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A Static and Dynamic Slope Stability Analysis of Sonapur

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Abstract : Sonapur is an intense hilly region on the border of Assam and Meghalaya lying in North-East India and is very near to a seismic fault named as Dauki besides which makes the region seismically active. Besides, these recently two earthquakes of magnitude 6.7 and 6.9 have struck North-East India in January and April 2016. Also, the slope concerned for this study is adjacent to NH 44 which for a long time has been a sole important connecting link to the states of Manipur and Mizoram along with some parts of Assam and so has been a cause of considerable loss to life and property since past decades as there has been several recorded incidents of landslide, road-blocks, etc. mostly during the rainy season which comes into news. Based on this issue this paper reports a static and dynamic slope stability analysis of Sonapur which has been carried out in MIDAS GTS NX. The slope being highly unreachable due to terrain and thick vegetation in-situ test was not feasible considering the current scope available so disturbed soil sample was collected from the site for the determination of strength parameters. The strength parameters were so determined for varying relative density with further variation in water content. The slopes were analyzed considering plane strain condition for three slope heights of 5 m, 10 m and 20 m which were then further categorized based on slope angles 30, 40, 50, 60, and 70 considering the possible extent of steepness. Initially static analysis under dry state was performed then considering the worst case that can develop during rainy season the slopes were analyzed for fully saturated condition along with partial degree of saturation with an increase in the waterfront. Furthermore, dynamic analysis was performed considering the El-Centro Earthquake which had a magnitude of 6.7 and peak ground acceleration of 0.3569g at 2.14 sec for the slope which were found to be safe during static analysis under both dry and fully saturated condition. Some of the conclusions were slopes with inclination above 40 onwards were found to be highly vulnerable for slopes of height 10 m and above even under dry static condition. Maximum horizontal displacement showed an exponential increase with an increase in inclination from 30 to 70. The vulnerability of the slopes was seen to be further increased during rainy season as even slopes of minimal steepness of 30 for height 20 m was seen to be on the verge of failure. Also, during dynamic analysis slopes safe during static analysis were found to be highly vulnerable. Lastly, as a part of the study a comparative study on Strength Reduction Method (SRM) versus Limit Equilibrium Method (LEM) was also carried out and some of the advantages and disadvantages were figured out.

Keywords : dynamic analysis, factor of safety, slope stability, strength reduction method
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