

MOTION CONTROL FOR BRIDGES AND FLOORS



Optimizing occupant experience and structural performance by mitigating motion and vibration

The Motioneering team has over 25 years of experience solving complex issues in the field of applied structural dynamics on bridges, floors, grandstands, buildings, spires, antenna, and other types of dynamically sensitive structures.

We believe in proactive collaboration. We listen. We engage. And together we develop a strategy that will suit your needs.

CLIENT FIRST APPROACH

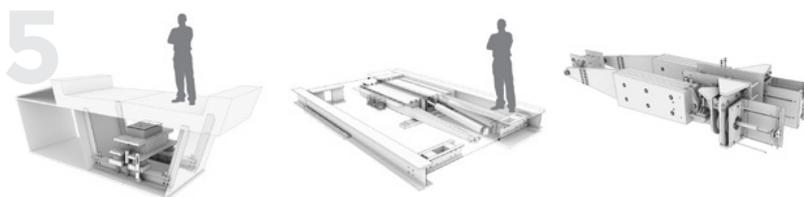
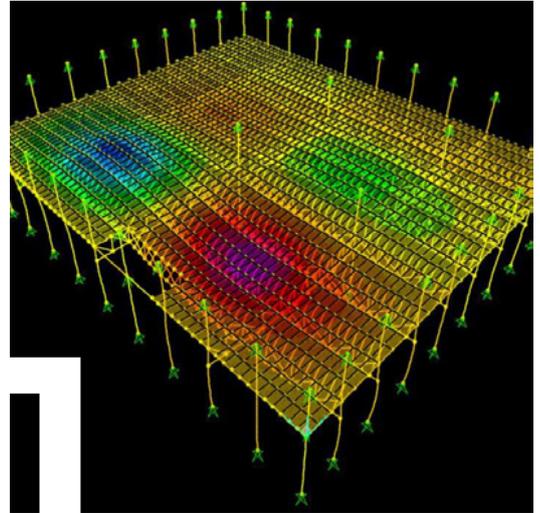
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ADVANCED, PROVEN TECHNIQUES

We assess the dynamic response of bridge and floor systems using advanced modeling techniques developed and calibrated from as-built measurements in the real world. We can accurately assess the motions of dynamically sensitive structures and help you to establish practical & achievable performance targets.

RISK MANAGEMENT SOLUTIONS

We have developed a range of modular, prefabricated, and compact damper solutions for bridges and floor systems. Constructability, cost efficiency, quality, and performance are at the core of our approach. Our construction services offering can be customized to serve the specific risk management and performance needs of the project.



1. Floor motion simulation
2. Grand Canyon Skywalk
3. Madison Square Garden suspended bridges
4. Wichita Pedestrian Bridge
5. Bridge and floor damper designs

SUPPLEMENTARY DAMPING SYSTEMS BRIDGES



WHAT IS AN SDS & WHY WOULD I NEED ONE

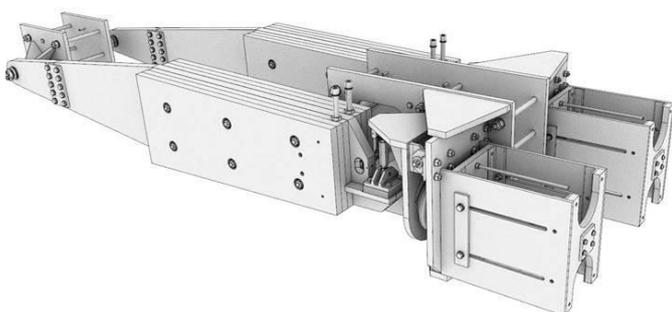
Light, flexible structures such as bridges can be susceptible to wind, pedestrian and vehicle-induced vibrations. With continual improvements in materials and design techniques, these increasingly efficient structures become ever more sensitive to these dynamic forces. With little intrinsic damping and limited practical methods to shift the structure's mass and stiffness to a configuration with lower dynamic response, the resulting vibrations can result in disconcerting or even dangerous motions. The implementation of an SDS has proven to be a very effective means to control these dynamic motions while using less materials and with little or no impact on the architecture of the design. For bridges, the SDS is typically in the form of a tuned mass damper (TMD).

CONCEPT DESIGN & ANALYSIS

The concept design is a first-pass evaluation of damping options that can be completed in a matter of weeks. It will target any identified dynamic motion issues and develop a mitigation strategy. Motioneering will ensure that the TMD performs satisfactorily under the entire range of expected loading conditions. Our team has developed a proprietary suite of software tools to optimize damping performance and cost.

By fully defining the scenarios that the TMD(s) will experience within the bridge, the amplitude of damper travel within the structure and energy dissipation characteristics can then be established. This in turn ensures that the supporting structure can be appropriately designed to accommodate the imposed loads and will provide the information required to proceed into the detailed, mechanical design stage.

A 3D concept model of the proposed solution(s) will be created to provide a visual representation of the proposed solution and to aid in the design integration and coordination.



DELIVERABLES

Concept Design Report

- Summary of inputs, assumptions in analysis, performance targets and results.
- Load cases that describe the static and dynamic fluctuating forces the TMD will apply locally to the structure.
- General requirements for SDS including: mass, tuning range, damping parameters, design travel and fatigue considerations.

SDS Concept Arrangement Drawing

- Illustrating a general layout, allowing for space and interface coordination.

BRIDGE VIBRATION MEASUREMENTS BRIDGES



The Motioneering team has over 25 years of experience solving complex issues in the field of applied structural dynamics for pedestrian, cycling and traffic bridges, skywalks, observation decks, and many other types of dynamically sensitive structures.

OBJECTIVE

- Establish baseline vibration criteria based on existing location(s) with proven functionality.
- Establish baseline vibration levels before the addition of a new vibration source (e.g. decks or cables)
- Assess the suitability of a bridge to meet vibration requirements for the proposed usage.
- Determine the attenuation characteristics of vibration with distance from a source.
- Determine the source of a problematic vibration.



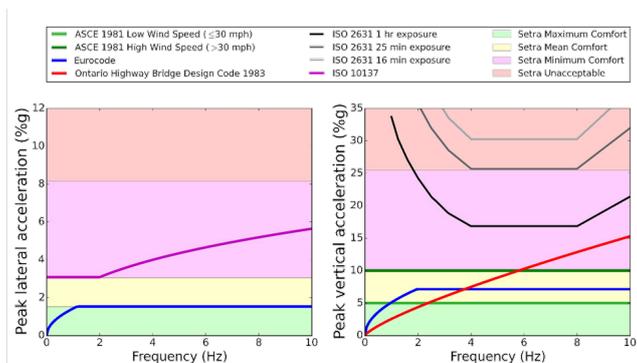
ANALYSIS

A representative of Motioneering will travel to the site to measure vibration levels. Prior to travel, we will consult with the owner or architect to establish a comprehensive measurement plan capable of achieving the specific project objectives and tailored to the site conditions. Motioneering has measurement equipment capable of measuring very low vibration levels (below VC-E). We can view and interpret vibration levels on site and adjust the measurement plan where necessary.



OUTCOME

The measured vibrations will be processed in a way that is compatible with the project objective. A report summarizing the measurement details (equipment used, locations, duration, vibration sources, etc.) and measurement results will be issued.



Contact Us

Reach out to learn more about the work we do, and how we can support the technical and business success of your next project.

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RELEVANT EXPERIENCE BRIDGES & FLOORS



**1. Bagley Avenue
Pedestrian Bridge,
Detroit, MI, USA**

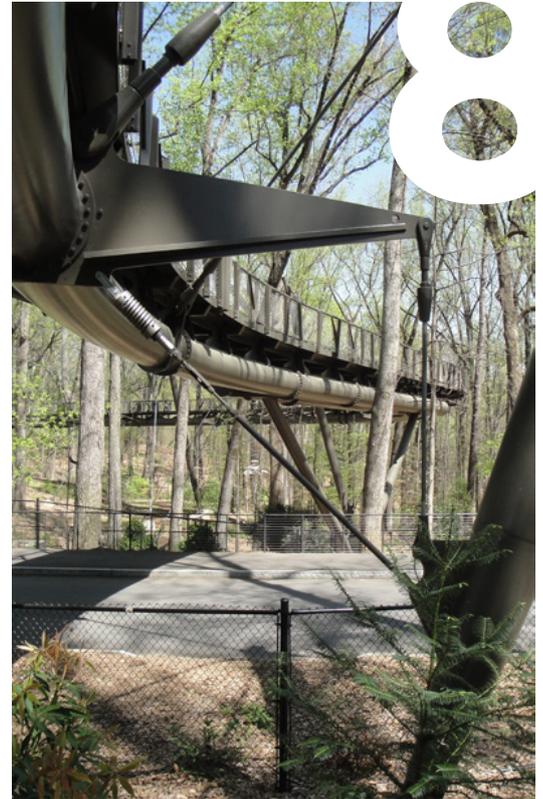
**2. Wichita Pedestrian
Bridge,
Wichita, KS, USA.**

**3. MGM Mirage
Pedestrian Bridges,
Las Vegas, NV, USA**

**4. Madison Square
Garden, New York,
NY, USA**

**5. Red Hill Creek
Pedestrian Bridge,
Hamilton, ON, Canada**

RELEVANT EXPERIENCE BRIDGES & FLOORS



6. Cumberland River Pedestrian Bridge, Nashville, TN, USA

7. Grand Canyon Skywalk, Grand Canyon West, NV, USA

8. Atlanta Botanical Garden, Atlanta, GA, USA

9. Treasure Island/Venetian Pedestrian Bridge, Las Vegas, NV, USA

10. Bellagio/Bally's Pedestrian Bridge, Las Vegas, NV, USA

RELEVANT EXPERIENCE BRIDGES & FLOORS



11. Ottawa Airport Parkway Pedestrian Bridge, Ottawa, ON, Canada

12. Beanfield Centre Pedestrian Bridge, Toronto, ON, Canada

13. Royal Alexandra Bridge, Ottawa, ON, Canada

14. Guangxi Baidong Lookout, China

15. SeaTac International Airport Bridge, Seattle, WA, USA

RELEVANT EXPERIENCE

BRIDGES & FLOORS



Project	Location
1175 Vanguard West Campus Building 35 bridge • Four 2 ton tuned mass dampers	Malvern, USA
Apple Store Pacific Centre • Tuned mass dampers (500 kg and 1 tonne)	Vancouver, Canada
ARIA Resort and Casino - Ballroom Floor • Vibration assessment and tuned mass damper concept design	Las Vegas, USA
Atlanta Botanical Gardens Pedestrian Bridge • Design of distributed tendon dampers	Atlanta, USA
Bagley Avenue Pedestrian Bridge (Ambassador Gateway) • Vertical and lateral tuned mass dampers (multiple)	Detroit, USA
Beanfield Centre - Pedestrian Bridge • One 500 kg tuned mass damper	Toronto, Canada
Bellagio and Spring Mountain Pedestrian Bridge • Twelve tuned mass dampers (multiple sizes)	Las Vegas, USA
Burgoyne Bridge • Damping solution – pickets	St. Catharines, Canada
Complexe les Ailes - Passerelle (Bridge) • One 1 tonne tuned mass damper	Montreal, Canada
Cumberland River Pedestrian bridge • Three tuned mass dampers	Nashville, USA
Grand Canyon Skywalk • Three 1.2 tonne tuned mass dampers	Peach Springs, USA
Guangxi Baidong Lookout • Three 1tonne tuned mass dampers	Guangxi, China
Hunt Club Pedestrian Bridge, Ottawa Airport Parkway • Two 750 kg tuned mass dampers	Ottawa, Canada
I-74 Bridge • Damping solution design	Davenport, USA
Kennedy Center Pedestrian Bridge • Tuned mass damper concept design	Washington, USA

RELEVANT EXPERIENCE

BRIDGES & FLOORS (cont'd)



Project	Location
Lusail Footbridge Vibrations • Monitoring of cable vibration mitigation devices	Lusail, Qatar
Madison Square Garden • Five tuned mass dampers	New York, USA
Martin Olav Sabo Pedestrian Bridge • Impact dampers on cables	Minneapolis, USA
MGM Mirage City Center Block B & C Pedestrian Bridges • Tuned mass damper design	Las Vegas, USA
Oakley C. Collins Memorial Bridge (Ironton-Russell Bridge) • Design of tuned mass dampers and stay cable dampers	Ohio/Kentucky, USA
Ottawa Airport Parkway Pedestrian Bridge • Two TMD's @ 750 kg each	Ottawa, Canada
Palms Casino Resort Rain Night Club Renovation – Floor Vibration • Tuned mass damper	Las Vegas, USA
Pearson-East Pedestrian Bridge • Six viscous damping devices	Toronto, Canada
Port Lands Pedestrian Bridges • Vehicle-induced vibration analysis	Toronto, Canada
Qiantan Four Square City Pedestrian Bridge • Tuned mass dampers (multiple)	Shanghai, China
Red Hill Creek Bridge • Five TMD's @ 2 tonnes each	Hamilton, Canada
Royal Alexandra Bridge Rehabilitation • Eight TMD's @ 5 tonnes each	Ottawa, Canada
Seattle-Tacoma (Sea-Tac) International Airport Bridge • Two 8.8 ton tuned mass dampers	Seattle, USA
Shenzhen Western Corridor Bridge • Seven 5-1/2 tonne tuned mass dampers	Hong Kong, China
Spring Mountain Road & Las Vegas Boulevard Pedestrian Bridges • Damping system design (3 bridges)	Las Vegas, USA
State Road 414 Bridge Extension Over US 441 • Four tuned mass dampers	Orlando, USA
Treasure Island/Venetian Pedestrian Bridge • Six 1.5 tonne tuned mass dampers	Las Vegas, USA
Wichita Riverfront Pedestrian Bridge • Five TMD's @ 1.5 tonnes each	Wichita, USA