

Long-period ground motion in the Kanto basin during the 2016 Kumamoto earthquake

*Tomiichi Uetake¹

1. Seismic Design Group, R&D Department, TEPCO research Institute, Tokyo Electric Power Company

During the M 7.3 Kumamoto earthquake of April 16, 2016, the long-period ground motion was observed in the metropolitan area about 900 km from the epicenter. It is important to understand the characteristics of the seismic motion that incident to the Kanto basin and the seismic response of the basin to it for evaluation of the earthquake ground motion in the metropolitan area during a large earthquake in the western part of Japan.

First, in order to confirm the incident wave to the basin, the velocity traces of F-NET were examined from the vicinity of the epicenter to around the Kanto region. There was a remarkable wave group with the dominant period of about 10 seconds and the duration of about 60 seconds in the transverse component, and it was propagated to the Kanto basin with the apparent velocity of about 3.3 km/s. This wave group showed dispersion characteristics and is considered to be a Love wave. In addition, the waveform of the Kanto Mountains in the west side of the basin was similar to the waveform of the western part of the basin, and this group of waves is considered to be an incident wave to the basin.

Next, we examined the change of the waveform features of the observation point in the basin. Wave packets were amplified in the basin and the duration of wave packets was extended. However, the dominant period of the seismic motion was about 10 seconds at any observation point. It suggests that the influence of the incident wave is large. In addition, the amplitude of velocity response spectra at the period of 10 seconds tended to be larger toward the east side, which were about 2 cm/s at the bedrock in the west side of the basin, 5 to 10 cm/s in the western part of the basin, and 10 to 20 cm/s in the eastern part of the basin. It seems that not only the amplification by the low velocity sediment but also the extension of the duration are related to the amplification of the velocity response spectra.

The duration of the wave packet changes with the propagation of the wave packet and tends to be longer on the east side than the west side of the basin. From the multiple filter analysis of the velocity waveform, it is confirmed that the dispersion of the seismic waves influences the extension of the duration, and that the wave groups are more dispersed in the eastern observation point. The velocity waveform from Shinjuku (SNJ) to Chiba (CHB) and Togane (TGN) are shown in the figure. The duration of wave packet is about 90 seconds at Shinjuku (SNJ) in the west side, but over 180 seconds at Chiba (CHB) in the east side. The duration of the wave packet with the period of 10 seconds greatly changes in about 45 km. Although the seismic ground motion of the north-south component was dominant in the western part of the Tokyo Bay, the large wave packets of the east-west component can be seen in the latter part of the wave traces in the east side. Examining the velocity locus shows that the dominant direction of vibration changes with the lapse of time. It suggests that the wraparound of surface waves due to the three-dimensional structure of the basin.

For this analysis, we used the records from Tokyo Electric Power Company, Japan Meteorological Agency and National Institute of Earth Science and Disaster Resilience (F-NET, K-NET, KiK-net). We used GMT for drawing figures.

Keywords: The 2016 Kumamoto earthquake, Surface wave, Long-period strong ground motion, Kanto basin

Site Location and Velocity Waveforms

