

Study on Spatial Distribution of Response Duration Time of Earthquake Motions in Tokyo Metropolitan Area

ARAI, Kensuke^{1*} ; ISHII, Toru¹ ; HIRATA, Naoshi²

¹Shimizu Corporation, ²University of Tokyo

1. Background and Objective

Ishii (2012) paid attention to the spectral characteristics of duration times of earthquake ground motions, newly defined the response duration time spectra in order to evaluate it quantitatively, and by using the proposed spectra, the ground motions recorded at Etchujima in Tokyo during the 2011 Off the Pacific Coast of Tohoku earthquake, its foreshock, aftershocks, and induced earthquakes, are examined. It was pointed out that the duration times of ground motions in the period range especially more than 1 second could be much longer than the ones in shorter period range or the ones evaluated by several past studies. It has been assumed that such characteristics are affected by the long period surface waves which generate and propagate in the deep underground structure of Tokyo metropolitan area.

The Metropolitan Seismic Observation Network (MeSO-net) is composed of more than 300 stations in Tokyo metropolitan area and observes broadband long-duration spatial records of earthquake ground motions. Arai et al. (2014) calculated and examined the response duration time spectra of the earthquake motions recorded at the MeSO-net stations during fourteen earthquakes including the 2011 Off the Pacific Coast of Tohoku earthquake, its foreshock and aftershocks. Continuously this paper examines the spatial characteristics of the recorded time histories, of its response spectra and of its response duration time spectra especially in rather longer period range, discussing with the deep underground structure of Tokyo metropolitan area and with the azimuth or the depth of the earthquakes.

2. Data and Analyses

The response spectra SV [cm/s] and the response duration time spectra TSV [s] of ground motions during six earthquakes which occurred since March 11 to April 12, 2011, including the 2011 Off the Pacific Coast of Tohoku earthquake and its aftershocks, are examined in this paper. According to Ishii (2012) and Arai et al. (2014), the spectral parameters are as follows; $h = 0.05$, $p1 = 0.03$ and $p2 = 0.95$. By picking up a few linear array data from the spatially distributed MeSO-net data, the characteristics of the spectra are examined and discussed comparing with the deep underground structure model presented by J-SHIS, Japan Seismic Hazard Information Station of National Research Institute for Earth Science and Disaster Prevention.

3. Discussion

The characteristics of the response duration time spectra of earthquake ground motions in Tokyo metropolitan area are affected by the deep underground structure. Especially in the longer period range, TSV seems to have simple spectral peaks where the deep underground structure is also simple, however TSV seems to have several spectral peaks where the deep underground structure is composed of several sedimental layers. It is supposed that the characteristics of the response duration time spectra highly depend on not only the magnitude and the distance of the earthquake but also the azimuth and the depth of the earthquake, and affected by the characteristics of surface waves propagating in the sedimental layers.

Acknowledgement

The authors express gratitude to the Special Project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area for supplying the data recorded by the Metropolitan Seismic Observation Network (MeSO-net).

Reference

- T. Ishii (2012): Journal of Structural and Construction Engineering (Transactions of AIJ), Vol.77, No. 676, pp.843-850
K. Arai et al. (2014): 2014, Fall Meeting, The Seismological Society of Japan, S16-P19
J-SHIS, National Research Institute for Earth Science and Disaster Prevention ; <http://www.j-shis.bosai.go.jp/>

Keywords: Tokyo, Earthquake Motion, Duration, Surface Wave, Structure