THE UNIVERSITY OF BRITISH COLUMBIA
Department of Civil Engineering
SIERA: Sustainable Infrastructure Research Group

IC-IMPACTS

SIERA Group 2020 Seminar Series – Seminar No. 28

Wednesday, November 25, 2020 @ 5:30pm Pacific Time (PST)

The Relevance of Seismic Assessment in Corroded Reinforced Concrete Structures

Invited Keynote, organized by the IC-IMPACTS Student Engagement Committee

Dr. Voula (S. J.) Pantazopoulou
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Dr. Voula Pantazopoulou holds an Undergraduate Degree in Civil Engineering from the National Technical University of Athens, Greece, and MSc and PhD Degrees from the University of California at Berkeley. She specializes in Reinforced Concrete Structures, Performance-based Earthquake Engineering, Structural Retrofit, and novel structural materials (such as CNTs in concrete, FRPs, UHPC, and structural biomaterials). Recent work deals with the development of innovative bricks with embedded biomaterial wastes, forensics of bridges damaged by Alkali-Aggregate Reactivity, Strain-hardening fibre-reinforced cementitious materials, sustainable concretes containing high volume of cement replacement with wastes, whereas a significant part of her past activity was dedicated to Seismic Assessment and Retrofit of Concrete Buildings and Bridges, evaluation and repair of corrosion-induced deterioration of structures, and the use of emerging materials in structural retrofit. ***Note: the full biography is provided on the next page.***

Abstract: Structural Seismic assessment methods of the reinforced concrete (RC) structures require extensive information concerning reinforcement ratios and detailing. The purpose of such assessment methods is to evaluate the reliable deformation capacity of structural members in order to foresee their seismic performance in a future seismic hazard. Considering the condition of the reinforcement complicates matters significantly due to the uncertainties it introduces regarding the actual properties and residual geometry of the embedded bars, particularly in quantifying the seismic behavior of poorly detailed RC members. To illustrate these influences in the established assessment procedures, a sample reinforced concrete element is studied, to identify how concrete cover cracking, bar section loss and bond degradation affects the mechanical strength and deformation capacity in the resistance curve of the component. ***Note: the extended abstract is provided on the next page.***

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Presenter's Biography: Dr. Voula (S. J.) Pantazopoulou is Professor and Chair of Civil Engineering, Lassonde Faculty, York University. She holds an Undergraduate Degree in Civil Engineering from the National Technical University of Athens, Greece, and MSc and PhD Degrees from the University of California at Berkeley. She specializes in Reinforced Concrete Structures, Performance-based Earthquake Engineering, Structural Retrofit, and novel structural materials (such as CNTs in concrete, FRPs, UHPC, and structural biomaterials). Recent work deals with the development of innovative bricks with embedded biomaterial wastes, forensics of bridges damaged by Alkali-Aggregate Reactivity, Strain-hardening fibre-reinforced cementitious materials, sustainable concretes containing high volume of cement replacement with wastes, whereas a significant part of her past activity was dedicated to Seismic Assessment and Retrofit of Concrete Buildings and Bridges, evaluation and repair of corrosion-induced deterioration of structures, and the use of emerging materials in structural retrofit.

She has served as faculty in several Universities having obtained an international expertise through training and the various posts she has taken up during her academic career. She begun her academic career at the University of Toronto, as Assistant Professor in 1988, and was promoted to Associate professor in 1992; in 1997 she was appointed Associate Professor at Democritus University of Thrace, in Greece, where she was promoted to full professor in 2001; she took the position on Professor in the Department of Civil and Environmental Engineering at the University of Cyprus in 2011, where she was appointed Department Chair in 2013-2015. Since 2016 she has returned to Canada as Professor in the Lassonde School of Engineering, York University, in Toronto. She has 32 years of experience in funded research and has supervised 17 PhD students (4 ongoing) and over 48 Master of Science (Thesis) students; more than 50% of her graduate students were women engineers most of whom are currently pursuing successful careers in Academia or the Industry. The research thus conducted has yielded more than 110 Journal papers with over 4000 citations to her work. She is currently member of the Canadian Standards' Association Bridge Design Committee Specializing in the use of Ultra High Performance Fiber Reinforced Concrete in Bridge Construction. She is also Member of the Board of Directors of the Canadian Society for Earthquake Engineering.

Dr. Pantazopoulou has been selected as a Fellow of the Engineering Institute of Canada for 2019, is a Fellow of the American Concrete Institute, and has received a meritorious award from ASCE (Moisseiff award for "notable contributions to the science and art of Civil Engineering").

Extended Abstract: Seismic assessment methods of RC structures require extensive information concerning reinforcement ratios and detailing. The purpose of such assessment methods is to evaluate the reliable deformation capacity of structural members in order to foresee their seismic performance in a future seismic hazard. Assessment Guidelines, however, do not take into consideration the condition of reinforcement, which has been proven to affect the member's residual deformation and strength capacity, the hierarchy of likely failure modes and the consequences thereof, on seismic performance. Considering the condition of the reinforcement complicates matters significantly due to the uncertainties it introduces regarding the actual properties and residual geometry of the embedded bars, particularly in quantifying the seismic behavior of poorly detailed RC members. To illustrate these influences in the established assessment procedures, a sample reinforced concrete element is studied, to identify how concrete cover cracking, bar section loss and bond degradation affects the mechanical strength and deformation capacity in the resistance curve of the component. The member is representative of old practices and subjected to moderate carbonation for a period of 50 years (a sample of a building in areas build in the 70's). The objective is to derive simple modifiers of the resistance curve and the acceptance criteria for the seismic response of corrosion-damaged members with emphasis on the effects on the secant to yield stiffness and drift capacity, which could be used in the framework of seismic assessment. The corrosion-compromised member response curves expressed in terms of shear vs drift capacity are introduced in the available methodologies of rapid assessment of reinforced concrete structures, showcasing the limitations and uncertainties of the existing state of the art in the field of seismic assessment of existing structures. This method is introduced into a case study of a multi-storey reinforced concrete building subjected to uniform corrosion exposure under low and high intensity ground motions and is used to illustrate the practical effects on the estimated response.