Assessment of the liquefaction risk at Re-liquefied site

*CHIH-SHENG KU[1], Yun-Ling Hsieh[1], Po-Wei Cheng[1]

1. I-SHOU University

The Beishih village, Hsinhua Dist., Tainan City, Taiwan is the only confirmed location in Taiwan having soil liquefaction and sand boil for the Hsinhua earthquake on 1946, Taoyuan earthquake on 2010, and Meinong earthquake on 2016. The soil liquefaction and sand boil in Beishih Village were observed from Taoyuan earthquake on March 4, 2010 and Meinong earthquake on Feb. 6, 2016. The authors surveyed the two liquefaction sites and used GPS to obtain the coordinates of each crater of sand boil cone, the authors found that the locations of the liquefaction were highly overlapped for those two liquefaction cases.

The seismic stations at Koupi elementary school (CHY063) and Yongkang meteorological station (CHY078) are close to Beishih Village. The seismic peak ground accelerations in the vertical, N-S, and W-E motion measured at station CHY063 for the earthquakes of Taoyuan and Meinong were 71.24, 174.66, and 385.18gal, and 163.26, 238.64, and 416.92 gal, respectively. Moreover, the seismic peak ground accelerations in the vertical, N-S, and W-E motion measured at station CHY078 for the earthquakes of Taoyuan and Meinong were 25.3, 61.54, and 101.66gal, and 43.6, 101.86, and 143.86 gal, respectively. The monitor information of the groundwater level obtained from liquefaction site shows that the variations of the groundwater level were quite a lot in this area. The ground water levels were about 0.24 to 3.67m below the ground surface.

The re-liquefied site is an alluvium at the west edge of the Hsinhua Hill. The Hsinhua fault passes through the east of the site. Based on the site investigated results, four different sub-soil layers were categorized for the soil layer within the depth of 30m in the site studied. The first sub-soil layer was from ground surface to the depth about 3m below surface and was characterized as low resistances soft soil. The second layer was at 3-6m below the surface and was characterized as sandy soil; the third layer was at 6-11m below the surface and was characterized as clayey soil (clay or silt); the fourth layer was characterized as dense sandy soil. The average shear wave velocities (V_{s30}) obtained from 3 different sampling locations for soil layers 30m below ground surface were 215, 201, and 213m/sec, respectively.

In this study, the CPT-based, SPT-based and Vs-based methods were applied to the LPI for the evaluation of the liquefaction potential. The LPIs obtained from different evaluation method were varied. The smaller and the largest of the LPI were obtained from SPT-based method and CPT-based method, respectively. Based on the Iwasaki criteria the liquefaction risk potentials were classified as high to extremely high under attack of these two earthquakes. However, the real investigation report shows that the liquefaction hazards were classified as moderate in which was conservative comparing to the analyzed results.

Keywords: Liquefaction, Cone Penetration Test (CPT), Liquefaction Potential Index (LPI)

