

Long-period ground motion of the Tokyo bay area during main and largest aftershock of the 2007 Niigataken Chuetsu-oki earthquake

Tomiichi Uetake[1]

[1] R&D Center, TEPCO

The Tokyo Electric Power Company had installed broadband velocity-type seismometers to the thermal power stations in the Tokyo Bay area March of 2006 to observe the long-period earthquake ground motions. The 2007 Niigataken Chuetsu-oki earthquake ($M_j=6.8$) and the 2007 Noto Hanto earthquake ($M_j=6.9$) occurred last year. The significant later arrivals with period of 7 seconds were detected only in the records of the Chuetsu-oki event at west side of Tokyo Bay. In this report, the records of the largest aftershock ($M_j=5.8$) of the Chuetsu-oki event are compared with the main shock. It is important to compare the characteristics of the different size events that occurred in the same area for the improvement of strong ground motion predictions. Epicenters of the main shock and the largest aftershock are very near and hypocenter depth of largest aftershock [23 km] is a little deeper than that of main shock [17 km]. Fault mechanisms of both events are reverse fault having the strike of the northeast - southwest direction [Japan Meteorological Agency (2008)]. Comparison of both events means the examination of the effect of event size on the excitation of long-period ground motions roughly.

At first, we compared the characteristic of the waveforms retrieved from both events. The amplitude of the main shock waveforms are about 10 times of those of the aftershock at almost stations. At Yokosuka station where the sedimentary deposit is thin, the waveforms of both events show common characteristics that there are no large later arrivals and the duration times are short. The waveforms of main shock observed at the station located in the east side of Tokyo Bay have many large later arrivals and show the longer duration than 300 seconds. Although, the waveforms of largest aftershock have not so many later arrivals and show shorter duration than that of main shock. The durations of waveforms at the station in the west side of Tokyo bay are short in comparison with those observed in the east side. The significant later arrivals with periods of around 7 seconds are detected in north-south component at Shinagawa and Kawasaki stations of the west side. We can confirm this later arrivals are remarkable as the independent wave packet in the west margin of Kanto Plain from the records of K-net and KiK-net. The north-south component is almost radial direction from epicenter. This suggests this significant phase is Rayleigh wave but this is not remarkable in up-down component. Considering the refract effect of Kanto Mountain on the west side of Kanto Plain, seismic waves propagate from west to east. In this case, North-South component are equivalent to transverse component and significant later arrivals may be Love wave. In addition, this later arrivals are not remarkable in the waveforms of largest aftershock.

Next, we compared the velocity response spectrum with 1% damping calculated from main shock and largest aftershock records. A remarkable peak is seen at about seven seconds in the response spectra of the north-south component of main shock at Kawasaki and Shinagawa stations. This peak was detected in the response spectrum of other stations but the peaks of Kawasaki and Shinagawa is 1.5 - 2 times higher than those of other stations and about 10 times of Yokosuka station. The remarkable later arrivals affect the response at 7 periods. Response spectrum ratios were made between main shock and the largest aftershock to confirm whether excitation of the later arrivals were in proportion to the size of the earthquake. The tendency to grow big with a period are shown in all stations and the value of ratios are 5- 10 in the period range of 1-5 seconds. But the characteristics at around seven seconds are changed by station by station. The spectral ratios of Kawasaki, Shinagawa, Sodegaura and Anesaki stations show remarkable peak of 20-30 times at around 7 seconds in a period.