Reduction Effect on Seismic Pounding Damage of Neighboring Buildings Using EPS Materials

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In recent years, large scale earthquakes have been predicted to cause extensive damage to urban areas in Japan. Under the current law, although there is a regulation for seismic resistance of buildings, there is no regulation for the distance between buildings. And in urban areas, the buildings are often located close to each other. Buildings with different heights and structures have different natural periods, and when such buildings are next to each other, they show different shaking behaviors depending on the seismic motions. If the distance between neighboring buildings is insufficient, there is a risk of collision between those buildings.

The collision between neighboring buildings cause a direct impact force on the buildings, which is different from the vibration caused by the seismic motion. Even if the seismic resistance is ensured, there is a possibility of serious damage such as damage to structural members or moreover, collapse of the building itself. In order to reduce this damage, an installation of a shock-absorbing material on the walls of a building is proposed. However, it is difficult to conduct experiments and the reduction effect on the impact force during collision has not yet been proved. This paper describes numerical verification on the damage reduction effect of shock-absorbing materials placed between two neighboring buildings during a seismic motion.

The numerical code is based on the Adaptively Shifted Integration (ASI) - Gauss technique [1]. As a shock-absorbing material, we focused on the EPS (Expanded PolyStyrol) materials that can be designed for any size and for a variety of rigidity. Since EPS materials have nonlinear compression properties that differs much from those of metallic materials, an algorithm that numerically reproduces these properties was devised and implemented in the numerical code. According to numerical results, it was found that when EPS materials was installed, the peak of acceleration at the time of collision and the ratio of yielded members to all structural members was reduced. It was shown from these results that the impact force and the damage of collision between neighboring buildings may be reduced by the EPS materials.

References

[1] D. Isobe: Progressive Collapse Analysis of Structures: Numerical Codes and Applications, Elsevier, eBook ISBN: 9780128130421, Paperback ISBN: 9780128129753, 2017.