Abstract

The north eastern region of India is interwoven with numerous tectonic faults. The movement along these faults have resulted in high seismic activity as well as given rise to the Shillong Plateau (SP). The SP is surrounded by the Oldham, Kopili, Dauki and Dhubri faults. Each of these faults has generated earthquakes (EQs) in the past which have caused damages in the SP and surrounding areas. Present study aims at understanding the location and orientation of the faults surrounding the plateau. In order words, this study aims at characterizing the seismic sources located in the vicinity of the SP. Hence a seismotectonic province of 500km radius is developed for identifying and characterizing the potential seismic sources. The seismotectonic region is found to vary in terms of seismicity, tectonic features, geology, thickness of overburden, rupture characteristics, rate of movement. Hence, the seismotectonic region is divided into four seismic source zones namely; 1) the Shillong Plateau - Assam Valley Zone (SP-AVZ), 2) the Indo-Burma Ranges Zone (IBRZ), 3) the Bengal Basin Zone (BBZ) and 4) the Eastern Himalaya Zone (EHZ). EQ catalogues for each source zone is analyzed for completeness of magnitude and time. Seismic parameter 'b' estimated using maximum likelihood method are found as 0.91±0.03 0.94±0.02, 0.80±0.03 and 0.89 ± 0.03 for SP-AVZ, IBRZ, BBZ and EHZ respectively. The SP-AVZ shows relatively high recurrence rate for 1000 years period. Based on 'b' value and return period, SP-AVZ is found as zone of high hazard. The 'b' values are used to estimate the maximum potential magnitudes (M_p) generated by the identified faults. The M_p values are then employed into the GMPEs developed by Toro (2002), NDMA (2010) and Anbazhagan et al. (2013) to perform DSHA for the East Khasi hills, Ri-Bhoi and West Garo hills districts located within the SP. The northern part of East Khasi hills & West Garo hills and eastern part of Ri-Bhoi districts exhibit the highest PHA values of 0.46g at bedrock level. The Barapani fault is found to be responsible for the high PHA values within the East Khasi hills and Ri-Bhoi districts. Whereas in the West Garo hills district the Oldham fault gives high PHA values. In addition, obtained response spectra for Shillong, Nongpoh and Tura indicate the maximum spectral acceleration reaches 0.67g, 0.77g, and 0.64g at 0.1s respectively. PSHA is also performed for the above motioned three districts. In PSHA, similar to DSHA the northern side of East Khasi hills and eastern side of Ri-Bhoi districts show highest PHA values of 0.33g at 10% probability of exceedance. Hazard curves developed in this study show that the Barapani fault is responsible for the high PHA values. For the West Garo hills district however, the southern part shows highest PHA value of 0.14g at10% probability of exceedance. Hazard curves developed for Tura in the West Garo hills district show that Dauki and Dhubri faults are responsible for the high PHA values. It is postulated in this study, that difference in DSHA and PSHA results for the West Garo hills district is due to collective effect of very high seismic hazard along with very low probability of occurrence along sources such as Oldham fault. Thus, even though Oldham fault had caused worst seismic scenario as highlighted in DSHA, its probability of occurrence during the design life is very less as observed from hazard curves based on PSHA.

Uniform hazard spectra are developed for Shillong, Nongpoh and Tura which give spectral acceleration values of 0.30g, 0.46g and 0.22g at 2% probability of exceedance respectively and 0.20g, 0.34g and 0.13g at 10% probability of exceedance respectively. Finally, response of local soil in the SP is assessed considering different EQs at selected sites in the absence of in situ sub soil characteristics. It is found that since the sites are mostly rocky the ground motion amplification is very less within the SP.