Connecting with the World Lecture Series

Dr. Alexandros A. Taflanidis: **Mitigating seismic risk in the developing world: lessons learned in Haiti and promotion of alternative housing solutions**

Dr. Dimitrios Vamvatsikos: **Hazard, ageing, probability and why infastrastructure needs to be designed for performance**

Wednesday, November 15, 2017

2:00 - 3:00 p.m.

OLIN ENGINEERING, room 202

1515 W. Wisconsin Ave., Milwaukee

On January 12, 2010 a devastating earthquake struck the Republic of Haiti. This earthquake is considered one of the most catastrophic natural disasters in recent history, exposing the vulnerabilities of established construction practices in a country plagued by poverty and political unrest. Over seven years after the earthquake, despite the millions of dollars pledged and the (initial) interest from the global structural engineering community, the sad reality is that most families displaced due to the earthquake do not have a clear road map toward permanent, earthquake resistant housing.

Dr. Alexandros Taflanidis is associate professor in the Department of Civil and Environmental Sciences at the University of Notre Dame. He holds a concurrent position at the Department of Aerospace and Mechanical Engineering and he is also a Faculty Fellow at the Kellogg Institute for International Studies. He also has a strong interest in engineering problems for the developing world and is the co-founder of Engineering2Empower, an organization training the next generation of global citizens to empower community resilience for vulnerable populations in developing nations.

A civil engineering project is a difficult battle with nature. We are fighting against uncertain loads, materials and ageing under changing climatic conditions, using imperfect analysis/modeling tools, and under severe financial, operational and architectural constraints. Our staunchest ally in this endeavor seems to be the design code that offers some standardization to the design process and essentially represents a social contract on what constitutes an acceptable structure. In the course of the presentation we shall argue the case for designing to cater to a user's needs, going beyond the structural code to achieve unique structures with the required performance.

Dr. Dimitrios Vamvatsikos is an assistant professor in the Institute of Steel Structures, School of Civil Engineering, National Technical University of Athens in Athens, Greece. His research interests are focused on integrating structural modeling, computational techniques, probabilistic concepts and experimental results into a coherent framework for the performance evaluation of structures and infrastructure under man-made and natural hazards.

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MARQUETTE UNIVERSITY

BE THE DIFFERENCE.

Mitigating seismic risk in the developing world: lessons learned in Haiti and promotion of alternative housing solutions

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On January 12, 2010 a devastating earthquake struck the Republic of Haiti. Despite measuring just a moderate 7.0 on the Richter scale, this earthquake is considered one of the most catastrophic natural disasters in recent history, exposing the vulnerabilities of established construction practices in a country plagued by poverty and political unrest. Over seven years after the earthquake, despite the millions of dollars pledged and the (initial) interest from the global structural engineering community, the sad reality is that most families displaced due to the earthquake do not have a clear road map toward permanent, earthquake resistant housing. While many agreed that sustainable redevelopment and self-reliance was essential for Haiti, international goodwill and intentions were insufficient to deliver such solutions, particularly in the domain of urban residential housing. Currently, the only construction practices that can compete in the free market, i.e., in absence of foreign aid and donor funds, are the same ones that created the vulnerabilities in the 2010 earthquake. Unfortunately this is not just the story of Haiti. Many parts of the developing world share the same vulnerabilities in the face of seismic hazards, especially resulting from residential construction practices among low income families.

This presentation shares the experience of our research team in Léogâne, Haiti, during the development of an empowerment framework for (a) assessing seismic vulnerabilities, (b) understanding the economic/cultural/societal origins of these vulnerabilities and (c) offering alternative solutions when operating in such unique, resource-constrained environments. Emphasis is placed on the challenges created by the financial realities families in these countries face as well as the hurdles created by the absence of quality control systems. It then proceeds to review technical aspects of a solution promoted for residential construction in Haiti. The main novelty for this solution is the replacement of the concrete masonry units (CMU) used in Haiti for wall construction by lightly reinforced, pre-cast concrete panels. The panels are simply used as a cladding element and facilitate a considerable reduction of the construction cost and mass of the walls (when compared to the traditional CMU-based solution). With the walls acting completely as a non-structural element, a special moment resisting reinforced concrete (RC) frame is used as the structural system. The design iterations for the panels, as well as the quality control mechanisms developed for the RC frame, established through the construction of prototypes at Notre Dame and in Léogâne, are discussed.

Bio: Dr. Alexandros Taflanidis is Associate Professor in the Department of Civil and Environmental Engineering and Earth Sciences at the University of Notre Dame. He holds a concurrent position at the Department of Aerospace and Mechanical Engineering and he is also a Faculty Fellow at the Kellogg Institute for International Studies. He received his Bachelors (2002) and Masters (2003) in Civil Engineering from Aristotle University of Thessaloniki, Greece. He receivedgot his PhD in Civil Engineering with minor in Control and Dynamical Systems from the California Institute of Technology (2008). His research focuses on uncertainty quantification and uncertainty-conscious analysis/design, with applications to dynamical system design, natural hazard risk mitigation and sustainability/resilience of civil infrastructure systems. A special area of interest for his group is integration of soft-computing techniques in risk assessment/design. He is an associate editor for the ASCE *Journal of Structural Engineering* as well as a member of the editorial board for *Sustainable and Resilient Infrastructure* and *International Journal of Uncertainty Quantification*. He also has a strong interest in engineering problems for the developing world and is the co-founder of Engineering2Empower (http://e2e.nd.edu), an organization training the next generation of global citizens to empower community resilience for vulnerable populations in developing nations.

Hazard, Ageing, Probability and Why Infrastructure Needs to be Designed for Performance

Dimitrios Vamvatsikos
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A civil engineering project is a difficult battle with nature. We are fighting against uncertain loads, materials and ageing under changing climatic conditions, using imperfect analysis/modeling tools, and under severe financial, operational and architectural constraints. Our staunchest ally in this endeavor seems to be the design code that offers some standardization to the design process and essentially represents a social contract on what constitutes an acceptable structure. At the same time, though, the design code may also obscure some fundamental principles that one seems to apply when making everyday financial decisions, like buying a car, a smartphone or a computer, but not necessarily when building vastly more expensive infrastructure (ports, bridges, pipelines, etc.). In a market saturated with competing consumer products that cater to every user need and purse size, it seems that very few structural solutions are made available to a risk-conscious future building owner. In the course of the presentation we shall argue the case for designing to cater to a user's needs, going beyond the structural code to achieve sui generis structures with the required performance.

Bio: Dr. Vamvatsikos studied civil engineering at the National Technical University of Athens (NTUA) (Diploma, 1997) and at Stanford University (MSc 1998, PhD 2002). Since 2011 he has joined the Institute of Steel Structures at NTUA, where he holds the position of Assistant Professor specializing in the static and dynamic analysis of steel structures. His research interests are focused on integrating structural modeling, computational techniques, probabilistic concepts and experimental results into a coherent framework for the performance evaluation of structures and infrastructure under man-made and natural hazards. His seminal work in risk assessment via Incremental Dynamic Analysis has received wide attention leading to more than 2000 citations. He has co-operated with leading structural engineering firms (ARUP, Halcrow/CH2M), the oil&gas industry (Shell, ExxonMobil), catastrophe risk modelers (AIR Worldwide, RED Srl), and insurance/reinsurance companies (AXA Insurance), while his research has been funded by the Applied Technology Council, the Federal Emergency Management Agency, the US National Institute of Standards and Technology and the European Commission. He is a long-time collaborator of the Global Earthquake Model (GEM) Foundation and has contributed to the GEM vulnerability assessment guidelines and the Risk Modeler's Toolkit for OpenQuake.