Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS023-15 Room:IC Time:May 23 12:15-12:30

Evaluation of Site Effects for Acceleration Response Spectra based on Recorded Data

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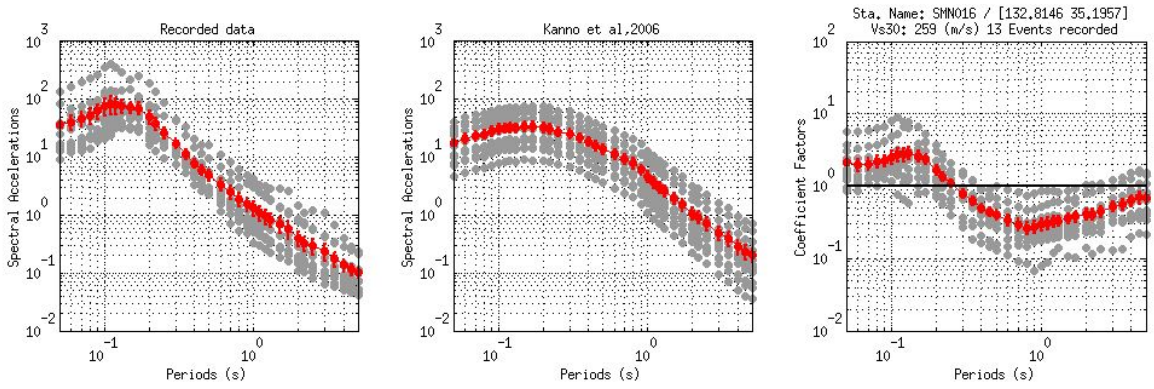
Figure 1. a) Attenuation model for acceleration response spectra proposed by Kanno et al. b) acceleration response spectra using observed records c) site effect correction factors

Seismic networks, such as KIK-net and Hi-net, provide valuable information for studies in engineering and seismology. Research related to the site effect of strong ground motion attenuation use the soil information (especially those extracted from Vs30) of the stations. Many other studies have been concerned with Vs30 at K-NET stations assuming this is the parameter that correlates with site effect. On the other hand, some networks (more than 1000 locations) that are operated by JMA or local prefectural administrations do not have soil information. While Vs30 is debated as the correct factor to evaluate site effects, Si et al, (2010) have proposed an effective yet easy methodology to assess site effect in attenuation relationships. This correction factor (CF) for site effect is not a function of Vs30 but instead is dependent on previous recordings. It is calculated by employing an average operator of the ratio of observed ground motion to a reference attenuation model. The advantage of the method is that the site effect can be estimate without soil information.

Kanno et al, (2006) proposed a standard attenuation relation considering acceleration response spectra for Japan. They used a CF function of Vs30 which were determined from KIK-net stations and summed these with spectral amplitudes in particular frequencies. They applied the CF to their data and were able to reduce the standard error. We use this attenuation relationship as a reference model in our analysis. The method was tested in an area bounded by 133-135E longitude to 32-36N latitude in which 152 K-NET stations are located. We focus on the Tottori region and have evaluated 46 crustal earthquakes with Mw>4.0. From over 7000 records we extracted 596 records that satisfied two criteria a) the stations were within 100 km hypocentral distance and b) the recorded seismic signal was larger than 10 gal.

The acceleration response spectra calculated attenuation model by Kanno et al, (2006) is shown in Figure 1a. Here, the K-NET station SMN016 with a Vs30 value of 259 m/s is given as an example. Figure 1b is acceleration response spectra estimated from 13 events recorded at that station from 1997 to 2010. The coefficient factors are plotted in Figure 1c. We observed that the method gave sufficiently good results if there are adequate station records. We find good agreement between our results and previously methods that use Vs30. Thus, the methodology used in this study is an alternative method for evaluating site effects to obtain more reliable attenuation relationship models.



Keywords: Site effects, acceleration response spectra, Tottori region