

Damage to Structures Due to Soil Liquefaction

Susumu YASUDA

In 1964 the Niigata and Alaska earthquakes inflicted huge damage to buildings, bridges and other structures by liquefying loose sandy soils. After these earthquakes many studies on the liquefaction of sandy soils have been conducted by laboratory cyclic shear tests, shaking table tests, site investigations and analyses. In this presentation, behaviour of buildings, bridges, underground tanks, river revetments, and railway embankments in the liquefied ground of Niigata City are introduced first. According to several witnesses, settlement of the terminal building of Niigata Airport and eruption of water and sand started about 80 seconds and 110 seconds after the occurrence of liquefaction, respectively. Showa Bridge fell down about 60 seconds after the occurrence of liquefaction. And, the apartment houses near Showa Bridge settled and tilted gradually after the occurrence of liquefaction. The maximum settlement of the apartment houses was 2.5 m. Next, the damages due to liquefaction during earthquakes that have occurred in the world since 1964 are surveyed and summarised. These damages are: i) settlement of buildings, timber houses, tanks and towers, ii) uplift of underground tanks, buried pipes and manholes, iii) settlement and flow of river revetments, road embankments, railway embankments, tailing dams and fill dams, iv) horizontal movements and tilt of quay walls and sea walls, and v) fallen bridges. Then mechanisms of these liquefaction-induced damages proved by site investigations, shaking table tests, seismic response analyses etc. are introduced. Finally, allowable deformations of these structures which are necessary for performance-based design are discussed.