Consideration of liquefaction damage rate based on liquefaction damage in recent years

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1. Introduction
In the 2011 off the Pacific coast of Tohoku Earthquake, liquefaction occurred in an extremely large area from the Tohoku region to the Kanto region, and a large number of liquefaction damage was confirmed in Kumamoto City and Aso City in the 2016 Kumamoto earthquake. In The past, the authors examined the rate of liquefaction in recent years of liquefaction and showed that the difference in the rate of liquefaction in the Tohoku-Pacific Ocean earthquake and other earthquakes was explained by the effects of the duration of the seismic motion. However, this creation of anation, liquefaction hazard map is difficult, and there is grouping based on the history of the microtopography of 250 m mesh and the regional classification method for this regionality consideration. the improvement of the high accuracy of the liquefaction rate prediction equation by setting the area ratio of the area and the subdivision of the micro-topography division, etc. by using topography and elevation data. We also collected information on building damage and investigated the rate of liquefaction damage.

2. Collected and maintained data
The 2011 off the Pacific coast of Tohoku Earthquake and the 2016 Kumamoto earthquake liquefaction Point by local surveys and aerial images, A re-reading of the sand point was performed from high sight point of the geographical institute immediately after the earthquake. we have created a detailed data set of about 50 m and about 25 m mesh units as well as the data set of approximate 250 m mesh units that have been prepared so far.
In addition, the following data were also prepared.

(1) Average elevation, average gradient, and ratio of high data for each mesh size (250 m, 50 m, 25 m) based on 10 MDEM data.
(2) Topographic classification data for each mesh size based on land use classification data based on the above data, we investigated the liquefaction incidence and the area ratio from the relationship between the data and the liquefaction point.
(3) We collected damage information such as slope and settlement of buildings in the 2011 off the Pacific coast of Tohoku Earthquake and the 2016 Kumamoto earthquake, and investigated the relationship with the incidence rate.

3. Investigation of liquefaction generation rate and area ratio
With regard to liquefaction incidence, data on liquefaction occurrence rates of the 2011 off the Pacific coast of Tohoku Earthquake and the 2016 Kumamoto Earthquake are summed up and the measured seismic intensity and maximum velocity fragility are calculated for each micro-topography classification using the least squares method and maximum likelihood Method and cluster analysis was carried out to group the micro topographical classification. As a result, it was able to be grouped into four new groups different from the micro topography group classified based on the liability to liquefaction by a previous study. For each group, the possibility of group subdivision was examined by comparing with average elevation, average gradient, specific height data etc. of each mesh. As a result of examination, it was found that the liquefaction occurrence rate has extremely high correlation with the specific height in any of the

micro topography classifications, and it is highly likely that the above four groups can be further subdivided. Regarding the liquefaction area ratio, assuming that 25 m mesh is the minimum unit, if there is even one sand in the mesh, it is assumed that the whole mesh is liquefied. Regarding the areal ratio, because there was no clear correlation with the measured seismic intensity and the maximum velocity in all the micro topographical classifications, the average value of the area ratio was calculated for each micro topographical classification. For the sake of simplicity, this study summarizes the final liquefaction occurrence rate by multiplying the liquefaction occurrence rate and liquefaction area rate shown above. In addition, we examined the relationship between seismic intensity, maximum speed and liquefaction occurrence rate for slope and settlement of building damage caused by liquefaction.

4. Conclusion (future plans)
The liquefaction incidence rate calculation formula (florality) examined in this study will be compared with building damage damage distribution data in the future, and the validity of the results will be verified.

Keywords: liquefaction, strong motion, phase-velocity curves

