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An overview of seismic hazard microzonation of Thrissur city, Thrissur District, Kerala, India

Behera, K.K.[1], Lakshminarayanan, B.[1], Umasankar, G.S.R.[1], Kumar, M.S.[1], Reddy, P.R.[1], Rajesh, V.G. [1] and Balaji, P.[1]

[1] GSI, SR, Bandlaguda, Hyderabad-500068, Telangana, India, E-mail: kkbehera.gsi@gmail.com

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Multidisciplinary studies have been conducted for carrying out seismic hazard microzonation of Thrissur (Trichur) city falling under Zone-III in the seismic zonation map of India. For the study of regional seismicity, 451 earthquake events (from 1858 to 2013) falling within a radial distance of 350km from Thrissur city has been considered for determination of maximum credible earthquake (MCE), peak ground acceleration (PGA) and *b*- value. A NNE-SSW trending lineament present at 1.8km north of Thrissur passes through Coimbatore and is presumed to record earthquake of 4.7Mw (occurred on 29 th July, 1972, epicenter located near Coimbatore) has yielded maximum PGA (0.171g) against the zone factor or effective PGA of 0.16 by Bureau of Indian Standards. The *b*- value of 0.447 indicates abundance of small shocks and low stress material at subsurface.

34 nos. of standard penetration test (SPT) boreholes have been explored in different geomorphic units (23 boreholes in Quaternary sediments comprising tidal flat, flood plain, strandline and pediment & 11nos. around Thrissur in laterite/upland areas (Upper Tertiary)) for determination of liquefaction susceptibility/factor of safety *(FS)* as well as depth of bedrock. Out of these, only 3 boreholes could be drilled upto 30m (strandline), whereas rest of the boreholes has depths between 6m and 20m. SPT has been conducted at an interval of every 2m starting from 3m upto 30m and corresponding undisturbed samples have been collected. The N-values obtained at each depth are corrected to obtain the N_{60} value, which has been used for calculation of *FS* against liquefaction. At 3m depth N_{60} value is more than 40 in the upland areas comprising laterite. Strandline comprising sand shows value between 20 and 40. Rest of the area (flood plain and tidal flat) has very low N_{60} value (<20) which comprise admixture of sand, silt and clay. At 5m depth, N_{60} value is more than 30 in the strandline and upland areas, whereas major part of flood plain and tidal flat show the values between 10 and 30. However, at 7m depth, the N_{60} values remained >30 in strandline, whereas the flood plain, tidal flat and laterite show lesser value ranging between <10 and 30. At 9m depth, N_{60} values in major part of the strandline, tidal flat, flood plain including laterite is >30. At a depth of 11m and onward, the N_{60} value is more than 30. On the other hand, tidal flat and laterite fall in very critical category (*FS* < 1) at 3m depth due to presence of sand and clay, but, at 5m depth, major part of the strandline, flood plain and tidal flat are non-liquefiable. At 7m, 9m and 11m depths, the area is safe except in few boreholes, whereas all the areas are safe/non-liquefiable at 13m and 15m depths.

Geophysical survey including i) site response study using three-channel digital seismograph, ii) vertical electrical sounding using Digital Resistivity Potentio Meter, and iii) shallow seismic refraction survey using 24 channel seismograph have been conducted at 231, 41 and 62 locations respectively to determine the site response parameters, such as amplification of the ground motion, natural resonance frequency (f_0) of the soil etc. The shear wave velocity i.e. $Vs=f_0 \times 4H$ (where, *H* is the thickness of

overburden) yielded 100-200m/s in parts of strandline and tidal flat (Quaternary). *Vs* varies between 200m/s and 600m/s in laterite (Tertiary) and higher (1052.8m/s) in hard rock.

Integration has been done considering geomorphology, soil thickness, landuse-landcover, shear wave velocity, amplification factor and predominant frequency following "Weighted Overlay" method for preparation of the integrated seismic hazard zonation map and the area has been thus classified into high, low and very low hazard zones. Comparatively high hazard zones (24.48%) are dominantly located in strandline which is characterized by high amplification, low *Vs* and comparatively deeper soil cover and also records past incidence of liquefaction. Major part of the study area falls in low hazard zones (73.17%) which comprise parts of tidal flat, flood plain and laterite.