

Genuine Safe and Secure Public Space by Development of New Concept and Safety Assessment of Ceiling Construction

Summary

On March 11, in 2011, large area of east part of Japan was hit by a series of devastating earthquakes and numerous suspended ceilings were collapsed. Some of them had killed people. In Japan, as the engineering for the earthquake resistant structures has been developed better, less structural damage of the buildings becomes to be reported. On the other hand, failure of non-structural components, such as suspended ceilings or other architectural finishing, gradually became more noticeable than before. Failure of suspended ceilings in railway stations, airports or public halls, where many people gather most of the time, causes enormous danger to the users and may spoil the important function of the buildings in the emergency. Failure of suspended ceiling occurs not just during earthquakes but also during normal time without any earthquakes or other disturbances. Therefore just applying seismic reinforcement never prevents the all collapse of suspended ceilings.

In the granted research we put the four goals described below and obtained following results.

1. Development of a new safety evaluation of ceilings at a height.
 - New safety-evaluation scheme referring to the human tolerance index was developed based on the results of many dummy-head tests.
2. Effective measures to prevent against accidental fall of existing ceilings.
 - Effective prevention of existing ceilings with the aid of membrane ceilings or safety nets were developed and some small scale tests were conducted.
 - Practical study for the application of the safety nets to the public gyms, which may be converted as refugee spaces in the emergency. The consultation and cooperation with Shizuoka prefecture has been proceeded for the real application.
3. No-fall and no-injury ceiling system
 - Kawaguchi has established brief guideline for the membrane ceiling system authorized by the Membrane Structure Association of Japan (MSAJ).
 - Collaborating with private companies, Kawaguchi supervised application of foamed polymers boards to the ceilings. The main hall of AIJ (Architectural Institute of Japan) is one of the examples of such applications. He also supervised recovering work of ceiling systems in the Fuji swimming pool in the Shizuoka prefecture.
4. Guideline for safety of ceilings from AIJ
 - Kawaguchi and committee members has successfully published “Guidelines for safety measures against accidental fall of ceilings and other non-structural components ”

As described above, the four goals were mostly successfully accomplished. The range of the activity was not limited just in the research but has been expanded to practical applications and the knowledge was published as an AIJ guideline, which gives real impact to the practical design and construction.

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