

Seismic Behavior of Pile-Supported Bridges Considering Soil-Structure Interaction and Structural Non-Linearity

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Abstract : Soil-structure interaction (SSI) in bridges under seismic excitation is a complex phenomenon which involves coupling between the non-linear behavior of bridge pier columns and SSI in the soil-foundation part. It is a common practice in the study of SSI to model the bridge piers as linear elastic while treating the soil and foundation with a non-linear or an equivalent linear modeling approach. Consequently, the contribution of soil and foundation to the SSI phenomenon is disproportionately highlighted. The present study considered non-linear behavior of bridge piers in FEM model of a 4-span, pile-supported bridge that was designed for five different soil conditions in a moderate seismic zone. The FEM model of the bridge system was subjected to a suite of 21 actual ground motions representative of three levels of earthquake hazard (i.e. Design Basis Earthquake, Functional Evaluation Earthquake and Maximum Considered Earthquake). Results of the FEM analysis were used to delineate the influence of pier column non-linearity and SSI on critical design parameters of the bridge system. It was found that pier column non-linearity influenced the bridge lateral displacement and base shear more than SSI for majority of the analysis cases for the class of bridge investigated in the study.

Keywords : bridge, FEM model, reinforced concrete pier, pile foundation, seismic loading, soil-structure interaction

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