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Computational Investigation of Soil Liquefaction Susceptibility based on Standard Penetration Test Value of Miri District (Sarawak, Malaysia)

Raudhah Ahmadi[1], Imtiyaz Akbar Najar[2]*, Ahmad Faysal Abdullahi[3], Norazzlina M. Sa'don[1], Hasmida Hamza[4], Nadeem Akbar Najar[5]
[1] *Senior Lecturer, Department of Civil Engineering, Universiti Malaysia Sarawak*
[2]*Research Student, Department of Civil Engineering, Universiti Malaysia Sarawak*
[3]*Assistant Professor, Department of Civil and Environmental Engineering, Dhofar University, Salalah, Oman*
[4]*Lecturer, Department of Civil Engineering, Universiti Malaysia Sarawak*
Ph.D. Student, Centre for Policy Studies, Indian Institute of Technology Bombay, India
**Corresponding Author Email: 18020020@siswa.unimas.my*

Abstract

Miri is a district of Sarawak state of Malaysia and is a coastal area located at the boundary of Brunei. This paper deciphers the analysis of liquefaction susceptibility of the Miri district. Standard penetration test with N values (SPT-N) empirical criteria has been used for evaluating the liquefaction susceptibility in the Miri district. The software LiquefyPro and LiqIT have been used for the analysis by using the Idriss and Boulanger approach as this methodology encompass a simple technique and calculation. This exploration utilized a seismic tremor record from another area well-matched from target response spectrum with comparative qualities of Sarawak earthquake acquired from the Pacific Earthquake Engineering Research Center (PEER) online database (PEER NGA) with a moment magnitude of 6.0 and peak ground acceleration as 0.15 g on the ground surface. The ground motions assigned for assessment are predominantly attentive on a good complete match for the target response spectrum and on actual earthquakes that might happen in Sarawak. Liquefaction potential index (LPI), the factor of safety (Fs) and the probability of liquefaction (PL) for each soil layer was determined and then summed up for each borehole and were used to plot the contour maps by utilizing the geographical information system (GIS). From the results, the overall area of Miri is not liquefiable, only a few sites have liquefaction index as high, moreover, the obtained results of this study by using the methodology of Idriss and Boulanger are reliable. The results of this study can be used in seismic microzonation.

INTRODUCTION

Earthquake is among the world's most devastating natural disasters. Generally, the impacts of solid seismic tremors are brought about by ground shaking, surface ruptures, liquefaction, and less generally, by tidal waves (tsunamis). Liquefaction is a physical phenomenon that can eventually lead to ground failure during some of the earthquakes. The strength of the soil decreases in this phenomenon, often drastically, to the point where it cannot support structures or stay stable. By this phenomenon, the deposits of soil will seem to flow like fluids [1-3]. Soil liquefaction is a process in which saturated, partially saturated and cohesionless soils lose strength and stiffness in response to earthquake shaking or other rapid loadings, resulting in soil liquid behaviour. The pore water pressure in the interior of the soil increases in this process and thereby decreases the effective stress caused by dynamic loading. Effective stress becomes negligible when pore pressure is equal to total stress that causes soil particles to be suspended in water, leading to liquefaction. Retaining walls can tilt or break the liquefied zone's fluid pressure [4]

Because of the loss of bearing quality of the primary soil, heavy building structures can tilt [5] although, it was seen that the significant harm to grounds and structures, was because of liquefaction, [6]. Figure