A Systematic Computational Framework for Multi-span Bridge PBEE Applications

PEER Transportation Systems Research Program

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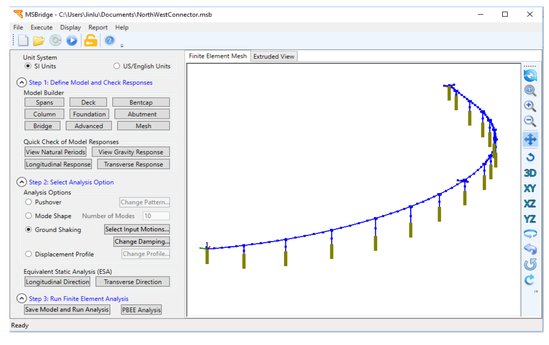
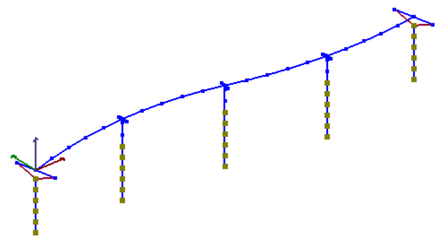
Summary

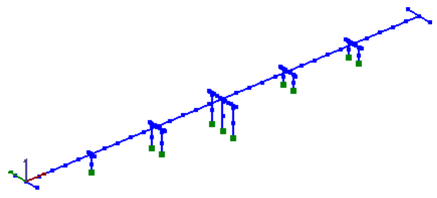
A computational user interface (MSBridge) is developed to combine nonlinear Time History Analysis (THA) of multi-span bridge systems with an implementation of a PBEE methodology developed by the Pacific Earthquake Engineering Research (PEER) Center. OpenSees is employed to conduct Nonlinear THA.



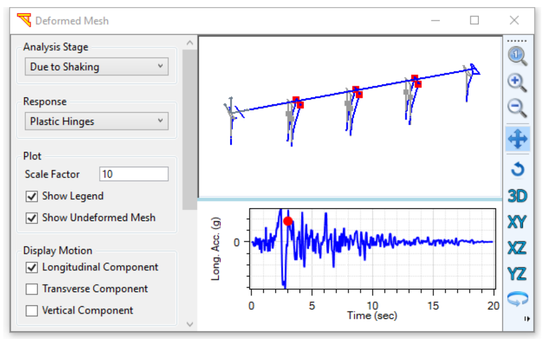
MSBridge user-interface



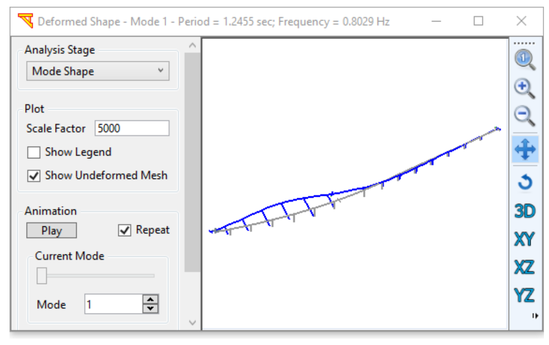
Curved bridge with foundation of soil springs



Bridge with different numbers of columns for bents (with Foundation stiffness matrix)



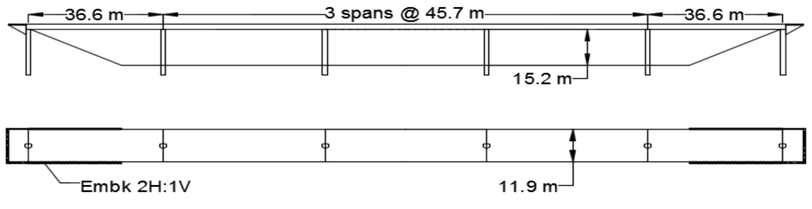
Visualization of plastic hinges



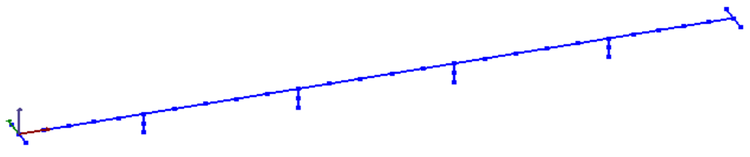
Mode shape analysis

Bridge Case Study

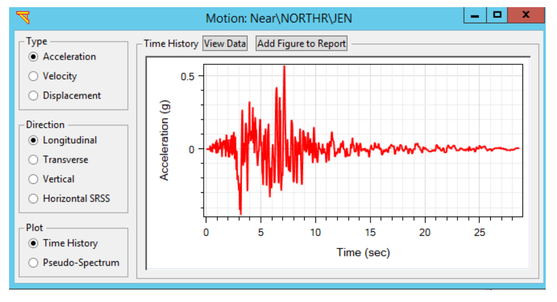
A straight, single column bents, box girder, reinforced concrete bridge with five spans is studied (bridge configuration from Ketchum et al. 2004).



Tested bridge

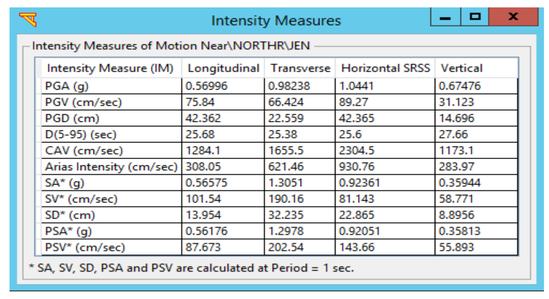


FE model created in MSBridge



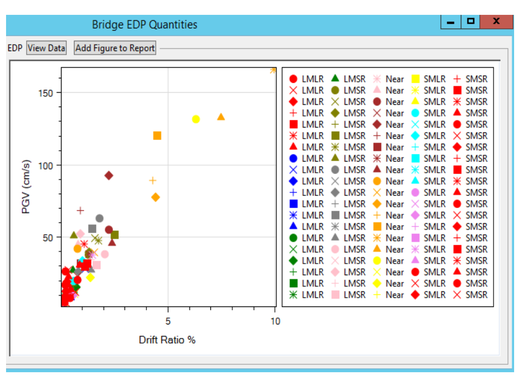
Ground motion viewer

Ground Motions A set of 100 ground motions selected to be representative of seismicity in typical regions in California was employed in this study (Mackie et al. 2007). The motions are divided into 5 bins: i) moment magnitude (Mw) 6.5–7.2 and closest distance (R) 15–30 km (denoted LMSR bin), ii) Mw 6.5–7.2 and R 30–60 km (LMLR), iii) Mw 5.8–6.5 and R 15–30 km (SMSR), iv) Mw 5.8–6.5 and R 30–60 km (SMLR), and v) Mw 5.8–7.2 and R 0–15 km (Near bin).

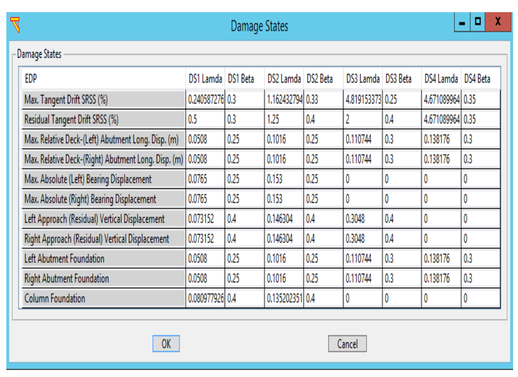


Ground motion intensity measures

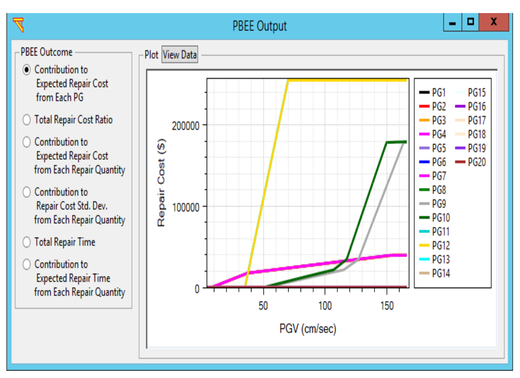
PBEE Outcomes Implementation of the PEER PBEE methodology by Mackie et al. (2010) is employed in this framework.



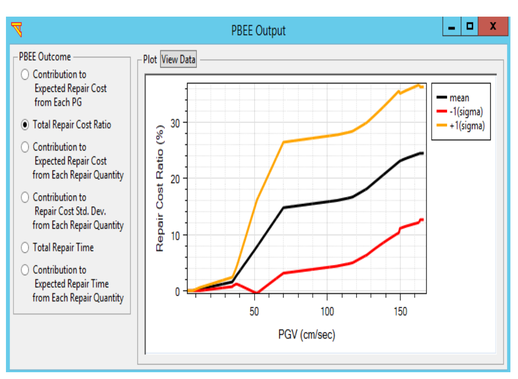
Engineering demand parameters



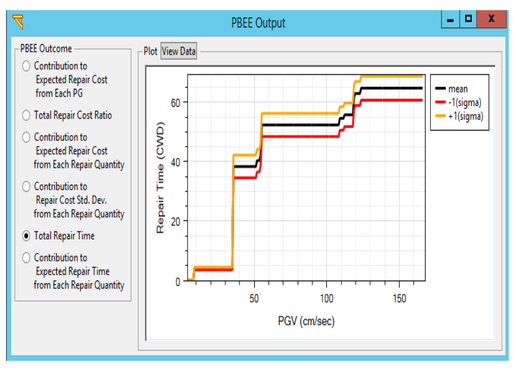
Performance Groups (PG) and Damage states



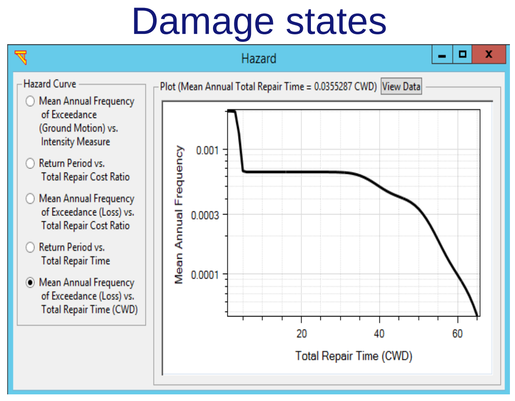
Repair cost



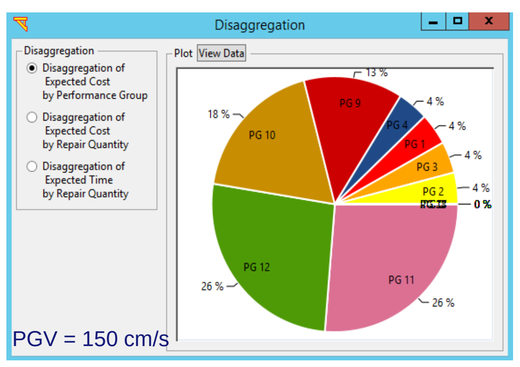
Repair cost ratio



Repair time

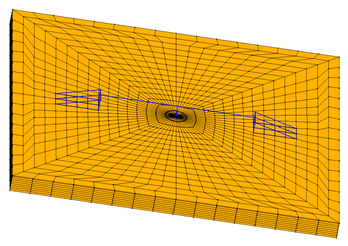


Repair time hazard curve



Disaggregation of repair cost by PG

PBEE analysis for a 2-span single-column bridge is available in BridgePBEE (peer.berkeley.edu/bridgepbee)



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