

Pembangunan Jalan Tol Yogyakarta – Bawen ditetapkan sebagai Proyek Strategis Nasional (PSN) berdasarkan Peraturan Presiden Nomor 58 tahun 2017 tentang Percepatan Pelaksanaan Proyek Strategis Nasional guna mempercepat pertumbuhan ekonomi dan konektivitas khususnya wilayah Yogyakarta, Solo dan Semarang. Namun, pembangunan jalan tol ini harus memperhitungkan dampak bahaya bencana alam yang mungkin terjadi seperti gempa bumi serta efek lanjutannya yaitu likuefaksi. Pada saat terjadi gempa Yogyakarta tahun 2006 dengan kekuatan  $M_w$  6.3, beberapa wilayah di Kabupaten Klaten mengalami kejadian likuefaksi seperti *sand boiling*, pergeseran lateral, dan penurunan tanah. Penelitian ini bertujuan untuk menganalisis potensi likuefaksi yang dapat terjadi pada Pembangunan Jalan Tol Yogyakarta – Bawen Seksi 3 STA 44+600 – 52+800. Lokasi tersebut berada pada Kecamatan Mungkid dan Kecamatan Magelang, Kabupaten Magelang, Provinsi Jawa Tengah.

Analisis potensi likuefaksi pada lokasi penelitian dilakukan menggunakan 94 data N-SPT hasil pengujian lapangan. Data seismik refraksi dan data geolistrik digunakan untuk memvalidasi kondisi lapisan tanah pada daerah penelitian. Pengukuran data mikrotremor dilakukan sebagai data pembanding untuk menghitung nilai PGA. Analisis preliminer dilakukan dengan melakukan analisis distribusi ukuran butir tanah dan korelasi kondisi stratigrafi daerah penelitian. Analisis potensi likuefaksi secara empiris dilakukan dengan Metode *Simplified Procedure*. Analisis indeks potensi likuefaksi dilakukan menggunakan metode *Liquefaction Potential Index* (LPI). Analisis indeks keparahan likuefaksi dilakukan menggunakan metode *Liquefaction Severity Index* (LSI). Analisis indeks perpindahan lateral dilakukan menggunakan metode *Lateral Displacement Index* (LDI). Analisis penurunan tanah pasca likuefaksi dilakukan menggunakan metode Ishihara dan Yoshimine (1992). Analisis pengaruh likuefaksi terhadap kapasitas dukung tiang bor menggunakan persamaan empiris difokuskan pada STA 50+789. Kemudian, analisis kapasitas dukung tiang bor dilanjutkan dengan melakukan pemodelan menggunakan perangkat lunak *RSPile* untuk mengetahui kapasitas dukung aksial, pergeseran lateral, dan penurunan tiang bor pada kondisi tanah tidak terlikuefaksi maupun pada saat kondisi tanah terlikuefaksi.

Hasil analisis LPI menunjukkan bahwa terdapat 4 titik bor dari 94 titik bor yang berpotensi likuefaksi dengan tingkat potensi rendah hingga sangat tinggi. Analisis LSI menunjukkan bahwa terdapat 4 titik bor dengan tingkat keparahan likuefaksi sangat rendah hingga rendah. Analisis LDI menunjukkan nilai perpindahan antara 0 - 3.84 m. Analisis penurunan tanah pasca likuefaksi menunjukkan tanah mengalami penurunan sebesar 0.11 – 0.42 m dengan tingkat kerusakan rendah hingga tingkat kerusakan luas. Hasil pemodelan menggunakan perangkat lunak *RSPile* menunjukkan tiang bor STA 50+789 pada kondisi tanah terlikuefaksi mengalami penurunan kapasitas dukung dari 42669.35 kN menjadi 37666.83 kN atau sebesar 11.72%.

Kata kunci: Tol Yogyakarta – Bawen Seksi 3, *lateral displacement*, *settlement*, kapasitas dukung fondasi, *RSPile*

## ABSTRACT

*The construction of the Yogyakarta – Bawen Toll Road was designated as National Strategic Project (PSN) based on Presidential Regulation No. 58, 2017 on Acceleration the Implementation of National Strategic Projects. The implementation of the toll road is anticipated to enhance connectivity and improve economic expansion, particularly in the Yogyakarta, Solo, and Semarang regions. Nevertheless, the design and construction of these toll roads must include the possible consequences of natural disasters such as earthquakes, including the resulting liquefaction phenomenon. During the 2006 Yogyakarta earthquake, reportedly had a magnitude of 6.3 Mw, certain regions in Klaten Regency encountered liquefaction phenomena, including sand boiling, lateral spreading, and soil settlement. The objective of this study is to examine the possibility of liquefaction during the construction of Section 3 of the Yogyakarta — Bawen Toll Road, namely from STA 44+600 to 52+800. The area is situated in both Mungkid District and Magelang District, within the Magelang Regency of the Central Java Province.*

*Analysed the liquefaction potential at the research site utilising 94 N-SPT data obtained from field testing. Refraction seismic and geolistric data are used to validate the condition of the soil layers in the research area. Microtremor data were carried out as comparative data to calculate the PGA. The initial analysis is conducted by examining the distribution of soil particle sizes and establishing the relationship between the stratigraphic conditions in the study region. The assessment of the likelihood of liquefaction is carried out by an empirical approach utilising a Simplified Procedure. The Liquefaction Potential Index (LPI) approach was utilised to conduct the analysis of liquefaction potential index. An examination of liquefaction severity index was conducted using the Liquefaction Severity Index (LSI) method. The Lateral Displacement Index (LDI) approach was utilised to conduct an analysis of the lateral displacement index. Analysed the settlement of soil after liquefaction using the Ishihara and Yoshimine method (1992). The study analyses the impact of liquefaction on the bearing capacity of bore piles, specifically focusing on STA 50+789, through the application of empirical equations. Next, the analysis of the bearing capacity of the bore pile was furthered through modelling with the software RSPile. This was done to ascertain the axial bearing capacity, lateral displacement, and settlement of the bore pile foundation under normal ground conditions and during liquefaction.*

*Out of the total of 94 drill holes analysed, the liquefaction potential index indicates that 4 of them have varying levels of potential for liquefaction, ranging from low to very high. The analysis of the liquefaction severity index revealed that there are four drill holes showing a range of extremely low to low liquefaction severity. The analysis of the lateral displacement index revealed displacement measurements ranging from 0 to 3.84 metres. The examination of soil settlement after liquefaction revealed a sinking of 0.11 to 0.42 metres, resulting in varying degrees of damage. The modelling results obtained using the RSPile programme indicated that the bore pile located at STA 50+789, when subjected to liquefied soil, exhibited a reduction in its bearing capacity from 42669.35 kN to 37666.83 kN, representing a loss of 11.72%.*

**Keywords:** Yogyakarta – Bawen Toll Road Section 3, lateral displacement, settlement, bearing capacity, RSPile,