Abstract

Preliminary, the east escarpment feature of Yogyakarta as the Opak Fault. Based on my lineament study, the Opak Fault consist of four parallel lineament that showing as a fault. So, it is called as the Opak Fault System. The Opak Fault system lineaments are trending Northeast - Southwest. On May 27th, 2006, an earthquake happened with moment magnitude 6.3 which was felt in the Yogyakarta City and Yogyakarta Province, more than 5700 people were killed and more than 37000 people were injured. It showed that this Opak Fault system is active. Although the magnitude of the earthquake was not so large, the damage was extremely high because 156,662 and 202,031 houses were totally destroyed and partially damaged. The estimation of strong ground motion characteristics including peak ground acceleration and spectral acceleration is important for engineering design. The strong-motion can be estimate based on the observed ground motion record during earthquake. In this study area, there is limited seismic observation site. So, a stochastic model was developed for characterization and simulation of earthquake ground motion time-histories. The earthquake source and site characteristics was considered that the type of faulting, the earthquake magnitude, the source-to-site distance, and the shear-wave velocity of the local soil at the site. Based on the stochastic simulation technique, the predictive equations are using the attenuation of Irikura and Miyake (2011). The location of the earthquake 6.3Mw (7.961°S – 110.446°E, depth 10 km) reported by USGS has been used. The source of the earthquake is modeled by a simple rectangular fault of which size is 20km x10 km. The depth of the fault is assumed to be 10km under surface. The fault plane is divided into 50 rectangular subfaults with 2km x 2km in each and each subfault is represented as a point source. Amplification of surface layers is linearly taken into account. Site class were classified based on data from microtremors survey with three-component seismometer at 6 sites, 14 boreholes data and 44 MASW survey sites. The computer program Eqsim-4 was developed by Kakawa (2004) for the simulated peak ground acceleration. The proposed stochastic ground motion simulation method is validated by comparing the resulting synthetics to real recorded motions at Yogi station. The synthetic peak ground acceleration is useful for predicting future seismic loading of structure. The analysis of response spectrum acceleration is important for the safety of structures. The response spectrum acceleration was calculated with SAP 2000. This response spectrum acceleration of synthetic motions results was compared with the design response spectrum acceleration of SNI 1726:2012. Generally, the synthetic response spectrum acceleration is closely agree with the SNI 1726-2012 response spectrum acceleration. Based on DEM map, the Opak fault system was estimated as the presence of four lineaments between Opak fault from geological map and the aftershock of 2006 Yogyakarta earthquake. According to geological field observation, one lineament can be interpreted as a fault. The seismic moment (Mo) and moment magnitude (Mw) was calculated by the relation of Wyss and Brune, 1968; Hanks and Kanamori, 1979; Giardini, 1997). The estimated maximum magnitude for this lineament is 7.1Mw for future earthquake.

Keywords: Opak Fault system, lineament, seismometer, boreholes, MASW, stochastic simulation, peak ground acceleration, response spectrum acceleration, seismic moment.

Abstrak

Pendahuluan, fitur lereng timur Yogyakarta sebagai Patahan Opak. Berdasarkan studi kelurusan saya, Kesalahan Opak terdiri dari empat kelurusan paralel yang menunjukkan kelurusan struktur, sehingga kenampakan itu disebut sebagai Sistem sesar Opak. Kelurusan sistem Opak Patahan berarah Timur Laut - Barat Daya. Pada 27 Mei 2006, gempa bumi berkekuatan 6,3 momen yang dirasakan di Kota Yogyakarta dan Provinsi Yogyakarta, lebih dari 5.700 orang tewas dan lebih dari 37.000 orang terluka. Ini menunjukkan bahwa sistem Kesalahan Opak ini aktif. Meskipun besarnya gempa tidak begitu besar, kerusakannya sangat tinggi karena 156.662 dan 202.031 rumah hancur total dan sebagian rusak. Perkiraan karakteristik gerak tanah yang kuat termasuk akselerasi puncak tanah dan percepatan spektral penting untuk desain teknik. Gerakan-kuat dapat diperkirakan berdasarkan catatan gerakan tanah yang diamati selama gempa bumi. Di daerah penelitian ini, ada situs pengamatan seismik yang terbatas. Jadi, model stokastik dikembangkan untuk karakterisasi dan simulasi sejarah waktu gerakan tanah gempa. Sumber gempa dan karakteristik lokasi dianggap bahwa jenis patahan, magnitudo gempa, jarak sumber-ke-lokasi, dan kecepatan gelombang geser tanah lokal di lokasi. Berdasarkan teknik simulasi stokastik, persamaan prediksi menggunakan atenuasi Irikura dan Miyake (2011). Lokasi gempa 6.3Mw (7.961 ° S - 110.446 ° E, kedalaman 10 km) yang dilaporkan oleh USGS telah digunakan. Sumber gempa dimodelkan oleh sesar persegi panjang sederhana dengan ukuran 20 km x 10 km. Kedalaman patahan diasumsikan 10 km di bawah permukaan. Bidang patahan dibagi menjadi 50 subfault persegi panjang dengan masing-masing 2 km x 2 km dan masing-masing subfault direpresentasikan sebagai sumber titik. Amplifikasi lapisan permukaan secara linear diperhitungkan. Kelas situs diklasifikasikan berdasarkan data dari survei mikrotremor dengan seismometer tiga komponen di 6 situs, 14 lubang bor, dan 44 lokasi survei MASW. Program komputer Eqsim-4 dikembangkan oleh Kakawa (2004) untuk percepatan simulasi puncak tanah. Metode simulasi gerakan tanah stokastik yang diusulkan divalidasi dengan membandingkan sintetis yang dihasilkan dengan gerakan nyata yang direkam di stasiun Yogi. Akselerasi puncak tanah sintetis berguna untuk memprediksi pembebanan seismik di masa depan. Analisis percepatan spektrum respons penting untuk keamanan struktur. Akselerasi spektrum respons dihitung dengan SAP 2000. Akselerasi spektrum respons ini dari hasil gerakan sintetis dibandingkan dengan percepatan spektrum respons desain SNI 1726: 2012. Secara umum, akselerasi spektrum respons sintetis sangat sesuai dengan akselerasi spektrum respons SNI 1726-2012. Berdasarkan peta DEM, sistem patahan Opak diperkirakan sebagai keberadaan empat kelurusan antara patahan Opak dari peta geologis dan gempa susulan gempa Yogyakarta 2006. Menurut pengamatan lapangan geologis, satu kelurusan dapat diartikan sebagai suatu kesalahan. Momen seismik (Mo) dan besaran momen (Mw) dihitung oleh hubungan Wyss dan Brune, 1968; Hanks dan Kanamori, 1979; Giardini, 1997). Perkiraan besarnya maksimum untuk kelurusan ini adalah 7.1 MW untuk gempa bumi di masa depan.

Kata kunci : Sistem Sesar Opak, kelurusan, seismometer, lubang bor, MASW, simulasi stokastik, momen seismic.