



motioneering

PERFORMANCE- BASED DAMPING®

Advanced motion control
to make skyscrapers and
other ambitious structures
more comfortable, durable
and efficient.

Motioneering has designed and implemented damping systems for some of the world's tallest and most ambitious structures.

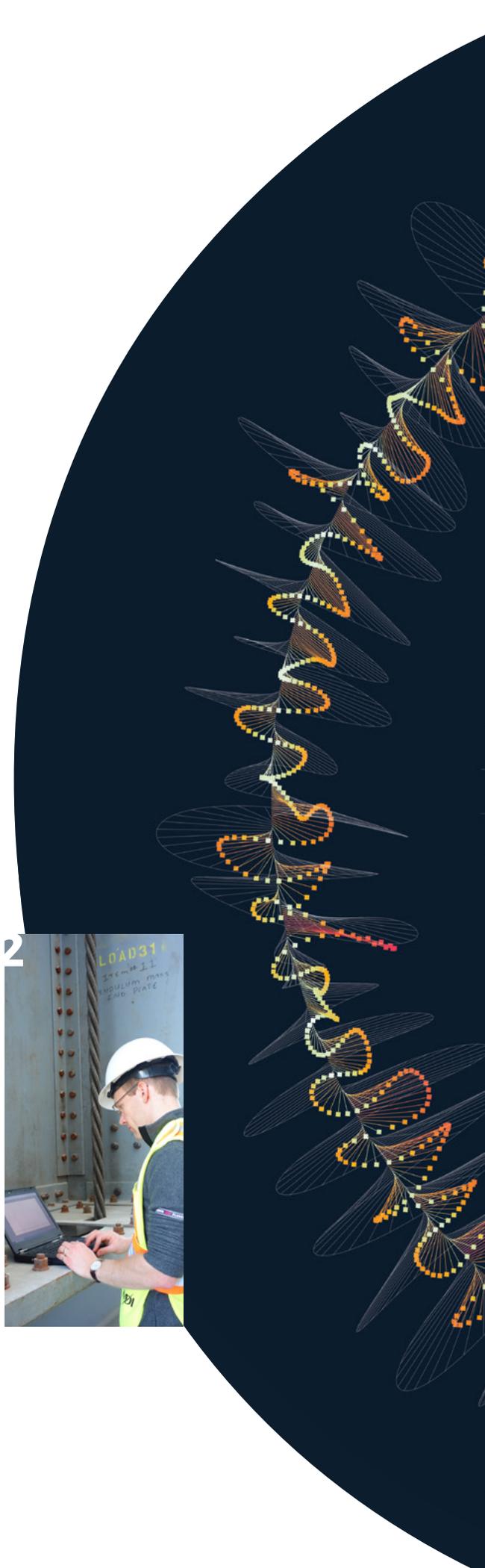
Our performance-based damping[®] systems promote occupant comfort and overall building performance by efficiently mitigating vibrations from wind loads, pedestrian movement and seismic activity.

Whether the project is a skyscraper, a bridge, or another structure, we collaborate closely with architects and fellow engineers to translate our rigorous technical analysis into lasting value for clients.



1. Our team celebrates the successful fabrication of two 600-tonne tuned mass dampers to be installed at 432 Park Avenue, New York

2. One of our experienced Vibration and Damping Specialists tunes and commissions an installed TMD to optimize performance.



Building motion

TMD motion

time

10:00

00:00

1:00

2:00

3:00

4:00

5:00

6:00

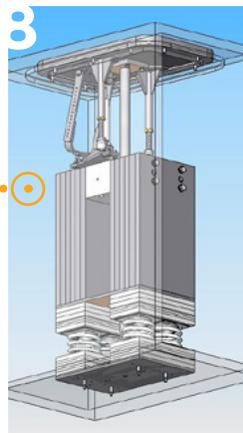
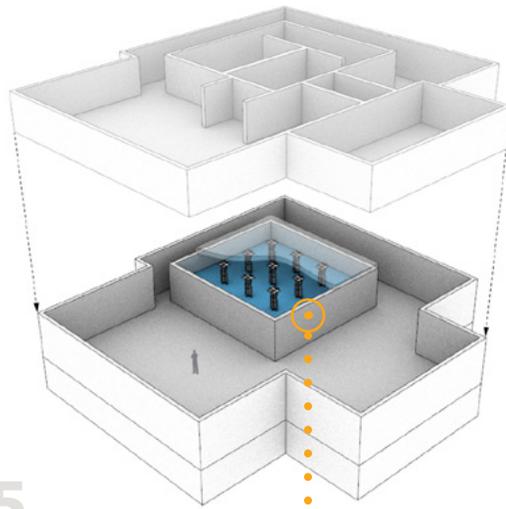
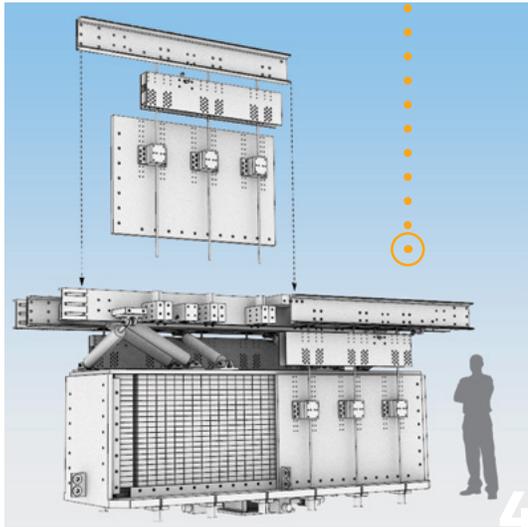
7:00

8:00

9:00

This graph shows the movement of a supertall tower and its tuned mass damper during a windstorm.

We combine our unique capabilities in wind engineering with decades of experience in the design and construction of damping solutions to solve complex structural dynamics problems. Our mitigation solutions are innovative, practical, and proven to perform.



3. Control tower, McCarran International Airport, Las Vegas

4. Damper design for the control tower at McCarran International Airport, Las Vegas

5. Tuned sloshing damper at 56 Leonard, New York

6. 56 Leonard, New York

7. Grand Canyon Skywalk viewing deck

8. Grand Canyon Skywalk damper design

9. Illustration of Taipei 101 damper

10. Taipei 101, Taipei

11. Opposed Pendulum Tuned Mass Damper, at 432 Park

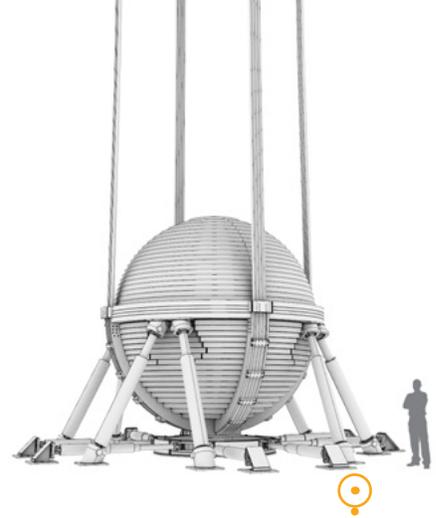
12. 432 Park, New York

Why a Tuned Mass Damping System?

Structures vibrate when they're subjected to forces like wind, pedestrian movement and seismic activity. In tall buildings and other slender structures, these vibrations can cause discomfort for occupants. They can also fatigue materials causing problems with facades, partitions and elevators. Although designers can often mitigate resonant motion by adding stiffness, adding mass or changing the shape of the structure, these modifications are costly – and still may not achieve the desired performance.

This is where tuned mass damping (TMD) systems come in: they supplement the inherently poor damping properties of the structure itself, minimizing undesirable motion. And they're typically more cost-effective than other approaches.

Around the world, TMDs have been essential to the realization of hundreds of breathtakingly innovative designs – some previously thought to be impossible to build. A skillfully engineered TMD can significantly enhance the damping capacity of a traditionally designed structure and allow boundaries to be pushed further and further.



What is Performance-Based Damping®?

All damping systems are not created equal. Performance-based damping means we will design, engineer and evaluate the performance of a damping system that addresses all of the project's performance requirements and ensure a fully functional system for the expected design life. Motioneering's performance-based damping® methodology enables maximum design flexibility and creativity for structural teams, architects, and engineers. Our approach includes demonstrating and monitoring the real-life performance achieved for full-scale installations, and uses this data to inform design practices that continuously advance this technology.

Performance-Based Damping®, A Proven Approach

From our work on many challenging structures around the world we've refined a rigorous and effective performance-based process for the design, construction and implementation of high-performance TMD systems.

Concept Design - Our analysis determines the most appropriate TMD for the structure, whether a solid or water-based mass system.

Performance Analysis - We use proprietary time-domain software tools, in conjunction with simulations of wind and seismic load events, to generate a high-fidelity dynamic TMD model.

Detailed Design - We deliver evidence-based design refinements, informed by insights from the performance analysis.

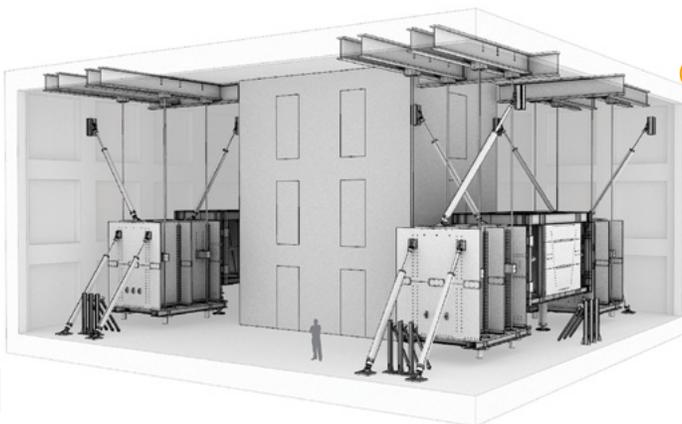
Fabrication and Factory Acceptance Tests - Development of shop drawings, fabrication works, quality control, trial assemblies, and performance testing of critical components as needed.

Tuning and Commissioning - We work on-site to measure the as-built structural frequencies and tune the system accordingly. Our TMDs are designed and manufactured to accommodate the expected as-built range of design structural properties. We test and tune to achieve optimal performance.

Maintenance and Monitoring -

We can provide long-term maintenance support and monitoring of the structure as part of a proactive and comprehensive operational strategy.

For every project there is an ideal solution. Our process ensures that we deliver it.

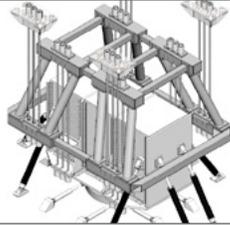


Which Damping System is Right for Your Application?

All of Motioneering's damping systems provide a robust motion control solution that is fully functional over a wide range of loading scenarios, meeting or exceeding performance-design targets.

Simple Pendulum Tuned Mass Damper

- multidirectional damping performance
- elegant appearance, potential visitor draw
- fewer parts for simplicity and a lower cost

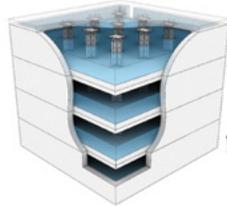
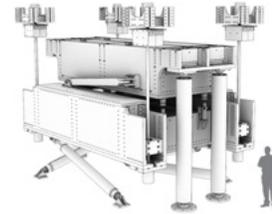


Compound (Dual) Pendulum Tuned Mass Damper

- multidirectional damping performance
- more compact than a simple pendulum

Opposed Pendulum Tuned Mass Damper

- multidirectional damping performance
- unique patented configuration enables the most compact passive TMD solution available for large towers

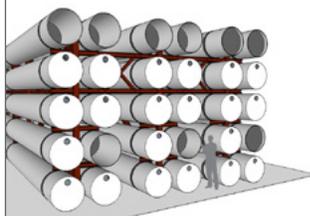
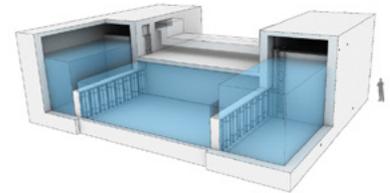


Tuned Sloshing Damper

- multidirectional damping performance in one system
- silent operation
- water can also be used for fire suppression and potable purposes
- lower capital costs than comparable mechanical TMD

Tuned Liquid Column Damper

- water can be used for fire suppression

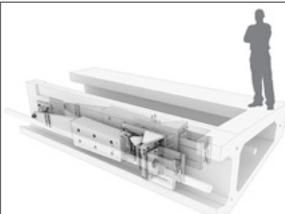


Hummingbird Damper

- highly efficient use of damping mass
- modular configuration allows for placement in multiple smaller spaces
- water can be used for fire suppression
- modular, prefabricated construction facilitates rapid installation

Telecom Tower and Wind Turbine Dampers

- extend design life of towers by reducing material fatigue damage
- feature a compact design that allows installation on slender structures
- help existing infrastructure accommodate operational demands for upgrades to newer technologies



Vertical Tuned Mass Damper

- versatile, smaller TMD for bridges and floors

Motioneering
is a valuable
partner
to clients
seeking to...

Explore Innovations

- Push structural boundaries for height or flexibility while keeping occupants comfortable and enhancing serviceability

Create Opportunities

- Optimize the profitable space in a “lively” structure by choosing a compact damping system design
- Optimize use of structural mass, eliminating unnecessary material and construction costs

Meet Challenges

- Manage motion (even post-construction) with a customizable, cost-effective solution based on proven designs
- Fit a damping solution into a challenging space

Fulfill Expectations

- Satisfy expectations for budget, schedule and performance simultaneously, with a damping solution that takes fabrication and installation costs and project-specific concerns into account

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