SEISMIC VIBRATION CONTROL OF A HIGH-RISE R.C. BUILDING BY A LARGE TUNED MASS DAMPER UTILIZING WHOLE WEIGHT OF THE TOP FLOOR

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1. INTRODUCTION

This paper outlines the design of the high-rise building whose top floor is isolated and utilized as the mass of a large-scale mass damper, and describes the effect of the vibration control system realized by the design.

2. STRUCTURAL OUTLINE

The framing work is in a pure rigid-frame RC structure, and a double tube structure is used, where columns are intensively laid out along the perimeter and around the center core.

3. OUTLINE OF LARGE-SCALE MASS DAMPER

The view lounge and helideck are individually base-isolated, which forms a dual structure of seismic isolation. The weight of the view lounge accounts for about 2.2% of the building weight above the ground, and the weight of the helideck accounts for about 0.2%.

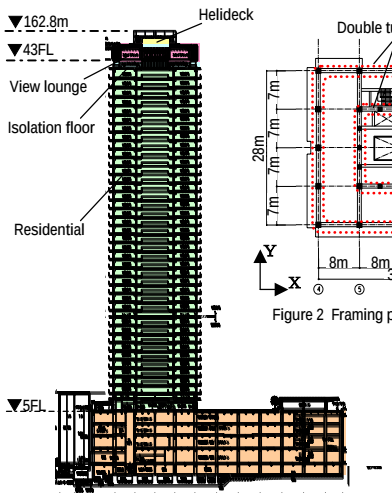


Figure 1 Building section

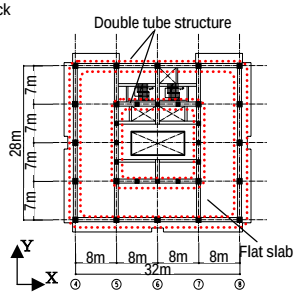


Figure 2 Framing plan of typical floor

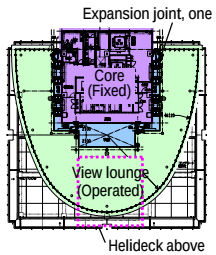


Figure 3 Floor plan of view lounge

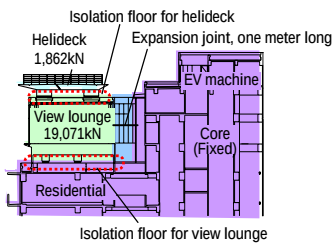


Figure 4 Cross section of mass damper

4. OUTLINE OF ISOLATION SYSTEM

The isolation system under the view lounge consists of the following elements. We have developed a long-stroke oil damper that can follow large displacements.

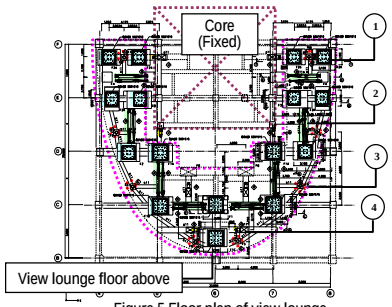
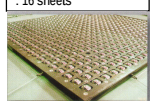


Figure 5 Floor plan of view lounge

① Supporting element

Steel ball bearing panel : 16 sheets



③ Restoring element

Base-isolator of laminated rubber bearing: 8 pieces

② Damping and control element

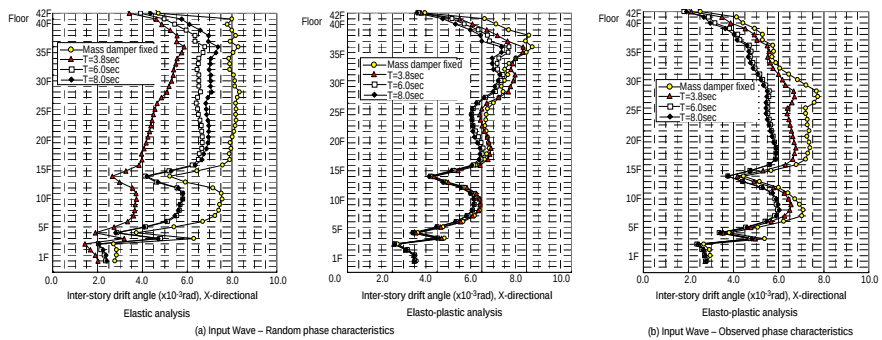
Oil damper for dumping: 8 pieces + Oil damper for control: 8 pieces

④ Protection against collision

Oil buffer: 8 pieces

5. SEISMIC RESPONSE ANALYSIS

In the analysis on an elastic building, the damper is the most effective when the natural period of mass damper is set to the optimum value; 3.8sec which is theoretically estimated. On the other hand, when the building is elasto-plastic, it will have to be as longer as about 8 sec. to attain a sufficient damping effect.



6. CONCLUSION

Sufficient mass and a long stroke enable the mass damper to be practically effective enough against large earthquakes. The natural vibration period of the mass damper should be set by considering the nonlinearity of the building.