Structural Analysis of Super High-Rise Steel Building Frame with Buckling-Restrained Braces under Long-Duration Earthquake Motion

Takumi Takeda[1] and Daigoro Isobe[2]

[1] Graduate School of Science and Technology, University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi, Ibaraki 305-8573, JAPAN
s1920919@s.tsukuba.ac.jp

[2]Division of Engineering Mechanics and Energy, University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi, Ibaraki 305-8573, JAPAN
isobe@kz.tsukuba.ac.jp

One of damping braces used for super high-rise steel building frames is a buckling-restrained brace. Low-yield steel used for the brace deform plastically so that they can stably absorb the energy of earthquakes. However, it is known that the low-yield steel cause low-cycle fatigue by being subjected to repeated loads. Therefore, there is a possibility that the damping function of buckling-restrained braces are lost under disturbances such as long-duration earthquakes.

In this study, behaviors of a super high-rise steel building frame with buckling-restrained braces subjected under a long-duration earthquake motion were simulated. Numerical models of the building with and without buckling-restrained braces were constructed with linear Timoshenko beam elements. The adaptively shifted integration (ASI)-Gauss code [1] with a fatigue fracture algorithm based on experimental results [2] was used in the analyses. According to the repeated loading experiment of buckling-restrained braces, fatigue fracture occurred after 18 repetitions.

The numerical results had shown the reduction of displacement and acceleration of the building owing to buckling-restrained braces. However, it had also shown a transition of dynamic characteristics during long-duration earthquake motion, due to fatigue damages of damping braces located in lower floors.

References

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