INTISARI

Likuefaksi merupakan fenomena hilangnya tegangan efektif tanah berjenis kepasiran lepas akibat peningkatan tekanan air pori yang dipicu oleh gempa kuat sebagai beban siklik. Dalam sejarahnya, peristiwa likuefaksi dapat menyebabkan keruntuhan bangunan, diantaranya adalah Gempa Niigata 1967 dan Gempa Palu 2018. Gempa Niigata 1964 mengakibatkan gedung apartemen terguling dan Jembatan Showa runtuh. Sementara pada Gempa Palu 2018 mengakibatkan sebaran lateral tanah yang masif, gedung ambruk, dan Jembatan Palu IV runtuh. Penelitian ini dilakukan untuk mengestimasi potensi likuefaksi yang terjadi di jembatan dan menilai kinerja fondasi tiang bor terhadap pengaruh dari likuefaksi.

Penelitian berlokasi di Jembatan Kretek 2, Kabupaten Bantul, D.I. Yogyakarta yang termasuk ke dalam area kerawanan likuefaksi tinggi-sedang. Studi likuefaksi dilakukan secara komprehensif dengan meninjau berbagai aspek; studi kegempaan menggunakan respon spesifik situs, studi potensi likuefaksi menggunakan pendekatan *preliminary* terhadap butiran tanah dan empiris menggunakan data N-SPT, studi korelasi peningkatan rasio tekanan air pori terhadap faktor keamanan dan probabilitas likuefaksi, studi pengaruh likuefaksi pada fondasi tiang bor menggunakan pendekatan empiris dan model numeris, dan studi pengaruh penggunaan *lead rubber bearing* pada jembatan terhadap reduksi beban gempa sebagai langkah mitigasi likuefaksi.

Hasil analisis kegempaan menunjukkan sumber gempa dominan adalah Gempa Bantul 2006 dengan kekuatan 6.2 M_w di kedalaman 17.2 km menghasilkan akselerasi di permukaan 0.558 g. Hasil analisis potensi likuefaksi secara *preliminary* membuktikan adanya potensi likuefaksi pada area jembatan. Hasil pendekatan empiris dan Settle3 menunjukkan lapisan tanah yang berpotensi terlikuefaksi pada kedalaman 0-6 m secara konsisten. Hasil analisis kenaikan air pori secara empiris dan Deepsoil v7.0 menunjukkan korelasi antara nilai faktor keamanan terhadap rasio kenaikan tekanan air pori. Hasil analisis kuantitatif dan kualitatif potensi likuefaksi menunjukkan sisi bagian utara bentang utama jembatan memiliki kecenderungan potensi yang lebih tinggi. Hasil analisis kapasitas dukung aksial tekan secara empiris, pemodelan MIDAS GTS NX, dan hasil uji PDA menunjukkan fondasi mampu menerima beban yang berkerja saat kondisi statis maupun likuefaksi. Hasil analisis kapasitas dukung lateral fondasi menggunakan MIDAS Civil dan GTS NX dibandingkan dengan hasil uji SLT juga menunjukkan tiang mampu dalam menerima beban saat kondisi statis dan likuefaksi. Hasil pemodelan *lead rubber bearing* sebagai perletakan jembatan secara efektif dapat mengurangi beban gempa hingga 64.48% dan dapat mengakomodir perpindahan yang lebih besar. Berdasarkan beberapa hasil analisis, disimpulkan bahwa fondasi Jembatan Kretek 2 yang terpasang memiliki ketahanan yang cukup untuk menerima beban saat kondisi likuefaksi.

Kata kunci: kegempaan, potensi likuefaksi, tekanan air pori, kapasitas dukung fondasi, *lead rubber bearing*.

ABSTRACT

Liquefaction is a phenomenon of effective stress loss in loose sandy soils due to the increase in pore water pressure induced by a strong earthquake as cyclic loading. Historically, liquefaction events have caused building collapses, including 1967 Niigata earthquake and 2018 Palu earthquake. The 1964 Niigata earthquake caused the apartment building and the Showa Bridge to collapse. While 2018 Palu earthquake resulted in massively lateral spreading of soil, buildings collapsed, and the Palu IV bridge collapsed. This study was delivered to estimate the potential for liquefaction experienced at the bridge and to evaluate the bored pile foundation's performance against effects of liquefaction.

The research located at the Kretek 2 Bridge, Bantul Regency, D.I. Yogyakarta, belongs to the area of high-medium vulnerability liquefaction. The liquefaction study was conducted comprehensively by checking various aspects; seismic studies using site-specific responses, liquefaction potential studies using preliminary for soil grains and empirical approaches using N-SPT data, and correlation of increased pore water pressure ratio with safety factor and liquefaction probability. Furthermore, this research also studies liquefaction effects on bored pile foundations using empirical approaches and numerical models. Lastly, for liquefaction mitigation, this study also examines the impact of using Lead rubber bearings on bridges to reduce seismic loads.

The seismic analysis showed that the earthquake's primary source was the 2006 Bantul earthquake, with a magnitude of 6.2 Mw at a depth of 17.2 km, resulting in a surface acceleration of 0.558 g. Preliminary results of the liquefaction potential analysis reveal a liquefaction potential in the bridge area. The empirical approach and Settle3 for liquefaction results show a top layer that has the potential to liquefy at depths of 0 to 6 m. The excess pore water analysis results of empirical and Deepsoil v7.0 show a correlation between safety factor and excess pore water pressure ratio. The quantitative and qualitative analysis of the liquefaction potential results shows that the north side of the bridge's main span tends to have a higher potential. The axial bearing capacity analysis by empirical approach, MIDAS GTS NX modeling, and PDA test results show that the foundation can withstand the working load under static and liquefaction states. The lateral bearing capacity analysis of the foundation using MIDAS Civil and GTS NX compared to the SLT test result shows that the pile foundation can carry out loads under static and liquefaction states. The modeling lead rubber bearing result as bridge support shows it can reduce seismic loads effectively by up to 64.48% and still accommodate larger displacements. Based on several analysis results, it is concluded that foundation of Kretek 2 Bridge has sufficient resilience to take in loads during liquefaction states.

Keywords: seismicity, liquefaction potential, pore water pressure, foundation bearing capacity, lead rubber bearing.