Vibration characteristics of the observation house at KiK-net Hino

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1. Background and objective

During the Tottori-ken-seibu earthquake of 2000, a strong ground motion of 918 Gal was observed at KiK-net Hino, which is a station of the strong ground motion observation network operated by NIED. This is an important near-fault record, but includes surface soil amplifications, topography effects, and influences of the observation house. It is important to remove the influences of the observation house for estimation of the strong ground motion. For this purpose, we carried out a on-site excitation test of the observation house.

2. Excitation test

Figure 1 shows the appearance of the observation house at KiK-net Hino. The floor space is 1800mm x 2700mm. The X direction is set to be the ridge direction (N53E), and Y the span direction (N37W). We hammered the house by a wooden maul in 15 seconds interval for 5 minutes in each direction. Two sensors for X, Y directions were located on the roof and 2 sensors for X, Y directions on the floor. To detect rocking vibration, additional 2 sensors were set on the floor at both wall-side in each excitation direction. Adding to this excitation test, we observed micro-tremors for 20 minutes.

3. Results

Figure 2 illustrates the example of acceleration waveforms from a Y direction excitation. The upper panel shows the Y component on the roof and the middle panel shows that on the floor. Following sharp peaks due to the hammering impact, periodic waves due to free oscillation of the house appear and decay. The lower panel shows the 2 records of Z direction on both wall-side. The periodic waves have opposite phase. This means that rocking vibration is dominant. Figure 3 shows the average Fourier spectra of 11 excitations for X, Y components on the roof. The X, Y components have the peak frequency of 7.9 Hz and 7.1 Hz respectively. To estimate the peak frequency of rocking vibration, Fig. 4 shows the average Fourier spectra of the difference between 2 records of Z direction. The X, Y components have the peak frequency of 7.9 Hz and 7.1 Hz respectively. Above results show that the first natural frequency of the soil-structure system is 7.9 Hz in X direction and 7.1 Hz in Y direction. To estimate the natural frequency of rigid base condition, Fig 5 shows the average Fourier spectral ratio between the micro-tremors on the roof and those on the floor. The X, Y direction have the first natural frequency of 10.0 Hz and 9.5 Hz respectively.

図１　Kik-net日野観測小屋

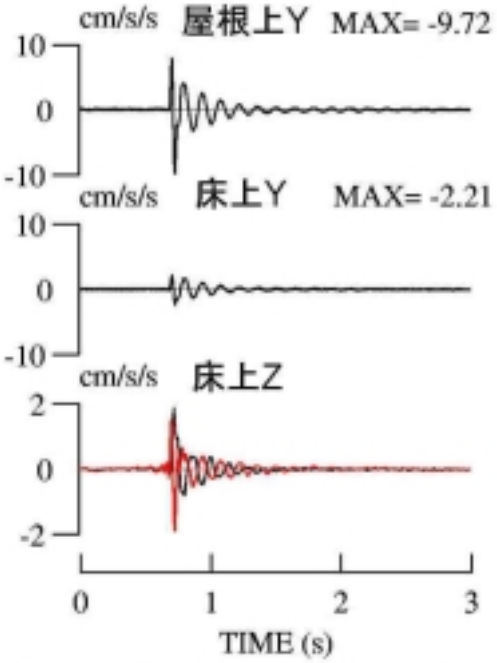

図２　加速度波形の例（Y加振）

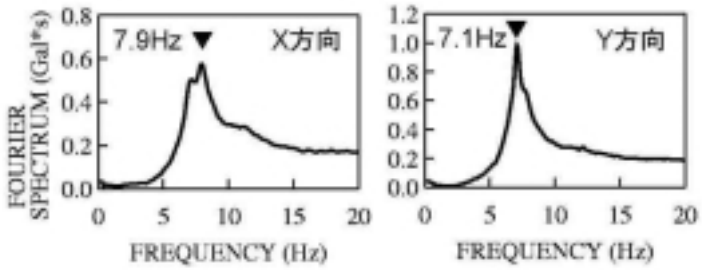

図３　屋根上水平成分のﾌｰﾘｴｽﾍﾟｸﾄﾙ

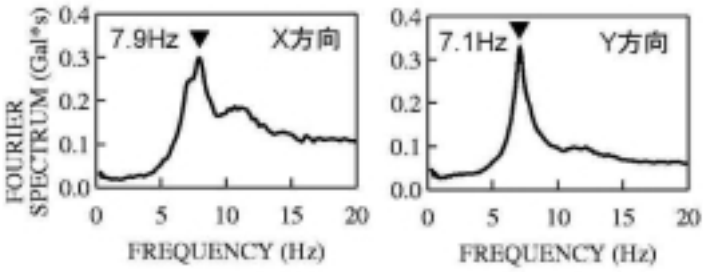

図４　床上ﾛｯｷﾝｸﾞ成分のﾌｰﾘｴｽﾍﾟｸﾄﾙ

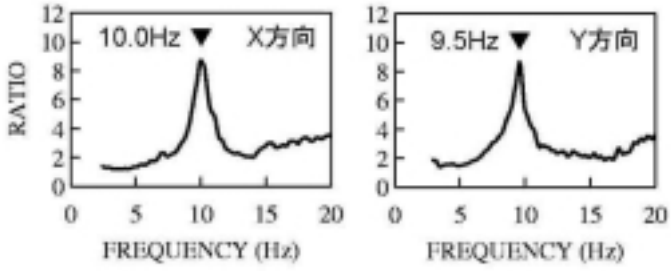

図５　微動の屋根上/床上のﾌｰﾘｴｽﾍﾟｸﾄﾙ比