A Supplementary Damping System (SDS) augments a structure’s inherent ability to control motion by providing additional damping. Fundamentally, an SDS absorbs dynamic energy from a structure and reduces the effects of excessive motions.

Structural motions can be caused by wind, pedestrians, vehicles, mechanical equipment or seismic activity. RWDI has successfully designed, developed and monitored SDS motion solutions for a wide range of structural applications, including buildings with high slenderness ratios, air traffic control towers, bridges, monuments, antennae, drilling rigs, and floor systems.

Adding Damping can be a cost-effective solution to vibration problems. There are a number of different types of Damping Systems available, but the basic principles of vibration apply to all of them. The Tuned Mass Damper is perhaps the most widely known type of Damping System, but others include Tuned Sloshing Water Dampers, Chain Impact Dampers, Visco-elastic Dampers and other hybrids.

Benefits
- Achievement of occupant comfort and safety criteria
- Increased design life (structural durability) through reducing structural stress and/or fatigue
- Decreased construction and maintenance costs
- Increased tenant space

What SDS services are provided by RWDI?
When a damping system is identified as part of the optimal solution to reduce motions, then RWDI can lead the design and implementation process. We make it easy for your team by providing a full range of services, such as:
- Feasibility Studies
- Design
- Construction
- Commissioning
- Maintenance & Monitoring
- Peer Reviews

Why choose RWDI to design / build / manage your next SDS project?

Key Features
- Creative engineering consultants using an interactive and collaborative approach with the client team
- Sophisticated, leading-edge modeling and testing techniques
- Multidisciplinary, proven, and practical team of SDS specialists with international experience.

Key Benefits
- SDS solutions that are customized to suit your needs
- Cost effective design with attention to your bottom line
- Single source responsibility
- Guaranteed performance
The Aura Residences was a proposed 240 m tall tower being built by Canderel Stoneridge.

- The tower contained 71 floors of residential condominiums beginning at the fifth floor
- There were three primary typical tower floor plates providing step-backs over the elevation of the structure.

With the lateral system developed for the 75-storey tower, the client became interested in an option to increase the height of the structure, thereby adding more residential units to the tower. Given concerns about high torsional velocities, there was no reserve in the current lateral system to achieve additional tower height, due to increased wind responses associated with the increased mass and reduced stiffness of the structure.

DAMPING SOLUTION FOR AURA

Halcrow Yolles and RWDI undertook two desktop analytical studies to estimate the wind induced tower responses, as follows:

- A conventional study to determine additional height (to reach 80+ storeys) that could be achieved while maintaining the base lateral system
- An assessment of achievable reductions in structural wall thicknesses for the 75-storey tower by adding supplemental damping, while maintaining the wind responses of the tower to acceptable levels of occupant comfort.

Based on preliminary data from RWDI, it was agreed that providing a total damping ratio of 3.0% (assumed inherent damping ratio of 2.0% plus 1.0% supplemental damping) of critical to the structure would produce a sizable reduction to structure while maintaining the cost of the damping system to a reasonable level.

Given the specific damping system design needs of the building, a Tuned Sloshing Damping system was determined to be the best candidate as it would likely provide the most cost effective solution for supplementary damping within the defined space envelope.

To provide a damping ratio of approximately 3.0% of critical for the three fundamental modes of vibration (X-sway, Y-sway and torsion):

- Two dual-axis TSD tanks were deemed necessary in this case.
- The water in these tanks can also be utilized for the fire-suppression system, thus removing the necessity of installing a third tank for dedicated fire-suppression.

Construction materials and cost savings

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount Saved</th>
<th>Cost</th>
<th>Value of Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>1,400 m³</td>
<td>$120/m³</td>
<td>$168,000.00</td>
</tr>
<tr>
<td>Mild reinforcing steel</td>
<td>88,000 kg</td>
<td>$1.80/kg</td>
<td>$158,400.00</td>
</tr>
<tr>
<td>Post-tension strand</td>
<td>9,300 kg</td>
<td>$8.50/kg</td>
<td>$79,050.00</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>405,450.00</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSIONS

A cost/benefit analysis has been performed which indicates that significant savings in structural costs (between $400,000 and $500,000) can be expected.

- These costs can offset the expense of designing and constructing an SDS. Environmental benefits of saving concrete and reinforcing steel can translate into reductions in greenhouse gas emissions (CO₂) of about 670 tonnes.
- These ‘green benefits’ can potentially earn credits towards LEED certification.
- Additional design flexibility has also been achieved for the developer, whereby the performance enhancement of the SDS will allow them to add five additional residential floors without changes to the baseline structural core system, wall thicknesses, or unit layouts.
- This could result in approximately $30 million of additional sales revenue for the developer without significant modifications to the original design.