

Influence of inhomogeneous structure in surficial reclaimed body traced by aerial photos and delineated by near surface geophysical survey at Makuhari-Kaihin Park liquefied by the 2011 off the Pacific coast of Tohoku earthquake.

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We reanalyzed the comprehensive geoscientific investigation data obtained at a site where outstanding liquefaction took place just after the 2011 off the Pacific coast of Tohoku earthquake. The studied site, Makuhari-Kaihin Park, Chiba Prefecture, faces the Tokyo Bay and is situated on a reclaimed land constructed through 1973 to 1987. The field surveys were composed of high-resolution seismic surveys along two short lines, core boring at 4 points, suspension PS logging, CPTs at 7 points, and dynamic cone penetration tests. Core descriptions and detailed grain size analyses were quite helpful to discriminate man-made strata from natural layers and classify them into wet deposits, dry soils and surface cover soils. A time series of aerial photos of the site was interpreted to reconstruct the reclamation process of the site. Our interpretation is as follows; 1) Northern block was first reclaimed since 1973 and the southern block was followed since 1976. Reclamation was completed till 1987 and then the surface was covered with improved soils to form a loan park surrounded by a planted zone. The boundary between the reclamation blocks was buried in the northern part of the park. Aerial photos clearly recorded dendritic sand dunes in the southern block spread by using aligned sand pipes. Wet deposits were overlain with 1 to 2 m thick dry soils toward the offshore.

Based on the time and spatial history of the reclamation process at the site, we implemented a geoscientific interpretation of liquefaction process of the site. 1) The cover soils acted as a cap layer which controlled the mode of occurrence of the surface fissures and sand boil chains caused by liquefaction. 2) Sand dominant parts in the wet deposits first liquefied during the earthquake, and it caused segmentation of man-made strata into several fragments and differential oscillations during the earthquake. Liquefaction resulted in fluidization of fine-grained parts in the wet deposits. No trace of liquefaction was recognized in the underlying natural layers. In contrast, characteristic structure associated with liquefaction and fluidization was obvious in the wet deposits in the whole points of the site. It means that the surface fissures and sand boil chains were inappropriate to explain liquefaction process because liquefaction inherently takes place in the subsurface.

Keywords: 2011 off the Pacific Coast Tohoku Earthquake, reclaimed land, liquefaction, fluidization, near surface geophysics, aerial photo interpretation