Finite Element Analysis of Ceiling Collapse during Seismic Excitation

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ABSTRACT

Collapse phenomena of ceilings have been observed frequently in the past earthquakes in Japan. It causes not only the possibility of human injuries, but may disturb the use of the facilities after the earthquakes. In this study, a finite element analysis of the ceiling collapse in a full-scale gymnasium during seismic excitation was conducted to investigate the collapse mechanism of the ceilings.

The numerical code used in this study is constituted based upon the adaptively shifted integration (ASI) – Gauss technique [1], which provides a higher computational efficiency than the conventional finite element method by appropriately shifting the numerical integration points of the finite elements. It can also handle dynamic phenomena, such as member fracturing, by expressing the precise locations of fractured sections.

The detachments of the ceiling joists and ceiling joist receivers were considered by setting the sectional forces of the clips, screws and hangers to be zero once the axial forces acting on these members exceeded the maximum strength. Collisions between plaster boards and structural components of the gymnasium were also considered by a contact algorithm introducing gap elements. The numerical result showed a certain resemblance with an experimental result which was obtained at the E-Defense shaking table test conducted in 2014 [2].

REFERENCES

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