

Number of pages: 18

Pages: 316-333

Publication date: 4 May 2015

Peer-reviewed: Yes

### Publication information

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Research output: Contribution to journal > Review Article > Scientific > peer-review

### Two models for hydraulic cylinders in flexible multibody simulations

In modelling hydraulic cylinders interaction between the structural response and the hydraulic system needs to be taken into account. In this chapter two approaches for modelling flexible multibody systems coupled with hydraulic actuators i.e. cylinders are presented and compared. These models are the truss-elementlike cylinder and bending flexible cylinder models. The bending flexible cylinder element is a super-element combining the geometrically exact Reissner-beam element, the  $C^1$ -continuous slide-spring element needed for the telescopic movement and the hydraulic fluid field. Both models are embedded with a friction model based on a bristle approach. The models are implemented in a finite element

environment. In time the coupled stiff differential equation system is integrated using the L-stable Rosenbrock method.

#### **General information**

Publication status: Published

MoE publication type: A3 Part of a book or another research book

Organisations: Department of Civil Engineering, Research group: Structural Mechanics, Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, FS Dynamics Finland Oy Ab

Contributors: Ylinen, A., Mäkinen, J., Kouhia, R.

Number of pages: 31

Pages: 463-493

Publication date: 2016

#### **Host publication information**

Title of host publication: Computational Methods for Solids and Fluids : Multiscale Analysis, Probability Aspects and Model Reduction

Publisher: Springer

ISBN (Print): 978-3-319-27994-7

ISBN (Electronic): 978-3-319-27996-1

#### **Publication series**

Name: Computational Methods in Applied Sciences

Volume: 41

ISSN (Print): 1871-3033

ASJC Scopus subject areas: Computational Mathematics, Modelling and Simulation, Fluid Flow and Transfer Processes, Computer Science Applications, Civil and Structural Engineering, Electrical and Electronic Engineering, Biomedical Engineering

DOIs:

10.1007/978-3-319-27996-1\_17

#### **Bibliographical note**

JUFID=79940

EXT="Ylinen, Antti"

Source: Scopus

Source ID: 84964233721

Research output: Chapter in Book/Report/Conference proceeding > Chapter > Scientific > peer-review

### **Practical experiences from several moisture performance assessments**

#### **General information**

Publication status: Published

MoE publication type: A3 Part of a book or another research book

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Research area: Structural Engineering

Contributors: Annala, P. J., Lahdensivu, J., Suonketo, J., Pentti, M.

Number of pages: 20

Pages: 1-20

Publication date: 2016

#### **Host publication information**

Title of host publication: Recent developments in building diagnosis techniques

Volume: 5

Place of publication: Porto, Portugal

Publisher: Springer Science+Business Media

Editor: Delgado, J.

ISBN (Print): 978-981-10-0465-0

ISBN (Electronic): 978-981-10-0466-7

#### **Publication series**

Name: Building Pathology and Rehabilitation

Publisher: Springer

Volume: 5

ISSN (Electronic): 2194-9840

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: indoor air quality, moisture, mould, sick building syndrome, iaq, sbs, condition assessment, moisture performance assessment, service life

DOIs:

10.1007/978-981-10-0466-7

Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

### **Societal impact as Cost-Benefit Analysis: Comparative analysis of two research infrastructures**

The impact of basic science projects is more difficult to assess than that of science projects, which lead to direct applications. Especially, the benefits of fundamental science projects are less obvious and indirect than applied science (e.g. pharmaceutical or IT). Pure scientific quality does not tell anything about the societal and economical value of the project. Public resources used for funding the growing scientific research face scarcity, and choosing where to distribute the limited resources is difficult without tools to assess the impacts. Politicians and other decision makers are struggling to evaluate the benefits of supporting science projects. Therefore, it is essential to find methods to fairly measure the impacts of science projects into the surrounding society. One way of assessing societal impact is Cost-Benefit Analysis (CBA). This contribution explores CBA as a tool for societal impact assessment by reviewing and comparing two research infrastructures' assessments.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Industrial Engineering and Management, Research group: Center for Innovation and Technology Research , European Organization for Nuclear Research

Contributors: Magazinik, A., Bedolla, J. S., Lasheras, N. C., Mäkinen, S.

Publication date: 1 Jun 2019

#### **Host publication information**

Title of host publication: 2019 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2019

Publisher: IEEE

ISBN (Electronic): 9781728134017

ASJC Scopus subject areas: Industrial and Manufacturing Engineering, Management of Technology and Innovation, Strategy and Management, Civil and Structural Engineering, Health Informatics, Health(social science), Computer Networks and Communications, Information Systems and Management

Keywords: Big Science Centre, research organisation, social impact assessment, societal impact assessment

DOIs:

10.1109/ICE.2019.8792600

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Second-order analysis of prestressed concrete columns**

The use of prestressed concrete columns has been quite rare in Finland, mainly for reason of a lack of national design regulations and guidelines. To promote their use, the Confederation of Finnish Construction Industries initiated a research project on precast prestressed concrete columns, in connection with an extensive research programme at Tampere University examining slender concrete structures. A displacement-based calculation model developed earlier in the programme for reinforced concrete columns and piles was developed further for evaluating the buckling of slender prestressed columns. The researchers applied this model to compare structural behaviour between prestressed and reinforced columns of the same dimensions and concrete strength and to evaluate the structure's suitability for test specimens for a later, experimental stage of research. The prestressed cross section cracked only after quite considerable bending. With simultaneous compressive force to the top of the column, there was even less cracking. The mathematical calculations took into account the normal force dependent bending stiffness. The results reveal a significant reduction in the amount of steel material necessary when prestressing is applied.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering, Research group: Concrete and Bridge Structures

Contributors: Haavisto, J., Kerokoski, O., Laaksonen, A.

Number of pages: 7

Pages: 1068-1074

Publication date: 2019

#### **Host publication information**

Title of host publication: Proceedings of the fib Symposium 2019 : Concrete - Innovations in Materials, Design and Structures

Publisher: International Federation for Structural Concrete

Editors: Derkowski, W., Krajewski, P., Gwozdziwicz, P., Pantak, M., Hojdis, L.

ISBN (Electronic): 9782940643004

#### **Publication series**

Name: FIB symposium proceedings



ISSN (Electronic): 2617-4820

ASJC Scopus subject areas: Building and Construction, Architecture , Civil and Structural Engineering

Keywords: Behaviour, Buckling, Column, Concrete, Prestressing

Source: Scopus

Source ID: 85066083246

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Alkali-silica reaction in finnish swimming pools**

Finland has traditionally been considered an alkali-silica reaction (ASR) free country. This was thought to be due to the exceptional quality of the mostly coarse crystalline igneous rocks. However, during the last few years dozens of cases of ASR have been reported. The scope of this study was to survey the occurrence and the propagation time of ASR in recent investigations of swimming pool structures. The research data consists of 9 condition investigation reports, and the reports of 144 thin section analyses, 188 tensile strength analyses and 29 compressive strength analyses made during 2005-2018. According to the research data, the occurrence of ASR is spread all over Finland. The reacting aggregates consist of rock types which are considered relatively stable or low reacting in literature. This may explain the relatively late emergence, usually around 40 years, of ASR. However, the swimming pool environment, with relatively high temperatures and humidity, is more favourable for ASR than the average Finnish outdoor climate. In most cases ASR has been incipient. Only few of the tensile strength tests made have indicated local weathering in the leaking concrete pool. ASR can be reliably detected in a petrographic thin section analysis, but evaluating the degree of ASR -caused damage also requires tensile strength testing. Observations of silica gel, or reacting aggregate, do not necessarily indicate serious damage or direct correlation with the degree of cracking. Therefore, parallel test methods, i.e. thin section analyses and tensile strength tests, are needed to diagnose the ASR in a concrete structure and the possibility of repair.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering, Ramboll Finland Ltd.

Contributors: Lahdensivu, J., Kekäläinen, P.

Number of pages: 8

Pages: 2006-2013

Publication date: 2019

### **Host publication information**

Title of host publication: Proceedings of the fib Symposium 2019 : Concrete - Innovations in Materials, Design and Structures

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ISBN (Electronic): 9782940643004

### **Publication series**

Name: fib Symposium Proceedings

ISSN (Electronic): 2617-4820

ASJC Scopus subject areas: Building and Construction, Architecture , Civil and Structural Engineering

Keywords: Alkali-silica reaction, Concrete, Concrete petrography, Initiation time, Swimming pool

URLs:

<http://www.scopus.com/inward/record.url?scp=85066082822&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Lahdensivu, Jukka"

Source: Scopus

Source ID: 85066082822

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Performance of Variable Partial Factor approach in a slope design**

Most of the design codes have moved from traditional total factor of safety method to the partial factor approach, aiming to cover the uncertainties better. The target has been to reach more consistent safety levels, but it has not always obtained. This has raised more interest towards reliability based design and its applications. In this paper, the performance of two partial factor approaches were compared from the reliability point of view; eurocode 7 design approach 3 and proposed Variable Partial Factor approach. The results show that the partial factor method with fixed partial factors cannot fully cover the uncertainties related to the design. The partial factors should be dependent on the level of uncertainty of the parameters. The results also shows that RBD can be applied in designer friendly way. In addition, some challenges in the determination of the characteristic values were pointed out.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Civil Engineering  
Contributors: Knuuti, M., Lämsivaara, T.  
Publication date: 2019

#### Host publication information

Title of host publication: 13th International Conference on Applications of Statistics and Probability in Civil Engineering(ICASP13), Seoul, South Korea, May 26-30, 2019

ASJC Scopus subject areas: Civil and Structural Engineering, Statistics and Probability

DOIs:

10.22725/ICASP13.475

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Buckling length assessment with finite element approach

In the design of steel frames, the consideration of stability and buckling is an important issue. It can be done in multiple ways. If the concept of buckling length is used, widely used procedure is to calculate the eigenmodes and corresponding eigenvalues for the frame and by using them define buckling length of the members with the well-known Euler's equation. However, it maybe difficult to tell, which eigenmode should be used for the definition of the buckling length of a specific member. Conservatively, the lowest positive eigenvalue can be used for all members. In this contribution, two methods to define the buckling length of a specific member are considered. The first one uses geometric stiffness matrix locally and the other one uses strain energy measures to identify members taking part in a buckling mode. Compared to simplified approaches presented in literature the approaches based on the finite element discretization have certain advantages. First, the method is applicable to any kind of distributed loading. Secondly, also tapered members can be handled with the technique. Moreover, the out-of-plane buckling behavior and with suitable element the lateral buckling loads can be also be assessed. The applicability and features of the methods are shown in a numerical 3D example. Both methods can be relatively easily implemented into automated frame design procedure. This is essential when optimization of frames is considered.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering

Contributors: Tiainen, T., Mela, K., Heinisuo, M.

Number of pages: 6

Pages: 1145-1150

Publication date: 2019

#### Host publication information

Title of host publication: Stability and Ductility of Steel Structures - Proceedings of the International Colloquia on Stability and Ductility of Steel Structures, 2019

Publisher: CRC Press/Balkema

Editors: Wald, F., Jandera, M.

ISBN (Print): 9780367335038

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Safety, Risk, Reliability and Quality

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Fatigue loading tests of concrete railway sleepers

In fatigue loading tests, unused Finnish concrete railway sleepers of type B97 and BP99 were loaded. The purpose of the loading tests was to analyse the fatigue properties of the sleepers and the effect of fatigue on their stiffness. The significance of cracks was also estimated. The load levels were chosen so that it was possible to estimate the significance of fatigue in actual use. A total of 11 fatigue loading tests were run. Eight targeted the rail seat section and three the centre. One sleeper was also loaded only statically to serve as a reference. In fatigue loading tests sleeper specimens were subjected to 200,000 loading cycles with standard load, after which they were loaded statically to failure. Sleepers in rail seat section tests failed at under 200,000 cycles when the loading level was 195 kN or higher. A fatigue model depicting the relationship between the stress level of the sleeper and the number of loading cycles it is subjected to was developed based on the results of the fatigue loading tests. The fatigue limit determined based on the loading tests and the calculated limit state of crack formation were clearly higher than the bending moments measured in field tests. Consequently, deterioration of the railway sleepers under a traffic load and due to fatigue is highly unlikely.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Civil Engineering, Research group: Track Structures

Contributors: Rantala, T., Kerokoski, O., Nurmikolu, A., Laaksonen, A.

Number of pages: 8  
Pages: 1445-1452  
Publication date: 2018

#### Host publication information

Title of host publication: High Tech Concrete: Where Technology and Engineering Meet - Proceedings of the 2017 fib Symposium

Publisher: Springer International Publishing

ISBN (Electronic): 9783319594705

ASJC Scopus subject areas: Architecture , Building and Construction, Civil and Structural Engineering

Keywords: Concrete railway sleeper, Fatigue, Loading test

DOIs:

10.1007/978-3-319-59471-2\_166

Source: Scopus

Source ID: 85025683818

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Solar Panel Breakage During Heavy Rain Caused by Thermal Stress

Solar panels and thermal collectors are increasingly popular. There is practical experience of large numbers of solar panel glasses being broken during heavy rain. The present paper studies the role of mean heat transfer between rain and the glass on the breaking. Thin tempered glass is preferred for its low weight, durability, and good optical quality. However, thin glass tempering is expensive and by understanding relevant stresses costs can be avoided. The heat transfer between a solid surface and rain is studied experimentally using a hot copper block and free falling drops. The thermal stresses are solved using a one-dimensional theory and the measured mean heat transfer coefficient.

The thermal stresses depend on rain rate, surface inclination, glass thickness and temperature difference. The results show that, expect for word record approaching rain rates, the thermal stresses are below 10 MPa. A non-heat treated soda-lime glass should withstand this stress without breaking. The

used rain rates were  $R = 1100, 340, 110$  mm/h and the maximum mean heat transfer coefficients  $h = 600, 250, 140$  W/m<sup>2</sup> K, respectively. All else being equal, the maximum mean heat transfer was observed for surfaces that were inclined 15° from horizontal. Based on the results in the present paper

the mean rain heat transfer causes no need to temper soda-lime glass to be use in solar panels. However, one should remember that thermal stresses must be added to all the other stresses.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics,

Research area: Design, Development and LCM

Contributors: Mikkonen, A., Karvinen, R.

Publication date: Oct 2016

#### Host publication information

Title of host publication: Engineered Transparency 2016 : Glass in Architecture and Structural Engineering

Publisher: Wiley

ISBN (Print): 978-3-433-03187-2

ASJC Scopus subject areas: Civil and Structural Engineering, Mechanical Engineering

Keywords: Thermal stress, heat transfer, rain, experimental, one-dimensional

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### The effect of climate change on the amount of wind driven rain on concrete facades

Private and public buildings built of concrete make up 34% of the whole building stock in Finland, of which almost 40% is now 30-50 years old. The financial and functional impact on Finnish society of this aged building stock is critical because one third of the country's population lives in these apartment blocks. There is a rising national concern on increasing maintenance needs of Finnish building stock. It has been concluded that new conceptual approaches to tackle the problem are acutely needed. The main reasons for facade degradation in the Finnish climate are freeze-thaw weathering of concrete and corrosion of reinforcement induced by carbonation of the surrounding concrete. A common denominator in every mechanism is water in varying forms. It can either work as a passage for harmful substances, e.g. chlorides, cause damage by its phase changes (freeze-thaw) or cause dissolution of substances in concrete. Two recent projects conducted by Finnish Meteorological Institute and Tampere University of Technology, have shown that future climate conditions in Finland are likely to get worse in terms of durability of structures exposed to climate. Precipitation during the winter season is going to increase while the form of precipitation is going to be increasingly water and sleet. At the same time, the conditions for drying are going to get worse. Thus, the deterioration rate of structures will accelerate in the most of Finland if maintenance and protection actions are neglected. To simulate the effect of changing climate conditions, it has been studied how the amount of wind-driven rain (WDR) on facades may change in future climate based on a greenhouse gas scenario. The study was conducted by comparing typical Finnish suburban concrete block build in 1970's in two different locations (coastal area and inland) at current climate and in 2050 and 2100. Based on the study the

amount of WDR will increase more in coastal areas than in inland and will be more focused on south and south-west directions. The total increase in WDR will be approx. 15%, while the greatest increase (50%) will be faced by the westward facades in coastal area.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Tampere University of Technology

Contributors: Pakkala, T., Lemberg, A., Lahdensivu, J.

Number of pages: 13

Pages: 153-165

Publication date: May 2016

#### **Host publication information**

Title of host publication: Proceedings of the CIB World Building Congress 2016 : Vol 2 : Environmental opportunities and challenges, Constructing commitment and acknowledging human experiences

Volume: 2

Place of publication: Tampere

Publisher: Tampere University of Technology. Department of Civil Engineering

Editors: Prins, M., Wamelink, H., Giddings, B., Ku, K., Feenstra, M.

ISBN (Print): 978-952-15-3742-4

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Climate change, Wind-driven rain, Concrete, Modelling

URLs:

[https://tutcris.tut.fi/portal/files/6186797/WBC16\\_Vol\\_2.pdf](https://tutcris.tut.fi/portal/files/6186797/WBC16_Vol_2.pdf)

URLs:

<http://www.wbc16.com/wbc16.html>

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Bus Transportation Accessibility - Does It Impact Housing Values?**

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Civil Engineering, Research group: Real estate development, Research group: Capacity Development of Water and Environmental Services CADWES

Contributors: Kurvinen, A., Sorri, J.

Number of pages: 11

Pages: 321-331

Publication date: 2016

#### **Host publication information**

Title of host publication: Proceedings of the CIB World Building Congress 2016 : Understanding impacts and functioning of different solutions

Volume: IV

Place of publication: Tampere

Publisher: Tampere University of Technology. Department of Civil Engineering

Editors: Nenonen, S., Junnonen, J.

ISBN (Electronic): 978-952-15-3744-8

ASJC Scopus subject areas: Economics, Econometrics and Finance (miscellaneous), Civil and Structural Engineering

Keywords: bus stops, bus traffic, housing prices, public transportation, residential property values, traffic related zones, urban form

Electronic versions:

WBC2016\_Bus\_Transportation\_Accessibility

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606224310>

URLs:

[https://tutcris.tut.fi/admin/files/6372875/WBC2016\\_Bus\\_Transportation\\_Accessibility.pdf](https://tutcris.tut.fi/admin/files/6372875/WBC2016_Bus_Transportation_Accessibility.pdf) (Proceedings of the CIB World Building congress 2016)

<http://www.wbc16.com/wbc16/welcome.html> (Proceedings of the CIB World Building congress 2016)

#### **Bibliographical note**

This paper won World Building Congress 2016 Best Paper Award.

### **Validation of the method to evaluate the corrosion propagation stage by hygrothermal simulation**

Evaluating the propagation period for reinforcement corrosion in concrete facades is an important but complex task which contains a high level of uncertainty. Corrosion current intensity during the propagation period have been measured in a large number of studies and there is a general consensus in regard to factors affecting carbonation induced corrosion. Hence, a proper evaluation of hygrothermal conditions in concrete facade becomes crucial. In this study a method to calculate the corrosion propagation period was validated based upon a field survey of prefabricated concrete facades in large-panel apartment buildings. The method combines existing corrosion propagation models and the Delphin dynamic hygrothermal simulation tool, and takes into consideration material properties, carbonation depth, concrete cover depth, indoor and outdoor climate loads. With the proposed method, propagation consists of a time that is required for a concrete cover to begin cracking and a further expansion of the crack to open to 0.3 mm in width. As a result, the method is validated via the correlation between measured and calculated propagation periods across a range of twenty years. The sensitivity of the results are also studied. The method allows for an evaluation to be carried out on degradation, residual service life, and the need for the renovation of reinforced concrete facades.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Tallinn University of Technology

Contributors: Ilomets, S., Kalamees, T., Lahdensivu, J.

Number of pages: 8

Pages: 1113-1120

Publication date: 2016

#### **Host publication information**

Title of host publication: CESB 2016 - Central Europe Towards Sustainable Building 2016: Innovations for Sustainable Future

Publisher: Czech Technical University in Prague

ISBN (Electronic): 9788027102488

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Concrete damage, Corrosion model, Corrosion propagation, Hygrothermal simulation, Service life

#### **Bibliographical note**

EXT="Kalamees, Targo"

Source: Scopus

Source ID: 84986883167

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **The target reliability of the eurocodes**

The target reliability of the Eurocodes is given clearly: One-year reliability is 4.7 and 50-year reliability 3.8 correspondingly. However, the implementation of the direction is unclear in many ways: The reliability calculations for the Eurocodes are made sometimes by using one-year reliability 4.45 or 4.2. The Eurocodes does not instruct for which reference time the reliability is calculated. Normally, the reliability is calculated for the service time, 50 years, but sometimes for one year. The paper concludes that the reliability must be calculated for the service time. The independent versus the dependent load combination results in different reliability. The independent load combination results in higher reliability with fixed safety factors and up to about 10 % less safety factors with fixed target reliability when two loads are combined and with three loads even less. The loads are combined in the Eurocodes sometimes independently and sometimes dependently. Arguments are given here that the loads must be combined dependently. The variable load distribution is generally assumed Gumbel. However, this distribution is excessively safe as it has a robust upper tail which unrealistically affects the reliability. Normal distribution is one possible alternative, however obviously somewhat unsafe. In the paper, the safety factors are given based on Gumbel and normal distribution. The combination of 20 % Gumbel and 80 % normal distribution is one feasible option. In the current reliability calculation 50-year return load, i.e. 0.98 fractile of the load distribution is usually set at the characteristic load with the target reliability of the service time. This means that one-year loads are only considered in the reliability calculation. For this reason the variable load safety factors are unrealistically low as the target reliability corresponds to the service time loads. Gumbel distribution partly counterbalances the unsafe error but the overall effect is unsafe. The material factors of the Eurocodes are given based on the current calculation and modified calculation. The paper concludes that the reliability should be calculated for the service time loads with the distributions set at the service time location and the reference reliability should be 3.8. The issue of partial factors and design values is shortly addressed and concluded that the design value code is simple with better reliability accuracy than the current partial factor code when the characteristic variable load is made variable.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Department of Civil Engineering  
Contributors: Poutanen, T.  
Number of pages: 7  
Pages: 202-208  
Publication date: 2015

#### Host publication information

Title of host publication: Safety, Robustness and Condition Assessment of Structures  
Publisher: International Association for Bridge and Structural Engineering (IABSE)

#### Publication series

Name: IABSE Symposium Report  
ISSN (Print): 2221-3783  
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction, Safety, Risk, Reliability and Quality  
Keywords: Code, Design value, Gumbel distribution, Normal distribution, Partial factor, Reliability  
DOIs:  
10.2749/222137815815622816  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84929340776&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84929340776  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Structural analysis of tubular truss in fire

Tubular trusses with welded gap joints are internally indeterminate if they are modeled with beam elements using continuous chords and eccentricities at the joints. Trusses may be externally statically determinate or not, depending on their support conditions. The start point was a tubular truss, which was sizing and shape optimized. This means that the members and the joints can resist just the load in normal situation. Next the same truss was analyzed using material and geometrical non-linear theory with reduced load in fire allowing horizontal displacement at the other end and restraining it. The idea was to study: 1) is the normal tubular truss such that in externally determinate case the linear theory can be used in fire, 2) what happens in externally indeterminate case? The results were: 1) the linear analysis can be used in fire to determine the stress resultants and 2) the linear model is very conservative.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Department of Civil Engineering, Research group: Metal and Light-wight structures  
Contributors: Diez Albero, J. A., Tiainen, T., Mela, K., Heinisuo, M.  
Number of pages: 7  
Pages: 181-187  
Publication date: 2015

#### Host publication information

Title of host publication: ISTS15, 15th International Symposium on Tubular Structures, : 27-29 May 2015  
Publisher: CRC Press/Balkema  
ISBN (Print): 9781138028371  
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84942280092&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

INT=rak,"Diez Albero, J. A."  
Source: Scopus  
Source ID: 84942280092  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### BIM based schedule control for precast concrete supply chain

Development of the schedule control of precast concrete supply chain has been studied. Main idea was to use BIM model created by structural engineer as a user-interface for schedule control, for saving different status information of the real-time schedule situation of the propagation of structural design, element manufacture, delivery and site erection directly to the BIM model by using a cloud-based networked service. Some of the missing software applications were programmed by the software companies participated in the project. Experiments were done in a real construction project in Finland,

where the information from design, prefabrication, delivery and erection phases was synchronized between the stakeholders by using the cloud service. The most important observations and results are introduced and analyzed. A future model for intelligent BIM based schedule control concept is concluded.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), Skanska Oy, Construction Technology Research Center, University of Oulu

Contributors: Nissilä, J., Heikkilä, R., Romo, I., Malaska, M., Aho, T.

Number of pages: 5

Pages: 667-671

Publication date: 2014

#### **Host publication information**

Title of host publication: 31st International Symposium on Automation and Robotics in Construction and Mining, ISARC 2014 - Proceedings

Publisher: University of Technology Sydney

ISBN (Print): 9780646597119

ASJC Scopus subject areas: Artificial Intelligence, Hardware and Architecture, Civil and Structural Engineering, Building and Construction

Keywords: BIM, Precast concrete, Schedule control, Supply chain

URLs:

<http://www.scopus.com/inward/record.url?scp=84912527773&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84912527773

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **A slotted patch antenna for wireless strain sensing**

This research studies the wireless strain sensing performance of a slotted patch antenna sensor. In our previous work, a folded patch antenna was designed for passive wireless strain and crack sensing. When experiencing deformation, the antenna shape changes, causing shift in electromagnetic resonance frequency of the antenna. The wireless interrogation system utilizes the principle of electromagnetic backscattering and adopts off-the-shelf 900MHz radiofrequency identification (RFID) technology. In this research, a new slotted patch antenna sensor is designed and tested. The antenna detours surface current using slot patterns so that the electrical length is kept similar as previous folded patch antenna. As a result, the sensor footprint is reduced and the antenna resonance frequency is maintained within 900MHz RFID band. To accurately describe both mechanical and electromagnetic behaviors of the antenna sensor, a multi-physics coupled simulation approach is pursued. Implemented through a commercial software package, COMSOL, a multi-physics finite element model of the antenna uses the same geometry and meshing for both mechanical and electromagnetic simulations. Wireless strain sensing performance of the antenna is first simulated using the multi-physics model. In addition, experimental tensile tests are performed to investigate the correlation between wirelessly interrogated resonance frequency and the strain experienced by the antenna. The strain sensing performance is tested.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Virginia Tech

Contributors: Yi, X., Cho, C., Cook, B., Wang, Y., Tentzeris, M. M., Leon, R. T.

Number of pages: 10

Pages: 2734-2743

Publication date: 2014

#### **Host publication information**

Title of host publication: Structures Congress 2014 - Proceedings of the 2014 Structures Congress

Publisher: American Society of Civil Engineers ASCE

ISBN (Electronic): 9780784413357

ASJC Scopus subject areas: Building and Construction, Civil and Structural Engineering

DOIs:

10.1061/9780784413357.239

URLs:

<http://www.scopus.com/inward/record.url?scp=84934325955&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84934325955

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Crack propagation measurement using a battery-free slotted patch antenna sensor**

This research studies the performance of a battery-free wireless antenna sensor for measuring crack propagation. In our previous work, a battery-free folded patch antenna was designed for wireless strain and crack sensing. When experiencing deformation, the antenna shape changes, causing shift in electromagnetic resonance frequency of the antenna. The wireless interrogation system utilizes the principle of electromagnetic backscattering and adopts off-the-shelf 900MHz radiofrequency identification (RFID) technology. Following the same sensing mechanism, a slotted patch antenna sensor of smaller size is designed. The antenna detours surface current using slot patterns, so that the effective electrical length is kept similar as previous folded patch antenna. As a result, the sensor footprint is reduced and the antenna resonance frequency is maintained within 900MHz RFID band. To validate the sensor performance for crack sensing, a fatigue crack experiment is conducted on a steel compact-tension specimen. A slotted patch antenna sensor is installed at the center of the A36 steel specimen. For wireless interrogation, a Yagi reader antenna is placed 36 in. away from the antenna sensor to wirelessly measure the resonance frequency shift of the antenna sensor. The measurement is taken after every 10,000 loading cycles, till the specimen fails. Meanwhile, the length and width of the fatigue crack are also recorded. Finally, the resonance frequency shift of the antenna sensor is correlated with crack length and width at each loading stage.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering, Virginia Tech

Contributors: Yi, X., Cho, C., Wang, Y., Cook, B., Tentzeris, M. M., Leon, R. T.

Number of pages: 8

Pages: 1040-1047

Publication date: 2014

#### **Host publication information**

Title of host publication: 7th European Workshop on Structural Health Monitoring, EWSHM 2014 - 2nd European Conference of the Prognostics and Health Management (PHM) Society

Publisher: INRIA

ASJC Scopus subject areas: Civil and Structural Engineering, Safety, Risk, Reliability and Quality, Building and Construction, Computer Science Applications

Keywords: Battery-free sensor, Fatigue crack, RFID, Slotted patch antenna

URLs:

<http://www.scopus.com/inward/record.url?scp=84939455742&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939455742

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Integration of BIM and automation in high-rise building construction**

In this paper the utilisation of building information models (BIM) and construction automation on building sites is discussed. A lot of research has been carried out to develop new applications for using BIM to assist construction site planning, different operations and logistics. The methods of production control and management on site utilize BIM together with machine control and navigation systems. In Finland machine control systems and the automation of construction equipment is widely used in infrastructure construction. Recently similar methods have been introduced also in building construction. This paper describes some latest Finnish examples where BIM-software is used for the planning, execution and control of building construction operations. University of Oulu has studied methods and technologies to capitalize BIM-models. The research has been mainly in infrastructure construction but the activities have recently been extended to building construction. In this paper a BIM-based tower crane operation and control system is discussed as a case study. The aim of this study was to highlight the potential areas where automation can increase the crane productivity and improve site operations and logistics. The construction site managers and tower crane operators interviewed in this study were experienced in using BIM-models on site.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Life Cycle Effectiveness of the Built Environment (LCE@BE), University of Oulu, Conxtech

Contributors: Heikkilä, R., Malaska, M., Törmänen, P., Keyack, C.

Number of pages: 6

Pages: 1171-1176

Publication date: 2013

#### **Host publication information**

Title of host publication: ISARC 2013 - 30th International Symposium on Automation and Robotics in Construction and Mining, Held in Conjunction with the 23rd World Mining Congress



ASJC Scopus subject areas: Artificial Intelligence, Human-Computer Interaction, Geotechnical Engineering and Engineering Geology, Civil and Structural Engineering

Keywords: BIM, Construction automation, Crane control, Robotics, Tower crane

URLs:

<http://www.scopus.com/inward/record.url?scp=84893521889&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893521889

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Structural behaviour of long integral abutment bridges**

The eccentric displacement of the bridge ends around the centre results from different soil properties at different ends of the bridge. This global variation of properties produces different stresses in the otherwise symmetrical integral bridge ends. The proposed parameter  $mG$  and behaviour model for taking this behaviour into account is presented. An estimate for the maximum length limit of a fully integral concrete bridge, 120 m, was also obtained from these analyses.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE), A-Insinöörin Suunnittelu Oy Bridge and Specific Structures

Contributors: Laaksonen, A.

Publication date: 2012

#### **Host publication information**

Title of host publication: Global Thinking in Structural Engineering: Recent Achievements

Publisher: International Association for Bridge and Structural Engineering (IABSE)

ISBN (Electronic): 9783857481253

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Bridge monitoring, Integral abutment bridge, Soil-structure interaction, Superstructure temperature, Thermal expansion length

URLs:

<http://www.scopus.com/inward/record.url?scp=84928957658&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928957658

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Passive frequency doubling antenna sensor for wireless strain sensing**

This paper presents the design, simulation, and preliminary measurement of a passive (battery-free) frequency doubling antenna sensor for strain sensing. Illuminated by a wireless reader, the sensor consists of three components, i.e. a receiving antenna with resonance frequency  $f_0$ , a transmitting antenna with resonance frequency  $2f_0$ , and a matching network between the receiving and transmitting antennas. A Schottky diode is integrated in the matching network. Exploiting nonlinear circuit behavior of the diode, the matching network is able to generate output signal at doubled frequency of the reader interrogation signal. The output signal is then backscattered to the reader through the sensor-side transmitting antenna. Because the backscattered signal has a doubled frequency, it is easily distinguished by the reader from environmental reflections of original interrogation signal. When one of the sensor-side antennas, say receiving antenna, is bonded to a structure that experiences strain/deformation, resonance frequency of the antenna shifts accordingly. Through wireless interrogation, this resonance frequency shift can be measured by the reader and used to derive strain in the structure. Since operation power of the diode is harvested from the reader interrogation signal, no other power source is needed by the sensor. This means the frequency doubling antenna sensor is wireless and passive. Based on simulation results, strain sensitivity of this novel frequency doubling antenna sensor is around  $-3.84 \text{ kHz}/\mu\epsilon$ .

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering, Virginia Tech

Contributors: Yi, X., Cho, C., Wang, Y., Cook, B. S., Cooper, J., Vyas, R., Tentzeris, M. M., Leon, R. T.

Number of pages: 8

Pages: 625-632

Publication date: 2012

#### **Host publication information**

Title of host publication: ASME 2012 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, SMASIS 2012

Volume: 1

ISBN (Print): 9780791845097

ASJC Scopus subject areas: Artificial Intelligence, Civil and Structural Engineering, Mechanics of Materials

DOIs:

10.1115/SMASIS2012-7923

URLs:

<http://www.scopus.com/inward/record.url?scp=84892656121&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84892656121

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Wireless crack sensing using an RFID-based folded patch antenna**

This paper describes the crack sensing performance of a wireless and passive smart-skin sensor designed as a folded patch antenna. When strain/deformation occurs on the patch antenna, the antenna's electrical length changes and its electromagnetic resonance frequency also changes accordingly. An inexpensive off-the-shelf radiofrequency identification (RFID) chip is adopted in the sensor design for signal modulation and collision avoidance. With assistance from the RFID chip, the resonance frequency change can be interrogated and recorded by a wireless reader. The RF interrogation energy from the reader is captured by the patch antenna, and then used to activate the RFID chip that transmits modulated signal back to the reader. Therefore, the interrogation process is wireless and the antenna sensor is battery-free. In this research, crack sensing performance of the antenna sensor is studied and tested by a specially designed crack testing device. Testing results show strong correlation between interrogated resonance frequency and crack opening size.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, School of Civil and Environmental Engineering, Georgia Institute of Technology, School of Electrical and Computer Engineering

Contributors: Yi, X., Wang, Y., Leon, R. T., Cooper, J., Tentzeris, M. M.

Number of pages: 7

Pages: 824-830

Publication date: 2012

#### **Host publication information**

Title of host publication: Bridge Maintenance, Safety, Management, Resilience and Sustainability - Proceedings of the Sixth International Conference on Bridge Maintenance, Safety and Management

ISBN (Print): 9780415621243

ASJC Scopus subject areas: Civil and Structural Engineering, Safety, Risk, Reliability and Quality

URLs:

<http://www.scopus.com/inward/record.url?scp=84863959320&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863959320

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Shear buckling and resistance of thin-walled steel plate at non-uniform elevated temperatures**

The shear resistance of thin metal plate consists of three components: shear buckling, the tension field effect and contribution of the flanges. This paper considers the first two. The shear resistance of steel plate at elevated temperatures is known when temperature across the plate is constant. However, in many practical applications the temperature distribution across the plate is non-uniform. This paper presents the results of a FEM analysis of thin carbon- and stainless steel plates at ambient as well as uniform and non-uniform elevated temperatures. A method for predicting the shear buckling- and post-buckling resistances of thin steel plate at non-uniform elevated temperatures is also proposed.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Software Systems, Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE)

Contributors: Salminen, M., Heinisuo, M.

Number of pages: 10

Pages: 267-276

Publication date: 2011

#### **Host publication information**

Title of host publication: 10th International Conference on Steel Space and Composite Structures

Publisher: CI-Premier Pte Ltd

ISBN (Print): 9789810888152

ASJC Scopus subject areas: Civil and Structural Engineering, Ceramics and Composites, Metals and Alloys

Keywords: Elevated temperatures, Numerical analysis, Shear resistance, Steel plate

URLs:

<http://www.scopus.com/inward/record.url?scp=84905856370&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84905856370

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Sensing resolution and measurement range of a passive wireless strain sensor**

In this research, folded patch antennas are explored for the development of low-cost and wireless smart-skin sensors that monitor the strain in metallic structures. When the patch antenna is under strain/deformation, its resonance frequency varies accordingly. The variation can be easily interrogated and recorded by a wireless reader that also wirelessly delivers power for the antenna operation. The patch antenna adopts a specially selected substrate material with low dielectric constant, as well as an inexpensive off-the-shelf radiofrequency identification (RFID) chip for signal modulation. This paper reports latest tensile test results on the strain sensing limit of the prototype folded patch antenna. In particular, it is shown that the passive wireless sensor can detect small strain changes lower than 20  $\mu\epsilon$ , and can perform well at a strain range higher than 10,000  $\mu\epsilon$ .

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Chemistry and Bioengineering, Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering, School of Civil and Environmental Engineering

Contributors: Yi, X., Wu, T., Lantz, G., Cooper, J., Cho, C., Wang, Y., Tentzeris, M. M., Leon, R. T.

Number of pages: 8

Pages: 759-766

Publication date: 2011

### **Host publication information**

Title of host publication: Structural Health Monitoring 2011: Condition-Based Maintenance and Intelligent Structures - Proceedings of the 8th International Workshop on Structural Health Monitoring

Volume: 1

ISBN (Print): 9781605950532

ASJC Scopus subject areas: Civil and Structural Engineering

URLs:

<http://www.scopus.com/inward/record.url?scp=84866688596&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84866688596

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Project feedback as a tool for learning**

In construction, project feedback has often been seen primarily as a means to measure customer satisfaction. Even though the measurement of customer satisfaction is an important factor, feedback information also has other purposes, for example, it highlights the frailties of the operations. With the help of the feedback information, companies can uncover development targets and develop their own competencies and co-operation competencies. Thus feedback information is also a vehicle for sharing knowledge about experiences and good solutions and thereby operates as a part of knowledge mechanism and learning. Construction can be characterized as a specific type of project industry, with specific features concerning production, such as temporality, bounded location and one-off products. From the point of view of learning, the uniqueness and temporality of the project organization bring their own challenges and difficulties. In this article we concentrate on how those challenges and difficulties can be overcome with the help of feedback information. The questions of this paper are defined as follows: • How does the uniqueness and temporality of a project organisation affect the learning processes? • How can feedback be used to intensify knowledge transfer and learning for the parties of the construction project?

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Helsinki University of Technology

Contributors: Kärnä, S., Junnonen, J. M.

Number of pages: 9

Pages: 47-55

Publication date: 2005

### Host publication information

Title of host publication: Proceedings of the 13th Annual Conference of the International Group for Lean Construction (IGLC 2005)

ISBN (Print): 1877040347, 9781877040344

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Customer satisfaction, Feedback, Learning organization

URLs:

<http://www.scopus.com/inward/record.url?scp=84856671776&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84856671776

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Reply to the discussion by koutsoftas on "evaluation of sample quality from different sampling methods in finnish soft sensitive clays"<sup>1</sup>

#### General information

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Civil Engineering, Research group: Foundation Structures, Norwegian Geotechnical Institute (NGI)

Contributors: Di Buò, B., Selänpää, J., Länsivaara, T. T., D'ignazio, M.

Number of pages: 2

Pages: 1261-1262

Publication date: 2020

Peer-reviewed: No

#### Publication information

Journal: Canadian Geotechnical Journal

Volume: 57

Issue number: 8

ISSN (Print): 0008-3674

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Geotechnical Engineering and Engineering Geology

DOIs:

10.1139/cgj-2019-0754

Source: Scopus

Source ID: 85089002938

Research output: Contribution to journal > Comment/debate > Scientific

### Editorial to "The best papers from the 32nd International Symposium on Automation and Robotics in Construction and Mining (ISARC 2015)"

#### General information

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Department of Civil Engineering, Research group: Responsible Construction, Univ of Oulu

Contributors: Malaska, M., Heikkilä, R.

Number of pages: 1

Pages: 1

Publication date: 1 Nov 2016

Peer-reviewed: No

#### Publication information

Journal: Automation in Construction

Volume: 71

ISSN (Print): 0926-5805

Ratings:

Scopus rating (2016): CiteScore 7.8 SJR 1.395 SNIP 2.754

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Civil and Structural Engineering, Building and Construction

DOIs:

10.1016/j.autcon.2016.08.045

Source: Scopus  
Source ID: 84988322453  
Research output: Contribution to journal › Editorial › Scientific

## **Paine-erot Pirkanmaan ja Helsingin julkisissa palvelurakennuksissa**

### **General information**

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics, Tampere University of Technology, Laboratory of Civil Engineering  
Contributors: Kauppinen, A., Kiviste, M., Pirhonen, J., Vinha, J.  
Number of pages: 7  
Pages: 215-221  
Publication date: 24 Oct 2017

### **Host publication information**

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24-26.10.2017, Tampere  
Volume: 1  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

### **Publication series**

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.  
ASJC Scopus subject areas: Civil and Structural Engineering  
URLs:  
[http://www.tut.fi/cs/groups/public\\_news/@l102/@web/@p/documents/liit/x251128.pdf](http://www.tut.fi/cs/groups/public_news/@l102/@web/@p/documents/liit/x251128.pdf)

### **Bibliographical note**

INT=RAK, "Pirhonen, Joni"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## **Maanvastaisten seinien lämpö- ja kosteustekninen toiminta**

### **General information**

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics, Tampere University of Technology, Laboratory of Civil Engineering  
Contributors: Laukkarinen, A., Heiskanen, R., Vinha, J.  
Number of pages: 6  
Pages: 71-76  
Publication date: 24 Oct 2017

### **Host publication information**

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere  
Volume: 1  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

### **Publication series**

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.  
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

### **Bibliographical note**

INT=rak,"Heiskanen, Roosa"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Kosteusvaurioiden vakavuus kuntien rakennuksissa

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Civil Engineering, Research group: Service Life Engineering of Structures, Research area: Structural Engineering, Research group: Building Physics

Contributors: Annala, P., Lahdensivu, J., Suonketo, J., Pentti, M., Laukkarinen, A., Vinha, J.

Number of pages: 6

Pages: 135-140

Publication date: 24 Oct 2017

### Host publication information

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere

Volume: 1

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka

Editors: Vinha, J., Kivioja, H.

ISBN (Print): 978-952-15-4022-6

### Publication series

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Puukerrostalon työmaavaiheen lämpö- ja kosteusolosuhteiden mittaukset

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Civil Engineering, Research group: Building Physics, Research group: Capacity Development of Water and Environmental Services CADWES, Laboratory of Civil Engineering, Tampere University of Technology

Contributors: Laukkarinen, A., Musakka, S., Penttilä, O., Teriö, O., Vinha, J.

Number of pages: 6

Pages: 167-172

Publication date: 24 Oct 2017

### Host publication information

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere

Volume: 1

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka

Editors: Vinha, J., Kivioja, H.

ISBN (Print): 978-952-15-4022-6

### Publication series

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

### Bibliographical note

INT=RAK, "Musakka, Sami"

INT=RAK, "Penttilä, Olavi"

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Puukerrostalorakentamisen kosteudenhallinta

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Civil Engineering, Research group: Capacity Development of Water and Environmental Services CADWES, Research group: Building Physics, Tampere University of Technology, Laboratory of Civil Engineering

Contributors: Teriö, O., Penttilä, O., Laukkarinen, A., Musakka, S., Vinha, J.

Number of pages: 6

Pages: 173-178  
Publication date: 24 Oct 2017

#### Host publication information

Title of host publication: Rakennusfysiikka 2017. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut : 24.-26.10.2017, Tampere  
Volume: 1  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

#### Publication series

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.  
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

#### Bibliographical note

INT=rak,"Penttilä, Olavi"

INT=rak,"Musakka, Sami"

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

#### Julkisivujen ja parvekkeiden talvikorjausohje

##### General information

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Civil Engineering, Research group: Service Life Engineering of Structures  
Contributors: Pakkala, T., Lahdensivu, J., Köliö, A., Annila, P.  
Number of pages: 6  
Pages: 179-184  
Publication date: Oct 2017

##### Host publication information

Title of host publication: Rakennusfysiikka 2017 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut, 24-26.10.2017, Tampere  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, Rakennustekniikka, Rakennusfysiikka  
Editors: Vinha, J., Kivioja, H.  
ISBN (Print): 978-952-15-4022-6

##### Publication series

Name: Tampereen teknillinen yliopisto. Rakennustekniikka. Rakennusfysiikka.  
ASJC Scopus subject areas: Civil and Structural Engineering

URLs:

[http://www.tut.fi/cs/groups/public\\_news/@1102/@web/@p/documents/liit/x229155.pdf](http://www.tut.fi/cs/groups/public_news/@1102/@web/@p/documents/liit/x229155.pdf)

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

#### ÄKK-hankkeen suositukset tulevaisuuden ääneneristysmääräyksiä koskien

##### General information

Publication status: Published  
MoE publication type: B3 Non-refereed article in conference proceedings  
Organisations: Department of Civil Engineering, Research group: Building Acoustics, University of Turku, Finnish Institute of Occupational Health, Indoor Environment Laboratory  
Contributors: Hongisto, V., Kylliäinen, M., Hyönä, J.  
Number of pages: 6  
Pages: 561-566  
Publication date: 22 Oct 2015

##### Host publication information

Title of host publication: Rakennusfysiikka 2015  
Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka  
ISBN (Print): 978-952-15-3580-2  
ASJC Scopus subject areas: Civil and Structural Engineering, Acoustics and Ultrasonics

Keywords: acoustics, sound insulation, airborne sound insulation, impact sound insulation, psychoacoustics  
URLs:

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## **Puuvälipohjien akustiset ominaisuudet**

### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Acoustics, A-Insinöörit Suunnittelu Oy

Contributors: Latvanne, P., Kylliäinen, M.

Number of pages: 6

Pages: 567-572

Publication date: 22 Oct 2015

### **Host publication information**

Title of host publication: Rakennusfysiikka 2015

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

ISBN (Print): 978-952-15-3580-2

ASJC Scopus subject areas: Civil and Structural Engineering, Acoustics and Ultrasonics

URLs:

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## **Menetelmä parvekelasien ääneneristävyyden mitoittamiseksi liikennemelualueilla**

### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Acoustics

Contributors: Kovalainen, V., Kylliäinen, M.

Number of pages: 6

Pages: 617-622

Publication date: 22 Oct 2015

### **Host publication information**

Title of host publication: Rakennusfysiikka 2015

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

ISBN (Print): 978-952-15-3580-2

ASJC Scopus subject areas: Civil and Structural Engineering, Acoustics and Ultrasonics

Keywords: acoustics, noise control

URLs:

<http://www.tut.fi/fi/tietoa->

[yliopistosta/laitokset/rakennustekniikka/tutkimus/rakennetekniikka/rakennusfysiikka/rakennusfysiikkaseminaarit/index.htm](http://www.tut.fi/fi/tietoa-yliopistosta/laitokset/rakennustekniikka/tutkimus/rakennetekniikka/rakennusfysiikka/rakennusfysiikkaseminaarit/index.htm)

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## **Puurunkoisten tuuletettujen yläpohjien kosteustekninen toiminta**

### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Physics

Contributors: Junttila, H., Laukkarinen, A., Vinha, J.

Number of pages: 6

Pages: 77-82

Publication date: 22 Oct 2015

### **Host publication information**

Title of host publication: Rakennusfysiikka 2015. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 20.-22.10.2015, Tampere.

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka



Editors: Vinha, J., Ruuska, T.  
ISBN (Print): 978-952-15-3580-2

#### Publication series

Name: Rakennustekniikan laitos. Rakennetekniikka. Seminaarijulkaisu

No.: 4

ASJC Scopus subject areas: Building and Construction, Civil and Structural Engineering

URLs:

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

### Lasitetun parvekkeen lämpötilan ja lämpöhäviöiden laskenta

#### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Physics, Research group: Service Life Engineering of Structures

Contributors: Laukkarinen, A., Hilliaho, K.

Number of pages: 6

Pages: 181-186

Publication date: 20 Oct 2015

#### Host publication information

Title of host publication: Rakennusfysiikka 2015. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 20.-22.10.2015, Tampere

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

Editors: Vinha, J., Ruuska, T.

ISBN (Print): 978-952-15-3580-2

#### Publication series

Name: Rakennustekniikan laitos. Rakennetekniikka. Seminaarijulkaisu

No.: 4

ASJC Scopus subject areas: Building and Construction, Civil and Structural Engineering

URLs:

<http://www.ril.fi/media/files/koulutus/rakennusfysiikka-2015-cfp.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

### Raudoitteiden korroosionopeuden määrittäminen betonijulkisivussa korkean aikaresoluution säädätan avulla

#### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Research group: Building Physics, The Finnish Meteorological Institute. Ilmatieteen laitos.

Contributors: Köliö, A., Hohti, H., Pakkala, T., Laukkarinen, A., Lahdensivu, J., Mattila, J.

Number of pages: 8

Pages: 195-202

Publication date: 20 Oct 2015

#### Host publication information

Title of host publication: Rakennusfysiikka 2015. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 20.-22.10.2015, Tampere.

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

ISBN (Print): 978-952-15-3580-2

#### Publication series

Name: Rakennustekniikan laitos. Rakennetekniikka. Seminaarijulkaisu

No.: 4

ASJC Scopus subject areas: Building and Construction, Civil and Structural Engineering

URLs:

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Uudessa COMBI-hankkeessa tutkitaan energiatehokkaan palvelurakentamisen haasteita ja ratkaisuja

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Physics, School of Architecture, Research group: ASUTUT, Research area: Structural Engineering, Research group: Capacity Development of Water and Environmental Services CADWES, Research group: Real estate development, Research group: Service Life Engineering of Structures, Aalto University, Tampere University of Applied Sciences TAMK

Contributors: Vinha, J., Hedman, M., Sirén, K., Harsia, P., Pentti, M., Teriö, O., Heljo, J., Laukkarinen, A., Annila, P., Kaasalainen, H., Jokisalo, J., Pihlajamaa, P.

Number of pages: 10

Pages: 487-496

Publication date: 20 Oct 2015

### Host publication information

Title of host publication: Rakennusfysiikka 2015. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 20.-22.10.2015, Tampere.

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

Editors: Vinha, J., Ruuska, T.

ISBN (Print): 978-952-15-3580-2

### Publication series

Name: Rakennustekniikan laitos. Rakennetekniikka. Seminaarijulkaisu

No.: 4

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

URLs:

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

### Bibliographical note

ORG=rak,0.8

ORG=ark,0.2

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Koko Julkisivua peittävän lasijulkisivun vaikutus Etelä-Ruotsissa sijaitsevan rakennuksen energiatehokkuuteen

Article discuss the effect of the added façade glazing on the building energy consumption in one case building in Malmö, Sweden

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Lund University

Contributors: Hilliaho, K., Nordquist, B., Wallentén, P.

Number of pages: 8

Pages: 509-516

Publication date: 20 Oct 2015

### Host publication information

Title of host publication: Rakennusfysiikka 2015. Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 20.-22.10.2015, Tampere

Place of publication: Tampere

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

Editors: Vinha, J., Ruuska, T.

ISBN (Print): 978-952-15-3580-2

### Publication series

Name: Rakennustekniikan laitos. Rakennetekniikka. Seminaarijulkaisu 4

No.: 4

ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction

Keywords: Double skin facade, Energy efficiency, New renovation concepts, Innovative HVAC, Earth to air heat exchanger

URLs:

<http://www.ril.fi/media/files/koulutus/rakennusfysiikka-2015-cfp.pdf>

<http://www.tut.fi/cs/groups/public/@I912/@web/@p/documents/liit/x124266.pdf>

## Acoustics of vanished 19th century concert halls in Helsinki

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Acoustics, A-Insinöörit Suunnittelu Oy, Helsinki City Museum

Contributors: Niemi, H., Kylliäinen, M., Jäppinen, J., Lindqvist, M.

Number of pages: 8

Pages: 182-189

Publication date: Oct 2015

### Host publication information

Title of host publication: 9th International conference on Auditorium Acoustics 2015

Volume: 37

Publisher: Institute of Acoustics

ISBN (Electronic): 978-1-906913-22-9

ASJC Scopus subject areas: Acoustics and Ultrasonics, Civil and Structural Engineering

Keywords: room acoustics, auditorium acoustics, concert halls, acoustics

URLs:

<https://ioa.org.uk/civicrm/event/info?reset=1&id=65>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Auralization of vanished 19th century concert halls in Helsinki

### General information

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Department of Civil Engineering, Research group: Building Acoustics, A-Insinöörit Suunnittelu Oy, Helsinki City Museum

Contributors: Niemi, H., Kylliäinen, M., Jäppinen, J., Lindqvist, M.

Number of pages: 8

Pages: 470-477

Publication date: Oct 2015

### Host publication information

Title of host publication: 9th International Conference on Auditorium Acoustics 2015

Volume: 37

Publisher: Institute of Acoustics

ISBN (Electronic): 978-1-906913-22-9

ASJC Scopus subject areas: Civil and Structural Engineering, Acoustics and Ultrasonics

Keywords: room acoustics, auditorium acoustics, auralization, acoustics

URLs:

<https://ioa.org.uk/civicrm/event/info?reset=1&id=65>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

## Kipsilevytuulensuojallisten puurunkoisten ulkoseinärakenteiden rakennusfysikaalinen toiminta

### General information

Publication status: Published

MoE publication type: D3 Professional conference proceedings

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Jokela, T., Laukkarinen, A., Vinha, J.

Pages: 61-66

Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere

Volume: Seminaarijulkaisu 6

Place of publication: Tampere

Publisher: Tampereen yliopisto, Rakennustekniikka

Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:

Jokela et al 2019 Kipsilevytuulensuojalliset puurunkoiset ulkoseinärakenteet  
URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002202256>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## **Ilmakehän pitkäaaltainen säteily rakennusfysikaalisissa laskentatarkasteluissa**

### **General information**

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Jokela, T., Laukkarinen, A., Vinha, J.  
Pages: 55-60  
Publication date: 2019

### **Host publication information**

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Jokela et al 2019 Pitkäaaltainen säteily  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002202255>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## **Koulujen ja päiväkotien sisäilman lämpötilan, suhteellisen kosteuden ja hiilidioksidipitoisuuden mittaukset COMBI-hankkeessa**

### **General information**

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Laukkarinen, A., Kauppinen, A., Tuominen, E., Raunima, T., Vinha, J.  
Pages: 133-138  
Publication date: 2019

### **Host publication information**

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): ISBN 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Laukkarinen et al 2019 T RH CO2 combi-hankkeessa  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202001301675>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## **Rakennuksen ulkovaipan yli vaikuttavien paine-erojen määrittäminen rakennusfysikaalisia laskentatarkasteluja varten**

### **General information**

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Moisio, T., Laukkarinen, A., Vinha, J.  
Pages: 49-54  
Publication date: 2019

#### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Moisio et al 2019 Paine-erojen määrittäminen  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002202258>

#### Bibliographical note

INT=ceng,"Moisio, Topi"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

### Puurunkoisten ulkoseinien liitosten lämpö- ja kosteustekninen toiminta

#### General information

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Moisio, T., Laukkarinen, A., Vinha, J.  
Pages: 67-74  
Publication date: 2019

#### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Print): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Moisio et al 2019 Puurunkoisten ulkoseinien liitokset  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002202257>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

### COMBI-hankkeen paine-eromittausten yhteenveto

#### General information

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Laukkarinen, A., Kauppinen, A., Raunima, T., Vinha, J.  
Pages: 139-144  
Publication date: 2019

#### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6

Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:

Tuominen et al 2019 COMBI-hankkeen paine-eromittaukset  
URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001301674>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## Huokoisten puukuitu- ja kipsilevytuulensuojalevyjen homehtumisherkyys

### General information

Publication status: Published

MoE publication type: D3 Professional conference proceedings

Organisations: Civil Engineering, Research group: Building Physics, Turun yliopisto, Turun yliopisto

Contributors: Tuominen, E., Ruusala, A., Laukkarinen, A., Pätsi, S., Pessi, A., Vinha, J.

Pages: 517-524

Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere

Volume: Seminaarijulkaisu 6

Place of publication: Tampere

Publisher: Tampereen yliopisto, Rakennustekniikka

Editors: Vinha, J., Raunima, T.

ISBN (Electronic): ISBN 978-952-03-1309-8

ASJC Scopus subject areas: Civil and Structural Engineering

Electronic versions:

Tuominen et al 2019 Tuulensuojalevyjen homehtumisherkyys

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002202254>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## COMBI-hankkeen suositukset korkeatasoisten ja kosteusturvallisten palvelurakennusten toteuttamiseksi - COMBI 8

### General information

Publication status: Published

MoE publication type: D3 Professional conference proceedings

Organisations: Civil Engineering, Research group: Building Physics

Contributors: Vinha, J., Laukkarinen, A.

Pages: 217-222

Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere

Volume: Seminaarijulkaisu 6

Place of publication: Tampere

Publisher: Tampereen yliopisto, Rakennustekniikka

Editors: Vinha, J., Raunima, T.

ISBN (Electronic): 978-952-03-1309-8

ASJC Scopus subject areas: Civil and Structural Engineering

Electronic versions:

Vinha et Laukkarinen 2019 COMBI 8

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002202253>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## Kapasitiivisten kosteusantureiden käyttäytyminen betoniseinien ja kipsivalulattoiden kuivumisen seurannassa

### General information

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Raunima, T., Vinha, J., Sekki, P.  
Pages: 103-110  
Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): ISBN 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Raunima et al 2019 Kapasitiiviset kosteusanturit  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002212280>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## Betonin kosteustekniset materiaaliominaisuudet ja mittausmenetelmän kehittäminen

### General information

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics  
Contributors: Tuominen, E., Vinha, J., Tuominen, O., Vääntinen, K., Vainio, M.  
Number of pages: 6  
Pages: 111-116  
Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere  
Volume: Seminaarijulkaisu 6  
Place of publication: Tampere  
Publisher: Tampereen yliopisto, Rakennustekniikka  
Editors: Vinha, J., Raunima, T.  
ISBN (Electronic): 978-952-03-1309-8  
ASJC Scopus subject areas: Civil and Structural Engineering  
Electronic versions:  
Tuominen et al 2019 Betonin kosteustekniset materiaaliominaisuudet ja mittausmenetelmät  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202001151306>

### Bibliographical note

INT=ceng,"Tuominen, Olli"  
INT=ceng,"Vääntinen, Kari"  
INT=ceng,"Vainio, Maarit"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Professional

## Puuelementtien välisen sauman tiivistys kumitiivisteellä

### General information

Publication status: Published  
MoE publication type: D3 Professional conference proceedings  
Organisations: Civil Engineering, Research group: Building Physics, Timberfinder  
Contributors: Tuominen, E., Vinha, J., Naskali, J.  
Pages: 125-129

Publication date: 2019

### Host publication information

Title of host publication: Rakennusfysiikka 2019 : Uusimmat tutkimustulokset ja hyvät käytännön ratkaisut. 28.-30.10.2019, Tampere

Volume: Seminaarijulkaisu 6

Place of publication: Tampere

Publisher: Tampereen yliopisto, Rakennustekniikka

Editors: Vinha, J., Raunima, T.

ISBN (Electronic): 978-952-03-1309-8

ASJC Scopus subject areas: Civil and Structural Engineering

Electronic versions:

Tuominen et al 2019 Puuelementtien välinen kumitiiviste

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001151289>

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Professional

### Pyörävylien tiedot ja laatutaso

In recent years, cycling has become increasingly popular in Finland. Finnish municipalities tend to have extensive cycling networks, but those networks also have quality defects that reduce the smoothness, speed and safety of cycling. Since the entire cycling network cannot be reconstructed at once, it must be repaired one section at a time. This calls for a method that enables an assessment of the quality of the cycling network. Such an assessment would, in turn, enable an estimation of the need for measures.

Cycling network quality classification would facilitate planning and contribute, in a number of ways, to the municipality-level development goals set for cycling. Several municipalities have supported cycling by defining goals for a better cycling network structure and hierarchical classification. This preliminary survey proposes a three-tier functional classification of cycling routes, which should also be used in the national guidelines for the planning of pedestrian and cycling routes: main network, regional network and local network (Finnish Transport Agency 2014). A shared data model would encourage municipalities to perform hierarchical classifications, while also providing a common platform for storing such data.

The data model would also contribute to the goal set in the National Strategy for Walking and Cycling, of increasing the amount of cycling by 20% by 2020. For example, the data model will enable the generation of precise cycling maps of an area, in order to improve maintenance and the availability of parking and to support the development of new applications that support cycling.

The quality classes have been developed to help define the quality of the cycling network; they comprehensively describe the quality of the routes based on a range of properties. Each quality class is divided into three parts: static, dynamic and perceived properties. These three parts can be used to calculate a numerical grade for each section of the route network. Static route properties are permanent, created by means of planning and related measures. Dynamic properties, on the other hand, change over time, for example as materials wear out. Ensuring the quality of these properties requires monitoring and continuous maintenance. Finally, perceived properties consist of any characteristics of the routes or the surrounding environment that affect cyclists' experiences.

In order to ensure the progress of the cycling data model's development, this preliminary survey also includes a proposal for a pilot project for creating a digital description of the cycling network for a limited area. For example, the pilot would consist of the following parallel subsections: defining the content of the first version of the data model and investigating the connection between the OpenStreetMap and the Digiroad database model. Another subsection would involve the piloting of new data generation models and tools.

### General information

Publication status: Published

MoE publication type: D4 Published development or research report or study

Organisations: Department of Information Management and Logistics, Ramboll

Contributors: Laitinen, K., Mattila, K., Metsäpuro, P., Nykänen, L.

Number of pages: 72

Publication date: 2015



### Publication information

Place of publication: Helsinki

Publisher: Liikennevirasto

Volume: 24

Edition: 2015

ISBN (Electronic): 978-952-317-091-9

Original language: Finnish

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: laatuluokka , tietomalli, pyöräily

URLs:

[http://www2.liikennevirasto.fi/julkaisut/pdf8/lts\\_2015-24\\_pyoravaylien\\_tiedot\\_web.pdf](http://www2.liikennevirasto.fi/julkaisut/pdf8/lts_2015-24_pyoravaylien_tiedot_web.pdf)

Research output: Book/Report › Commissioned report › Professional

### WIN-WINTER - Tie- ja katuverkon talvihoidon tutkimusohjelma. Esiselvitys: Raportti tuloksista

#### General information

Publication status: Published

MoE publication type: D4 Published development or research report or study

Organisations: Department of Information Management and Logistics, Tampere University of Technology

Contributors: Karhula, K., Pöllänen, M., Mäntynen, J., Rauhamäki, H., Leppäniemi, M., Luukkonen, T.

Number of pages: 15

Publication date: 2015

#### Publication information

Publisher: Tampereen teknillinen yliopisto. Liikenteen tutkimuskeskus Verne.

Original language: Finnish

ASJC Scopus subject areas: Civil and Structural Engineering, Transportation

Electronic versions:

talvihoito\_esiselvitys\_raportti\_LIITTEET

URLs:

<http://urn.fi/URN:NBN:fi:ty-201603183719>

#### Bibliographical note

AUX=tlo,"Leppäniemi, Marika"

Research output: Book/Report › Commissioned report › Professional

### WIN-WINTER - Nordic winter road maintenance research program. Preliminary study: Project report

#### General information

Publication status: Published

MoE publication type: D4 Published development or research report or study

Organisations: Department of Information Management and Logistics, Tampere University of Technology

Contributors: Karhula, K., Pöllänen, M., Mäntynen, J., Rauhamäki, H., Leppäniemi, M., Luukkonen, T.

Number of pages: 15

Publication date: 2015

#### Publication information

Publisher: Tampere University of Technology

Original language: English

ASJC Scopus subject areas: Civil and Structural Engineering, Transportation

Electronic versions:

wintermaintenance\_prestudy\_report

URLs:

<http://urn.fi/URN:NBN:fi:ty-201603183720>

#### Bibliographical note

Käännös, ei tilastoida erikseen.

Research output: Book/Report › Commissioned report › Professional

### ÄKK Loppuraportti: rakennusten ääniolosuhteiden käyttäjälähtöinen kehittäminen

#### General information

Publication status: Published

MoE publication type: D4 Published development or research report or study  
Organisations: Department of Civil Engineering, Research group: Building Acoustics, Finnish Institute of Occupational Health, Indoor Environment Laboratory  
Contributors: Hongisto, V., Kylliäinen, M.  
Number of pages: 40  
Publication date: 2015

#### **Publication information**

Place of publication: Helsinki  
Publisher: Finnish Institute of Occupational Health  
ISBN (Print): 978-952-261-581-7  
ISBN (Electronic): 978-952-261-580-0  
Original language: English  
ASJC Scopus subject areas: Civil and Structural Engineering, Acoustics and Ultrasonics  
Keywords: acoustics, sound insulation, airborne sound insulation, impact sound insulation, psychoacoustics  
URLs:  
<http://urn.fi/URN:978-952-261-580-0>  
Research output: Book/Report > Commissioned report > Professional

#### **Lähtökohtia tie- ja rataverkon peruspalvelutason määrittämiselle**

##### **General information**

Publication status: Published  
MoE publication type: D4 Published development or research report or study  
Contributors: Mäntynen, J., Pöllänen, M., Eskelinen, H., Lehtola, I., Perrels, A., Johanna, K.  
Number of pages: 134  
Publication date: 1 Dec 2002

##### **Publication information**

Place of publication: Helsinki  
Publisher: Liikenne- ja viestintäministeriö  
ISBN (Print): 951-723-811-8  
Original language: Finnish

##### **Publication series**

Name: Liikenne- ja viestintäministeriön julkaisuja  
No.: 48/2002  
ISSN (Print): 1457-7488  
ASJC Scopus subject areas: Transportation, Civil and Structural Engineering  
URLs:  
<http://urn.fi/URN:ISBN:951-723-811-8>  
Research output: Book/Report > Commissioned report > Professional

#### **Julkisivujen ja parvekkeiden talvikorjaus 2018**

##### **General information**

Publication status: Published  
MoE publication type: D5 Text book, professional manual or guide or a dictionary  
Organisations: Civil Engineering, Research group: Service Life Engineering of Structures  
Contributors: Pakkala, T., Lahdensivu, J., Köliö, A., Annala, P.  
Publication date: 2018

##### **Publication information**

Place of publication: Vaasa  
Publisher: Suomen Betoniyhdistys r.y.  
ISBN (Print): 978-952-68619-8-2  
Original language: Finnish

##### **Publication series**

Name: BY Tekniset ohjeet  
No.: 70  
ISSN (Print): 0358-5239  
ASJC Scopus subject areas: Civil and Structural Engineering, Building and Construction  
Research output: Book/Report > Book > Professional

## **Eriste- ja levyrappaus 2016, by 57**

### **General information**

Publication status: Published  
MoE publication type: D5 Text book, professional manual or guide or a dictionary  
Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures  
Contributors: Lahdensivu, J., Annila, P., Pikkuvirta, J.  
Number of pages: 145  
Publication date: Jun 2016

### **Publication information**

Place of publication: Helsinki  
Publisher: Suomen Betoniyhdistys r.y.  
ISBN (Print): 978-952-68068-8-4  
Original language: Finnish

### **Publication series**

Name: BY. Tekniset ohjeet  
No.: 57  
ISSN (Print): 0358-5239  
ASJC Scopus subject areas: Civil and Structural Engineering  
Research output: Book/Report › Book › Professional

## **Tuulettuvat julkisivut 2016, by 64**

### **General information**

Publication status: Published  
MoE publication type: D5 Text book, professional manual or guide or a dictionary  
Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures  
Contributors: Annila, P., Lahdensivu, J., Lemberg, A., Pikkuvirta, J., Pakkala, T.  
Number of pages: 121  
Publication date: Apr 2016

### **Publication information**

Place of publication: Helsinki  
Publisher: Suomen Betoniyhdistys r.y.  
ISBN (Print): 978-952-68068-5-3  
Original language: Finnish  
ASJC Scopus subject areas: Civil and Structural Engineering  
URLs:

<https://www.rakennustietokauppa.fi/by-64-tuulettuvat-julkisivut-2016/113457/dp>

Research output: Book/Report › Book › Professional

## **Liikennetekniikan perusteet: Opetusmoniste**

### **General information**

Publication status: Published  
MoE publication type: D5 Text book, professional manual or guide or a dictionary  
Contributors: Mäntynen, J., Kallberg, H., Kalenoja, H., Rauhamäki, H., Pöllänen, M. M., Luukkonen, T., Karhula, K.  
Number of pages: 216  
Publication date: 2012

### **Publication information**

Place of publication: Tampere  
Publisher: Tampereen teknillinen yliopisto. Liikenteen tutkimuskeskus Verne.  
ISBN (Print): 978-952-15-2923  
Original language: Finnish  
ASJC Scopus subject areas: Transportation, Civil and Structural Engineering  
Research output: Book/Report › Book › Professional

## **Tuulettuvien yläpohjien lämpö- ja kosteustekninen toiminta nykyisessä ja tulevaisuuden ilmastossa**

### General information

Publication status: Published

MoE publication type: G2 Master's thesis, polytechnic Master's thesis

Organisations: Department of Civil Engineering, Research group: Building Physics

Contributors: Laukkarinen, A.

Number of pages: 107

Publication date: Oct 2015

### Publication information

Publisher: Tampereen teknillinen yliopisto, rakennustekniikan laitos, rakennetekniikka

Original language: Finnish

ASJC Scopus subject areas: Building and Construction, Civil and Structural Engineering

URLs:

<http://URN.fi/URN:NBN:fi:tyy-201509281632> (Permanent address of the item)

Research output: Book/Report › Master's Thesis › Scientific

### The effect of climate change on freeze-thaw durability of concrete structures in Finland

Lahdensivu presented in his Doctoral Thesis (Durability Properties and Actual Deterioration of Finnish Concrete Facades and Balconies, 2012) that without proper air-entrainment outdoor concrete structures have needed average of 307 freeze-thaw cycles (threshold value:  $t \leq -5$  °C) after a rain event in southern Finland and 388 cycles in inland for incipient freeze-thaw damage to occur. The difference between figures can be explained by the greater amount of wind-driven rain (WDR) before the freeze-thaw cycle on coastal areas.

As a consequence of climate change it has been shown that by the end of the century, the amount of WDR is going to increase 30 % at southern Finland and 40 % at inland. At the same time the amount of freeze-thaw cycles after a rain event are decreasing significantly at both locations which indicates freeze-thaw durability-wise longer service life for outdoor concrete structures. However, the latest studies show that while the amount of freeze-thaw cycles is decreasing, the amount of WDR before the cycles is also increasing significantly.

The WDR at winter time in Finland is highly orientated on west to south-east directions which can be seen also by the degradation rate observations of concrete facades and balconies based on condition assessments. In this study, the changes at WDR before the freeze-thaw events and the effect of climate change on them depending on the structure orientation are calculated to estimate the changes of climatic stress level on outdoor concrete structures.

### General information

Publication status: Published

Organisations: Department of Civil Engineering, Research group: Service Life Engineering of Structures, Tampere University of Technology

Contributors: Pakkala, T., Lemberg, A., Lahdensivu, J.

Number of pages: 1

Pages: 53

Publication date: Jun 2016

Peer-reviewed: Unknown

Event: Paper presented at OCEANEXT : Interdisciplinary Conference, .

ASJC Scopus subject areas: Civil and Structural Engineering

Keywords: Freeze/thaw, Concrete, Wind-driven rain, Service life

URLs:

<https://oceanext.sciencesconf.org/?lang=en>

<https://oceanext.sciencesconf.org/93828/document>

### Bibliographical note

INT=rak,"Lemberg, Antti-Matti"

Research output: Other conference contribution › Paper, poster or abstract › Scientific