

ABSTRACT

Kolkata lies on the Pericratonic Tertiary Bengal basin and faces constant seismic threat from the Central Himalaya, Northeast India and Bengal Basin. The City is overlain by ~7.5 km thick fluviomarine sediments of Ganga-Brahmaputra-Meghna delta which causes amplification of ground motion fundamentally due to impedance contrast between the sediments and the underlying bedrock. This necessitates site response study of the City, and incorporation of the same in earthquake hazard mapping. In view of this, geophysical and geotechnical investigations *viz.* Microtremor Survey, Multi-channel Analysis of Surface Wave Survey, Downhole Seismic Refraction Survey, and Standard Penetration Test have been carried out in the City at 654 locations. Site Classification of the City has been performed based on effective shear wave velocity (V_s^{30}), delineating site class D3 (V_s^{30} :300-360 m/s), D2 (V_s^{30} :300-240 m/s), D1 (V_s^{30} :180-240 m/s), and E (V_s^{30} <180 m/s) in the terrain. Predominant frequency has been assessed from Horizontal-to-Vertical spectral ratio computed at each Microtremor Survey site. Using the input time series obtained from stochastic simulation of both near-and-far source earthquakes at engineering bedrock and 5% damping for all soil types, both predominant frequency and site response have been estimated through geotechnical analyses. Predominant frequency in Kolkata is seen to vary between 0.67-4.42 Hz while the site amplification is seen to vary between 6.1-2.8. Owing to the presence of potentially liquefiable sediments in the shallow groundwater condition, liquefaction susceptibility analysis has been performed by considering 1897 Shillong and 1934 Bihar-Nepal earthquakes of M_w 8.1. Additionally, a deterministic liquefaction scenario has also been proposed in compliance with the probabilistic seismic hazard model at surface level for 10% probability of exceedance in 50 years. An integrated seismic hazard zonation map of Kolkata has been produced by integrating seismological, geological, geotechnical and geophysical information through Analytical Hierarchical process dividing the City into four hazard zones *viz.* Low, Moderate, High, and Severe. The results of this investigation are expected to play pivotal roles in earthquake-related disaster mitigation and management of the city of Kolkata.

Keywords: Kolkata, Bengal Basin, Effective shear wave velocity, Predominant frequency, Site response, Soil liquefaction.