

4th - 7th June - Queens University Belfast



FRPRCS-14, Belfast - June 2019

FRPRCS 14 SYMPOSIUM



Welcome to Belfast



**QUEEN'S
UNIVERSITY
BELFAST**

Esteemed delegates, on behalf of myself and the organising committee I would like to welcome you to the Fibre Reinforced Polymer Reinforced Concrete Structures Symposium in Queens University Belfast. Founded in 1845 as Queen's College Belfast, we became an independent university in 1908. Today, we are ranked in the top 180 universities in the world (QS World Rankings 2019), and a member of the Russell Group of UK research intensive universities, combining excellence in research and education with a student-centred ethos.

This is the longest running conference series on the application of FRP in civil construction. FRPRCS commenced in Vancouver in 1993 and was last in the UK in Cambridge in 2001. Queen's University Belfast is delighted to see that the IIFC and FRPRCS Committee have integrated for the management of the FRPRCS conference series to enable coordination of FRPRCS in odd numbered years and that the utilisation of IIFCs resources will ensure the longevity of FRPRCS. The Local Organising Committee for FRPRCS-14 is composed of members from the two Universities in Northern Ireland, industry members from the Northern Ireland Centre for Advanced Composites and Engineering (NIACE) and our Knowledge Transfer Partners working in the area of FRP in Concrete, namely:

- Prof Su Taylor
- Prof Gerry Hamill
- Prof JF Chen
- Dr Esmaeel Esmaeeli
- Dr Nikolaos Perogamvros
- Dr Des Robinson
- Dr Giuseppina Amato
- Dr Mohammed Sonebi
- Prof Ali Njai

- Prof Adrian Murphy
- Prof Brian McFarland (McFarland Associates and RAEng VP)
- Darragh Lydon
- Stathis Polydorou
- Dr Tony Martin
- Prof Ruth Morrow
- Philip Crossett (FP McCann)
- Dr Peter Deegan (Banagher Concrete)
- Simon Bullivant (Bullivant Taranto)
- Rosyln McMullan (Moore Concrete)
- Aaron Gillies (Thales group)
- Abhey Gupta (Macrete Ltd)

I look forward to meeting as many of you as possible, and hope you have an enjoyable and stimulating experience at FRPRCS 14.

Professor Su Taylor
Dean of Research
Chair of the Local Organising Committee



General Information

Workshop Venue

Riddel Hall,
185 Stranmillis Road,
Belfast BT9 5EE

Website: www.qub.ac.uk/sites/FRPRCS-14

Social Programme

- **Welcome Event**
17:15-19:00 on Tuesday 4th June - David Keir Building
39-123 Stranmillis Road
BT9 5AG
- **Conference Banquet**
18:30 - 21:30 on Thursday 6th June - Isdell Courtyard
Riddel Hall

Presentation Information

Presenting authors are kindly asked to prepare their presentation using MS powerpoint according to the template available on the FRPRCS website. Please bring this presentation on a USB drive for upload to the computer in the session room. Please upload your presentation before the start of the session.

Internet Service

Free internet access is available via wireless network. Login details will be provided at registration. No technical support is provided; delegates must assume responsibility for PC security.

Queens University Belfast Campus Map



Date/Time	4th June	5th June	5th June	6th June	6th June	7th June	7th June	8th June			
	David Keir Building	Riddel Hall 1	Riddel Hall 2	Riddel Hall 1	Riddel Hall 2	Riddel Hall 1	Riddel Hall 2				
08:30 -09:00		Registration									
09:00-09:30		Presidents Welcome		Keynote 3 - Professor Arghadeep Laskar		Keynote 5 - Dr Peter Deegan					
09:30-10:00		Keynote 1 - Professor Guijun Xian		Keynote 4 - Professor Mark Green		Keynote 6- Professor Xiao-Ling Zhao					
10:00-10:15	BREAK										
10:15 - 12:00		Session 1 - FRP materials: properties, tests and standards		Session 5 - FRP Design codes and guidelines		Session 9 - FRP reinforced concrete structures	Session 10 - Applications of FRCM and TRM in concrete and masonry structures				
12:00- 13:00	LUNCH										
13:00- 13:30		Keynote 2 - Professor Rudi Seracino				Closing Comments					
13:30 - 15:15		Session 2 - Bond behaviour between FRP and concrete		Session 6 - Strengthening of concrete structures using FRP Systems							
15:15-15:30	BREAK										
15:30-17:15		Session 3 - FRP materials: properties, tests and standards	Session 4 - Bond behaviour between FRP and concrete	Session 7 - Engineering applications of FRP	Session 8 -FRP reinforced concrete structures						
1715:- 18:00	Conference Registration	Keynote Panel									
18:00 - 18:30	Welcome Event										
18:30 - 21:00								Conference Banquet - Isdell Courtyard			

**Optional
Game of
Thrones
Tour**

June 5th - Morning

Session 1 - FRP materials: properties, tests and standards (Session Chair: Amir Fam)		
Time: 10:15 - 12:00		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
164	Improved Endurance Limits for GFRP Reinforcement of Concrete	Bryan Barragan
165	GFRP Bars Extracted from Bridges in Service for 15 to 20 Years	Antonio Nanni
166	Durability Evaluation of Bridge-Extracted GFRP Bars	John J. Myers
170	Sulphuric acid penetration kinetics in externally bonded FRP-strengthened RC structures: mechanism and prediction	Ali Hadigheh
172	The Effect of Elevated Temperatures on the Tensile Strength of CFRP Bars with a Cladding Layer	Jiahui Shen
101	Size Effect in Shear-Deficient Reinforced Concrete T-Beams Strengthened with Embedded FRP Bars	Kagan Sogut

June 5th - Afternoon

Session 2 - Bond behaviour between FRP and concrete (Session Chair: Riadh Al-Mahaidi)		
Time: 13:30 - 15:15		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
154	Impact test of RC beams flexurally strengthened with AFRP sheet varying sheet volume	Norimitsu Kishi
155	Elasto-plastic impact response analysis of RC beams flexurally strengthened with externally bonded FRP sheet	Tomoki Kawarai
156	Quasi-Continuous Strain Measurement with Distributed fibre-optic sensors in reinforcement bars and externally bonded CFRP strips at concrete slabs- Experiment and Modelling	Zhuo Chen
158	Bond Strength of GFRP Reinforcing Bars in Concrete Containing Seawater	Martin Noël
130	Experimental investigation of NSM Carbon Fibre Strand Sheet (CFSS) method for flexural strengthening of the RC beams	Justin Shrestha
110	Interaction between internal steel stirrups and externally bonded CFRP U-strips for shear strengthening of concrete T-beams	Jose David Jimenez-Vicaria

June 5th - Afternoon

Session 3 - FRP materials: properties, tests and standards (Session Chair: John Myers)		
Time: 15:30 - 17:15		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
117	Creep Rupture Testing of GFRP Bars under Sustained Loading	Antonio Nanni
169	Characterisation of carbon fibre recovered by pyrolysis using thermal gravimetric analysis	Ali Hadigheh
132	Study on Anchor Efficiency and Stress Relaxation of BFRP Bars using Digital Image Correlation and FBG Sensing Technology	Prashant Motwani
147	Cold Temperature Effects on the Impact Resistance of SFRC Panels Strengthened with FRP Straps	Matthew Beirnes
157	Static behaviour of circumferential stress releasing anchor for large-capacity FRP cable	Jingyang Zhou
160	An Innovative Tensile Test for Short GFRP Rebar Samples	Bryan Barragan
174	Effect of concrete strength and FRP confinement on the compressive behaviour of FRP-HSC-steel double-skin columns	Jian-Fei Chen

June 5th - Afternoon

Session 4 - Bond behaviour between FRP and concrete (Session Chair: Issam Harik)		
Time: 15:30 - 17:15		
Location: Riddel Hall 2		
Paper ID	Title	Presented by:
108	Experimental study of the long-term durability of FRP-to-concrete joints subjected to cyclic temperature, moisture and aqueous salt environmental conditions	Rebecca Gravina
126	Bond Performance of GFRP Rebars Embedded in High Volume Fly Ash Concrete	John J. Myers
119	Evaluation of design models for predicting the strength of prestressed T beams using CFRP and patch anchors	Robin Kalfat
134	Bond Behaviour of GFRP Rebars in Reinforced Concrete Members under Flexure	Aurelio Tassinari
137	Behaviour of concrete shear walls with BFRP reinforcement for Concrete Structures	Hamid Rahman
179	Single shear pull-off tests of FRP-to-concrete and mortar	Yaqi Li
175	A numerical procedure for determining GFRP bar-concrete bond parameters	Heng-Lei Dong

June 6th - Morning

Session 5 - FRP Design codes and guidelines (Session Chair: Esmaeel Esmaeli)		
Time: 10:15 - 12:00		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
109	Calibration of Reduction Factor for Concrete Columns Strengthened with Unidirectional Fiber-Reinforced Wrapping	Pedram Sadeghian
135	Fan-to-sheet failure mode of FRP anchors	Enrique del Rey Castillo
111	Strengthening Slender Steel Compression Members Using a Fibre-Reinforced Polymer Shell Buckling Restrained Bracing System	Pedram Sadeghian
151	CFRP Contribution in Reinforced Concrete Beams Strengthened in Shear with Anchored CFRP Strips	Nawaf K. Alotaibi
116	Large-Scale Tests on the Structural and Deformation Behaviour of I-Beams with Carbon Reinforcement	Maximilian Schmidt
149	Possible Interaction between the Existing Transverse Steel and the Rehabilitating FRP Shear Reinforcement in RC Beams Strengthened with EB, NSM, ETS and L-Shaped FRP Methods	Amir Mofidi

June 6th - Afternoon

Session 6 - Strengthening of concrete structures using FRP Systems (Session Chair: Antonio Nanni)		
Time: 13:30 - 15:15		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
105	Damage Repair of a Bridge Girder Previously Retrofitted With CFRP Fabric	Issam Elias Harik
180	From Hybrid Composite Plate (HCP) to SMartPlate - Innovative Strengthening and Post-tensioning Solutions for RC Elements	Esmaeel Esmaeli
139	Experimental Investigation of Fire-damaged Reinforced Concrete Columns Retrofitted with CFRP Jackets	Jia Xu
140	Structural Strengthening of Concrete Footings Using FRP and External Prestressing	Xingji Lu
142	RC beams strengthened by prestressed CFRP plate subjected to sustained loading	Deng, J
178	Compressive Membrane Action in FRP NSM strengthened slabs	Tony Martin

June 6th - Afternoon

Session 7 - Engineering applications of FRP (Session Chair: Rebecca Gravina)		
Time: 15:30 - 17:15		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
121	FRP Anchors to Enhance Efficiency of Externally Bonded FRP – Design Methodology and Case Studies	Ravi Kanitkar
171	Structural Repair of Submerged Piles and Seawalls	Mo Ehsani
136	Finite Element Analysis Modelling of bed scour in the FlexiArch™ bridge system	Evi Gyftaki
159	Performance of Solar Cells Integrated with Fiber-Reinforced Polymer-Confined Concrete Beams under Bending Load	An Chen
167	Behavior of Concrete-Filled Near-Cross-Ply Filament-Wound GFRP Tubes Loaded in Combined Flexure and Torsion	Amir Fam
168	A New Solution for Reconstruction of Deteriorated Concrete Pipelines	Mo Ehsani
176	Analysis and Design of a Pedestrian Bridge with Decommissioned FRP Windblades and Concrete	Raj Suhail

June 6th - Afternoon

Session 8 - FRP reinforced concrete structures (Session Chair: Ahmad Rteil)		
Time: 15:30 - 17:15		
Location: Riddel Hall 2		
Paper ID	Title	Presented by:
104	Exploitation of FRP Fabric Reinforcement	Mithila Achintha
115	Shear Capacity of Carbon Reinforced Concrete Slabs with Planar and C-Shaped Shear Reinforcement	Jan Bielak
150	Design Considerations of Anchored Carbon Fiber Reinforced Polymer (CFRP) anchors	Nawaf K. Alotaibi
118	Initial estimate of short and long term prestress losses of BFRP pretensioned RC beams	Ana Pavlović
120	Production and Structural Performance of Thin Doubly Curved Elements Prestressed With CFRP Tendons	Maximilian Schmidt
125	Experimental investigation of FRP reinforced RC frames under cyclic in-plane loading	George Hopartean
141	Bridge Widening and Strengthening Using CFRP Composites – Experimental Investigation	Cheng Tan

June 7th - Morning

Session 9 - FRP reinforced concrete structures (Session Chair: Mo Ehsani)		
Time: 10:15 - 12:00		
Location: Riddel Hall 1		
Paper ID	Title	Presented by:
122	Behaviour of BFRP reinforced concrete element under axial loading	Nabi, P
131	Behaviour of GFRP-steel reinforced I shape beams with steel fibers as shear reinforcement	Ali Edalat Behbahani
133	The Development and Testing of Triple-layer sandwich panel made from LightWeight Self-Compacting Concrete and reinforced with GFRP bars and mesh	Andrey Lapshinov
103	Seismic Upgrading of RC Coupled Shear Walls Designed According to Codes Prior to 1970s Using FRP Composites	Sara Honarparast
143	A New Type of GFRP Shear Reinforcement for Slab-Column Edge Connections subjected to Reversed-Cyclic Lateral Load	Mohammed El-Gendy
153	Behaviour of Continuous Concrete Deep Beams Reinforced with GFRP Headed Bars	Mohammed El-Gendy
177	Compressive Membrane Action in pre-cast BFRP reinforced box-culverts	Philip Crossett

June 7th - Morning

Session 10 - Applications of FRCM and TRM in concrete and masonry structures (Session Chair: Amir Mofidi)		
Time: 10:15 - 12:00		
Location: Riddel Hall 2		
Paper ID	Title	Presented by:
128	Fatigue Performance of FRCM Strengthened RC Beams Subjected to Environmental Exposure and Varied Fatigue Frequencies	John J. Myers
129	Flexural Evaluation of RC One-Way Slabs Strengthened with Different Composite Materials	John J. Myers
114	Effect of Surface Roughness on FRCM-Concrete Bond	Tanya Fraser
162	Flexure Critical Corroded RC Beams Strengthened with Carbon and PBO FRCM	Bressan, J
146	Thermo-Mechanical Analysis of Fibre Reinforced Cementitious Matrix (FRCM) Systems	Rebin Mohammad
173	Experimental Analysis of Small Clay Brick Cylinders Confined by BFRP Grid under Axial Compression	Giuseppina Amato

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