Estimation on spatial distribution of dynamic response by shallow sedimens in Furukawa, Japan

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It is very important to know the causes of anomaly of damage distribution by an earthquake. This may be occurred by the differences of structural strengths, ground motions, and so on. After the 2011 off the Pacific coast of Tohoku earthquake, we have found the typical examples on this problem at Furukawa district, Miyagi, Japan. To make clear this, we have installed very dense seismic observation network into Furukawa, which is named Furukawa Seismic Network (FuSeN) (Goto et al. 2012), and carried out microtremor survey around the area. Goto et al. (2016) proposed a detailed model of velocity structure for Furukawa using the observed data of earthquakes and microtremors.

We have applied the model of velocity structure and calculated numerically the dynamic responses by the soft soil sediments, which are shallower layers than engineering-base layer. Although the target area is only about 1.5 x 1.5 km, the responses in the frequency range between 1 to 2 Hz differ according to location in the area. The transfer functions from engineering base to surface for linear response at typical two sites, where F14 and F17 are located in severely damaged and in the area without any damages, respectively. In this case, F17 is about 1.1 times larger than F14. On the other hand, the amplitudes of transfer function at F14 is about 1.5 times larger than F17 in average for non-linear responses, in the frequency range between 1 to 2 Hz. Figure shows the transfer function for non-linear response at sites F14 and F17.

Generally speaking, the predominant frequencies are around 1 to 2 Hz for typical wooden structures in Japan. This suggests that the small differences of velocity structures of ground cause the large differences of structural damage and the non-linear responses of soft soils play very important roles at the target area.

References:
Goto et al., Very dense seismic array observations in Furukawa district, Japan, Seism. Res. Lett., 83, 765-774.

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