INTISARI

Bunaken terletak di sisi utara Pulau Sulawesi dan termasuk dalam Kawasan Taman Laut Nasional Bunaken. Bunaken terletak dekat dengan *North Sulawesi Thrust* yang berpotensi menyebabkan gempa di utara Pulau Sulawesi. Pesisir pantai Pulau Bunaken bagian selatan terdiri atas material endapan berusia holocene, lokasinya yang terpengaruh pasang surut air laut menyebabkan daerah tersebut rawan terhadap likuefaksi. Sebuah bangunan dibangun sebagai bagian dari renovasi Kawasan Wisata Bunaken. Bangunan berdiri diatas tiang pancang berdiameter 45 cm yang ditanam sedalam 13 m. Penelitian ini bertujuan untuk mengetahui potensi likuefaksi di Pulau Bunaken, mengetahui nilai parameter gempa terkecil yang dapat menyebabkan likuefaksi, dan melakukan evaluasi stabilitas fondasi yang akan dibangun.

Empat buah titik bor diambil di sekitar lokasi penelitian dan didapatkan bahwa tanah di lokasi berupa tanah pasir lepas dan gravel. Dimodelkan sebuah gempa yang bersumber dari *North Sulawesi Thrust*. PGA kemudian dianalisis dengan metode Liu and Tsai (2005), Abrahamson et al. (2016), Atkinson and Boore (2003), dan Zhao et al. (2006). Analisis potensi likuefaksi dilakukan dengan metode empiris Idriss and Boulanger (2008). Dengan memisalkan beberapa gempa, ditentukan nilai gempa minimal yang dapat memicu potensi likuefaksi. Evaluasi terhadap stabilitasi fondasi dilakukan dengan meninjau daya dukung dan deformasi tiang. Daya dukung tiang dianalisis dengan persaman empiris Meyerhof (1979). Deformasi dianalisis dengan software Plaxis 2D v8.6. Analisis Plaxis memodelkan kondisi statis, kondisi gempa, kondisi likuefaksi, dan kondisi ekstrem likuefaksi dan gempa terjadi bersama-sama. Analisis gempa dilakukan secara dinamis menggunakan rekaman data gempa Mentawai 2007.

Dari analisis potensi likuefaksi didapatkan bahwa keempat titik bor memiliki potensi likuefaksi pada beberapa lapisan tanah dengan klasifikasi LPI dari rendah, sedang, dan sangat tinggi. Titik BH02 merupakan titik paling rawan terhadap potensi likuefaksi. Parameter gempa minimal yang menyebabkan potensi likuefaksi di BH02 adalah magnitudo 6,4 dan PGA 0,09 dengan metode Abrahamson et al. (2016). Daya dukung tiang pada kondisi likuefaksi mengalami penurunan sebesar 10,71% dari kondisi normalnya. Deformasi fondasi setelah kejadian gempa mengalami kenaikan yang signifikan dibandingkan kondisi normalnya. Deformasi menjadi semakin besar pada kondisi likuefaksi dan kondisi gempa ekstrem. Pemodelan gempa dengan rekaman gempa memudahkan untuk melihat deformasi dan gaya setiap periode waktu. Deformasi tanah pada saat terjadi gempa berubah-ubah seiring dengan perubahan akselerasi gempa yang bekerja. Gaya dalam fondasi (*axial force, shear force dan bending moment*) mengalami kenaikan pada pemodelan gempa, likuefaksi, dan kondisi ekstrem. Kondisi ekstrem menyebabkan fondasi mengalami gaya dalam yang paling besar. Analisis yang dilakukan terhadap fondasi infrastruktur kawasan wisata Bunaken pada simulasi gempa Mentawai 2007 dan likuefaksi menunjukkan bahwa daya dukung tiang fondasi sudah memenuhi ketentuan SNI 8460:2019, akan tetapi belum memenuhi ketentuan untuk parameter penurunan yang diizinkan.

Kata kunci: Bunaken, likuefaksi, LPI, daya dukung fondasi tiang, analisis dinamik, plaxis 2D

ABSTRACT

Bunaken is located at the northern tip of Sulawesi Island. It is part of Bunaken National Marine Park and popular for its underwater scenery. Bunaken is located close to The North Sulawesi Thrust which causes earthquakes in Sulawesi Island's northern waters. The coast of the southern part of Bunaken Island consists of Holocene-age sedimentary material, affected by tides, so it's making the area prone to liquefaction. As part of the renovation of the Bunaken Tourism Area, a building was constructed on piles with a diameter of 45 cm planted to a depth of 13 m. This study aims to determine the potential for liquefaction on Bunaken Island, identify the smallest earthquake parameter that can trigger liquefaction, and evaluate the stability of the foundation to be built.

For research purposes, drilling was carried out at four points around the arrival pier of Bunaken Island. It was found that the soil at the location consisted of loose sand and gravel. An earthquake originating from the North Sulawesi Thrust was modeled in this study. The Peak Ground Acceleration (PGA) value was then analyzed using several methods by Liu and Tsai (2005), Abrahamson et al. (2016), Atkinson and Boore (2003), and Zhao et al. (2006). Meanwhile, the analysis of liquefaction potential was carried out using the empirical method by Idriss and Boulanger (2008). By assuming various earthquakes, the minimum earthquake parameter that can trigger liquefaction potential was determined. Then, the evaluation of foundation stability was made by reviewing the bearing capacity and pile deformation. The bearing capacity of the piles was analyzed using the empirical equation by Meyerhof (1979), whereas the deformation was analyzed with Plaxis 2D v8.6 software. The Plaxis analysis modeled static, earthquake, and liquefaction conditions, as well as extreme conditions of liquefaction and earthquakes occurring together. Furthermore, the earthquake analysis was performed dynamically using recorded data from the 2007 Mentawai earthquake.

From the liquefaction potential analysis, it was found that the four boreholes have liquefaction potential in several layers of soil, with the classification based on the Liquefaction Potential Index (LPI), namely low, medium, high, and very high. The BH02 borehole is the most vulnerable to liquefaction potential. Based on the analysis applying the Abrahamson et al. (2016) method, the minimum earthquake parameters that trigger liquefaction potential at BH02 are magnitude 6.4 and PGA 0.09. Furthermore, the bearing capacity of the piles in liquefaction conditions was found to experience a decrease by 10,71% from normal conditions. On the other hand, foundation deformation after the earthquake has increased significantly compared to normal conditions. This deformation becomes larger in liquefaction conditions and extreme earthquake conditions. Earthquake modeling with earthquake records facilitates observation of deformations and forces over time periods. Soil deformation upon the occurrence of an earthquake changes along with changes in the acceleration of the occurring earthquake. Meanwhile, forces in the foundation (axial force, shear force, and bending moment) increase in modeling earthquakes, liquefaction, and extreme conditions. Such extreme conditions cause the foundation to experience the greatest internal forces. Analysis conducted on the foundation of Bunaken tourism infrastructure area during the 2007 Mentawai earthquake simulation and liquefaction showed that the bearing capacity of the foundation piles complies with the provisions of SNI 8460:2019, while the settlement of the foundation has not complied with the provisions.

Keywords: Bunaken, liquefaction, LPI, pile foundation's bearing capacity, dynamic analysis, plaxis 2D