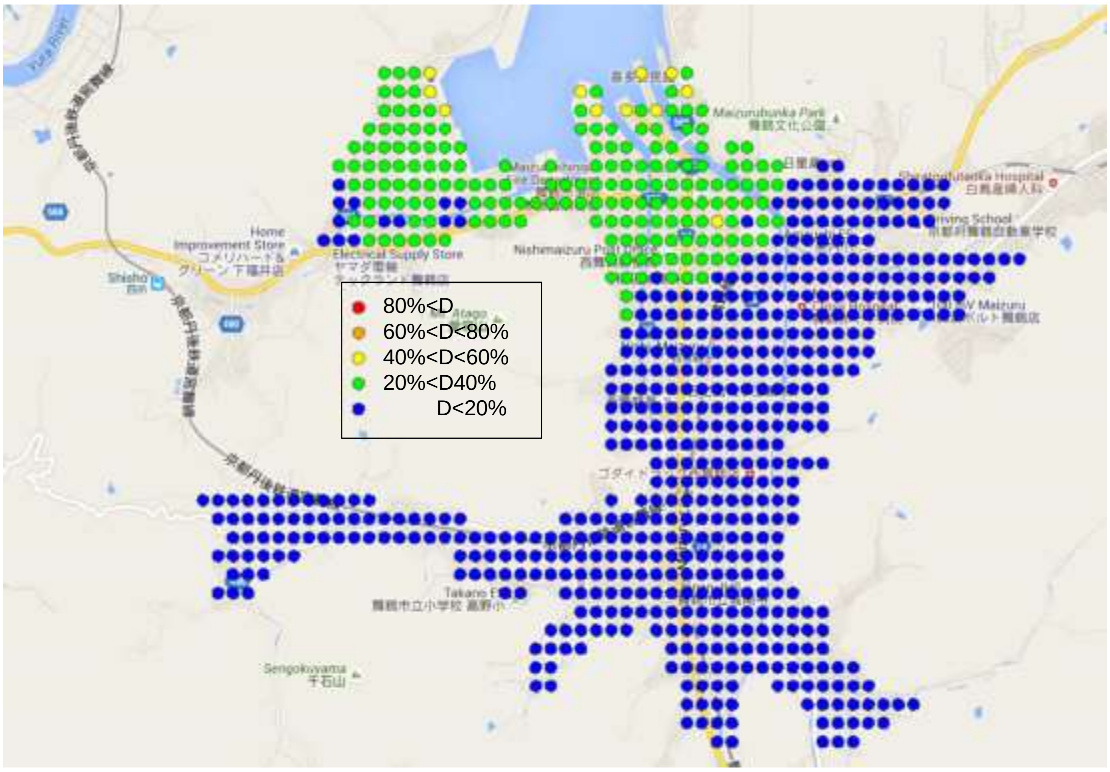

Fig. 10 Seismic damage of old Japanese-style wooden house
(Yielding base shear coefficient C_y=0.4)

ically calculated using a simulated earthquake ground motion wave due to a ground boring data in this paper. Based on a calculation result for each predominant period of ground surface, a total collapse ratio of wooden structure in this paper is defined as a percentage that the maximum drift angle is over 1/30.

A seismic fragility function for each yielding base shear coefficient C_y of wooden structure can be obtained from a curve fitting technique. Seismic fragility function, that is, a cumulative distribution function given by a logarithmic normal distribution may be applied to the relationship between the predominant period of ground surface layer and the total collapse ratio of wooden structure.

Fig. 7 indicates a relationship between the seismic fragility function and the predominant period of ground surface layer for three yielding base shear coefficients C_y. The larger the yielding base shear coefficient C_y becomes, the higher the seismic fragility function of wooden house is with the increase of a predominant period T_g.

4.4 Seismic damage prediction of old Japanese-style wooden house

Seismic damage prediction of old Japanese-style wooden house in the west district in Maizuru city can be numerically evaluated using the seismic fragility functions of wooden structure shown in Fig. 7, which were obtained from the procedure previously mentioned.

Fig. 8 shows seismic damage prediction result of old Japanese-style wooden house with a yielding base shear coefficient C_y=0.2 against a strong earthquake ground motion with the JMA seismic intensity of over "6 upper" level. This seismic damage prediction was numerically evaluated from the seismic fragility function for a yielding base shear coefficient C_y=0.2 shown in Fig. 7(a). Seismic damage of D>80% for old Japanese-style wooden house covers a wide range of the west district of Maizuru city, and also is distributed in the range of the predominant period of T>0.3s shown in Fig. 2.

Fig. 9 indicates seismic damage prediction result of old Japanese-style wooden house with a yielding base shear coefficient C_y=0.3 against a strong earthquake ground motion with the JMA seismic intensity of over "6 upper" level. This seismic damage prediction was numerically evaluated from the seismic fragility function for a yielding base shear coefficient C_y=0.3 shown in Fig. 7(b). It is found that seismic damage of D>60% for old Japanese-style wooden house is distributed in the range of the predominant period of T>0.5s shown in Fig. 2.

Fig. 10 illustrates seismic damage prediction result of old Japanese-style wood house with a yielding base shear coefficient C_y=0.4 against a strong earthquake ground motion with the JMA seismic intensity of over "6 upper" level. This seismic damage prediction was numerically evaluated from the seismic fragility function for a yielding base shear coefficient C_y=0.4 shown in Fig. 7(c). It is found that seismic damage of D>20% for old Japanese-style wooden house is distributed in the range of the predominant period of T>0.5s shown in Fig. 2. Consequently, because the old Japanese-style wooden house with a yielding base shear coefficient C_y=0.4 has a high seismic performance against a strong earthquake ground motion, its seismic damage is a narrow range and also is limited within the range of predominant period of T>0.5s.

5. CONCLUSIONS

The evaluation of a site effect is very important in the earthquake engineering when a seismic damage distribution of wooden house will be predicted by an accurate estimation of seismic intensity. In this paper, both horizontal and vertical microtremors at 51 sites in the west district in Maizuru city were measured by servo type accelerometers, and also the predominant periods at 727 sites in the same area were numerically evaluated from the predominant periods measured at 51 sites. Moreover, seismic damage prediction of wooden house against a strong earthquake ground motion with the Japan Meteorological Agency seismic intensity of "5 lower to 6 upper" level was conducted by the relationship between the seismic fragility function and the maximum drift angle of old Japanese-style wooden house.

The summary obtained in this paper is as follows.

(1) A predominant period at the site without any ground information can be easily evaluated from microtremor *H/V* spectral ratio obtained from microtremor measurement.

(2) Using the Inverse Distance Weighting method, a distribution map of predominant period of ground can be numerically estimated under the limited microtremor observation values.

(3) Seismic fragility function with a base shear coefficient can be obtained from the maximum drift angle of old Japanese-style wooden house, which is evaluated by the predominant period of ground. Also, the collapse rate of old Japanese-style wooden house for each base shear coefficient can be predicted by the seismic fragility func-

tion.

The challenge of the future is to make an accurate evaluation of seismic damage prediction of old Japanese-style wooden house against a string earthquake ground motion with the Japan Meteorological Agency seismic intensity of “6 upper” level. In addition to the evaluation of seismic damage prediction of old Japanese-style wooden house, it is very important to accurately evaluate a predominant period of ground surface layer under the limited microtremor measurements. Predominant period distribution greatly depends on the seismic fragility function for a base shear coefficient as well as H/V spectral ratio obtained from microtremor measurement.

Therefore, further investigation on seismic damage prediction of old Japanese-style wooden house against a string earthquake ground motion may be needed to accurately evaluate the effect of seismic fragility function with a base shear coefficient on the seismic damage prediction of old Japanese-style wooden house and make some concrete conclusions.

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