

# **14th International Conference on Durability of Building Materials and Components (XIV DBMC)**

RILEM Proceedings Pro 107

Ghent, Belgium  
29-31 May 2017

## **Editors:**

**Geert De Schutter  
Arnold Janssens**

**Nele De Belie  
Nathan Van Den Bossche**

ISBN: 978-1-5108-5675-2

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2017) by RILEM Publications  
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact RILEM Publications  
at the address below.

RILEM Publications  
4 avenue du Recteur Poincare  
75016 Paris  
France

Phone: +33 1 42 24 64 46  
Fax: +33 9 70 29 51 20

dg@rilem.net

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: curran@proceedings.com  
Web: www.proceedings.com

## Contents

### PLENARY LECTURES

<b>3D printed concrete - beyond durability?</b>	3
<i>SALET Theo</i>	
<b>Advanced high-resolution X-ray CT as a characterization tool to study building materials</b>	5
<i>CNUUDE Veerle</i>	
<b>Fit for purpose selection of wood materials</b>	7
<i>VAN ACKER Joris, DE WINDT Imke, DEFOIRDT Nele, VANPACHTENBEKE Michiel and VAN DEN BULCKE Jan</i>	
<b>A novel approach towards conservation of the world heritage RC building in Japan</b>	9
<i>IMAMOTO Kei-ichi and KIYOHARA Chizuru</i>	
<b>Influence of mineral binder type on alkali carbonate reaction</b>	11
<i>ŠTUKOVNIK Petra, MARINŠEK Marjan and BOKAN BOSILJKOV Violeta</i>	
<b>Durability of Concrete Prepared with Ternary Binder Systems Involving Limestone and Calcined clay</b>	13
<i>DHANDAPANI Yuvaraja and SANTHANAM Manu</i>	

### THEME A: BUILDING PHYSICS AND DURABILITY

<b>An Approach to Assessing the Long-term Performance of Wall Assemblies – Durability of Low-rise Wood-frame walls</b>	17
<i>LACASSE Michael A. and MORELLI Martin</i>	
<b>Hygrothermal simulation and evaluation of frost risk of masonry walls subjected to inside insulation retrofitting</b>	19
<i>ZHOU Xiaohai, DEROME Dominique and CARMELIET Jan</i>	
<b>An Evaluation on Preventing Delamination of Exterior Tiles</b>	21
<i>FUNAKOSHI Kie and NACHI Hiroshi</i>	
<b>Study of carbonation progress prediction on existing reinforced concrete buildings with variations in surface mortar layer</b>	23
<i>SATO Sachie and MASUDA Yoshihiro</i>	
<b>Influence of height from the ground in the vertical salinity distribution of marine aerosol</b>	25
<i>MEIRA Gibson and PINTO Wladimir</i>	
<b>A new test standard to evaluate the watertightness of window-wall interfaces</b>	27
<i>ARCE RECATALÁ María, GARCÍA MORALES Soledad and VAN DEN BOSSCHE Nathan</i>	

<b>Development of experimental methods to evaluate infiltration of wind-driven rain into external thermal insulation composite systems (ETICS)</b>	29
<i>MOLNÁR Miklós, JÖNSSON Johan and ROSENKVIST Per-Olof</i>	
<b>Experimental and numerical analysis of the hygrothermal behaviour of ventilated cavity wall used for external insulation</b>	31
<i>BENDOUMA Mathieu, COLINART Thibaut and GLOUANNEC Patrick</i>	
<b>Analysis of mould growth models and influence of the hygrothermal properties</b>	33
<i>COLINART Thibaut, BENDOUMA Mathieu and GLOUANNEC Patrick</i>	
<b>Tape as a means to ensure air- and watertightness of building joints – experimental assessment</b>	35
<i>VAN LINDEN Stéphanie, MAROY Katrien, STEEMAN Marijke and VAN DEN BOSSCHE Nathan</i>	
<b>Results of an European FP7 project - Microbial performance of “ECO-innovative, Safe and Energy Efficient materials for a healthier indoor environment”</b>	37
<i>HOFBAUER Wolfgang Karl, KRUEGER Nicole, NAGELE-RENZL Anna and MAYER Florian</i>	
<b>Main stadium structures of summer Olympic Games: efficiency assessment of their physical performances</b>	39
<i>MADANI Nigar, TAVUKÇUOĞLU Ayşe and GÜNEL Mehmet Halis</i>	
<b>Measurement of materials emissivity using an emissometer: Influence of variations in the procedure</b>	41
<i>BARREIRA E., SIMÕES M.L. and PEREIRA A.</i>	
<b>Dynamic Vapour Sorption – A versatile technique for materials characterization</b>	43
<i>SUBRAMANIAN Nachal, NADERI Majid, ACHARYA Manaswini, CATTANEO Damiano and BURNETT Daniel</i>	
<b>Inverse Gas Chromatography as a tool for studying solid surfaces</b>	45
<i>SUBRAMANIAN Nachal, NADERI Majid, KONDOR Anett, ACHARYA Manaswini and BURNETT Daniel</i>	
<b>THEME B: HISTORICAL BUILDINGS AND RENOVATION</b>	
<b>Airflows behind insulated modules attached to façades of old buildings. Combined effects on U-value and drying out of rain water</b>	49
<i>HAGENTOFT Carl-Eric</i>	
<b>The accomplishment of Portuguese Thermal Code exigencies in old housing buildings’ interventions</b>	51
<i>RAMOS Ana and SILVA J. Mendes</i>	

<b>Maintenance of historical buildings - case studies from Belgium and Portugal</b>	53
<i>HUTSEBAUT-BUYSSÉ Véronique, FLORES-COLEN Inês and LOBO DE CARVALHO José Maria</i>	
<b>Evaluation of the hygric properties of a wooden panel painting to perform HAM simulations</b>	55
<i>DE BACKER Lien, VAN DEN BOSSCHE Nathan, JANSSENS Arnold and DE PAEPE Michel</i>	
<b>Parametrical Analysis of Stone Consolidation Actions</b>	57
<i>BRAUN Franziska and ORLOWSKY Jeanette</i>	
<b>Non-destructive investigation of hypogean sites toward conservation and fruition: a case study</b>	59
<i>DE FINO Mariella, SCIOTI Albina, RUBINO Rocco and FATIGUSO Fabio</i>	
<b>Analysis of different frost indexes and their potential to assess frost based on HAM simulations</b>	61
<i>CALLE Klaas and VAN DEN BOSSCHE Nathan</i>	
<b>THEME C: BUILDING PATHOLOGY</b>	
<b>Isopleth ranges for a better understanding of wood decay</b>	65
<i>HOFBAUER Wolfgang Karl, KRUEGER Nicole, RENNEBARTH Thorsten and MAYER Florian</i>	
<b>Recreation of cultural historical values in buildings from before 1945: Inventory with focus on building physics performance</b>	67
<i>JOHANSSON Pär and WAHLGREN Paula</i>	
<b>Detection of chloride-induced corrosion damage at the reinforcement-concrete interface with X-ray computed tomography and acoustic emission</b>	69
<i>VAN STEEN C., ROEDEL H., WEVERS M. and VERSTRYNGE E.</i>	
<b>Evaluation of mould growth in Portuguese dwellings - Sensitivity analysis</b>	71
<i>ALMEIDA Ricardo M.S.F., BARREIRA Eva and BROCHADO João</i>	
<b>Application of FMEA and FTA methods on detection and control of building pathologies</b>	73
<i>SILVA Arthur, VAZQUEZ Elaine, HADDAD Assed, QUALHARINI Eduardo and ALVES Lais</i>	
<b>Constructive Characterization and Conservation State of Facades in the Old City Centre of Viseu</b>	75
<i>SILVA J. Mendes and MOURAZ Catarina P.</i>	
<b>Analyzing the Local Climatic Characteristics as a Deterioration Reason in Buildings</b>	77
<i>GÜZELÇOBAN MAYUK Seher and ÖZTÜRK Selin</i>	

## **THEME D: DIAGNOSIS, REPAIR, AND MAINTENANCE**

<b>Applicability of non/minor destructive test methods for evaluation of material properties of existing timber structures</b> <i>MINAMIKAWA Takaaki, OHTSUKA Akiko , IMAMOTO Kei-ichi and KIYOHARA Chizuru</i>	81
<b>Maintenance of buildings supported by BIM methodology</b> <i>SAMPAIO Zita and SIMOES Diogo</i>	83
<b>Assessment of Nanostructured Inorganic Consolidants Used in Stone Conservation Practice</b> <i>TAVUKÇUOĞLU Ayşe, CANER-SALTIK Emine, GÜNEY Alp, KARAHAN DAĞ Fulya, ÇETİN Özlem, EROL Fatma, MISIR Çağkan Tunç and ATAKLI Yiğit</i>	85
<b>Predictive maintenance for monitoring performance decay of plaster coverings according to the criteria of ISO 15686-7 code</b> <i>NICOLELLA Maurizio, SCOGNAMILLO Claudio and PINO Alessio</i>	87
<b>Dynamic Facility Condition Index calculation for asset management</b> <i>MALTESE Sebastiano, DEJACO Mario Claudio and RE CECCONI Fulvio</i>	89
<b>Reinstallation of Salvaged Historic Terra Cotta</b> <i>GERNS Edward and KARRELS Chelsea</i>	91
<b>Materials analyses guiding for repairs in conservation: An Historical Bath Structure “Yeni Hamam” in Sivrihisar, Turkey</b> <i>MADANI Nigar, EROL Fatma, ÇETİN Özlem, MISIR Çağkan Tunç, TAVUKÇUOĞLU Ayşe, SALTIK Emine Caner and GÜNEY Alp</i>	93
<b>Design of UHPC-AAC light-weight composite façade elements for refurbishment</b> <i>MICCOLI Lorenzo, FONTANA Patrick, KREFT Oliver, PIETRUSZKA Barbara, ŁUKASZEWSKA Agnieszka and KLINGE Andrea</i>	95
<b>Finite difference method based modelling of electrochemical treatment in reinforced concrete structure</b> <i>GAO Yun and JIANG Jinyang</i>	97
<b>An investigation into impressed current cathodic protection systems in an Australian jetty</b> <i>LAW David William and NICHOLLS Peter</i>	99
<b>The study on the estimation of the deterioration of reinforcing bar in reinforced concrete</b> <i>WATANABE Ruiko and MIZOBUCHI Toshiaki</i>	101
<b>Effect of carbonation on sulfate salt weathering of concrete</b> <i>LIU Zanqun, DENG Dehua , XIE Youjun, LONG Guangcheng and YUAN Qiang</i>	103

<b>Assessment of in-situ compressive concrete strength by means of various non/semi-destructive and destructive techniques</b>	105
<i>CRAEYE Bart, LAURIKS Leen, VAN DE LAAR Hannes, VAN DER EIJK Jelle and GIJBELS Wilfried</i>	
<b>Improvement in Compressive Strength of Internally Deteriorated Timber</b>	107
<i>GOROMARU Shuhei, OHTSUKA Akiko, IMAMOTO Kei-ichi and KIYOHARA Chizuru</i>	
<b>Investigation of Concrete Mixtures for the Concrete Cover Repairs of RC Square Columns</b>	109
<i>ORETA Andres Winston, DEL CASTILLO Anna Francesca, TAN Romwell Louis and CORNEJO Sarah Linette</i>	
 <b>THEME E: DURABILITY OF MATERIALS, SYSTEMS AND COMPONENTS</b>	
<b>Improving the quality of various types of recycled aggregates by biodeposition</b>	113
<i>DE BELIE Nele, WANG Jianyun, GARCÍA-GONZÁLEZ Julia, RODRÍGUEZ ROBLES Desirée, VANDEVYVERE Brecht, VANHESSCHE Sam, BOON Nico, SCHOON Joris and JUAN-VALDÉS Andrés</i>	
<b>Microstructure and permeability of glass waste of concrete in the marine environment</b>	115
<i>CHAÏD Rabah, PERROT Arnaud and MERIDA Hacène</i>	
<b>Effect of recycled aggregate on concrete permeability to water</b>	117
<i>CANTERO Blas, SÁEZ DEL BOSQUE Isabel F., MATÍAS Agustín, SÁNCHEZ DE ROJAS María Isabel and MEDINA César</i>	
<b>Durability properties of concrete recycling clay-rich dredging sediments as a novel supplementary cementitious material</b>	119
<i>VAN BUNDEREN Céline, SNELLINGS Ruben, HORCKMANS Liesbeth, DOCKX Joris, VANDEKEYBUS Jos, VAN BALEN Koenraad, VANDEWALLE Lucie and CIZER Özlem</i>	
<b>Effect of Acidic Pumice on Frost Durability of Self-Compacting Concrete</b>	121
<i>YÜCEL Hasan Erhan, ÖZ Hatice Öznur and GÜNEŞ Muhammet</i>	
<b>Value-Added Recycling of Construction Waste Wood into Water Repellent and Fire Resistant Cement-Bonded Particleboards</b>	123
<i>WANG Lei, TSANG Daniel C.W. and POON Chi Sun</i>	
<b>The effect of fine crushed concrete aggregate on the durability of structural concrete</b>	125
<i>DODDS Wayne, GOODIER Chris, AUSTIN Simon, CHRISTODOULOU Christian, DUNNE David and CHAN Matthew</i>	

<b>The properties of mortar and concrete using Gehlenite clinker as fine aggregate</b>	127
<i>KAWATO Takaya, FUJIWARA Hiromi, MARUOKA Masanori, HAYASHI Kensuke, OTSUKA Ryosuke, OGASAWARA Ken, SHIRAYAMA Kosuke and YAMANAKA Yuto</i>	
<b>Design of Ternary Blended Cements to Control ASR</b>	129
<i>SHI Zhenguo and SHI Caijun</i>	
<b>ASR and Mechanical Crack Width in Reinforced Concrete</b>	131
<i>ALAUD Salhin and VAN ZIJL Gideon</i>	
<b>Online Monitoring of the Expansion of Alkali-Silica Reaction Affected Concrete Prisms Implemented to the Accelerated Concrete Prism Test at 60°C</b>	133
<i>WALLAU Wilma, PIRSKAWETZ Stephan, VOLAND Katja, WEISE Frank, MENG Birgit</i>	
<b>Preliminary Investigation on the Effect of Cement Replacement by Residues from the incineration of non-hazardous waste on Strength and Alkali Silica Reaction</b>	135
<i>JOSEPH Aneeta Mary, DOLCE Rosaida, VAN DEN HEEDE Philip, SNELLINGS Ruben, VAN BRECHT Andres, GRÜNEWALD Steffen, MATTHYS Stijn and DE BELIE Nele</i>	
<b>An ASR-preventive strategy for durable concrete in Sweden</b>	137
<i>APPELQUIST Karin, TRÄGÅRDH Jan and MUELLER Urs</i>	
<b>Experimental and numerical investigation of the dependence between the alkali-silica reaction development and the material microstructure</b>	139
<i>GRYMIN Witold, KONIORCZYK Marcin, PESAVENTO Francesco, MARCINIAK Alicja and GAWIN Dariusz</i>	
<b>A series of “double-multi” models for mechanism studies on ionic transport phenomena in cement based materials</b>	141
<i>LIU Qing-feng, LI Long-yuan , XIA Jin and FENG Gan-lin</i>	
<b>Studies on the evolution of alkali silicate in a simulated alkali-silica reaction system</b>	143
<i>ZHENG Kunpeng, ADRIAENSENS Peter, DE SCHUTTER Geert, YE Guang, TAERWE Luc</i>	
<b>Effects of nano-particles on the properties of ultra-high performance cement based composites</b>	145
<i>RONG Zhidan, SUN Wei and JIANG Guang</i>	
<b>Influence of ternary cements containing limestone filler on concrete resistance to carbonation</b>	147
<i>LAUCH Kim-Séang, DIERYCK Vinciane and VANHAMME Géraldine</i>	
<b>Effect of supplementary cementitious materials on capillary sorption: relation with drying rate and testing time</b>	149
<i>ALDERETE Natalia, VILLAGRÁN-ZACCARDI Yury and DE BELIE Nele</i>	



<b>Analysis of chloride transport and binding in limestone-calcined clay binders with various kaolinite content</b>	151
<i>AVET Francois, MARAGHECHI Hamed and SCRIVENER Karen</i>	
<b>Influence of concrete composition on chloride ingress and carbonation: analysis by means of an extended data-set</b>	153
<i>CRAEYE Bart, MINNE Peter, DE WINTER Liesbet, CASPEELE Robby, DE SCHUTTER Geert, DE PAUW Peter and DOOMS Bram</i>	
<b>The Durability of Concrete Produced with Reclaimed Fly Ash</b>	155
<i>THOMAS Michael and MOFFATT Edward</i>	
<b>Performance of Concrete Made with Calcined Clays, Limestone and Portland Cement Under Natural Aggressive Condition</b>	157
<i>MARTIRENA Fernando, RIBALTA Juan, MARAGUESHI Hamed, ROCHA Dayran, ALUJAS Adrian and SCRIVENER Karen</i>	
<b>Ultrafine Fly ash and Ultrafine GGBS for High strength and Durable HPC</b>	159
<i>BANDIVADEKAR Tanuja P. and RATHOD Alok</i>	
<b>Self-desiccation and self-desiccation shrinkage of silica fume-cement pastes</b>	161
<i>LV Yang, YE Guang and DE SCHUTTER Geert</i>	
<b>Effect of curing conditions on microstructure, cracking and durability of SCC</b>	163
<i>BARLUENGA Gonzalo, PUENTES Javier and GUARDIA Cynthia</i>	
<b>Durability of ultra-high performance concrete – Experiences from a real-scale application</b>	165
<i>SPIESZ Przemek and HUNGER Martin</i>	
<b>Performance evaluation of polymer modified cement mortars at elevated temperatures</b>	167
<i>RAJENDRAN Aswathy and GETTU Ravindra</i>	
<b>Effect of additions on binder durability</b>	169
<i>MEDINA César, ASENSIO Eloy, MEDINA Gabriel, MEDINA José María, RIVERA Julián, FRÍAS Moisés and SÁNCHEZ DE ROJAS María Isabel</i>	
<b>Mechanism of pulverized fuel ash and CO<sub>2</sub> curing to improve the water resistance of magnesium oxychloride cement</b>	171
<i>HE Pingping , POON Chi Sun and TSANG Daniel C.W</i>	
<b>Mineralogical Stability of Metakaolin-based Alkali-Activated Cements</b>	173
<i>GEVAUDAN Juan Pablo, CAMPBELL Kate M., KANE Tyler J., SHOEMAKER Richard K. and SRUBAR Wil V. III</i>	
<b>An experimental investigation of hardness and pore structure of low-calcium fly ash cement paste internally alkali activated using roof tile waste aggregate</b>	175
<i>BUI Phuong Trinh, OGAWA Yuko, NAKARAI Kenichiro and KAWAI Kenji</i>	

<b>Use of fired-clay brick waste as supplementary cementitious material and alkali-activated cement: influence on alkali-aggregate reaction</b>	177
<i>GUILLANTE Patricia, KULAKOWSKI P. Marlova and MANCIO Mauricio</i>	
<b>Recent Studies on Durability of Alkali-activated Materials</b>	179
<i>ZHANG Jian, SHI Caijun, LI Ning, JIANG Lei and OU Zhihua</i>	
<b>A study of the passive state stability of steel embedded in alkali activated slag mortars</b>	181
<i>CRIADO Maria, MUNDRA Shishir, BERNAL Susan A., and PROVIS John L.</i>	
<b>Study on corrosion durability with electrochemical tests of GGBS/Portland blends activated by chlorides</b>	183
<i>SALESSES Bernard, PATAPY Cédric, STEGER Laurent, DEBY Fabrice and CYR Martin</i>	
<b>Evaluation of the migration coefficient, diffusion coefficient and the ageing factor according to the chloride ingress model described in the fib bulletin 34 applied to Belgian concrete mixtures</b>	185
<i>DE WINTER Liesbet, MINNE Peter, CASPEELE Robby, CRAEYE Bart, DE SCHUTTER Geert, DE PAUW Peter and DOOMS Bram</i>	
<b>Corrosion Threshold Value of Chloride and Sulphate in Simulated Concrete Pore Solution</b>	187
<i>LIU Guojian, HUANG Ran and ZHANG Yunsheng</i>	
<b>Sodium Chloride ingress into OPC concrete subjected to compressive load</b>	189
<i>EGUEZ ÁLAVA Hugo, DE BELIE Nele and DE SCHUTTER Geert</i>	
<b>Evolution of carbonation rate in concrete under frost attack</b>	191
<i>MARCINIAK Alicja, GRYMIN Witold, MARGIEWICZ Tomasz and KONIORCZYK Marcin</i>	
<b>Natural and accelerate carbonation in concretes with rice husk ash and recycled concrete aggregate: comparison by water absorption and mechanical strength</b>	193
<i>SARTORI Bruno, HENTGES Tatiane, KULAKOWSKI Marlova, KAZMIERCZAK Cláudio and MANCIO Maurício</i>	
<b>Effects of chloride concentration on microstructure of cement pastes by AC impedance spectroscopy</b>	195
<i>HU Xiang, SHI Caijun, YE Guang and DE SCHUTTER Geert</i>	
<b>Influence of the curing period of encapsulated polyurethane precursor on the capillary water absorption of cracked mortar with self-healing properties</b>	197
<i>VAN DEN HEEDE Philip, VAN BELLEGHEM Bjorn, ALDERETE Natalia, VAN TITTELBOOM Kim and DE BELIE Nele</i>	

<b>Use of encapsulated healing agents to limit water uptake through cracks in mortar</b> <i>VAN BELLEGHEM Bjorn, VAN TITTELBOOM Kim and DE BELIE Nele</i>	199
<b>Self-healing of concrete cracks by the release of embedded water repellent agents and corrosion inhibitors to reduce the risk for reinforcement corrosion</b> <i>VAN TITTELBOOM Kim, KESSLER Sylvia, DE MAESSCHALCK Claudia, VAN BELLEGHEM Bjorn, VAN DEN HEEDE Philip and DE BELIE Nele</i>	201
<b>Evaluation of the performance of self-healing concrete at small and large scale under laboratory conditions</b> <i>GRUYAERT Elke, DEBBAUT Brenda, KAASGAARD Martin, ERNDAHL SØRENSEN Henrik, PELTO Jani, BRANCO Vanda, MALM Fabian, GROSSE Christian, PRICE Eric, KRÜGER Markus and DE BELIE Nele</i>	203
<b>Microstructure alteration of PC-GGBS mortars by superabsorbent polymers (SAP)</b> <i>ALMEIDA Fernando C.R. and KLEMM Agnieszka J.</i>	205
<b>Internal curing of cement pastes by superabsorbent polymers studied by means of neutron radiography</b> <i>SNOECK Didier, ALDERETE Natalia, VAN BELLEGHEM Bjorn, VAN DEN HEEDE Philip, VAN TITTELBOOM Kim and DE BELIE Nele</i>	207
<b>Durability of UHPC for Façade Elements with Self-cleaning Surfaces</b> <i>FONTANA Patrick, QVAESCHNING Dirk and HOPPE Johannes</i>	209
<b>A new model approach describing the decisive role of acidophilic bacteria on concrete corrosion in sewers</b> <i>GRENGG Cyrill, MITTERMAYR Florian, KORAIMANN Günther, SZABÓ Máté, DEMENY Attila and DIETZEL Martin</i>	211
<b>Durability of Cementitious Materials in Acidic Environments: Evaluation of Degradation Kinetics</b> <i>RAMASWAMY K. P. and SANTHANAM Manu</i>	213
<b>Understanding the resistance of calcium aluminate cements in sewer environments: role of soluble aluminium on the SOB activity</b> <i>BUVIGNIER Amaury, PEYRE-LAVIGNE Matthieu, PATAPY Cédric, PAUL Etienne and BERTRON Alexandra</i>	215
<b>Application of Multiple Techniques to Quantify Pore Structure of Degraded Cementitious Materials</b> <i>PHUNG Quoc Tri, MAES Norbert and JACQUES Diederik</i>	217
<b>The relative gas permeability: a main indicator of the durability of unsaturated ordinary concrete</b> <i>KAMECHE Zine Abidine, GHOMARI Fouad, CHOINSKA Marta and KHELIDJ Abdelhafid</i>	219

<b>On the quantitative thermogravimetric analysis of calcite content in hydrated cementitious systems</b> <i>VILLAGRÁN-ZACCARDI Yury, EGUEZ ÁLAVA Hugo, DE BUYSSER Klaartje and DE BELIE Nele</i>	221
<b>Leaching of aluminium by blast furnace slag cement linings of drinking water pipes</b> <i>BERTHOMIER Mathilde, BERTRON Alexandra, LORS Christine, MAZARS Vanessa, HOT Julie, CYR Martin, DAMIDOT Denis and DE LARRARD Thomas</i>	223
<b>Probabilistic evaluation of concrete durability subject to accelerated decay by salt crystallization</b> <i>GARAVAGLIA Elsa, TEDESCHI Cristina and PEREGO Sara</i>	225
<b>Cement paste expansion under external sulfate attack</b> <i>MA Xu, ÇOPUROĞLU Oğuzhan, SCHLANGEN Erik, HAN Ningxu and XING Feng</i>	227
<b>The effect of external sulfate attack on concrete, mortar and cement paste</b> <i>TEDESCHI Cristina, CEFIS Nicola and COMI Claudia</i>	229
<b>Investigation of the deterioration of blended cement concrete under sulfate attack in terms of interfacial transition zone</b> <i>WU Kai, SHI Huisheng, GAO Yun, YE Guang and DE SCHUTTER Geert</i>	231
<b>Accelerated ageing of textile reinforced concrete (TRC)</b> <i>MALAGA Katarina, WILLIAMS PORTAL Natalie and OUTRAS Ilias</i>	233
<b>Impact of drying and carbonation on microstructure and dimensional changes for supplementary cementitious materials (SCMs)</b> <i>BERTIN Matthieu, OMIKRINE METALSSI Othman, BAROGHEL BOUNY Véronique and OURO KOURA Baba Issa</i>	235
<b>Fracture Properties of Concrete Subjected to Heating up to 60°C</b> <i>MATSUZAWA Koichi and KITSUTAKA Yoshinori</i>	237
<b>Influence of geometry on the fracturing behavior of textile reinforced calcium phosphate cement using acoustic emission</b> <i>BLOM Johan and AGGELIS Dimitrios</i>	239
<b>Experimental Research of Formwork Pressure by Pumping Concrete for an Underground Diaphragm Wall Bottom Up</b> <i>JIANG Wei, LIU Xian and YUAN Yong</i>	241
<b>Acoustic Emission Monitoring of Fresh Cementitious Material</b> <i>DZAYE Evin Dildar, DE SCHUTTER Geert and AGGELIS Dimitrios</i>	243
<b>Estimation of concrete's quality based on innovative early age ultrasonic measurements</b> <i>ILIOPOULOS N. Sokratis and AGGELIS G. Dimitrios</i>	245
<b>Consequences of an adjusted slip layer thickness for the hardened properties of UHPC</b> <i>VAN DER PUTTEN Jolien, LESAGE Karel and DE SCHUTTER Geert</i>	247

<b>Robustness as a tool to improve the durability of self-compacting concrete</b>	249
<i>VAN DER VURST Farid, LESAGE Karel, VANTOMME John, VANDEWALLE Lucie and DE SCHUTTER Geert</i>	
<b>Casting concrete structures in a smarter way</b>	251
<i>DE SCHUTTER Geert, LESAGE Karel, EL CHEIKH Khadija, DE SCHRYVER Robin, MUHAMMAD Metwally and CHIBULU Chizya</i>	
<b>Numerical approach for thixotropic behaviour of concrete – current status</b>	253
<i>DE SCHRYVER Robin, LESAGE Karel, EL CHEIKH Khadija and DE SCHUTTER Geert</i>	
<b>Adjusting concrete rheology through mix design – short overview</b>	255
<i>EL CHEIKH Khadija, LESAGE Karel and DE SCHUTTER Geert</i>	
<b>Interactions between Cement and Combined Concrete Admixtures</b>	257
<i>LESAGE Karel, VANDEWALLE Lucie and DE SCHUTTER Geert</i>	
<b>Distinct protocols to measure dynamic and static yield stress of fresh cement mortars</b>	259
<i>QIAN Ye and KAWASHIMA Shiho</i>	
<b>Assessing Mortar Extrudability through the Jolting Test</b>	261
<i>LESAGE Karel, INGELBRECHT Thomas and DE SCHUTTER Geert</i>	
<b>3D Printing of cementitious materials</b>	263
<i>EL CHEIKH Khadija, LESAGE Karel, VAN DER PUTTEN Jolien, VAN TITTELBOOM Kim and DE SCHUTTER Geert</i>	
<b>Evaluation of Ceramic Tiles on Façades – Case Study</b>	265
<i>FREITAS Vasco Peixoto de, FERREIRA Cláudia, FREITAS Sara S. de and SILVA Luís Pedro</i>	
<b>Determination of wear and material properties of surface protection systems for car parks</b>	267
<i>LADNER Eva-Maria and BREIT Wolfgang</i>	
<b>The assessment over time of the performance of jute-basalt hybrid composites for cladding panels</b>	269
<i>ENEA Daniele, ALAIMO Giuseppe, FIORE Vincenzo, SCALICI Tommaso, BADAGLIACCO Dionisio and VALENZA Antonino</i>	
<b>Puncture and Impact Resistance of Single-Ply Roofing Membranes</b>	271
<i>TAYLOR Thomas J., BHAWALKAR Sarang and YANG Tammy</i>	
<b>Evolution of leached depth of cement asphalt mortar with time in ammonia nitrate solution</b>	273
<i>WANG Yong, YUAN Qiang, DENG Dehua, XIE Youjun and FANG Lei</i>	
<b>Understanding Accelerated UV, Field, and Thermal Aging of Thermoplastic Roofing Membranes</b>	275
<i>XING Linlin and PIERCE Helene Hardy</i>	

<b>Durability of waterborne liquid applied roof waterproof coatings</b> <i>VYÖRYKKÄ Jouko, SZEWCZYK Janah, IMBESI Philip and MIOTTO Cristina</i>	277
<b>A review of recent advances on durability of FRP-strengthened masonry</b> <i>GHIASSI Bahman, MALJAEI Hamid, OLIVEIRA Daniel V. and LOURENÇO Paulo B.</i>	279
<b>Frost resistance of clay masonry units: experimental parametric study of CEN/TS 772-22 and proposal for its optimization</b> <i>SMITS Arwen, MERTENS Stijn and GREGOIRE Yves</i>	281
<b>Preliminary investigation of the durability of structural adhesives using FTIR spectroscopy and chemometrics</b> <i>NICHOLSON Catherine L., SHAW Patricia and MARSTON Nick</i>	283
<b>Artificial aging of air-and-vapour barriers</b> <i>MØLLER Eva B. and HANSEN Thor</i>	285
<b>Durability and resistance to degradation of hemp fibres-based insulating envelopes</b> <i>DONATELLI Antonio, CUNA Daniela, TAGLIENTE Maria Antonia, PROTOPAPA Maria Lucia, MEVOLI Anna, AVERSA Patrizia, BLASI Caterina, CAPODIECI Laura and LUPRANO Vincenza Anna Maria</i>	287
<b>Effect of moisture on delamination of glued laminated timber</b> <i>MATSUMOTO Yumi and NOGUCHI Takafumi</i>	289
<b>Improvement effect on mechanical properties of cementitious-woodship compound board introducing stimulating agent of seawater in disaster situation</b> <i>TAMURA Masaki and SAYAMA Shunsuke</i>	291

## **THEME F: SERVICE LIFE ANALYSIS AND PREDICTION METHODOLOGIES**

<b>Design and service life prediction concept for timber structures - Part 1: A factorization approach based on dose-response models</b> <i>BRISCHKE Christian, MEYER-VELTRUP Linda, FRÜHWALD HANSSON Eva, NIKLEWSKI Jonas, THELANDERSSON Sven and ISAKSSON Tord</i>	295
<b>Design and service life prediction concept for timber structures - Part 2: Climate effects</b> <i>BRISCHKE Christian, NIKLEWSKI Jonas, FRÜHWALD HANSSON Eva and KAVURMACI Denis</i>	297
<b>Continuous moisture measurements of exterior wood to simulate time of wetness</b> <i>VAN ACKER Joris, VAN DEN BULCKE Jan, DE WINDT Imke and DE BOEVER Lieven</i>	299

<b>Factor method for aluminium windows and curtain walls</b> <i>RE CECCONI Fulvio, RIGONE Paolo and VATAVALIS Pavlos</i>	301
<b>The Use of a Novel Prediction Methodology to Quantitatively Assess the Service Life of 55% Al-Zn Alloy-Coated Steel, Low-Slope Standing Seam Roof Systems</b> <i>DUTTON Ron and HADDOCK Rob</i>	303
<b>Durability of thermal renders: material properties and system performance</b> <i>MAIA J., RAMOS N. M. M. and VEIGA R.</i>	305
<b>Durability assessment of mineral wool insulation: what are the thermal properties after 20 years?</b> <i>LANGMANS Jelle and ROELS Staf</i>	307
<b>Multi-scale modeling strategies to improve durability models for service life predictions of concrete structures</b> <i>PATEL Ravi A., PERKO Janez and JACQUES Diederik</i>	309
<b>Effect of Curing Temperatures on the Formation Factor of Capillary Pore Structure in Cement Paste</b> <i>NAITO Daisuke and IGARASHI Shin-ichi</i>	311
<b>Innovation in Air-Permeability NDT: Concept and Performance</b> <i>TORRENT Roberto and SZYCHOWSKI Julio</i>	313
<b>Autogenous mineral textures in micropores and microcracks, Roman architectural concrete, Markets of Trajan, Rome</b> <i>JACKSON Marie, ZHANG Yi, CHEN Heng and MOON Juhyuk</i>	315
<b>Interaction between microorganisms and cementitious materials in sewer pipe conditions</b> <i>GRANDCLERC Anaïs, GUEGUEN-MINERBE Marielle, NOUR Issam, CHAUSSADENT Thierry and DANGLA Patrick</i>	317
<b>Benchmarking of different methodologies for service life prediction of ceramic claddings</b> <i>SILVA Ana, GASPAR Pedro L. and DE BRITO Jorge</i>	319
<b>A fuzzy expert system in buildings serviceability</b> <i>PRIETO A. J., MACÍAS-BERNAL J. M., ALEJANDRE F. J. and SILVA A.</i>	321
<b>The application of survival analysis for service life prediction of building materials: a proof of concept</b> <i>BUYLE Matthias, BRAET Johan and AUDENAERT Amaryllis</i>	323
<b>BRAIN: Building Research Analysis and Information Network</b> <i>SERRAT Carles, GIBERT Vicenç, CASAS Joan Ramon and RAPINSKI Jacek</i>	325
<b>Air- and water tightness of prefabricated envelope modules for the renovation of buildings</b> <i>MAROY Katrien, VAN LINDEN Stéphanie, DE VOGELAERE Koen, VAN DEN BOSSCHE Nathan and STEEMAN Marijke</i>	327
<b>Surface consolidation of natural stones by use of bio-agents and</b>	329

**chemical consolidate**

*WANG Jianyun, FRAEYE Domien, ERSAN Yusuf Cagatay, DE MUYNCK Willem, BOON Nico and DE BELIE Nele*

**Effect of hybrid fiber reinforcement on corrosion induced degradation of reinforced concrete columns** 331

*DUNCAN Jacob F., NGUYEN Wilson and OSTERTAG Claudia P.*

**Durability of PTFE-coated glass fibre fabric for architectural membrane structures** 333

*TOYODA Hiroshi, ABE Kazuhiro and MOTOHASHI Kenji*

**Yantra: A lattice Boltzmann method based simulation tool for modelling physico-chemical processes in concrete at different spatial scales** 335

*PATEL Ravi A., PERKO Janez and JACQUES Diederik*

**Construction technologies and systems of shelters and temporary houses for improving the living environment for people with pets in disaster situations** 337

*KANEMAKI Tomoko and TAMURA Masaki*

**THEME G: DURABILITY, LCA AND SUSTAINABLE CONSTRUCTION**

**Physical and Mechanical Properties of Recycled Concrete Aggregate Exposed to Natural and Accelerated Carbonation** 341

*HABERT Guillaume, MARINKOVIĆ Snežana, BRUMAUD Coralie, IGNJATOVIĆ Ivan, DRAGAŠ Jelena and TOŠIĆ Nikola*

**Quantifying the Carbon Sequestration Potential of Exposed Reinforced Concrete** 343

*SOUTO-MARTINEZ Adriana and SRUBAR Wil V. III*

**Life cycle assessment of façade solutions made of durable reactive powder concrete** 345

*AL-AYISH Nadia, MUELLER Urs, MALAGA Katarina and GUDMUNDSSON Kjartan*

**Life cycle assessment of reinforced concrete units** 347

*IANNICELLI ZUBIANI Elena Maria, GIANI Martina Irene, GALLO STAMPINO Paola, DOTELLI Giovanni and NANNI Antonio*

**Vascular self-healing of a reinforced concrete beam under 4-point bending** 349

*MINNEBO Pieter, VAN TITTELBOOM Kim, DE BELIE Nele and VAN HEMELRIJCK Danny*

**Effects of cellulose fibers on durability of concrete subjected to freezing-thawing and drying-immersion attack** 351

*WANG Dezhi, MENG Yunfang and ZHOU Xiangming*



<b>SEACON Project: sustainable concrete using seawater, salt-contaminated aggregates, and non-corrosive reinforcement</b>	353
<i>BERTOLA Federica, GASTALDI Daniela, CANONICO Fulvio and NANNI Antonio</i>	
<b>Freeze-thaw durability of recycled concrete from construction and demolition wastes</b>	355
<i>JUAN-VALDÉS Andrés, RODRÍGUEZ-ROBLES Desirée, GARCÍA-GONZÁLEZ Julia, MORÁN-DEL POZO Julia M., GUERRA-ROMERO M. Ignacio and DE BELIE Nele</i>	
<b>Performance studies of self-compacting concrete by using nano-silica along with superabsorbent polymer</b>	357
<i>KHAN Asis Kumar and GOEL Rajeew Kumar</i>	
<b>Use of Copper slag with magnetized water in Concrete for Sustainable Development</b>	359
<i>WANJARI Swapnil and PATEL Brijhban</i>	
<b>Use of electric arc furnace slag for the production of durable sustainable concretes</b>	361
<i>SIDERIS K.K., CHATZOPOULOS A. and TASSOS Ch.</i>	
<b>Mechanical and durability study of kerbs and paving blocks made with recycled concrete</b>	363
<i>JUAN-VALDÉS Andrés, GUERRA-ROMERO M. Ignacio, RODRÍGUEZ-ROBLES Desirée, GARCÍA-GONZÁLEZ Julia and MORÁN-DEL POZO Julia M.</i>	
<b>The influence of estimated service life on the embodied emissions of zero emission buildings (ZEBs) when choosing low-carbon building products</b>	365
<i>FUFA Selamawit Mamo, KJENDSETH WIIK Marianne, DAHL SCHLANBUSCH Reidun and ANDRESEN Inger</i>	
<b>Parametric LCA of a ventilated timber wall construction in tall timber buildings</b>	367
<i>FUFA Selamawit Mamo, SKAAR Christofer, GRADECI Klodian, LABONNOTE Nathalie, TIME Berit and KÖHLER Jochen</i>	
<b>Effect of dimensions on embodied environmental impact of buildings</b>	369
<i>HOXHA Endrit, CHEVALIER Jacques, LE ROY Robert and HABERT Guillaume</i>	
<b>Influence of life span prediction on building component's LCA performance</b>	371
<i>SIE Marion, SUSCA Tiziana, WILLIAMS PORTAL Natalie, DURING Otto, FONTANA Patrick, SJOSTROM Christer and PAYET Jérôme</i>	
<b>Roof Replacement Roof Edge Design Details on Commercial Roofs for the New Requirements of Energy Codes</b>	373
<i>HUTCHINSON Thomas W.</i>	
<b>Lightweight Bathrooms with Increased Durability</b>	375
<i>MORELLI Martin and BRANDT Erik</i>	

<b>End-of-life consideration for hybrid material systems</b>	377
<i>AGUSTÍ-JUAN Isolda, ZINGG Sharon and HABERT Guillaume</i>	
<b>Evaluation of Carbon Emission for Quantification of Environmental Load on Structural wood products in Korea</b>	379
<i>CHANG Yoon-Seong, KIM Sejong and SHIM Kug-Bo</i>	
<b>Durability Research Needs for a Low-Carbon Cement-based Materials Industry</b>	381
<i>QUATTRONE Marco and JOHN Vanderley M.</i>	

### **SPECIAL SESSION: CONCRETE WITH LOW CLINKER CEMENTS**

<b>Formulation, use and durability of concrete with low clinker cements</b>	385
<i>PALACIOS Marta, SOJA Wioletta, STEFANONI Matteo, MARAGHECHI Hamed, ZINGG Sharon, SCRIVENER Karen, ELSENER Bernhard, HABERT Guillaume and FLATT Robert J.</i>	
<b>Influence of comb-type superplasticizers on the properties of low clinker cementitious materials</b>	387
<i>PALACIOS Marta, NASKAR Nilanjon, BOSCARO Federica and FLATT Robert J.</i>	
<b>Evolution of microstructure and phase assemblage in blended cement pastes exposed to natural carbonation</b>	389
<i>SOJA Wioletta, MARAGHECHI Hamed, DURDZIŃSKI Paweł and SCRIVENER Karen</i>	
<b>Corrosion Rates in Carbonated Low Clinker Cements: Are the New Binders Really Sustainable?</b>	391
<i>STEFANONI Matteo, ANGST Ueli and ELSENER Bernhard</i>	
<b>Environmental assessment of radical innovation in concrete structures</b>	393
<i>ZINGG S., PITTAU F., LÄMMLEIN T., HAJIESMAEILI A., LURA P., DENARIE E. and HABERT G.</i>	

### **SPECIAL SESSION: CULTURAL HERITAGE**

<b>Comparison of transparent coatings and water-repellents for the protection of historic buildings made of concrete</b>	397
<i>CAILLEUX Emmanuel</i>	
<b>Water-repellents as alternative carbonation-induced corrosion treatments for reinforced concrete cultural heritage</b>	399
<i>MARIE-VICTOIRE Elisabeth, BOUICHOU Myriam and JOURDAN Héloïse</i>	
<b>Surface Inhibitors for the Non-Invasive treatment of Corroded Structures</b>	401
<i>ANDRADE Carmena, REBOLLEDO Nuriab and MORALES J.A.</i>	

XIV DBMC – 14<sup>th</sup> International Conference on Durability of Building Materials and  
Components, 29-31 May 2017, Ghent University, Belgium

<b>Influence of hydrophobic treatments applications on the concrete carbonation delay</b> <i>COURARD Luc and LUCQUIAUD Vincent</i>	403
<b>KEYWORDS</b>	405
<b>AUTHOR INDEX</b>	421