Response Evaluation Of Base-Isolated Buildings Considering Multi-Cyclic Characteristics Under Long-Period Ground Motion

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Recently, large-scale long-period ground motions caused by the Nankai Trough earthquake occur with high probability and will cause great damage to buildings. The isolation device in isolated buildings multi-cyclically deform over a long period of time due to long-period ground motion. For example, high-damping rubber bearing and lead rubber bearing increase the absorption energy, resulting in an increase in the temperature of the high-damping rubber and lead plugs. Therefore, the horizontal characteristics of the isolation device change, and the performance deteriorates. However, there are few examples that take into consideration the change in multi-cyclic characteristics of isolation devices. In this paper, the responses of the base-isolated buildings considering the multi-cyclic characteristics characteristic change of the isolation devices in the Nankai Trough earthquake is evaluated using the exact method or the simplified method. In addition, we will compare it with the response result when the multi-cyclic characteristics of the isolation devices is not taken into consideration. Furthermore, the response of the superstructure and the isolation devices are also clarified. In addition, the behavior of the collision to retaining wall is confirmed in the case where large deformation occurs in an isolation story. The analytical model is an equivalent shear linear model of the five-degree-of-freedom system. The primary natural period of the superstructure is set to 0.75 seconds and 1.5 seconds. The seismic isolation device is a lead rubber bearing (LRB) and a high-damping rubber bearing(HDR) in two cases. The input seismic motions are long-period seismic motions, assuming a Nankai Trough earthquake, and a total of 10 waves (Osaka area:3 waves(OS1, OS2 and OS3), Chukyo area:3 waves(CH1, CH2 and CH3), Shizuoka area:3 waves(SZ1, SZ2 and SC3) and Kanto area:1wave(KA1)) are adopted. As a result, the maximum inter-story displacement response of the isolation story increased in the exact method in all cases regardless of the input seismic motion, and exceeded the criteria (75 cm) of the isolation story. The maximum response story shear force coefficient showed different tendencies under the influence of the natural period of the superstructure. In addition, focusing on the cumulative absorbed energy amount, it was found that there is a clear difference between the case where the multi-cyclic characteristics is considered and the case where the multi-cyclic characteristics is not considered in Osaka area earthquake(OS1), but there is not much difference in Chukyo area earthquake(CH1). Case of the collision to retaining wall, the lower stories of the building immediately experiences a large response. On the other hand, the response of the upper stories increases due to the propagation of the impact force from the lower stories. Then, as time passes, the time history behavior returned to that of no collision.