CURRENT STATUS OF BUILDING PASSIVE CONTROL IN JAPAN

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Spectacular Projects of Passively-Controlled Buildings

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1. INTRODUCTION

This paper discusses three key issues:

- A major research program on passive control: E-Defense shaking table tests of full-scale 5-Story damped frame.
- Code and specifications: Code design check method vs. JSSI specifications' direct design method (DDM) for target performance.
- Damage-Free Design: Dampers and frames of the "super high strength steel". Its DDM for future code is being investigated by ANUHT.

2. VALIDATION OF PASSIVE CONTROL TECHNOLOGY

A full-scale 5-story building with dampers will be experimented in Feb. and March 2009 using the E-Defense, the world's largest three-dimensional shaking table (Fig. 1). In order to assure performance of the damper to be used in the building as well as to validate analytical model, dampers of three different sizes per each type (Fig. 2) were dynamically tested. The damper capacities were in the range between 500kN and 1500kN.

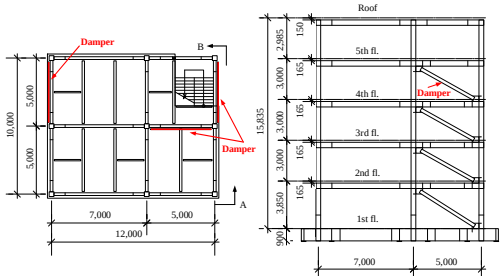

Fig. 1 Full-Scale 5-story Building with Dampers (E-Defense Tests)

Fig. 2 Full-scale Dampers Tested Prior to Building Experiments

3. CURRENT CODE AND JSSI SPECIFICATIONS

The second issue is standardization of the technology and design method. Fig. 3 shows design procedures of steel buildings stipulated by the Japanese code called Building Standard Law, and new options being proposed by Association of New Urban Housing Technology (ANUHT), Japan.

Methods (1) and (2) are intended for conventional structures, and do not consider dampers. Method (3) is the so-called energy-balance method for steel dampers only. Thus, the code is not yet covering different damper types. On the other hand, an accurate and simple design procedure is available from specifications in "Manual for Design and Construction of Passively-Controlled Buildings" that is published by Japan Society of Seismic Isolation (JSSI 2003, 2005, 2007). The Manual considers 5 different major damper types being used in Japan (Fig. 4).

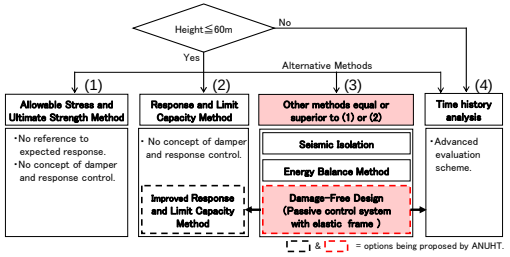

Fig. 3 Current Japanese Code Procedures and Proposed Additions

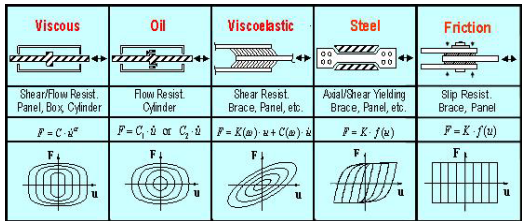

Fig. 4 Five Types of Dampers Considered by JSSI Manual

4. DAMGE-FREE STRUCTURE AND DESIGN SPECIFICATIONS BY ANUHT

Figs. 10(a,b) project Kasai's performance curve on story-drift vs. spectral acc. spectra. The performance curve is adopted by the JSSI manual. This clearly shows effects of damper and frame on the max. responses.

Figs. 10(c,d) show modified curves for easy balancing of frame and damper properties. Tf ≈ 0.03H~0.05H for tall to short conventional frame. To meet a target drift, use stiffer (short period) frame and small damper, or vice versa.

Inclusion of the modified curves in the code is considered by ANUHT for a damage-free structure having high-strength steel frame materials.

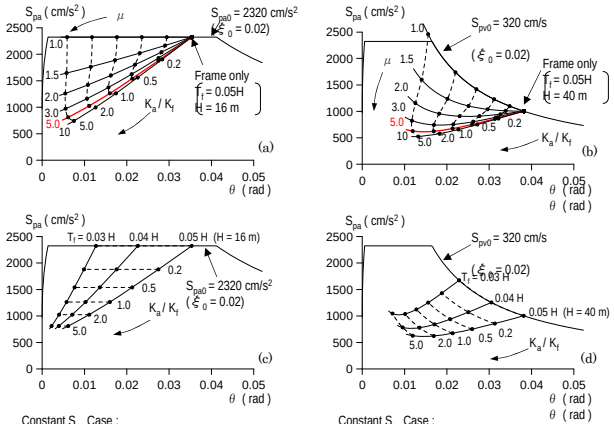

Fig. 10 Modified Performance Curve for Convenient Evaluation