INTISARI

Bangunan di daerah dengan tingkat seismisitas tinggi dengan lapisan tanah berpasir longgar dan kedalaman air tanah yang dangkal diperlukan perhitungan potensi likuefaksi berdasarkan Standar Desain Seismik Indonesia. Fenomena likuefaksi telah menyebabkan berbagai jenis kerusakan pada struktur di atas dan bawah pada bangunan. Berdasarkan Peta Kerentanan Likuefaksi Indonesia, Sumatra Utara dikategorikan sebagai daerah rawan likuefaksi. Berdasarkan kriteria tersebut, perlu dilakukan analisis potensi likuefaksi dan pengaruhnya terhadap keselamatan bangunan. Penelitian ini bertujuan untuk mengevaluasi kinerja struktural dan stabilitas fondasi *bored pile* akibat pengaruh likuefaksi pada Proyek Konstruksi Stadion di Sumatera Utara.

Analisis potensi likuefaksi dilakukan dengan perhitungan empiris menggunakan metode Idriss dan Boulanger serta pemodelan nonlinier dengan model konstitutif PM4Sand. Percepatan puncak tanah *(PGA)* diperoleh dari analisis bahaya seismik probabilistik *(PSHA)* dan analisis bahaya seismik deterministik *(DSHA)*. *PSHA* didasarkan pada peta bahaya gempa Indonesia dari Pusat Studi Gempa Nasional Indonesia dengan probabilitas lebih dari 2% dalam 50 tahun. *DSHA* dihitung berdasarkan sumber gempa di sekitar lokasi penelitian sesuai dengan Peta Deagregasi Bahaya Seismik Indonesia. Beban gempa yang digunakan untuk analisis nonlinier adalah *synthetic ground motion* berdasarkan spektrum gempa target MCER.

Hasil analisis menunjukkan bahwa lapisan likuefaksi teridentifikasi pada kedalaman 4-15 m berdasarkan 17 data N-SPT. Analisa kinerja struktur juga dilakukan untuk melihat performa bangunan saat terjadi gempa. Pemodelan struktur dilakukan secara 3D dengan beban gempa berdasarkan artificial ground motion. Hasil analisis didapatkan bahwa level kinerja struktur mencapai collapse prevention pada komponen struktur, dan memenuhi persyaratan pada ASCE41:2017. Analisis fondasi dilakukan secara empiris dan numeris pada kondisi servis dan kondisi likuefaksi. Hasil analisis menunjukkan terdapat peningkatan kapasitas deformasi lateral tiang dari tiang tunggal sebesar 16.8 mm menjadi 1.2 mm pada tiang grup pada kondisi likuefaksi. Hal ini menunjukkan bahwa fondasi *bored pile* dapat memikul struktur dengan baik dalam kondisi servis dan likuefaksi.

Kata kunci: Analisisis likuefaksi, Modifikasi gerak tanah, *PM4Sand*, analisis kinerja struktur, Sumatera Utara

ABSTRACT

Buildings in areas with high seismicity, loose sandy soil layers, and shallow groundwater depth require calculations of liquefaction potential based on the Indonesian Seismic Design Standards. The phenomenon of liquefaction has caused various types of damage to both the aboveground and belowground structures in buildings. According to the Indonesian Liquefaction Vulnerability Zone, North Sumatra is categorized as a liquefaction area. Based on these criteria, it is necessary to analyze the liquefaction potential and its effect on the building's safety. This study aims to evaluate the structural performance and the bearing capacity of bored pile foundations due to the liquefaction effect in the Stadium Construction Project in North Sumatera.

Liquefaction potential analysis was performed using empirical calculation with Idriss and Boulanger method and nonlinear modeling with the PM4Sand constitutive model. Peak ground acceleration was obtained from probabilistic seismic hazard analysis, PSHA and deterministic seismic hazard analysis, DSHA. The PSHA is based on the Indonesian earthquake hazard map from the National Earthquake Study Centre of Indonesia with a probability exceeding 2% in 50 years. The DSHA is calculated based on earthquake sources around the research location according to the Seismic Hazard Deaggregation Map of Indonesia. The seismic load used for nonlinier analysis was artificial ground motion based on the target earthquake spectrum MCER.

The liquefaction layers were identified at depths 4-15 m based on 17 N-SPT data. The performance based design is also conducted to assess the building's behavior during an earthquake. The structural modeling is done in 3D with earthquake loads based on synthetic ground motion. The analysis results show that the structural performance level reaches collapse prevention for the structural components and meets the requirements of ASCE41:2017. The foundation analysis is performed both empirically and numerically under service conditions and liquefaction conditions. The analysis results indicate an increase in the lateral deformation capacity of the bored pile, from 16.8 mm in a single pile to 1.2 mm in a group of piles under liquefaction conditions. This demonstrates that the bored pile foundation can support the structure well in both service and liquefaction conditions.

Keywords: Liquefaction Analysis, Ground motion modification, PM4Sand, Performance Based Design, North Sumatera