

## Response of the twin test buildings during the 2011 off the Pacific coast of Tohoku Earthquake

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### SUMMARY

The 2011 off the Pacific coast of Tohoku Earthquake occurred offshore in the east of Japan. Big shakings (Japanese seismic intensity scale: upper 6) were observed in Sendai which is one of the biggest cities in the Tohoku district. To verify base isolation effects, twin test buildings at Tohoku University in Sendai were constructed by Tohoku University and Shimizu Corporation jointly in 1986, and earthquake observations in the buildings have been continued since the completion. This paper reports observed records at the twin test buildings during this big earthquake and simulation results by using lumped mass models. Figure 1 shows the sectional elevational view of the twin test buildings. The two demonstration buildings made of reinforced concrete have the same size and are adjacently located. One is an earthquake-resistant structure, the other is a base-isolated structure with high damping rubber bearings (Photo. 1). Figure 2 shows observed records in the buildings. Records observed on the ground of the site and the foundation of both buildings reached upper 6 in the seismic intensity scale of the Meteorological Agency of Japan, and the maximum acceleration was about  $300\text{cm/s}^2$ . This figure shows the base-isolation effects that the maximum acceleration at the top floor was almost the same as that at the base in the base isolation structure. On the other hand, the maximum acceleration at the top floor in the earthquake-resistant structure was amplified more than double at the base. Figure 3 shows trajectories of displacement on the isolation layer. The maximum in the X-direction was 11.5 cm (Maximum of magnitude of displacement vector: 11.7cm) and larger than that in the Y-direction. Simulation results on the isolation layer give close agreement with the observed orbit. The maximum accelerations of the observation and simulation are shown in Fig. 4. The simulation can properly estimate the behavior of the base-isolated demonstration buildings. Moreover, the responses of the base-isolated demonstration buildings were calculated using the records of Miyagiken-oki Earthquake in 1978.

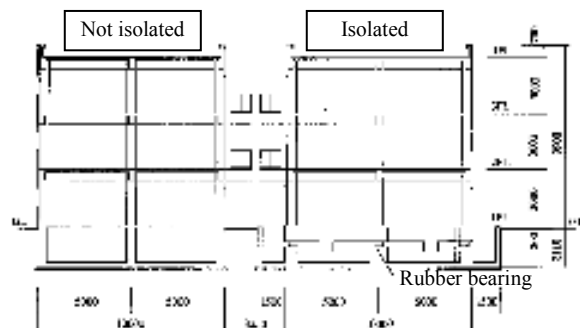


Photo 1 Twin test buildings at Tohoku University

Fig. 1 Sectional elevational view of twin test buildings

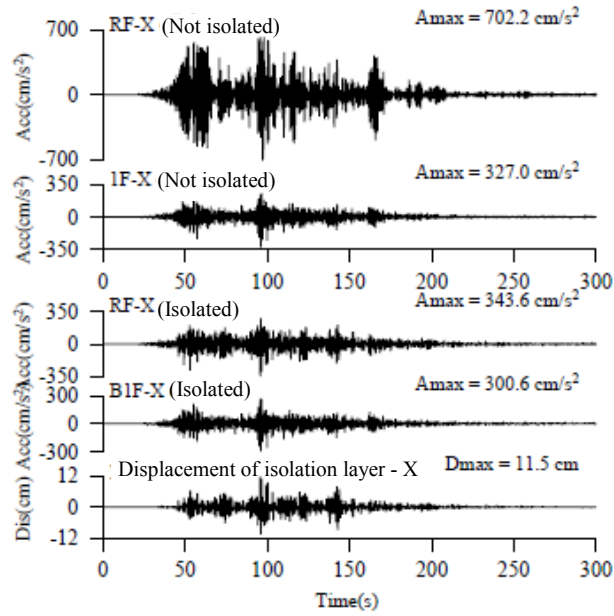


Fig. 2 Recorded time histories

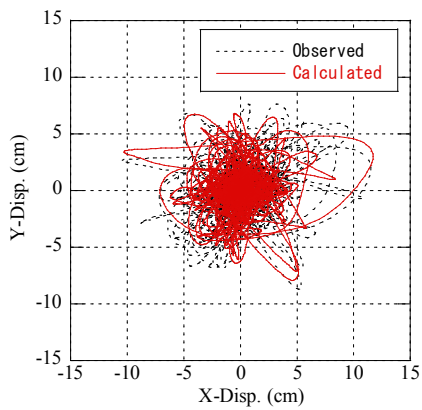


Fig. 3 Trajectories of displacement on the isolation layer

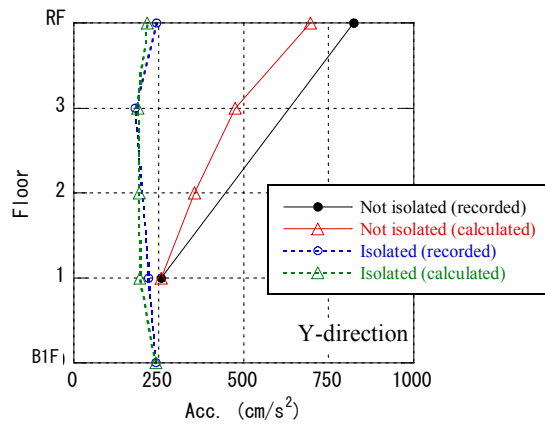


Fig.4 Maximal absolute accelerations