Pemodelan Likuefaksi Deposit Pasir - Kerikil Berlapis Terhadap Gerak Tanah Gempa Palu dengan Software OpenSees = Liquefaction Modeling of Layered Sand - Gravel Deposit Towards Palu Earthquake's Ground Motion Using OpenSees Software

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Abstrak

Fenomena likuefaksi akibat beban dinamis biasanya terjadi pada jenis tanah tidak berkohesi (cohesionless soil) karena sifatnya yang tidak memiliki daya lekat antar partikel. Kerikil merupakan contoh tanah tidak berkohesi namun kerentanan terhadap likuefaksi tergolong rendah karena sifatnya yang mudah mengalirkan air pori. Namun, sebuah deposit tanah tidak hanya terdiri atas satu jenis tanah saja, yang menyebabkan kemungkinan terjebaknya air pori berlebih ketika tanah tersebut dikenai beban gempa sehingga meningkatkan kerentanan terhadap likuefaksi. Penelitian ini dilakukan untuk mengetahui respons tekanan air pori, regangan geser, dan perpindahan lateral pada tanah pasir – kerikil apabila dikenai beban gempa. Penelitian ini menggunakan gerak tanah gempa Palu 2018 sebagai beban dinamis karena gerak tanah ini menyebabkan terjadinya salah satu fenomena likuefaksi paling buruk yang terjadi di Indonesia. Dilakukan permodelan dua deposit tanah hingga kedalaman 30 meter menggunakan model konstitutif PM4Sand dan PM4Silt dan elemen SSPquadUP. Pemodelan dilakukan software OpenSees dengan analisis berbasis nonlinear dynamic Effective Stress Analysis (ESA). Didapatkan penemuan bahwa besarnya perbedaan permeabilitas antarlapisan dapat meningkatkan kerentanan likuefaksi, termasuk pada tanah kerikil. Selain itu, respons tekanan air pori, regangan geser, dan perpindahan lateral memiliki hubungan dan sangat bergantung dengan gerak tanah yang digunakan.

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Liquefaction due to dynamic loads usually occurs in cohesionless soils due to their lack of adhesion between particles. Gravel is an example of non-cohesive soil, but it has lower susceptibility to liquefaction because of how easily it drains pore water. However, a soil deposit does not consist of only one type of soil. This then creates the possibility of trapping excess pore water pressure when the soil is subjected to an earthquake thereby increasing its susceptibility to liquefaction. This research was conducted to find out the response of pore water pressure, shear strain, and lateral displacement in sand – gravel soil when subjected to earthquake. This research used Palu 2018 earthquake’s ground motion as dynamic load due to the fact that is caused one of the worst liquefaction phenomena in Indonesia. Two soil deposits were modeled to a depth of 30 meters using PM4Sand and PM4Silt as constitutive model and SSPquadUP elements. Modeling is done by OpenSees software with analysis based on nonlinear dynamic Effective Stress Analysis (ESA). It was found that the large difference in permeability between layers can increase the susceptibility of liquefaction, even in gravelly soils. In addition, the response of pore water pressure, shear strain, and lateral displacement have a close relationship with each other and are highly dependent on the ground motion.