

6th Conference on Performance-based Fire and Fire Protection Engineering (PROTECT 2017)

**Performance of Materials and Structures
Under Extreme Conditions**

Procedia Engineering Volume 210

Guangzhou, China
11 – 12 December 2017

Editors:

**Bo Wu
Venkatesh Kumar Kodur**

**Hai Yan Zhang
Nemkumar Banthia**

ISBN: 978-1-5108-5598-4

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© by Elsevier B.V.
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact Elsevier B.V.
at the address below.

Elsevier B.V.
Radarweg 29
Amsterdam 1043 NX
The Netherlands

Phone: +31 20 485 3911
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

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

TABLE OF CONTENTS

PREFACE	1
<i>Bo Wu, Venkatesh Kumar Kodur, Hai Yan Zhang, Nemkumar Banthia</i>	
<u>CONSTRUCTION MATERIALS-PROPERTIES AND PERFORMANCE</u>	
USING MODIFIED CORE DRILLING METHOD TO ESTIMATE THE DAMAGE OF FIRE EXPOSED CONCRETE	3
<i>Likang Tian, Xingyan Shang, Jiangtao Yu</i>	
INVESTIGATION INTO PURE RATE EFFECT ON DYNAMIC INCREASE FACTOR FOR CONCRETE COMPRESSIVE STRENGTH	11
<i>Sangho Lee, Kyoung-Min Kim, Jae-Yeol Cho</i>	
AXIAL COMPRESSION PERFORMANCE OF STEEL/BAMBOO COMPOSITE COLUMN	18
<i>Weifeng Zhao, Zhuosheng Chen, Bin Yang</i>	
CONCRETE UNDER BIAXIAL DYNAMIC COMPRESSIVE LOADING	24
<i>Matthias Quast, Manfred Curbach</i>	
ON THE EQUATION OF STATE OF CEMENTITIOUS COMPOSITES - AN EXPERIMENTAL STUDY	32
<i>Yuri S. Karinski, David Z. Yankelevsky, Semion Zhutovsky, Vladimir R. Feldgun</i>	
FINITE ELEMENT PARAMETRIC STUDY ON THE EFFECT OF LOADING RATE ON THE BOND OF REINFORCEMENT IN CONCRETE	39
<i>Evmorfia Panteki, Petr Máca, Ulrich Häussler-Combe</i>	
EXPERIMENTAL STUDY OF GEOPOLYMER USED AS ADHESIVE IN ANCHORAGE OF STEEL BARS	45
<i>Jiang-Xia Quan, Hai-Yan Zhang, Le-Yuan Zhou, Yue Zhou, Jia-Wen Su</i>	
SHEAR STRENGTH OF ENGINEERED CEMENTITIOUS COMPOSITES UNDER PUSH-OFF LOADS	53
<i>Pei-Zhi Zhao, Shao-Bo Kang, Bo Yang</i>	
EXPERIMENTAL STUDY ON DURABILITY OF FRP SHEETS UNDER WET-DRY CYCLES IN VARIOUS SOLUTIONS	61
<i>Fen-Tao Liu, Guo-Hui He, Jun-Hua Xiong</i>	
INVESTIGATION FOR PLASTIC DAMAGE CONSTITUTIVE MODELS OF THE CONCRETE MATERIAL	71
<i>Wei Demin, He Fukang</i>	
INVESTIGATION ON CORROSION OF WELDED JOINT OF PRESTRESSED HIGH-STRENGTH CONCRETE PIPE PILES	79
<i>Wei Demin, Wang Peng</i>	
EFFECT OF PARTICLE SHAPE OF LIMESTONE MANUFACTURED SAND AND NATURAL SAND ON CONCRETE	87
<i>Huang Yamei, Wang Lihua</i>	
EFFECT OF HIGH STRAIN-RATES ON THE TENSILE CONSTITUTIVE RESPONSE OF ECOFRIENDLY DUCTILE CEMENTITIOUS COMPOSITE (EDCC)	93
<i>Salman Soleimani-Dashtaki, Saghar Soleimani, Qiannan Wang, Nemkumar Banthia, Carlos E. Ventura</i>	
SHEAR STRENGTH OF RECYCLED AGGREGATES CONCRETE	105
<i>Khaldoun Rahal</i>	
A REVIEW OF EXPERIMENTAL RESULTS OF STEEL REINFORCED RECYCLED AGGREGATE CONCRETE MEMBERS AND STRUCTURES IN CHINA (2010-2016)	109
<i>Jinjun Xu, Zongping Chen, Jianyang Xue, Yuliang Chen, Zuqiang Liu</i>	
TEST STUDY ON HYDRATION TEMPERATURE OF COMPOUND CONCRETE MADE OF DEMOLISHED CONCRETE LUMPS AND FRESH CONCRETE	120
<i>Bo Wu, Daozhong Wu</i>	
RESISTANCE OF GEOPOLYMER MORTAR TO ACID AND CHLORIDE ATTACKS	126
<i>Huang Ji Zhuang, Hai Yan Zhang, Hao Xu</i>	

STRUCTURAL PERFORMANCE-GENERAL

PERFORMANCE OF REINFORCED CONCRETE BEAMS RETROFITTED BY A DIRECT-SHEAR ANCHORAGE RETROFITTING SYSTEM	132
<i>Hu Ying, Pang Huawei, Quan Xueyou, Pang Jun, L.L. Xiancun, P. Qiyun, Liu Bao</i>	
THE STRENGTHENING EFFECT OF CFRP FOR REINFORCED CONCRETE BEAM	141
<i>Myeongjung Kim, Ashesh Pokhrel, Daegyun Jung, Seungwon Kim, Cheolwoo Park</i>	
ON THE EFFECTIVENESS OF BLAST MITIGATION WITH LIGHTWEIGHT CLADDINGS.....	148
<i>Hongyuan Zhou, Xiaojuan Wang, Guowei Ma, Zhongxian Liu</i>	
SEISMIC STRENGTHENING OF UNREINFORCED MASONRY WALLS USING SPRAYABLE ECO-FRIENDLY DUCTILE CEMENTITIOUS COMPOSITE (EDCC)	154
<i>Salman Soleimani-Dashtaki, Carlos E. Ventura, Nemkumar Banthia</i>	
ANALYSIS OF LOAD CHARACTERISTICS AND RESPONSES OF LOW-RISE BUILDING UNDER TORNADO.....	165
<i>Feng Xu, Jie Ma, Wen-Li Chen, Yi-Qing Xiao, Zhong-Dong Duan</i>	
CFRP STRENGTHENED RC BEAMS SUBJECTED TO IMPACT LOADING.....	173
<i>Kazunori Fujikake, Sam Soeum, Takahiro Matsui</i>	
MINERAL-BONDED COMPOSITES FOR ENHANCED STRUCTURAL IMPACT SAFETY – A NEW RESEARCH TRAINING GROUP GRK 2250 OF THE GERMAN RESEARCH SOCIETY.....	182
<i>Viktor Mechtcherine, Iurie Curosu</i>	
SHEAR STRENGTHENING OF FIRE-DAMAGED REINFORCED CONCRETE BEAMS USING BOLTED-SIDE PLATING.....	186
<i>Ling-Zhi Li, Chang-Jiu Jiang, Bo-Zhou Liu, Zhou-Dao Lu</i>	
BEHAVIOR OF SLENDER SQUARE STEEL TUBULAR COLUMNS FILLED WITH FRESH CONCRETE AND DEMOLISHED CONCRETE LUMPS.....	196
<i>Bo Wu, Wei-Feng Li, Xin-Yu Zhao</i>	
AXIAL COMPRESSION BEHAVIOR OF REINFORCED GEOPOLYMER CONCRETE COLUMNS WITH DEMOLISHED CONCRETE LUMPS	203
<i>Zhi-Jian Zhang, Hai-Yan Zhang, Jun-Hong Zheng, Kai-Hang Lin, Yi Su</i>	
MODELING THE RESPONSE OF ULTRA HIGH PERFORMANCE FIBER REINFORCED CONCRETE BEAMS	211
<i>R. Solhimirzaei, V. K. R. Kodur</i>	
NUMERICAL INVESTIGATION ON LATERAL TORSIONAL BUCKLING OF WELDED Q460 STEEL BEAMS	220
<i>Liuchen Meng, Lan Kang</i>	
A STUDY ON EFFECTIVE LENGTH OF SLENDER COLUMN WITH ELASTIC RESTRAINTS	228
<i>Hongwei Ma, Liang Ye, Lang Lin</i>	
THE TEMPERATURE CONTROL TECHNOLOGY OF BRIDGE FOUNDATION IN PERMAFROST REGIONS	235
<i>Zhao Xiu-Yun, Wang Jian, Wang Yu-Zhuo</i>	
NUMERICAL SIMULATION METHOD OF THERMAL ANALYSIS FOR BRIDGES WITHOUT USING FIELD MEASUREMENTS	240
<i>Linren Zhou, Chunfang Liang, Lan Chen, Yong Xia</i>	
NUMERICAL SIMULATION OF TEMPERATURE INDUCED STRUCTURAL STATIC RESPONSES FOR LONG-SPAN SUSPENSION BRIDGE.....	246
<i>Lan Chen, Jingliang Deng, Linren Zhou, Yong Xia</i>	
PAVEMENT MAINTENANCE OPTIMIZATION STRATEGIES FOR NATIONAL ROAD NETWORK IN INDONESIA APPLYING GENETIC ALGORITHM.....	253
<i>Hamdi, Sigit P. Hadiwardoyo, A. Gomes Correia, Paulo Pereira</i>	

STRUCTURAL PERFORMANCE-EARTHQUAKE, IMPACT AND BLAST

TESTING AND ANALYSIS OF COMPOSITE FLOOR SYSTEMS UNDER PERIPHERAL COLUMN REMOVAL SCENARIOS	261
<i>Hui-Yuan Liu, Bo Yang, Shao-Bo Kang</i>	
NONLINEAR DYNAMIC ANALYSIS OF FRAME ELEMENTS SUBJECTED TO BLAST EXPLOSIONS	269
<i>Serhan Guner</i>	
EXPERIMENTAL STUDY OF STIFFENING RINGS REINFORCED TUBULAR T-JOINT WITH PRECOMPRESSION CHORD.....	278
<i>Xing Su, Kang Gao, Hui Qu</i>	

SEISMIC PERFORMANCE OF Q690 HIGH STRENGTH STEEL WELDED H-SECTION COLUMNS.....	286
<i>Yuqi Wang, Lan Kang</i>	
EXPERIMENTAL RESEARCH ON T-SHAPED BEAM-COLUMN JOINTS AT TOP FLOOR WITH MECHANICALLY ANCHORED REINFORCEMENT.....	297
<i>Yuebing Li, Yasushi Sanada, Satoru Ichikawa, Bah Alpha Oumar Bagou</i>	
EFFECTS OF FRAGMENTS IMPACT ON REINFORCED CONCRETE PROTECTIVE ELEMENTS.....	306
<i>Hezi Y. Grisaro, David Benamou, Avraham N. Dancygier</i>	
SIMULATION OF A HOT-ROLLED H-SECTION STEEL BEAM SUBJECT TO STATIC LOADING BASED ON DISCRETE ELEMENT METHOD.....	312
<i>Li-Qiang Zhou, Bo Yang</i>	
COMPARISON OF RESPONSE OF BUILDING STRUCTURES TO BLAST LOADING AND SEISMIC EXCITATIONS.....	320
<i>Dan (Danesh) Nourzadeh, Jagmohan Humar, Abass Braimah</i>	
BEHAVIOUR OF UNDERCUT ANCHORS SUBJECTED TO HIGH STRAIN RATE LOADING.....	326
<i>Lenda T. Ahmed, Abass Braimah</i>	
NUMERICAL STUDY ON DYNAMIC RESPONSE OF REINFORCED CONCRETE COLUMNS UNDER LOW-SPEED HORIZONTAL IMPACT LOADING.....	334
<i>Jian Cai, Jiabin Ye, Yongqi Wang, Qingjun Chen</i>	
A NUMERICAL STUDY ON THE IMPACT RESISTANT CAPACITY OF RC BEAMS WITH CORRODED REINFORCEMENT.....	341
<i>Chi Lu, Hiroki Tamai, Yoshimi Sonoda</i>	
THEORETICAL RATIONALITY ANALYSIS OF THE FORCE EQUATION DUE TO AIRCRAFT STRIKE.....	349
<i>Xinyi Zhao, Zhebiao Yang</i>	
INVESTIGATION OF BEHAVIOR OF RC BEAMS SUBJECTED TO IMPACT LOADING CONSIDERING COMBINATION OF MASS AND IMPACT VELOCITY.....	353
<i>Yong Jae Yu, Chyng-Hyeon Kim, Jae-Yeol Cho</i>	
MULTIFACTOR INFLUENCE ANALYSIS OF SEISMIC PERFORMANCE OF RC FRAME STRUCTURE WITH CAST-IN-SITE SLABS.....	360
<i>Wang-Xi Zhang, Bao Chen, Long-Jie Xiao, Jia-Jia Shi, Yong-Tao Wei</i>	
PRELIMINARY STUDY ON MULTILAYER BULLETPROOF CONCRETE PANEL: IMPACT ENERGY ABSORPTION AND FAILURE PATTERN OF FIBRE REINFORCED CONCRETE, PARA-RUBBER AND STYROFOAM SHEETS.....	369
<i>Buchit Maho, Sittisak Jamnam, Piti Sukontasukkul, Kazunori Fujikake, Nemkumar Banthia</i>	
EXPERIMENTAL TESTING AND NUMERICAL MODELING OF STEEL FRAMES UNDER CLOSE-IN DETONATIONS.....	377
<i>Florea Dinu, Ioan Marginean, Dan Dubina, Attila Kovacs, Emilian Ghiciei</i>	
BLAST PRESSURE LEAKAGE INTO BUILDINGS AND EFFECTS ON HUMANS.....	386
<i>Ashok Malhotra, Dan Carson, Scott McFadden</i>	
DAMAGE MONITORING OF THE RC FRAME SHAKING TABLE TEST AND COMPARISON WITH FEM RESULTS.....	393
<i>Shuang Hou, Haibin Zhang, Xin Han, Jinping Ou</i>	
PERFORMANCE OF SIFCON BASED HPFRCC UNDER FIELD BLAST LOAD.....	401
<i>Haekook Jung, Sangin Park, Seungwon Kim, Chelwoo Park</i>	
DIAGONAL STRUT MECHANISM OF URM WALL INFILLED RC FRAME FOR MULTI BAYS.....	409
<i>Ho Choi, Yasushi Sanada, Yoshiaki Nakano</i>	
SEISMIC RESPONSE ANALYSIS OF K8 PATTERN SINGLE-LAYER RETICULATED DOMES UNDER VERTICAL RARE EARTHQUAKES.....	417
<i>De-Min Wei, Sheng-Fu Gao</i>	
SIMULATION OF SEVERE ACCIDENT SCENARIOS IN NUCLEAR CONTAINMENTS.....	425
<i>Jan Cervenka, Zdenek Janda, Libor Jendele, Radomir Pukl, Vladimir Cervenka</i>	
A-Z OF SEISMIC FAILURES.....	433
<i>Luis Gonzalo Mejía</i>	
TESTS STUDY OF A 1:20 SCALE STEEL-CONCRETE HYBRID STRUCTURE.....	441
<i>Di Wu, Yan Xiong</i>	

STRUCTURAL PERFORMANCE-FIRE

BEHAVIOR OF PRESTRESSED CONCRETE BOX BRIDGE GIRDERS UNDER HYDROCARBON FIRE CONDITION	449
<i>Gang Zhang, Venkatesh Kodur, Jincheng Xie, Shuanhai He, Wei Hou</i>	
EXPERIMENTAL RESEARCH ON THE POST-FIRE SEISMIC PERFORMANCE OF STEEL REINFORCED CONCRETE COLUMNS.....	456
<i>Wang Guangyong, Zhang Dongming</i>	
A PARAMETRIC STUDY ON A CURVATURE APPROXIMATION BASED ON INTERACTION DIAGRAMS OF CONCRETE COLUMNS EXPOSED TO AN ISO 834 STANDARD FIRE.....	464
<i>Lijie Wang, Robby Caspeele, Luc Taerwe</i>	
FIRE PROTECTION OF CONCRETE TUNNEL LININGS WITH WASTE TYRE FIBRES	472
<i>Fabio P. Figueiredo, Asif Hussain Shah, Shan-Shan Huang, Harris Angelakopoulos, K. Pilakoutas, Ian Burgess</i>	
ROTATIONAL RESTRAINT STIFFNESS OF CONCRETE BEAM-SLAB ASSEMBLY EXPOSED TO FIRE.....	479
<i>Bo Wu, Rujia Zhang</i>	
INITIAL PROBABILISTIC STUDIES INTO A DEFLECTION-BASED DESIGN FORMAT FOR CONCRETE FLOORS EXPOSED TO FIRE.....	488
<i>Ruben Van Coile, Luke Bisby</i>	
MECHANICAL AND DUCTILE FRACTURE PERFORMANCES OF HIGH STRENGTH STRUCTURAL STEEL Q690 AFTER A FIRE: EXPERIMENTAL INVESTIGATION.....	496
<i>Chen Siwei, Jiang Shaokun, Guo Houzuo, Cao Huixuan, L. Yifeng, Lan Kang</i>	
EFFICIENT THREE DIMENSIONAL NONLINEAR THERMO-MECHANICAL ANALYSIS OF STRUCTURES SUBJECTED TO FIRE.....	504
<i>P. Ravi Prakash, Gaurav Srivastava</i>	
PERFORMANCE OF GLASS-ACP FAÇADE SYSTEM IN A FULL-SCALE REAL FIRE TEST IN A G+2 STRUCTURE	512
<i>Pravin Gandhi, V Jagdish, G Karthikeyan, Aravind Chakravarthy, D. Nakrani, C. Ghoroi, Gaurav Srivastava</i>	
EXPERIMENTAL STUDY ON VERTICAL WOODEN FAÇADE COMBUSTION	520
<i>El Mehdi Koutaiba, Dhionis Dhima, Mathieu Duny, Jean-Pierre Garo, H. Wang, Quentin Jullien</i>	
THE MEANING OF BETA: BACKGROUND AND APPLICABILITY OF THE TARGET RELIABILITY INDEX FOR NORMAL CONDITIONS TO STRUCTURAL FIRE ENGINEERING	528
<i>Ruben Van Coile, Danny Hopkin, Luke Bisby, Robby Caspeele</i>	
FIRE-INDUCED PROGRESSIVE COLLAPSE OF 3D STEEL PORTAL FRAMES.....	537
<i>Guobiao Lou, Chenghao Wang, Jian Jiang, Yaqiang Jiang, Guo-Qiang Li</i>	
AN APPROACH FOR EVALUATING FIRE RESISTANCE OF STEEL BEAMS CONSIDERING CREEP EFFECT.....	544
<i>Weiyong Wang, Linbo Zhang</i>	
BEHAVIOR OF BEAM-TO-COLUMN WELDED CONNECTIONS IN STEEL STRUCTURES AFTER FIRE	551
<i>Mei-Chun Zhu, Guo-Qiang Li</i>	
FRACTAL NATURE OF CEMENTITIOUS SYSTEMS EXPOSED TO SUSTAINED ELEVATED TEMPERATURES.....	557
<i>Muhammad Mamun, Vivek Bindiganavile</i>	
PERFORMANCE OF T-SHAPED STEEL REINFORCED CONCRETE COLUMN UNDER HIGH TEMPERATURE	565
<i>Yuzhuo Wang, Ying Huang, Chuanguo Fu</i>	
RESIDUAL RESPONSE OF REINFORCED CONCRETE COLUMNS EXPOSED TO DESIGN FIRES	574
<i>Venkatesh Kodur, Derek Hibner, Ankit Agrawal</i>	
FIRE RISK EVALUATION OF BRIDGE UNDERNEATH CONDITIONS BASED ON FIELD INVESTIGATION.....	582
<i>Sanghyun Joo, Seulgi Kim, Yongjae Kim, Cheolwoo Park</i>	
EVALUATION OF RESIDUAL MECHANICAL PROPERTIES OF STEEL FIBER-REINFORCED REACTIVE POWDER CONCRETE AFTER EXPOSURE TO HIGH TEMPERATURE USING NONDESTRUCTIVE TESTING.....	588
<i>Xiaomeng Hou, Muhammad Abid, Wenzhong Zheng, Ghulam Qadir Waqar</i>	
MECHANICAL PROPERTIES OF STEEL FIBER-REINFORCED REACTIVE POWDER CONCRETE AT HIGH TEMPERATURE AND AFTER COOLING.....	597
<i>Muhammad Abid, Xiaomeng Hou, Wenzhong Zheng, Ghulam Qadir Waqar</i>	

FIRE BEHAVIORS OF DOUBLE-LAYER GRID STRUCTURES UNDER A NEW TEMPERATURE-TIME CURVE	605
<i>Yong Du</i>	
DEFORMATION CAPTURING OF CONCRETE STRUCTURES AT ELEVATED TEMPERATURES	613
<i>Dinh Ba Le, Son Duy Tran, Vinh T. N. Dao, José Torero</i>	
EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF CORRODED STEEL BARS AFTER ELEVATED TEMPERATURE	622
<i>Xiong Yan, Wu Di, Tang Yingfeng, Hu Minqiu, Shu Hai</i>	
Author Index	