

Thirteenth International Conference on Recent Advances in Concrete Technology and Sustainability Issues

ACI SP 303

Ottawa, Ontario, Canada
14-17 July 2015

Editors:

**Terence C. Holland
V. Mohan Malhotra**

Pawan R. Gupta

ISBN: 978-1-5108-1979-5

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© (2015) by American Concrete Institute
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact American Concrete Institute
at the address below.

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48333 USA

Phone: (248) 848-3700

Fax: (248) 848-3701

BKStore@concrete.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

Preface	3	SP-303-04	45
		Effect of Steam Curing on	
SP-303-01	9	Mechanical Properties of Self-	
Responsibility, Durability, and		Compacting Concrete Containing	
Construction Requirements in ACI		Pozzolan	
318-14		by Aliakbar Ramezaniapour,	
by Terence C. Holland		SeyedAli Ghahari, AmirMohammad	
INTRODUCTION	9	Ramezaninapour, and Khashayar	
HISTORY	10	Esmaeili	
DEVELOPMENT OF 2014 CODE	13	INTRODUCTION	45
FUTURE WORK	18	RESEARCH SIGNIFICANCE	46
CONCLUSIONS	18	EXPERIMENTAL INVESTIGATION	46
		ANALYTICAL INVESTIGATION AND	
SP-303-02	21	EXPERIMENTAL RESULTS	48
Grouts for Bridge Post-tensioning		CONCLUSIONS	53
Tendons at Below-Freezing			
Temperature		SP-303-05	57
by Yang Fumin, Ma Rongtian, Zhang		Performance of Sulpho-Based	
Yuanqing, and Zhang Yong		Rapid-Hardening Concrete	
INTRODUCTION	21	by Sergio Tortelli and Maurizio Marchi	
EXPERIMENTAL	22	INTRODUCTION	57
RESULTS AND DISCUSSION	24	RESEARCH SIGNIFIANCE	58
CONCLUSIONS	31	EXPERIMENTAL PROCEDURE	58
		ANALYTICAL INVESTIGATION	61
SP-303-03	33	EXPERIMENTAL RESULTS AND	
Case Studies of CO₂ Utilization in		DISCUSSION	62
Concrete		CONCLUSIONS	65
by Sean Monkman and Mark			
MacDonald		SP-303-06	69
SYNOPSIS	33	Rapid Strength Concrete for	
INTRODUCTION	33	Extending Service Life of	
RESEARCH SIGNIFICANCE	35	Transportation Infrastructure	
EXPERIMENTAL INVESTIGATION	35	by Boris Stein, Robert Ryan, Vincent	
EXPERIMENTAL RESULTS AND		Perez, and Tanmay Kumar	
DISCUSSION	37	INTRODUCTION	69
FURTHER RESEARCH	42	PRINCIPLES OF PROPORTIONING	
CONCLUSIONS	43	AND PROPERTIES OF RSC	70
		CASE STUDIES	76
		FUTURE RESEARCH NEEDS	80
		CONCLUSIONS	80

SP-303-07	83	SP-303-10	133
Flexural Crack Width of Reinforced Concrete Beams with Roof Tile Waste Aggregate		Influence of Coal Mining By-Products on the New Blended Cement Properties	
by Mwangi Martin Macharia, Yuko Ogawa, Katsumi Yamaguchi, Kenji Kawai, and Ryoichi Sato		by Moisés Frías, Olga Rodríguez, Rosario García, Raquel Vigil, Iñigo Vegas, Sagrario Martínez-Ramírez, Lucía Fernández-Carrasco, and M ^a Isabel Sánchez de Rojas	
INTRODUCTION	83	INTRODUCTION	134
RESEARCH SIGNIFICANCE	84	RESEARCH SIGNIFICANCE	134
EXPERIMENTAL INVESTIGATION	84	EXPERIMENTAL PROCEDURE	134
EXPERIMENTAL RESULTS AND DISCUSSION	86	EXPERIMENTAL RESULTS AND DISCUSSION	136
CRACKING BEHAVIOR OF THE RC BEAMS	90	CONCLUSIONS	140
CONCLUSIONS	98		
SP-303-08	103	SP-303-11	147
Processing of Sugar Cane Bagasse for Making it Pozzolanic		Characterization of Concrete with Recycled Aggregates Produced from Returned Concrete	
by Rein Terje Thorstensen		by Giorgio Ferrari, Alberto Brocchi, Luca Torelli, Gilberto Artioli, Michele Secco Luca Valentini, and Maria Chiara Dalconi	
INTRODUCTION	103	INTRODUCTION	147
RESEARCH SIGNIFICANCE	104	DESCRIPTION OF THE NEW TECHNOLOGY	148
EXPERIMENTAL INVESTIGATION	104	PROPERTIES OF THE RECYCLED AGGREGATES	150
ANALYTICAL INVESTIGATION	107	MATERIALS AND METHODS	152
RESULTS AND DISCUSSION	108	RESULTS AND DISCUSSION	154
CONCLUSIONS	114	SUSTAINABILITY ISSUES OF THE NEW TECHNOLOGY	159
		CONCLUSIONS	163
SP-303-09	119	SP-303-12	167
Phase Compositions and Strengths of One-Year-Old Ternary Cement Composites		The Influence of a New Metal Silicate Hydrate Admixture on Concrete Strength and Durability	
by L'udovít Krajci, Ivan Janotka, Michal Bacuvčík, and Subhash C. Mojumdar		by Giorgio Ferrari, Vincenzo Russo, Davide Salvioni, Francesco Surico, Gilberto Artioli, Maria Chiara Dalconi, Michele Secco, and Luca Valentini	
INTRODUCTION	119	INTRODUCTION	167
RESEARCH SIGNIFICANCE	120	RESEARCH SIGNIFICANCE	168
EXPERIMENTAL INVESTIGATION	120	MATERIALS AND METHODS	168
ANALYTICAL INVESTIGATION	122	RESULTS AND DISCUSSION	172
EXPERIMENTAL RESULTS AND DISCUSSION	123	CONCLUSIONS	177
FURTHER RESEARCH	128		
CONCLUSIONS	128		

SP-303-13	183	EXPERIMENTAL PROCEDURE	219
Shotcrete Test Center		EXPERIMENTAL RESULTS AND	
by by Espen A Rudberg and Thomas Beck		DISCUSSION	223
INTRODUCTION	183	FURTHER RESEARCH	233
RESEARCH SIGNIFICANCE	184	SUMMARY AND CONCLUSIONS	233
EXPERIMENTAL RESULTS AND			
DISCUSSION	188	SP-303-17	237
FURTHER RESEARCH	189	Hydration Properties and Technical Behavior of Calcium Sulfoaluminate Cements	
CONCLUSIONS	189	by Antonio Telesca, Milena Marroccoli, Michele Tomasulo, and Gian Lorenzo Valenti	
SP-303-14	191	INTRODUCTION	237
Designing Alternative Binders Utilizing Synergistic Reactions		RESEARCH SIGNIFICANCE	239
by Harald Justnes and Tone Anita Østnor		EXPERIMENTAL PROCEDURE	239
INTRODUCTION	191	EXPERIMENTAL RESULTS AND	
RESEARCH SIGNIFICANCE	192	DISCUSSION	241
MATERIALS AND EXPERIMENTS	195	CONCLUSIONS	246
RESULTS AND DISCUSSION	198		
CONCLUSIONS	202	SP-303-18	255
SP-303-15	205	Microspheres-Based Admixture for Free-Thaw Durability of Concrete	
Effect of Supplementary Cementitious Materials on the Rheology of Blended Cements		by Frank Shaode Ong, Charles K. Nmai, James Curtis Smith, and John Luciano	
by Ashok. K. Tiwari, Maulik. M. Panseriya, Prakash C. Mathur, and Subrato Chowdhury		INTRODUCTION	255
INTRODUCTION	205	RESEARCH SIGNIFICANCE	256
RESEARCH SIGNIFICANCE	206	REPROPORTIONING AND OPTIMIZATION OF CONCRETE MIXTURES CONTAINING MICROSPHERES	256
RHEOLOGICAL BACK GROUND OF CONCRETE	206	EFFECTIVENESS OF MICROSPHERES WITH CONCRETE MATERIALS THAT HINDER AIR ENTRAINMENT	258
EXPERIMENTAL INVESTIGATION	206	MEASURING THE MICROSPHERES CONTENT IN FRESH CONCRETE	259
MIXING AND TESTING DETAILS	207	SUMMARY AND CONCLUSIONS	265
RESULTS	209		
DISCUSSION	212	SP-303-19	269
CONCLUSIONS	214	Adoption of Resistivity Tests for Concrete Acceptance	
SP-303-16	217	by Robert Douglas Hooton and Gita Charmchi	
Durability and Dimensional Stability of Concrete Containing Zinc Slag as Sand		INTRODUCTION	269
by Bhavna Tripathi, Tarush Chandra, and Sandeep Chaudhary		RESEARCH SIGNIFICANCE	270
INTRODUCTION	217	EXPERIMENTAL RESULTS AND	
RESEARCH SIGNIFICANCE	219	DISCUSSION	274
		FURTHER RESEARCH	277

SUMMARY AND CONCLUSIONS	277	SP-303-24	323
		Properties of Steam-Cured Fly Ash Concrete Using Porous Ceramic Waste Aggregate	
		by Phuong Trinh Bui, Yuko Ogawa, Naoki Doi, Kenji Kawai, and Ryoichi Sato	
SP-303-20	281	INTRODUCTION	323
Compatibility of Superplasticisers in Concrete with Mixed Recycled Aggregate		RESEARCH SIGNIFICANCE	324
by C. Medina, W. Zhu, E.Asensio, I.F. Saéz del Bosque, M. Frías, and M. I. Sánchez de Rojas		EXPERIMENTAL INVESTIGATION	324
INTRODUCTION	281	EXPERIMENTAL RESULTS AND DISCUSSION	327
RESEARCH SIGNIFICANCE	282	CONCLUSIONS	332
EXPERIMENTAL PROCEDURE	282		
RESULTS AND DISCUSSION	285	SP-303-25	337
CONCLUSIONS	287	Evaluation and Modification of <i>fib</i> Service Life Design Model for Persian Gulf Region	
		by Aliakbar Ramezaniyanpour, Ehsan Jahangiri, Babak Ahmadi, and Faramarz Moodi	
SP-303-21	293	INTRODUCTION	337
Research on Using Fluorosilicate for the Enhanced Performance of Concrete		<i>fib</i> MODEL	338
by Wei Li, Yi Wang, Gao-ming Wang, Yu Shi, and Zi-ming Wang		EVALUATION OF THE MODEL	339
INTRODUCTION	293	MODIFICATION OF THE MODEL	343
EXPERIMENT PROCEDURE	294	ANALYSIS AND EVALUATION THE MODIFIED MODEL	349
RESULTS AND DISCUSSION	294	CONCLUSION	349
CONCLUSIONS	299		
SP-303-22	301	SP-303-26	355
An Overview of ACI Report on High-Volume Fly Ash Concrete		Aggregate Reactivity and the Efficiency of Supplementary Cementing Materials	
by Harvey H. Haynes		by Jens Kronemann and Klaus-Juergen Huenger	
INTRODUCTION	301	INTRODUCTION	355
HISTORICAL BACKGROUND	302	RESEARCH SIGNIFICANCE	356
SUMMARY	309	EXPERIMENTAL INVESTIGATION	356
SP-303-23	311	ANALYTICAL INVESTIGATION	357
Reinforcement of Hollow Concrete Beams with FRP Bars Made from Recycled Materials		EXPERIMENTAL RESULTS AND DISCUSSION	357
by Robert J. Thomas and Sulapha Peethamparan		CONCLUDING REMARKS	367
INTRODUCTION	311		
RESEARCH SIGNIFICANCE	312	Index	
EXPERIMENTAL INVESTIGATION	312		
EXPERIMENTAL RESULTS AND DISCUSSION	314		
SUMMARY AND CONCLUSIONS	319		