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DAMAGE-CONTROLLED STRUCTURES AFTER KOBE-EARTHQUAKE

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ABSTRACT

In seismic design of building structures, almost all researchers and engineers discuss lateral movements of ground as well as corresponding lateral responses of the structures. They focus on story shear strength and deformation of the frame, and energy absorption of structural members, without paying attention to whether the yielded frame is still capable of sustaining gravity load.

This is a large mistake in seismic design. Prohibitively too many people had been killed by the gravity force of the building in the past major earthquakes. Most important issue of the seismic design is that structural systems should support the building weight during and after the major earthquake.

In our idea of the damage-controlled structures, the main frames consist of beams and columns that must behave elastically. One the other hand, lateral resistant members such as shear walls, braces, or dampers will behave plastically, enabling the main frames to sustain well the building weight after the earthquake. The system so-designed can be viewed as a part of passive control structures.

In these 20 years, many buildings were constructed using active or semi-active control systems. Structural engineers or researchers tend to prefer new technology such as tuned mass damper, active tuned mass damper, semi-active control damping system, and so on.

Building life will be longer than 60 years, most probably longer than life of the structural engineer who designed the building. The engineer, if he should be alive, may have neither interest nor access to the active controlled structures that he designed many years before.

The active control system needs computer system whose typical life is no longer than 5 years, thus, maintaining the computer system during the building's life appears to be impractical. In this regard, passive control system is much more desirable for a seismic use.

In the presentation, I would like to introduce many actual building projects designed using the damage-controlled structural system in Japan after Kobe Earthquake 1995.