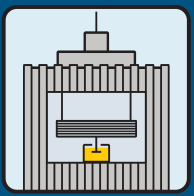
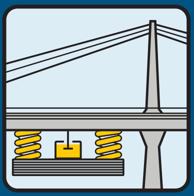
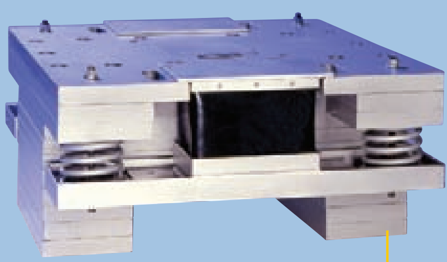
Tuned Mass Dampers for Bridges, Floors and Tall Structures





GERB

Tuned Mass Dampers for Bridges, Floors and Tall Structures



Vertical TMD

Millennium Bridge – London, GB

Wide span structures such as bridges, stairs, and roofs, as well as tall, narrow structures such as chimneys, antennas, masts and buildings, can be easily excited to high vibration amplitudes in their first or higher eigenforms. Excitations can be caused by wind forces, pedestrian traffic, machinery or earthquakes. Natural frequencies and damping are typically low for these structures. With GERB tuned mass dampers (TMD), these vibrations can be easily reduced.

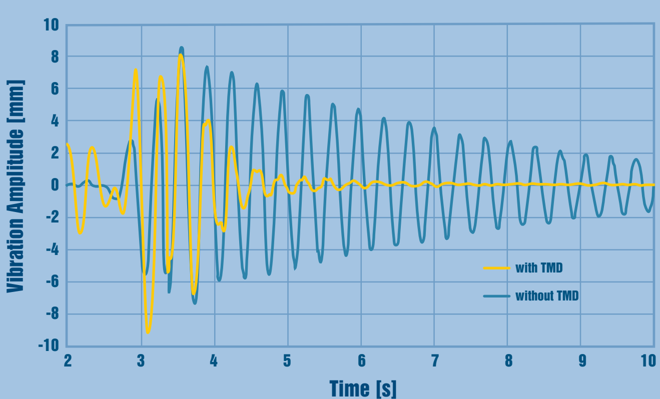
All GERB TMDs, both vertical or horizontal, have three main components: **Spring or pendulum – Oscillating Mass – Viscodamper® (viscous fluid damper).**

Every TMD is exactly tuned to the main natural frequency of the structure.

Although TMDs have been well-known for a long time, it is still difficult to provide exact tuning and predefined system damping. Furthermore, the three components must not change their dynamic properties over time, even when exposed to variable weather conditions. GERB has worldwide success in designing and manufacturing TMDs with masses from 20 to 10,000 kg, and vibration frequencies from 40 to as low as 0.3 Hz.

To protect against vertical vibrations, GERB TMDs are equipped with helical compression springs and Viscodampers®. For horizontal and torsional vibrations, GERB supplies TMDs with leaf springs or pendulums, and Viscodampers®.

Typical Damped Vibration of a Structure without and with TMD



Horizontal TMD

Fans in a Cooling Tower – Scholven, Germany

Horizontal TMD

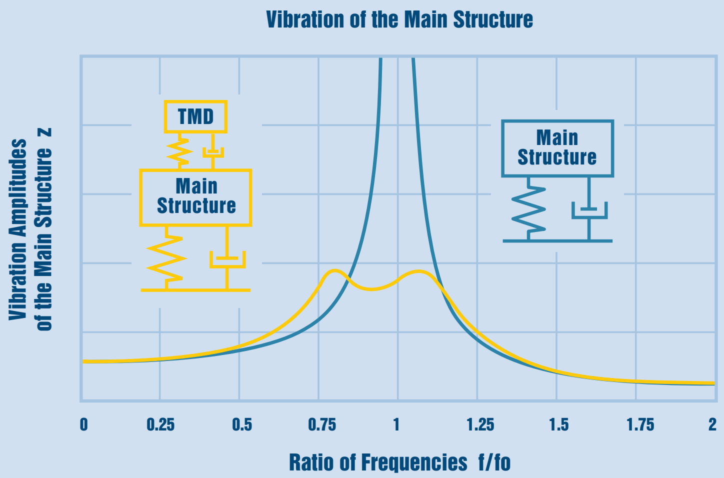
There are generally three types of applications that often require the use of tuned mass dampers:

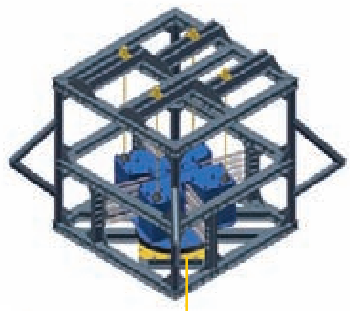
1. **Tall, free-standing structures (bridges, pylons, chimneys, antennas and TV towers) may be excited by wind forces, with dangerous Eigenform amplitudes.**
2. **Smaller bridges, e.g. pedestrian bridges, and tribunes may be excited by vehicle or foot traffic. Although usually not dangerous to the structure itself, vibrations may become very unpleasant to people on the bridge or tribune.**
3. **Structures may have machine-induced vibrations. Vertical or horizontal TMDs are tuned to the disturbing frequency of the machine (e.g., excitation by unbalance forces).**

In any case GERB tuned mass dampers help reduce vibrations. The TMD may be included in the original design of the structure, or may be installed later.

Vertical TMD

Bridge – Berlin, Germany

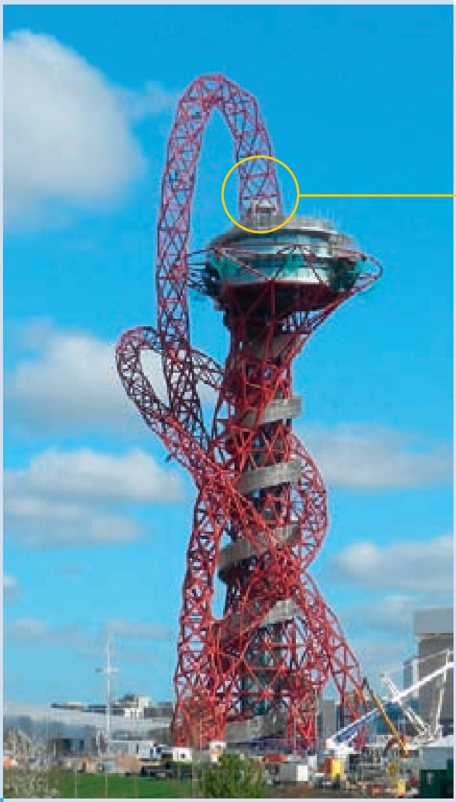




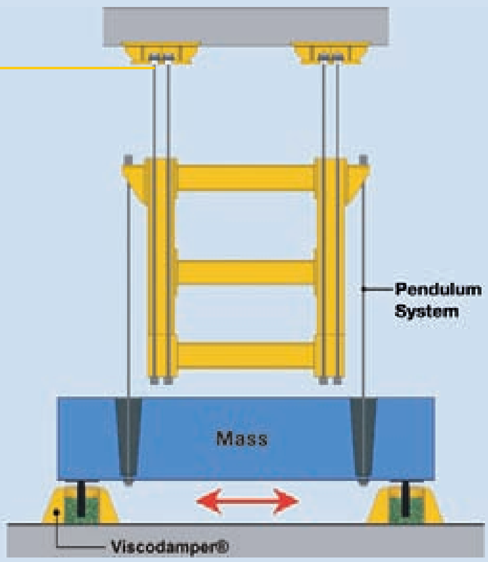
Horizontal TMD

GERB tuned mass dampers are passive, and do not require an energy source. Other advantages include:

- Simple in design, ruggedly built, and maintenance-free,
- Highly effective, providing maximum reduction of vibration amplitudes,
- Able to tune on-site,
- Low price.



ArcelorMittal Orbit Tower, London

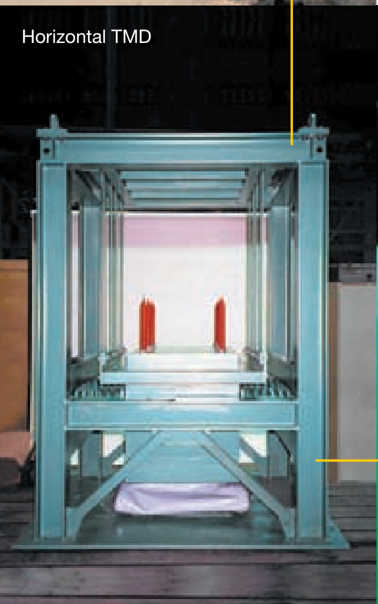


Aspire Tower with TMD – Doha, Qatar

Tuned Mass Dampers
Reference List (Excerpt)

Country	Project	Tuned Mass [kg]	Frequency [Hz]	Type of TMD	Year
Australia	Brisbane, Kurilpa Footbridge	3 x 3000	1.8	horizontal	2009
Austria	Wernstein, Footbridge	6 x 700	1.2	vertical	2006
Belgium	Offshore Windpark Belwind, OHVS Station	20000	0.35	horizontal	2010
Brazil	REFAB 2, Stack	2 x 5000	0.7	horizontal	2003
Canada	Toronto, Art Gallery, Ceiling	2 x 5000	3.5	vertical	2008
China	Shanghai, Pudong Airport, 23 Gangways	92 x 750	2.3	vertical	2007
	Shanghai Expo Area, Galleries	12 x 4800	2.5	vertical	2009
	Hangzhou Bay Bridge Tower	100000	0.3	horizontal	2009
Denmark	Nykredit's New Domicil, Floor	3 x 1000	6.8	vertical	2001
	Copenhagen, Langelinie, Footbridge	14 x 1600 - 3000	1.4 - 4.2	vertical	2005
France	Paris, Stade de France, Footbridge	3 x 2050 - 2800	1.8 - 2.1	vertical	1997
	Paris, Solferino Footbridge	14 x 1900 - 2500	0.8 - 2.2	horiz./vert.	2000
Germany	Berlin, Bundeskanzleramt, Footbridge	6 x 1500 - 2200	1.7 - 3.3	vertical	2000
	Dresden, Neue Terassen, Floor Slabs	8 x 5000	2.4	vertical	2003
	Scholven, Cooling Tower Fans	22 x 100	14.0	horizontal	1998
Great Britain	Inverness, Kessock Bridge	8 x 2000	0.5	vertical	1989
	London, ArcelorMittal Orbit Tower	40 000	0.31 + 0.42 bi-directional	horizontal	2012
	London, Millennium Bridge	58 x 1000 - 2500	0.8 - 2.2	horiz./vert.	2001
	Newport, USK Bridge	18 x 800 - 1200	0.7 - 1.9	horiz./vert.	2005
	Stockton on Tees, Northshore Footbridge	7 x 5000	0.8 - 2.5	horiz./vert.	2008
Hungary	Budapest, Refinery Tower	16000	0.4	horizontal	2005
Iceland	Footbridge	4 x 350	2.6	vertical	1999
Italy	Barberino di Mugello, Footbridge	4 x 100 - 200	1.6 - 2.3	vertical	2002
	Sardinia, Sarlux, Cooling Tower Fan	24 x 700	11.0	horizontal	2000
Japan	Ube, Stack	300	3.1	horizontal	2000
Korea (South)	Seoul, Sun You Footbridge	4 x 1500 - 1650	0.75 - 2.0	horiz./vert.	2002
Malaysia	Kuala Lumpur, Skybridge LCCT Airport	8 x 7500	1.1 - 2.5	horiz./vert.	2013
Mexico	Guadalajara, Theatro Diana, Spectator Balconies	8 x 2500	2.9	vertical	2005
	Mexico City, Estela de la Luz	8 x 3000	0,25	horizontal	2010
Norway	Bergen, Gym Floor	2 x 2000	3.8	vertical	2003
	Bulandet/Vaerlandet, 3 Bridges	5 x 5000 - 10000	0.8 - 2.0	vertical	
	North Trondelag, Bridge	10000	0.53	vertical	1989
Poland	Wroclaw, Footbridge "Zabia Kladka"	3 x 850 - 2100	1.2 - 1.5	vertical	2004
Qatar	Doha, Aspire Tower	140000	0.16 - 0.23	horizontal	2006
	Doha, QEEC, Floor	16 x 12500 - 17500	2.5	vertical	2009
Singapore	Singapore, Changi Airport, Footbridge	2 x 500	0.9	horizontal	2003
Spain	Bilbao, Radar Tower	1 x 8000	1.4	horizontal	2005
Switzerland	Rümlang, Footbridge	1000	2.0	vertical	1992
Thailand	Bangkok, Chao Phya Bridge	18 x 4500	0.3 - 0.7	horiz./vert.	1985
	Bangkok, Stack	3500	0.8	horizontal	1999
UAE	Abu Dhabi, Capital Gate Tower, Footbridge	2 x 750	3.5	vertical	2010
	Abu Dhabi, YAS Marina Hotel, Footbridge	4 x 3000	1.8 - 2.7	vertical	2009
	Dubai, Burj Al Arab, Steel Sceleton and Spire	11 x 5000	0.8 - 2.0	horizontal	1997
	Dubai, Emirates Towers, Spire	6 x 1200	0,9	horizontal	1999
	Dubai, Al Mas Tower, Spire	4 x 2000	0.45 - 0.6 / 2.1 - 2.8	horizontal	2008
USA	Ivanpah Solar Tower	3 x 115000	0.3	horizontal	2012
	Buffalo, NY, Civic Center	4 x 500	4.0	vertical	2011
	Las Vegas, Giant Wheel - High Roller	13 x 750	0.6 - 2.5	horizontal	2013

Burj Al Arab Hotel – Dubai, UAE



Horizontal TMD

Building structure with TMDs

GERB
worldwide

We offer:

- Dynamic analysis of the structure
- On-site vibration measurement and assessment of bridges, buildings, machinery and other equipment
- Design of tuned mass dampers, tuned to the main structure
- Fabrication and testing of tuned mass dampers
- Installation and fine tuning of tuned mass dampers and final measurement and assessment

For more information, please contact us.

GERB Schwingungsisolierungen GmbH & Co.KG

Roedernallee 174-176
13407 Berlin/Germany
Tel. +49 30 4191-0
Fax +49 30 4191-199

Ruhrallee 311
45136 Essen/Germany
Tel. +49 201 26604-0
Fax +49 201 26604-40

info@gerb.com
www.gerb.com

GERB Vibration Control Systems

Certified to **ISO 9001 ISO 14001 BS OHSAS 18001**

TIL_07/14 · Design: Sijades, Berlin · Printed: Woeste, Essen