EFFECTS OF CHANGE IN DENSITY OF SAMPLED DATA ON INTERPOLATION IN LIQUEFACTION POTENTIAL ZONING

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INTRODUCTION

In the sedimentary deposits the liquefaction potential is spatially variable. The conventional methods uses borehole geotechnical data to evaluate liquefaction potential at any point. It is not always possible to get borehole data in every point within the study area especially in the developing countries. If there is no sufficient borehole data to evaluate liquefaction potential at every point, it is necessary to interpolate the liquefaction potential at the point of interest by using limited number of sampled data from surroundings. Though the interpolation method gives the required P_L value, the number (density) of sampled data plays an important role for interpolation methods and results. Therefore the study focused to analyze the minimum density of data required to give the significance result by the interpolation.

METHODOLOGY AND DISCUSSION

Saitama city, the capital and most populated city of the Saitama prefecture in Japan, is taken as a study area (220 sq. km). Geologically the city is a sedimentary basin composed of Neocene and quaternary formations surrounded by pre-Neocene and early Miocene formations in the Kanto mountains. There are two distinct types of lithology in the study area: Holocene alluvial

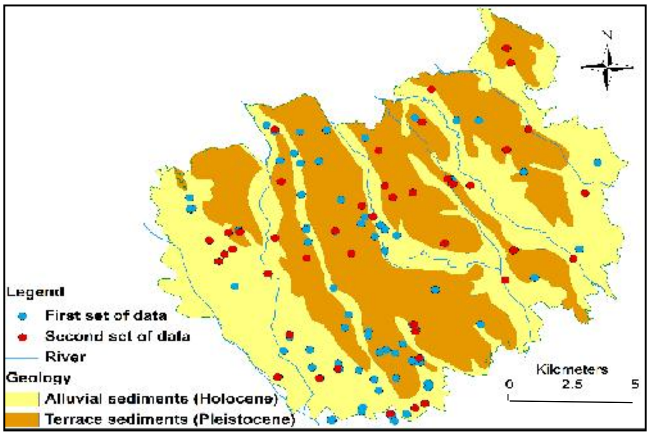

Fig. 1 Study area with locations of first and second set of borehole data

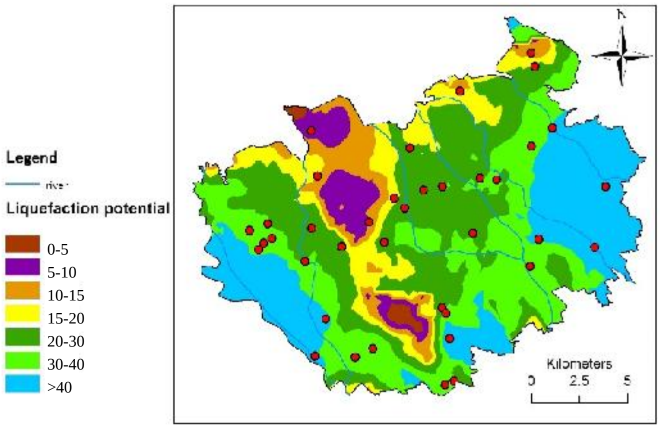

Fig. 2 Study area with interpolated liquefaction potential and second set of borehole data red dots

sediments and Pleistocene terrace sediments Fig.1. For this study independently collected two sets of randomly distributed borehole data are used. First set contains 86 boreholes (the ratio is 0.4 boreholes per sq.km) blue dots in Fig.1 and second set contents 40, red dots in Fig.1. At first the liquefaction potential at each sampled borehole location was quantified by introducing an index called the liquefaction potential index, P_L, defined by Iwasaki et al. (1982). Secondly, the liquefaction potential at the unsampled (where borehole data are not available) locations color indication Fig.2 were estimated by interpolating the first set of 86 boreholes. The result of the interpolation were validated by using second set of 40 borehole data. In location of 40 boreholes the measured and interpolated data were taken and compare the result. The comparison shows significant result. Refer Pokhrel et al., (2012, 2013) for the detailed procedure.

In this study we are focused on effects of change in number (density) of data on interpolation. For this purpose we randomly (by using a software "random number selection") select 80 (0.36 per sq.km) boreholes from the first set only. By using these 80 numbers of randomly distributed borehole data we prepared an interpolated liquefaction potential map.
On this map the second set of boreholes are plotted and pick up the interpolated data and compare the result with interpolated and directly observed P_L value in the second set. The graphs in Fig. 3 (a), shows the R^2 value obtained is 0.64.

Similarly this process were done for 60 (0.27 per sq.km), 40 (0.18 per sq.km) and 20 (0.09 per sq.km) randomly distributed boreholes and R^2 value found are shown in Fig. 3 (b), (c) and (d) respectively. These graphs show increases in density of

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sampled data gives more reliable interpolation which is also proves from the Fig. 4. In Fig. 4 the regression coefficient R^2 was plotted against density of borehole data used shows in this study that increases the density of sampled data for interpolation shows increase the significance of the result.

Similarly, the first set (86 boreholes) of data was randomly divided into two half and second set (40 boreholes) are also divided into two parts by using software “random number selection”. The one half of the both set (63 boreholes) of data are selected for preparing continuous liquefaction potential map by interpolation and second half (63 boreholes) of the both sets are used for evaluation of the method. The comparison of the result is obtained in Fig. 5. The regression coefficient obtained is 0.5024. This is also plotted in the R^2 versus density of borehole data plotted in the curve as shown in Fig. 4. The curve from Fig. 4 is indicated that we can obtain the maximum reliable map or zoning process if we have more dense data within the study area. In such type (alluvial ground as shown in Fig. 1) of area the density of data for significant result is 0.5 data per square km or 1 data per 2 square km sometimes it depends on degree of spatial variability in geotechnical properties of the soil.

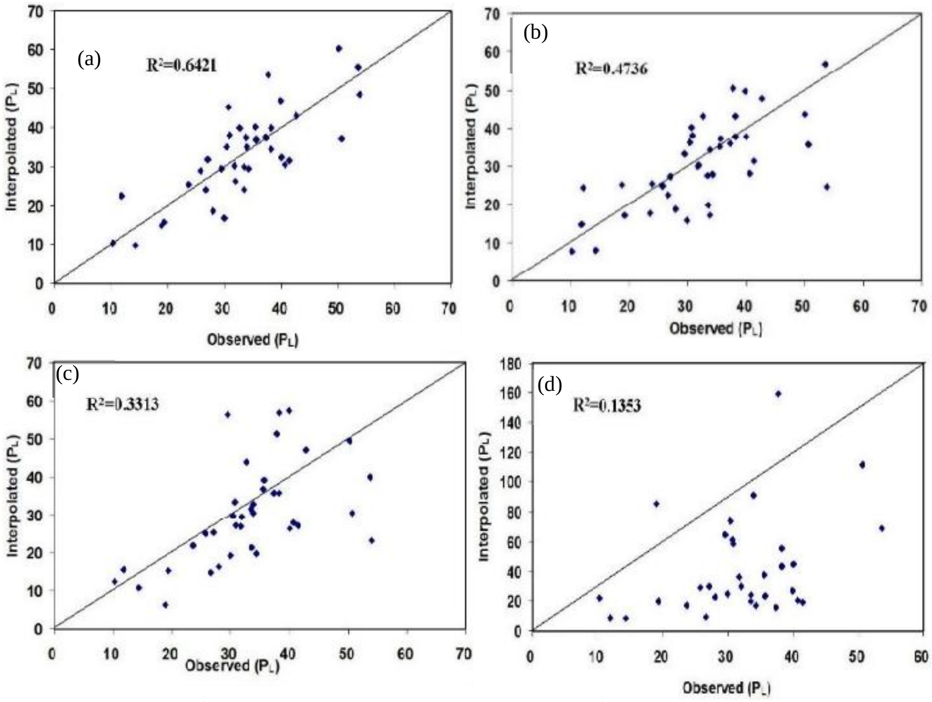

Fig.3 Comparison of directly evaluated and interpolated P_L values from 80 borehole data (a), 60 boreholes data (b), 40 boreholes data (c), and 20 boreholes data (d).

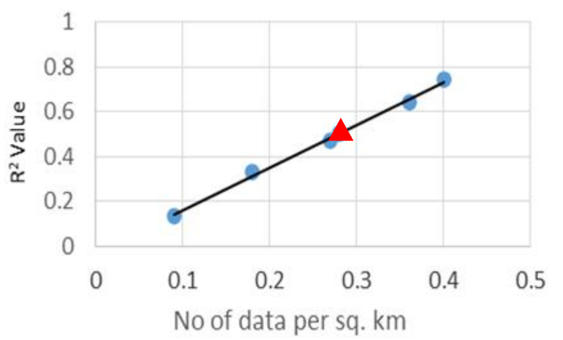

Fig 4: Curve shows changes in R^2 value with density of sampled data red triangle indicates result obtained from Fig.5

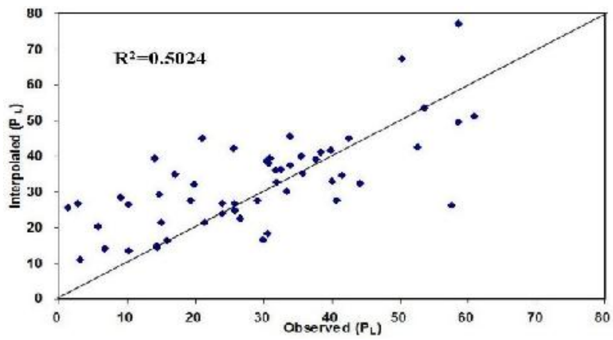

Fig. 5 A correlation curve between interpolated P_L for randomly selected one half of the data and directly evaluated P_L for the rest half (Both 1st and 2nd sets are mixed together and used for interpolation and evaluation)

CONCLUSION

The liquefaction potential at unsampled locations was estimated by using a limited number of sampled data points. A geostatistical interpolation method is suitable method for interpolating liquefaction potential values at such locations. This interpolations was done with independently collected first set of 86 boreholes. The interpolated values was validated by using second set of 40 boreholes. The study shows density of data used for interpolation effects the results. To check the effects of change in density of data for interpolation different number of data are taken randomly from first set and used for interpolation and validate with second set. The validations with second set shows the increase in the density of sampled data shows increase the significance of results. The study shows in such area, 0.5 data per square km can give good interpolation results.

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