

# Surface wave surveys in the affected area of liquefaction which was generated by the 2011 off the Pacific coast of Tohoku Earthquake - A case study at Kozaki, Katori, Chiba -

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Serious liquefaction damage arose according to the 2011 off the Pacific coast of Tohoku Earthquake in the Tone River downstream region. Many of them occurred in the area where water zones were reclaimed until relatively recent years. In the survey area, Mukoya and the Kanzaki-Shinsyuku area, Kozaki, Katori, Chiba, the liquefaction was occurred in case of the 1987 Chibaken Toho Oki Earthquake (Kazaoka, 2003). Liquefaction damage was observed almost the same location in case of the 2011 off the Pacific coast of Tohoku Earthquake, the main reason of the repeated liquefaction damage at the identical location can be explained by the existence of the dredged-sand layer which filled up the old river channel of the Furu-Tone River which was reclaimed in 1963.

In this research, we carried out the surface wave surveys in Mukoya and Kozaki-Shinsyuku area along the four survey lines, GS13\_KZM1 (500 m), GS13\_KZM2 (300 m), GS13\_KZM3 (500 m), and GS13\_KZM4 (600 m). We used the land streamer for P-SV wave with a 1-m receiver interval for data acquisition. The central frequency of the receiver was 4.5 Hz, shot-point interval was 2 m, and the maximum offset was 96 m. The acquired data were sorted into the common mid-point gathers as the manner of Hayashi (2001) (the CMPPC method), and processed with the quasi-two-dimensional analysis with assuming the one-dimensional structure (horizontal layered model) beneath each CMP locations. Since the feature of inverse-dispersion nature was observed in the acquired data, both fundamental and higher modes were used in the inversion procedure.

The result of survey-line GS13\_KZM3 is shown among the obtained S-wave velocity structures. It is the survey line which crosses the old river channel of the Furu-Tone River, distance of about 100-300 m corresponds to the old river channel portion. Within the 0-100 m interval, the low velocity zone of  $V_s$  value is less than 100 m/s can be observed in the shallower portion. We can interpret the low velocity layer as silty layer, and the interpretation agrees well with drilling results. In the section of the old river channel along the survey line GS13\_KZM3, we can see the syncline structure of  $V_s$  values about 140 to 170 m/s, and another syncline structure of less than 100 m/s can be seen under it. The most probable interpretation of these structures is the existence of the old river channel which were filled with dredged-sand. As considering the interval from the view point of liquefaction, since the silty layer locates beneath the dredge sand layer with homogeneous particle diameter, the water level in the sand layer tends to be kept high, moreover, the shape of the layer tends to enlarge the ground motion when the earthquake happens. From these, liquefaction probably happen in this domain when another big earthquake occurs. In the interval of about 300-500 m, we can see relatively flat alternation of strata with some layers.

Keywords: surface wave survey, the 2011 off the Pacific Coast of Tohoku Earthquake, liquefaction, old river channel

