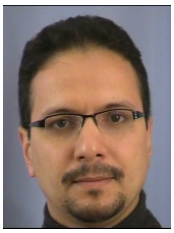
Structures Seminar
Department of Civil and Environmental Engineering
Northeastern University

Monday, October 28, 2013, 12:00-1:00 p.m.

105 Shillman Hall



FINITE ELEMENT MODELS FOR THE NONLINEAR ANALYSIS OF COMPOSITE BEAMS TAKING INTO ACCOUNT TIME EFFECTS

Professor Mohammed Hjiaj, INSA de Rennes, Rennes, France

This presentation addresses the behavior of composite steel-concrete beams with partial shear connection. The goal of this study is to develop and implement numerical tools that are able to predict the short and long-term behavior of composite steel-concrete beams. The first part of the presentation concerns the modeling of composite beams in the linear elastic range in which two bond models at the interface are considered: discrete bond and distributed bond. A finite element with exact stiffness matrix is developed in order to conduct a critical analysis of these two bond models. In the second part of the presentation, the time-dependent behavior of the concrete (creep and shrinkage) is considered by adopting a linear viscoelastic model. An original semi-analytical solution is proposed for the two bond models. This solution enables the analysis of the time-dependent behaviour of composite beams and to evaluate the performances of simplified viscoelastic approaches for concrete creep. The third part of the presentation addresses the constitutive modeling of the materials (steel, concrete and connectors) based on nonlinear continuum mechanics concepts. A coupled elasto-plastic damage model for concrete is proposed. The fourth part of the presentation is dedicated to the development of three nonlinear F.E. formulations (displacement-based, force-based, and a two-field mixed formulation) for composite beams and for the two bond models. An original state determination approach, taking into account the element internal load, is proposed for the force-based and two-field mixed formulations. At the conclusion, we propose a viscoelastic/plastic model for concrete in order to simulate the interaction between the time-dependent effects and the cracking of concrete in composite beams.

Professor Mohammed Hjiaj is head of the Structural Engineering Research Group within the Laboratoire de Genie Civil et Genie Mecanique (LGCGM) at INSA de Rennes in France. He graduated with honors from Ecole Centrale des Arts & Métiers in Brussels, Belgium in 1990 with a B.S. in Civil Engineering; from Faculté Polytechnique de Mons in Belgium in 1992 with an M.Sc. in Mechanics of Solids and Structures; and from Faculté Polytechnique de Mons in 1999 with the highest distinction. Prior to joining INSA de Rennes in 2004, he was a Research Scientist at CNRS, and a post-doctoral fellow at the University of Newcastle (Australia). His research interests include computational mechanics, computational plasticity, error analysis, and adaptive strategies, as applied to a range of applications including foundation engineering, soil-structure interaction, and steel and composite steel/concrete structures. At INSA de Rennes, his recent research is on applications of seismic engineering, fire behavior and robustness of steel and composite structures. Professor Hjiaj serves on two technical committees, including TC 11 (Composite Structures) and TC 13 (Seismic) of the European Convention for Constructional Steelwork (ECCS), he is on the editorial board of the French journal *Construction Métallique*, and is an associate editor for the ASCE *Journal of Structural Engineering*.