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## **Liquefaction-fluidization mechanism in man-made strata on Yodaura along Tone River at the 2011 off the Pacific coast of Tohoku Earthquake**

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Liquefaction - fluidity phenomenon was observed on the reclaimed land in the paleo-river channel widely at the low land along the Tone river, northeastern the Quaternary Kanto basin at the 2011 off the Pacific coast of Tohoku Earthquake. The trenches were dug for geological survey to examine the horizon of liquefaction - fluidization and to elucidate the mechanism of liquefaction-fluidization phenomena on the reclaimed land along Yodaura lake. Around the survey site, bottom sediments of Yodaura lake were filled on the thick lake mud in Yodaura lake by sand pump method at 1960' s—1970' s. Some sand volcanoes distributed here at the 1987 east off Chiba prefecture earthquake. Furthermore, a large quantity of groundwater and sand spouted out from cracks at the 2011 off the Pacific coast of Tohoku Earthquake in 2011.

The geological cross sections were observed under the cracks. Groundwater level was lowered by pumping up before trench digging. The trench depth was about 3.2m. Large relief peels by isocyanate resin were took out the trench cross section to observe the cross section in detail. Liquefaction - fluidization part was found by parts in the man-made strata. And sand spouted out to the ground through the sand pulses from the liquefaction-fluidization parts.

The litho-stratigraphy of the man-made strata and mechanism of liquefaction – fluidization are as follows.

Litho-stratigraphy of the man-made strata: Man-made strata on the survey site is composed of Lower Filling Association, Middle Filling Association, Upper Filling Association, Dumped Association. Filling Associations were filled by sand pump method.

Lower Filling Association consists of trough cross stratified sandy pebble gravel bed (Lower Bundle, 0.4 m + thick), low-angle cross stratified sandy pebble gravel bed (Middle Bundle, 0.4-0.5 m thick) and parallel laminated loose medium sand bed with shell fragments (Upper Bundle, 0.3 m thick) . Disappeared or deformed laminated parts distribute in Upper Bundle.

Middle Filling Association consists of alternation of parallel laminated sorted dense very fine sand bed and parallel laminated silt bed (Lower Bundle, 0.4-0.7 m thick) and parallel laminated dense fine sand bed with shell fragments with thin silt beds (Upper Bundle, 0.8-1.0 m thick). The Lower Bundle waved with 0.2m wavelength and the Upper bundle waved with 2 m wavelength. The Lower Bundle have bowl and pillow structure. Sand dikes distribute in this association. The sand dikes connect with disappeared or deformed laminated parts in the Lower Filling Association.

Upper Filling Association consists of very dense parallel laminated sorted fine sand bed with shell fragments, about 0.5m thick. This association eroded lower association.

The Mechanism of liquefaction-fluidization: The Upper Bundle of Lower Association was covered by the silt bed of the Lower Bundle of Middle Association. Accordingly, groundwater pressure increased by the earthquake shaking in the Lower Filling Association, and some parts of the Upper Bundle of Lower Filling Association liquefied. Furthermore, Jinami, ground wave, occurred, and strata over the Middle Filling Association cracked. Moreover, it is estimated that the sand which ,the Lower Filling Association liquefied along this crack flows with groundwater and jetted out to the surface.

