Civil & Environmental ENGINEERING

UCONN SCHOOL OF ENGINEERING

Civil and Environmental Engineering

Structures and Applied Mechanics Seminar Series

Present

"Probabilistic Fatigue Damage Assessment of Coastal Slender Bridges under Coupled Dynamic Loads"

Speaker:

Jin Zhu, Ph.D. student

Abstract: With coupled dynamic interactions of vehicle-bridge-wind-wave (VBWW) system, fatigue damage accumulations at complicated weldments of the orthotropic steel deck (OSD) for coastal slender bridges could be critical and might affect structural safety and reliability. Due to the stochastic nature of the environmental loadings including vehicles, wind and waves, it is challenging to include uncertainties for the assessment of the fatigue damage accumulations in the bridge's life cycle. In the present study, an efficient probabilistic fatigue damage assessment framework for coastal slender bridges is proposed with a machine learning algorithm to include the coupled stochastic dynamic loads in the VBWW system. Firstly, stochastic load models are developed based on the long-term field measurements for realistic modeling of the truck load and the correlated wind and wave load, which serve as the input for the VBWW system to extract the stress time histories at critical structural details using multi-scale finite-element analysis (FEA). After calculating the equivalent stress range and the corresponding number of cycles using the rain-flow counting method, the daily equivalent fatigue damage is obtained using the linear fatigue damage rule. To reduce the calculation cost, a machine learning algorithm is utilized for probabilistic modeling of the daily equivalent fatigue damage by integrating uniform design and support vector regression to link the multiple random inputs of environmental loadings with the single output of the stress time history. The fatigue life of critical structural details, therefore, can be obtained using the established limit-state function with a target reliability index. A prototype cable-stayed bridge in a coastal region is presented to demonstrate the effectiveness of the proposed simulation framework. Finally, the impacts of the traffic growth including the traffic volume and the gross vehicle weight on the fatigue life of three welded joints are investigated and discussed, as well.

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"The Bearing Performance of the Bolt-Sphere Joints with Stochastic Pitting Corrosion Damage"

Speaker:

Hao Yuan, Ph.D. Student

Abstract: The durability of the lattice domes is degraded when working in a highly corrosive environment. With the increase in service time, the aggravation of corrosion at joints, in our case, bolted spherical nodes, will lead to the decrease of the ultimate bearing capacity of the lattice domes, and finally the overall failure of the structures. However, at present, the studies are limited on the degradation of bolted spherical nodes caused by corrosion especially pitting corrosion. Therefore a pilot study is performed on the ultimate bearing capacity of the bolt-sphere joint portion in the bolted spherical nodes with stochastic pitting corrosion damage. Aided by the commercial finite element software ABAQUS, the bolt-sphere joints are modeled in 3D incorporating the helical thread contact. The corrosion damage is induced by explicitly adding uniform distributed pits on the intact model while the pit depth distribution is depending on the corrosion rate and service time. Through fine numerical analyses, specifically a number of uniaxial tension test simulations under different corrosion time, a group of load-displacement curves of the process are obtained. The stiffness variation in the whole loading process, the ultimate bearing capacity and failure mode of joints can also be estimated.

Friday, March 23, 2018

12:20 – 1:10 PM

Laurel Hall (LH) - Room 206