Research on External Force and Experiment Method contributing to Structural Performance Verification for Building Members

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(Keywords) Nonstructural components, Structural performance verification, External force evaluation, Experiment method

1. Research Background

This research is aimed at investigating the seismic force evaluation and experiment methods and to arrange a technical reference for the structural performance verifications of building members, primarily targeting nonstructural components that have not been paid much attention until the recent earthquakes. The main experimental subject of this research is the glass screen system that would assumedly be affected greatly by out-of-plane deformation and inertial force. The three-year research will include strong motion observations, structural analysis and full-scale shaking table tests. A full-scale shaking table test was carried out in 2014.

2. Full scale test on glass screen system

A full-scale glass specimen (Photo 1) was shaken in normal direction to the glass pane (10mm thickness.) Two ground motion records were selected as the source of input waves, as glass screen breakage was found near the sites. One site was JMA Ninohe EW, which was the east-west component recorded at JMA Ninohe in the 2008 Iwate prefecture north shore earthquake, and the other was JMA Sendai NS, the north-south component recorded at JMA Sendai in the Great East Japan Earthquake.

The main input waves used in the shaking tests were scaled waves and random sine waves to confirm the natural frequency..

The first natural frequency of the glass pane in the normal direction was observed to be 6.1 Hz in the free vibration test conducted before the shaking tests. Shaking tests were carried out seven times with scaled JMA Ninohe EW (20-200%) amplitude levels and eight times with scaled JMA Sendai NS (20-250%) amplitude levels, and although the glass pane bent out-of-plane, it did not break. After shaking tests of scaled observed ground motions were carried out, a sweep test (6-8Hz) was conducted and the entire glass pane broke at approximately 7.3 Hz. The breakage was presumed to have started not at the center of the glass but at the corners, judging from the high-speed video footage and the broken glass condition.

3. Study in this year

In this final research year of 2015, we will compile a technical reference for structural performance verifications along with results of the strong motion observations, structural analysis and full-scale shaking tests conducted in the last two years.

Photo 1: Damaged glass screen by earthquake after its damage

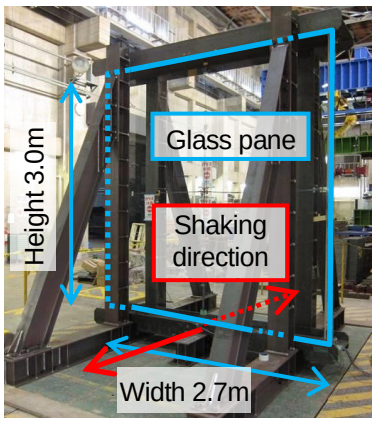

Photo 2: Whole view of the specimen

Photo 3: Glass plane