



INTISARI

Likuifaksi yang masif dan destruktif terjadi di Kota Palu dan sekitarnya saat Gempa Palu 28 September 2018. Gempa terjadi akibat pergeseran Sesar Palu Koro yang memotong Kota Palu dengan *rupture* patahan merambat dari epicenter ke selatan menuju Kota Palu. Arah rambatan *rupture* mengindikasikan Kota Palu mengalami efek *directivity* dengan karakteristik *near-fault (NF) ground motion*. Penelitian ini bertujuan untuk menganalisis pengaruh *NF ground motion* terhadap likuifaksi pada Gempa Palu 2018. Penelitian dilakukan dengan menggunakan studi parametrik dan studi kasus. Data yang digunakan berasal dari data historis *NF ground motion* yang telah diklasifikasi dan dilakukan penyaringan. Studi parametrik dilakukan dengan analisis statistik dan analisis respons situs nonlinier. Analisis statistik dilakukan untuk mengetahui karakteristik data historis *NF ground motion*. Analisis respons situs dilakukan untuk mengetahui pengembangan rasio tekanan air pori dengan pendekatan tegangan efektif secara 1D menggunakan perangkat DEEPSOIL. Estimasi koefisien korelasi untuk mengetahui hubungan antara rasio tekanan air pori dengan parameter *ground motion*. Studi kasus dilakukan untuk mengevaluasi likuifaksi akibat *NF ground motion* saat Gempa Palu 2018 dengan analisis respons situs. Analisis dimulai dengan pemilihan model atenuasi yang sesuai dan estimasi nilai PGA lokasi. Hasil penelitian menunjukkan *NF ground motion* dapat terjadi pada mekanisme Sesar Normal, Sesar Naik, Sesar Naik Miring dan Sesar Geser. Sesar Geser memiliki frekuensi kejadian yang paling banyak dibandingkan mekanisme sesar lainnya. *NF ground motion* dapat terjadi pada lokasi dengan *Rrup* 0 – 60 km dengan frekuensi paling banyak pada 0 – 30 km. Pada *NF ground motion* rasio tekanan air pori berkorelasi positif cukup kuat dengan PGV dan HI ($r = 0,56 - 0,57$) dan berkorelasi lemah dengan PGA, PGD dan AI ($r = 0,31 - 0,39$) serta berkorelasi sangat lemah dengan Durasi signifikan (D_{5-95}) ($r = 0,22$) dan jumlah N siklik ($r = 0,23$). Sementara itu PGV berkorelasi kuat dengan HI ($r = 0,93$) sedangkan PGA berkorelasi kuat dengan AI ($r = 0,72$) dan berkorelasi negatif lemah dengan D_{5-95} ($r = -0,32$). *NF ground motion* menghasilkan rasio tegangan siklik (CSR), rasio tekanan air pori, regangan dan perpindahan yang lebih besar dibandingkan dengan *general ground motion* meskipun dengan PGA dan D_{5-95} yang identik. Estimasi PGA di lokasi penelitian menggunakan model atenuasi Campbell dan Bozorgnia sebesar 0,43 g. Hasil analisis respons situs dengan *input motion NF ground motion* menunjukkan likuifaksi pada Gempa Palu 2018 dipengaruhi oleh parameter PGV. PGV *NF ground motion* merepresentasikan kepadatan energi seismik. Besarnya energi seismik dan kondisi geoteknik menyebabkan manifestasi likuifaksi terjadi pada *forward directivity region* dengan sebaran pada arah *fault-normal*.

Kata kunci: *near-fault ground motion*, parameter *ground motion*, koefisien korelasi, analisis respons situs, rasio tekanan air pori, likuifaksi.



ABSTRACT

Massive and destructive liquefaction occurred in Palu City and its surroundings during the September 28, 2018, Palu Earthquake. The earthquake occurred due to the displacement of the Palu Koro Fault that crosses Palu City, and the rupture propagated from the epicenter to the south towards Palu City. The direction of rupture propagation indicates that Palu City experienced directivity effects with near-fault (NF) ground motion characteristics. This study aims to analyze the influence of NF ground motion on liquefaction in the 2018 Palu Earthquake. The research was conducted through parametric studies and case studies. The data used comes from historical NF ground motion data that has been classified and filtered. Parametric studies were conducted using statistical analysis and nonlinear site response analysis. Statistical analysis was performed to characterize the historical NF ground motion data. Site response analysis was conducted to determine the development of pore water pressure ratio with a 1D effective stress approach using DEEPSOIL. Correlation coefficient estimation to determine the relationship between pore water pressure ratio and ground motion parameters. A case study was conducted to evaluate liquefaction due to NF ground motion during the 2018 Palu Earthquake by site response analysis. The analysis started with selecting a suitable attenuation model and estimation of the PGA value of the site. The results show that NF ground motion can occur in Normal Fault, Reverse Fault, Reverse Oblique Fault, and Strike-Slip Fault mechanisms. Strike-slip faults have the highest frequency of occurrence than other fault mechanisms. NF ground motion can occur at Rrup 0 - 60 km locations, with the most frequency at 0 - 30 km. In NF ground motion, the pore water pressure ratio is strongly positively correlated with PGV and HI ($r = 0,56 - 0,57$), weakly correlated with PGA, PGD, and AI ($r = 0,31 - 0,39$), very weakly correlated with significant durations (D_{5-95}) ($r = 0,22$) and number of N cyclic ($r = 0,23$). Meanwhile, PGV was strongly correlated with HI ($r = 0,93$), while PGA was strongly correlated with AI ($r = 0,72$) and weakly negatively correlated with D_{5-95} ($r = -0,32$). NF ground motion produces a greater cyclic stress ratio (CSR), pore water pressure ratio, strain, and displacement than general ground motion, even with similar PGA and D_{5-95} . The estimated PGA at the study site using the Campbell and Bozorgnia attenuation model is 0,43 g. The results of the site response analysis with NF ground motion input showed that the PGV parameter influenced liquefaction in the 2018 Palu Earthquake. PGV NF ground motion represents seismic energy density. The amount of seismic energy and geotechnical conditions cause liquefaction manifestations to occur in the forward directivity region with distribution in the fault-normal direction.

Keywords: *near-fault ground motion, ground motion parameters, correlation coefficient, site response analysis, pore water pressure ratio, liquefaction*