New Site Classification System of Korea and 2016 Gyeongju Earthquakes

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Extended Abstract

Korea is part of a region of low to moderate seismicity located inside the Eurasian plate with bedrock located at depths less than 30 m, generally. However, the spectral acceleration obtained from site response analyses based on the geologic conditions of inland areas of the Korean peninsula are significantly different from the current Korean seismic code. Recently, suitable site classification scheme and design response spectra (DRS) based on local site conditions in the Korean peninsula were developed and proposed to produce reliable estimates of earthquake ground motion [1]. The new site classification system adopted bedrock depth (H) and average V_S of soil above the bedrock ($V_{S,Soil}$) as parameters to classify the sites into sub-categories because these two factors mostly affect site amplification, especially for shallow bedrock region. The 20 m of depth to bedrock are selected as the initial parameter for site classification based on the trend of site coefficients obtained from the site-specific response analyses. The sites having less than 20 m of depth to bedrock are sub-divided into two site classes using 260 m/s of $V_{S,Soil}$ while the sites having greater than 20 m of depth to bedrock are sub-divided into two site classes at $V_{S,Soil}$ equal to 180 m/s.

On September 12, 2016, Korea experienced the biggest-ever earthquake since 1978, when government started monitoring seismic activity. A series of earthquakes having maximum M_L 5.8 have been occurred in south-eastern Korean peninsular, Gyeongju, continuously [2]. These earthquakes have shown that Korea is no longer safe against earthquakes. The provincial government of North Gyeongsang announced that property damage from strong earthquakes and hundreds of aftershocks in Gyeongju amounts to 23 billion won ($20.8 million) including some 4,900 shattered rooftops and cracked walls and 32 human injuries [3]. Despite these damages, the Gyeongju earthquakes made a meaningful record in the earthquake related research in Korea. Korea has been using oversea earthquake records for the development of ground motion for seismic design due to a lack of strong recorded ground motions. However, the Gyeongju earthquakes offers a great opportunity to estimate design ground motion in Korea. This can lead to better development of DRS considering real Korean geotechnical condition and earthquake amplification characteristics.

In this study, newly proposed site coefficients and corresponding-DRS [1] were verified using three-main Gyeongju earthquakes, which are greater than M_L 4.5 among a series of earthquakes. Firstly, the proposed DRS curves were compared with seismic responses of Gyeongju earthquakes. The proposed DRS curves showed better covering the seismic response of the Gyeongju earthquakes than those in current seismic code. Secondly, short- and long-period site coefficients (F_a, F_v) from Gyeongju earthquake records were compared with the proposed site coefficients. If the distance between each pair of recording stations at soil and rock sites are less than 30 km, it is possible to estimate site amplification characteristics by obtaining the site coefficients for an identical earthquake event. The proposed site coefficients showed similar trend ($F_a > F_v$) with the site coefficients from the Gyeongju earthquake motions, while the site coefficients from the current seismic code showed opposite trend ($F_v > F_a$). To sum up, the proposed site classification system and DRS reasonably represented the site amplification characteristic of shallow bedrock condition in Korea and, thus, it is possible to conclude that the newly proposed seismic provisions are more reliable and superior to those defined in the current seismic code.

References

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