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SEISMIC FRAGILITY CURVES OF MULTI-SPAN HIGHWAY BRIDGES CONSIDERING MULTIPLE DAMAGE PARAMETERS

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Recent earthquakes have caused collapse and severe damage to a considerable number of major highway bridges. Bridges are one of the main components of transportation networks. They should be functional before and after earthquakes for emergency services. Therefore we need to assess seismic performance of highway bridges under different seismic loadings. Fragility analysis for highway bridges has become increasingly important in the risk assessment of highway transportation network exposed to seismic hazards. An important issue in Performance-Based Earthquake Engineering (PBEE) is estimation of structural performance under seismic loads. Incremental Dynamic Analysis (IDA) is an emerging analysis method that offers through seismic demand and capacity by using a series of nonlinear dynamic analyses under a multi scaled suit of ground motion records. The purpose of this paper is to develop fragility curves for multi span three classes of highway bridges include concrete simple girder bridges, steel continuous girder bridges and voided slab bridges considering two performance limit state parameters: column ductility and deformation in the abutment. Three dimensional finite-element models of the three 3-spans and three 5-spans bridges modelled in CsiBridge shown in Figures 1 to 3.

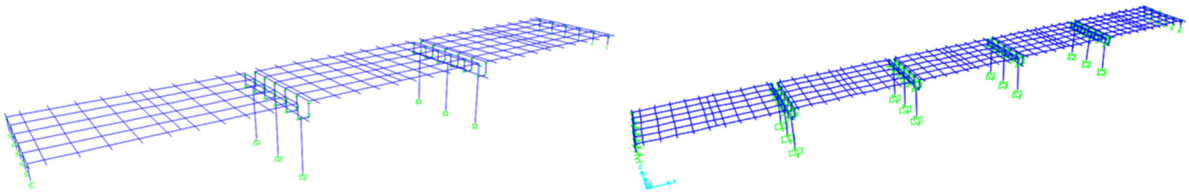

Figure 1. 3D View of 3-span and 5-span concrete simple girder bridges.

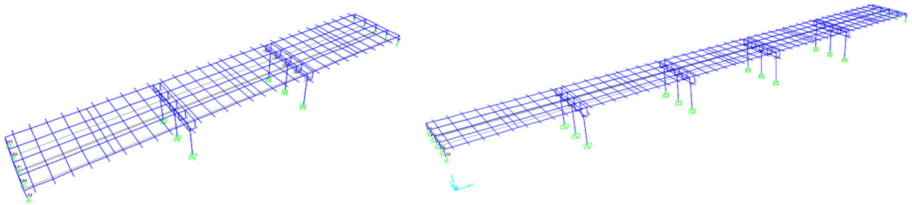

Figure 2. 3D View of 3-span and 5-span steel continuous girder bridges

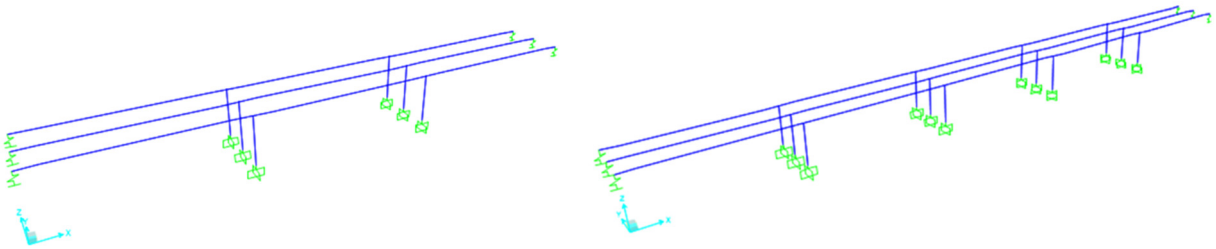

Figure 3. 3D View of 3-span and 5-span voided slab bridges.

Fragility curve is a statistical tool representing the probability of exceeding a given damage state. Fragility curves can be either empirical or analytical. Empirical fragility curves are based on the reported bridge damage from the past earthquakes. Analytical fragility curves are developed through seismic response data from the analysis of bridges. In this study, the analytical fragility curves developed based on incremental nonlinear time history analysis.

The results indicate that the 5-span bridges are more vulnerable than 3-span bridges and continuous bridges are more vulnerable than simple bridges.

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