Seismicity of Peninsular India and A Case Study of Microzonation and Site Response for Bangalore

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SUMMARY

Many past earthquakes damages necessitate the study of neotectonic seismicity and microzonation of Indian cities. In this paper the seismicity of southern India and a case study of microzonation and site response study of Bangalore will be presented. Southern India, once considered as part of a stable continental region has recently experienced many earthquakes indicating that its perceived low seismicity is not real. The region of the Indian subcontinent south of 20^0N latitude is taken here as Southern India (SI). Part of continental SI has reliably experienced more than 400 earthquakes in a period of 600 years. This number will be much larger if all instrumentally recorded shocks of small magnitudes were also included. A catalogue of earthquakes of magnitude ≥ 3 for Peninsular India (PI) has been compiled by Guha and Basu (1993). With data available upto 1984, Rao and Rao (1984) fitted the frequency-magnitude relationship Log10 N = a-bM to get a=4.4 and b=0.85, for Peninsular India (PI). Seeber et al (1999) have studied the seismicity of PI with particular reference to Maharashtra. They concluded that between 1960 and 1990 the seismicity of PI showed a threefold increase. This was the period during which industrial development also increased several fold in PI. The Indian code on earthquake resistant design of structures IS-1893, presents a zonation map of India which has been revised after the Koyna and Khillari earthquakes. In the revised zonation most of southern India is upgrade from lower zone to higher zones, major part of SI in the seismic zone 2 and 3 smaller part of western cost line in zone 4.

As a case study, a deterministic Seismic Hazard Analysis (DSHA) for the Bangalore, India has been carried out by considering the historic earthquakes, assumed subsurface fault lengths and point source synthetic ground motion model. The sources have been identified using satellite remote sensing images and seismotectonic atlas map of India. Maximum Credible Earthquake (MCE) has been determined by considering the regional seismotectonic activity in about 350 km radius around Bangalore. The seismotectonic map has been prepared by considering the faults, lineaments, shear zones in the area and historic moderate events of more than 125 events having the moment magnitude of 3.5 and above. Vulnerable source has been identified using regional attenuation law. Based on Wells and Coppersmith (1994) relationship, subsurface fault rupture length of about 3.8% of total length of the fault shown to be matching with historic earthquake events in the area. To simulate synthetic ground motions, Boore (1983, 2003) SMSIM programs have been used and the PHA for the different locations is evaluated. Design of seismic resistant structures requires a good estimation of the site amplification during the expected earthquake and also the response spectrum at the ground surface. The subsurface profile was collected from 125 bore logs and site response study has been carried out. The response and amplification spectrum as well as stress and strain have been evaluated for each layer of borehole location. The peak acceleration at ground surface varied from 0.088g to 0.727g. The microzonation map prepared using these outputs indicate varied amplification potential. A peculiar feature of the study region, falling in zone II in the seismic zoning map of India, is its vast portion of reclaimed land from silted ponds/tanks leading to significant variations in ground response. With the amplification factors varying from 1 to 4.5 and period of soil column from 0.08 to 4.5 seconds, the region is moderately amplifying.

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