INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The present study carries out the seismic vulnerability assessment of a class of multispan continuous reinforced concrete Integral Abutment Bridges (IABs) through generation of Fragility Curves (FCs). Analytical models are generated in OpenSees for pier and Pile-Soil System (PSS) (simulating pile-soil interaction), developed herein for bearing and adopted from a past abutment-backfill interaction study for Abutment-Backfill System (ABS). Parametric uncertainties are propagated by creating 144 Bridge System (BS) samples employing Latin Hypercube Sampling Technique (LHST). Capacity (*C*) data (144 values for each) with respect to the Damage States (DSs) of the individual components are obtained while analysing the corresponding damage models (develop herein) for the numerical models of the respective samples. Data roughly follow lognormal distribution for PSS, pier and bearing, and uniform distribution for ABS. Component-level demands are assessed while evolving further the adaptive capacity spectrum method on the numerical models in OpenSees of the BS samples. At each specified value upto 1.8g to which the Peak Ground Acceleration (PGA) and pseudo-spectral acceleration at the time period of 0.7s (S_a (0.7s)) of the nine input ground motions (selected over varying frequency contents) are scaled, 1296 demand (*D*) data values are obtained against each DS; data follow lognormal distribution roughly and show more refinement to the fit and lesser dispersions with respect to S_a (0.7s) than PGA. Component-level FCs are derived through Numerical Computation (NC) of fragilities using the as evaluated *C* and *D* data profiles as well as the traditional Lognormal Formulation (LF) imposing lognormal fit on the *C* and *D* data. With respect to each of the BS DSs (mapped component-level DSs of the same rank), the joint demand cumulative probability surface is generated in MATLAB based on the computed correlations among the component-level demands. The BS FC is derived assuming system failure in a series sequence and comparing the samples (102 nos.) of joint demands with 102 quartets obtained through random pairing of individual 102 samples of the mutually independent component-level capacities, with the sampling done employing LHST on the distributions.

For the IAB class, component-level fragilities are mostly of higher magnitudes with respect to PGA and NC (validated) as compared to S_a (0.7s) and LF. S_a (0.7s) being more optimal than PGA and NC approach being based on the actual *C* and *D* data profiles unlike LF (when the data do not follow lognormal fit), both of them lead to realistic fragility estimates. Abutment-PSS as well as ABS, bearing and pier follow the order of decreasing level of vulnerability, though bearing is the most vulnerable one upto certain initial ranges of PGA and S_a (0.7s). The BS is more vulnerable than the individual components at the same DS ranks, while at higher ranks compared to those of the components, it shows more or less vulnerabilities upto certain PGA and S_a (0.7s) ranges and vice versa beyond.

As future applications to damage or fragility assessment studies over wide ranges of parametric combinations, generalised expressions with respect to the individual component capacities and trends of sequences of attainments of the DSs of the components in cases of continuous and full integral configurations of IABs, are prescribed.

The present work is limited to IABs founded on dry sandy soil sites, elastomeric bearings and fixed-headed piles.