

INTISARI

Tantangan perencanaan desain infrastruktur ketenagalistrikan memiliki ancaman potensi gempa serta potensi likuefaksi pada lapisan tanah pasiran, sehingga dibutuhkan interpretasi lapisan tanah dengan teliti. Selanjutnya diperlukan analisis likuefaksi setiap lapisan tanah pada hasil uji SPT dengan metode LPI. Perencanaan konfigurasi desain fondasi kemudian dihitung memperhitungkan reduksi daya dukung tiang akibat likuefaksi. Defleksi tiang harus memenuhi kriteria standar SNI 8460-2017 terhadap beban dinamik.

Kriteria gempa menggunakan acuan SNI 8899-2020 modifikasi gerak tanah permukaan serta fungsi atenuasi NGA-West2. Metode perhitungan menggunakan *mean spectral matching* untuk mengetahui nilai percepatan akselogram. Perilaku tiang bor disimulasikan menggunakan Plaxis 2D untuk mengetahui defleksi maksimum tiang dan respon *non-linier* tanah-pondasi saat kondisi gempa. Analisis likuefaksi menggunakan metode simplifikasi oleh (Idriss dan Boulanger, 2010; H Bolton Seed dan Idriss, 1971) untuk menghitung nilai rasio CRR dan CSR, Sedangkan nilai tingkat potensi likuefaksi (LPI) dihitung berdasarkan (Iwasaki dkk., 1982). Analisis daya dukung tiang menggunakan metode (Reese dan O'Neill, 1989) untuk tahanan ujung dan gesek, sedangkan perhitungan negatif friksi mengacu pada persamaan (Dan A. Brown dkk., 2018) menggunakan nilai tegangan efektif.

Hasil interpretasi, lapisan tanah pasiran dengan konsistensi lepas paling dominan adalah BH-01. Selaras dengan hasil interpretasi profil BH-01 memiliki ancaman potensi paling tinggi terhadap likuefaksi dengan nilai LPI adalah 17.79 (sangat tinggi), dengan lapisan likuefaksi kedalaman 4 hingga 18 meter. Konfigurasi desain tiang yang optimal didapatkan diameter 0.6 dengan jumlah 13 tiang. Hasil perhitungan stabilitas fondasi didapatkan kapasitas aksial mengalami reduksi sekitar 72,66% dari kondisi statik ke dinamik. Hasil respon *non-linier* pemodelan Plaxis 2D dengan desain tiang menembus lapisan likuefaksi hingga kedalaman 20 meter didapatkan defleksi lateral tiang sebesar 18,18 mm, atau memenuhi syarat kurang dari ($\leq$ 25 mm) sesuai SNI 8460-2017. Hal ini menunjukkan interaksi material tanah dan tiang pada zona pasir terlikuefaksi tetap menghasilkan defleksi tiang cukup signifikan.

Kata kunci: Likuefaksi, Fondasi tiang bor, Plaxis 2D

ABSTRACT

The design of power infrastructure faces challenges associated with seismic hazards and the potential for liquefaction in sandy soil layers, requiring careful interpretation of subsurface soil conditions. Liquefaction analysis was subsequently conducted for each soil layer based on Standard Penetration Test (SPT) data using the Liquefaction Potential Index (LPI) method. The foundation design configuration was then evaluated by considering the reduction in pile bearing capacity caused by liquefaction. Furthermore, pile deflection was assessed to ensure compliance with the requirements specified in SNI 8460:2017 under dynamic loading conditions.

The seismic criteria were established in accordance with SNI 8899:2020, incorporating modified surface ground motions and the NGA-West2 ground motion prediction equations. A mean spectral matching approach was employed to determine the acceleration time-history records (accelerograms). The behavior of the bored pile foundation was simulated using Plaxis 2D to evaluate the maximum pile deflection and the nonlinear soil–foundation response under earthquake loading conditions. Liquefaction analysis was performed using the simplified procedures proposed by (Idriss and Boulanger, 2010; H Bolton Seed and Idriss, 1971) to determine the CRR and CSR. The Liquefaction Potential Index (LPI) was calculated based on the method developed by (Iwasaki et al., 1982). Pile bearing capacity was evaluated using the method of (Reese and O'Neill, 1989) for end-bearing and shaft resistance, while negative skin friction was calculated using the effective stress approach proposed by (Dan A. Brown et al., 2018).

The soil profile interpretation indicated that loose sandy layers were predominantly encountered at BH-01. Consistent with this interpretation, BH-01 exhibited the highest liquefaction susceptibility, with an LPI value of 17.79, classified as a very high liquefaction risk. The liquefiable layers were identified at depths ranging from 4 m to 18 meters. The optimum pile foundation configuration consisted of thirteen piles with a diameter of 0.6 meters. The foundation stability analysis revealed that the axial bearing capacity decreased by approximately 72.66% from static to dynamic conditions due to liquefaction effects. The nonlinear response obtained from the Plaxis 2D simulation, with piles penetrating through the liquefiable layer to a depth of 20 m, showed a maximum lateral pile deflection of approximately 18.18 mm. This value satisfies the requirements of SNI 8460:2017, which limits pile deflection to 25 mm or less. These findings indicate that the interaction between the pile and the liquefied sandy soil layer still produces a considerable pile deflection, although the performance remains within the allowable design criteria.

Keywords: *Liquefaction, Drilled shaft foundation, Plaxis 2D*