

# GERB Viscous Wall Dampers (GVWD)

Protection of buildings & structures against earthquakes and wind-induced vibrations



# Seismic energy absorption through induced damping instead of intended damage

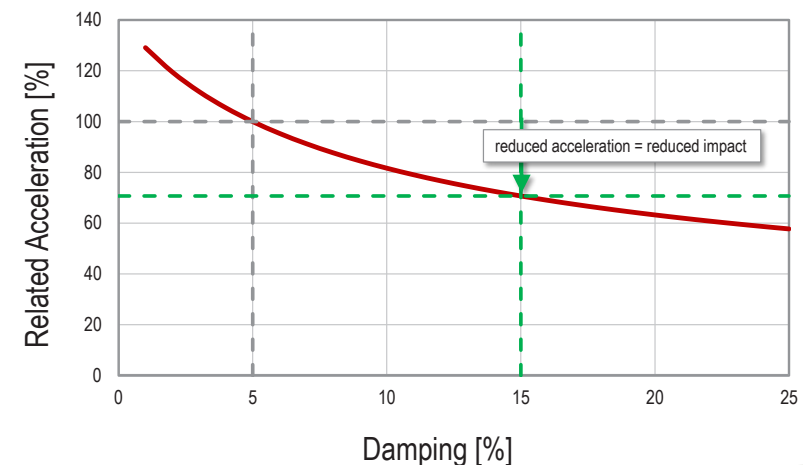
Earthquakes can have different effects on buildings depending on their duration, ground conditions and construction of the building. At the earth's surface, the earthquake waves cause the ground to move both horizontally and vertically. In particular, the horizontal forces released during earthquakes endanger the stability of structures. The consequences can be:

- » Deformations and corresponding effects due to rapid movements from one direction to another
- » Local damages (e.g. of non-structural elements like walls)
- » Damaged doors and windows that can no longer be used
- » Damage of important machinery where operation cannot be guaranteed
- » No access to lifeline structures such as power or water
- » Partial or complete collapse of the building

The main target of seismic construction standards is life safety. A safe evacuation of people must be guaranteed at all times. Appropriate construction measures help to significantly reduce the risk of collapse of a structure even during strong earthquakes. In addition, it is advisable to install seismic protection measures adapted to the conditions of structure and environment.

## Seismic protection due to increase of damping

A damping solution using the latest technology can provide additional protection for structures in the event of an earthquake. The reduction of the induced structural responses by the increase of viscous damping can be taken from different national and international standards. Like illustrated in the figure, an increase of structural damping causes the reduction of the acceleration and thus of the earthquake impact on the structure. Seismic stress decreases with increase of damping.



# Protection of buildings & structures against earthquakes with GERB Viscous Wall Dampers

GERB Viscous Wall Dampers (GVWD) are a special design of common Viscodampers®. They are installed in buildings and structures connecting different floors addressing shear deformation between them. In this position they are especially reducing inter-storey drift ratios during wind or seismic excitation. They act in one horizontal direction and increase the overall damping of the structure. Reduced inter-storey drifts result in lower internal forces and moments in all structural members improving comfort, safety and reliability.

GVWDs consist of a steel housing connected to the lower floor/structure, an inner piston connected to the upper floor, and viscous liquid inbetween. During seismic and strong wind excitation, the relative displacement between upper and lower structure causes the piston moving through the viscous liquid. Damping forces are induced and yield kinetic energy dissipation. Depending on the damping required and/or to achieve acceptable relative displacements between the floors, different damper sizes with suitable performance levels can be selected. Several dampers can work in parallel, if required.

GERB Viscous Wall Dampers have been developed and designed to meet the needs of architects and structural engineers. GVWDs come in various sizes and can be installed within the regular wall structures. They are suitable for new builds but also applicable for retrofitting measures.





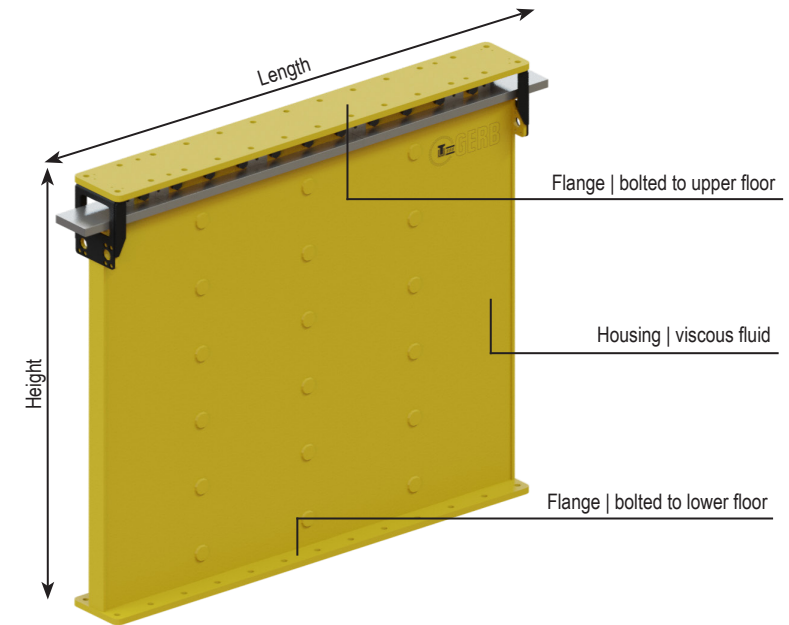
## Standard GVWD types

The table below shows standard sizes of GVWDs, which are available as single or double chamber dampers (SD, DD) at any time. DD types provide twice the dissipation performance of SD GVWDs.

Type designation: GVWD-SD(DD)-Length/Height

Length (mm)	Height (mm)					
	750	1000	1600	1800	2100	2400
1600	SD DD	SD DD	SD DD	SD DD	SD DD	SD DD
1800	SD DD	SD DD	SD DD	SD DD	SD DD	SD DD
2100	SD DD	SD DD	SD DD	SD DD	SD DD	SD DD
2400	SD DD	SD DD	SD DD	SD DD	SD DD	SD DD

customized  
sizes available  
upon request!



GVWD – basic assembly

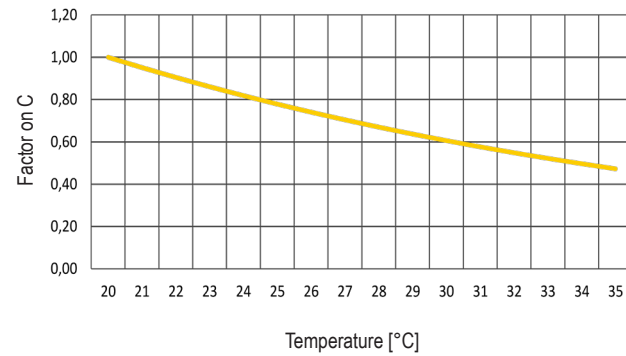
## Characteristics

- Technology well known and proven in all kind of structures worldwide
- Reliable technology as based on viscous shear forces
- Maintenance / abrasion free (no mechanical wear and tear)
- Working in horizontal direction of the wall
- High damping forces / increasing demands lead to increased damping forces

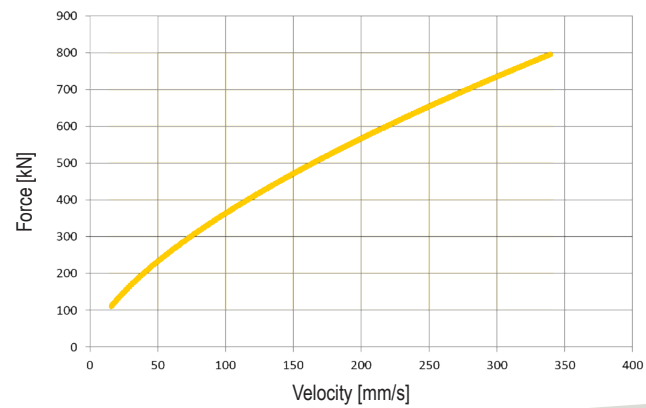
## Fields of application

- Tall and medium to large buildings
- Buildings potentially prone to high earthquakes
- Flexible buildings
- Buildings with a high utility value
- Buildings that require continuous operation
- Retrofitting measures

Temperature Dependency



Force vs. velocity



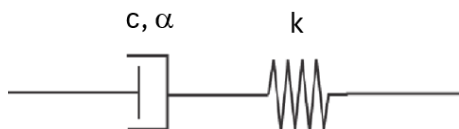
GVWD in a test rig

## Reference / Design values\* for the most common types

Type	Stiffness k	Damping Coefficient c	Exponent $\alpha$
	[kN/m]	[kN*(s/m) <sup><math>\alpha</math></sup> ]	
GVWD-SD-2100/2400	28500	1090	0,5
GVWD-DD-1600/2400	42750	1635	0,5
GVWD-DD-2100/2400	57000	2180	0,5
GVWD-SD-1600/1800	16342	625	0,5

\* Note: These are exemplary values. Further information, for example regarding measurement results at certain frequencies and velocity ranges, can be provided on request.

## Corresponding model for description of damper behaviour



The damping properties are based on the Maxwell model of viscoelasticity having an exponential viscous damper in series with a linear spring.

L. E. Malvern, 1969

*Introduction to the Mechanics of a Continuous Medium*, Prentice-Hall, Englewood Cliffs, N.J.

## Modeling of GVWDs in Finite Element Software (e.g. SAP2000, ETABS).

The dynamic behavior of GERB Viscous Wall Dampers (GVWDs) can be accurately modeled using nonlinear link elements in SAP2000, similar to ETABS.

For details on these link elements, refer to the \*CSI Analysis Reference Manual\*. For other finite element software, consult the respective documentation.

GVWDs are best represented by an Exponential Maxwell Damper model, as shown on the left. The table provides values for the linear spring (k), damping coefficient (c), and exponent ( $\alpha$ ).

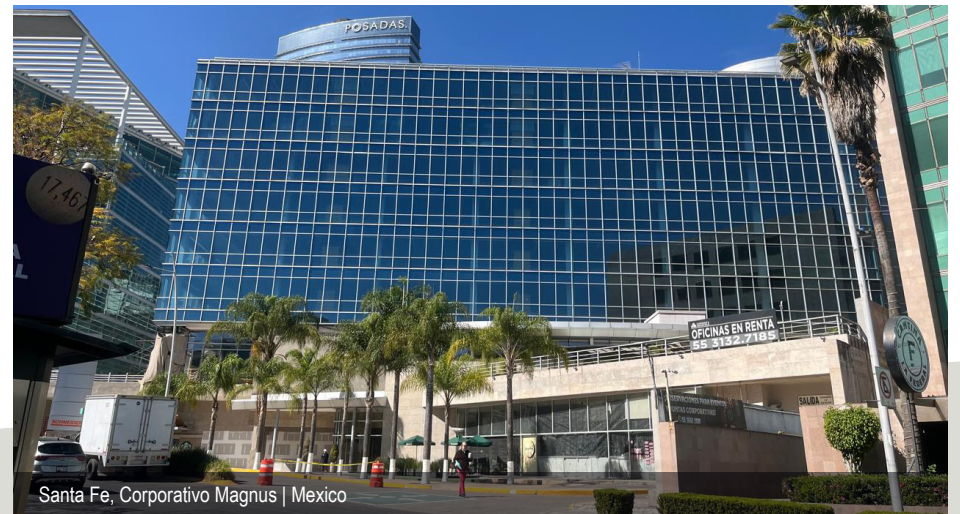
**Note 1:** Due to the description of the damper parameters it will be required to perform non-linear time history analyses (due to the usage of the non-linear link element in SAP2000).

**Note 2:** In general, the devices should be installed/arranged at locations where a significant relative (shear) deformation between upper and lower floor is occurring during the event.

**Note 3:** Take care about the connecting elements to avoid local issues within the finite element model, that do not exist in reality.

Please contact us if you have any questions or need any kind of support.





# Further seismic protection systems designed and delivered by GERB

## Base Control System (BCS)

The Base Control System (BCS) consists of helical steel springs and highly efficient Viscodamper®, which are arranged underneath the structure. The system is flexible in horizontal directions, but possesses also a vertical elasticity. Viscodamper® supply absorption forces in horizontal and vertical directions. In particular the resulting demands (e.g. accelerations, base shear etc.) of the structure can be significantly reduced by using the BCS - due to reduction of frequencies and increase of structural damping.

## Tuned Mass Control System (TMCS)

Tuned Mass Control Systems (TMCS) are additional mass-spring-damper systems. They provide passively working earthquake protection due to increase of structural damping. The Tuned Mass Control Systems absorb horizontal forces and are practically maintenance-free. Requiring no electrical power supply or any other form of drive or control mechanism they are immediately effective when an earthquake strikes.

## Damper Systems

In addition to the 1-dimensional viscous wall dampers, viscous dampers are also available that generate damping forces in both horizontal directions and in the vertical direction. They provide passively working earthquake protection due to increase of structural damping.





# More than 80 years of GERB viscoelastic dampers (Viscodampers®)

## Performance and variability

- Damping fluids with different viscosities are available for different load and ambient conditions to achieve the requested damping values for given requirements and broad temperature ranges
- For applications in nuclear facilities high radiation resistance is often required whereas outside applications require damping fluids with low temperature dependency
- GERB always strives to use the optimal damping fluid for each application and tests its tailor-made solutions on in-house shaking tables

## Certified solutions

- First patent for Viscodampers 1939
- TÜV certification since 1981
- Since then multiple design approvals from international certifying bodies
- Third party performance tests at facilities like BAM, MPA Karlsruhe, Fondazione Eucentre and UC San Diego

## Longlasting solutions

- Reversible damper systems
- GERB has significant project records for seismic protection systems, vibration control systems and tuned mass dampers
- These maintenance free components perform for more than 35 years at certain facilities

## Service and consulting

- Technical consulting measurements and tests
- Research & Development
- Quality Management
- Mounting, Installation & Supervising



GVWDs ready for delivery

**We support you in all areas!**

Contact us via **gerb.com** and together we will find the right damping solution for your project requirements.

# About GERB

## – Your single source of expertise

With locations worldwide, GERB is a full-range provider and your professional partner for engineering, manufacturing and supplying vibration isolation solutions. Our service covers all phases of your project, from structural dynamic analyses, dynamic measurements, project-specific product development, to the installation of our products and inspections.



### Consulting

We offer comprehensive consulting: from simplified dynamic calculations and measurements to complete calculations with numerical models.

### Engineering

Our GERB Engineering team offers expert support for structural dynamic analyses, from feasibility studies to design, planning, and construction supervision.

### Research & Development

We offer standard and custom solutions, continuously innovating and conducting project-specific tests. We also support you in the approval process with in-house or third-party testing.

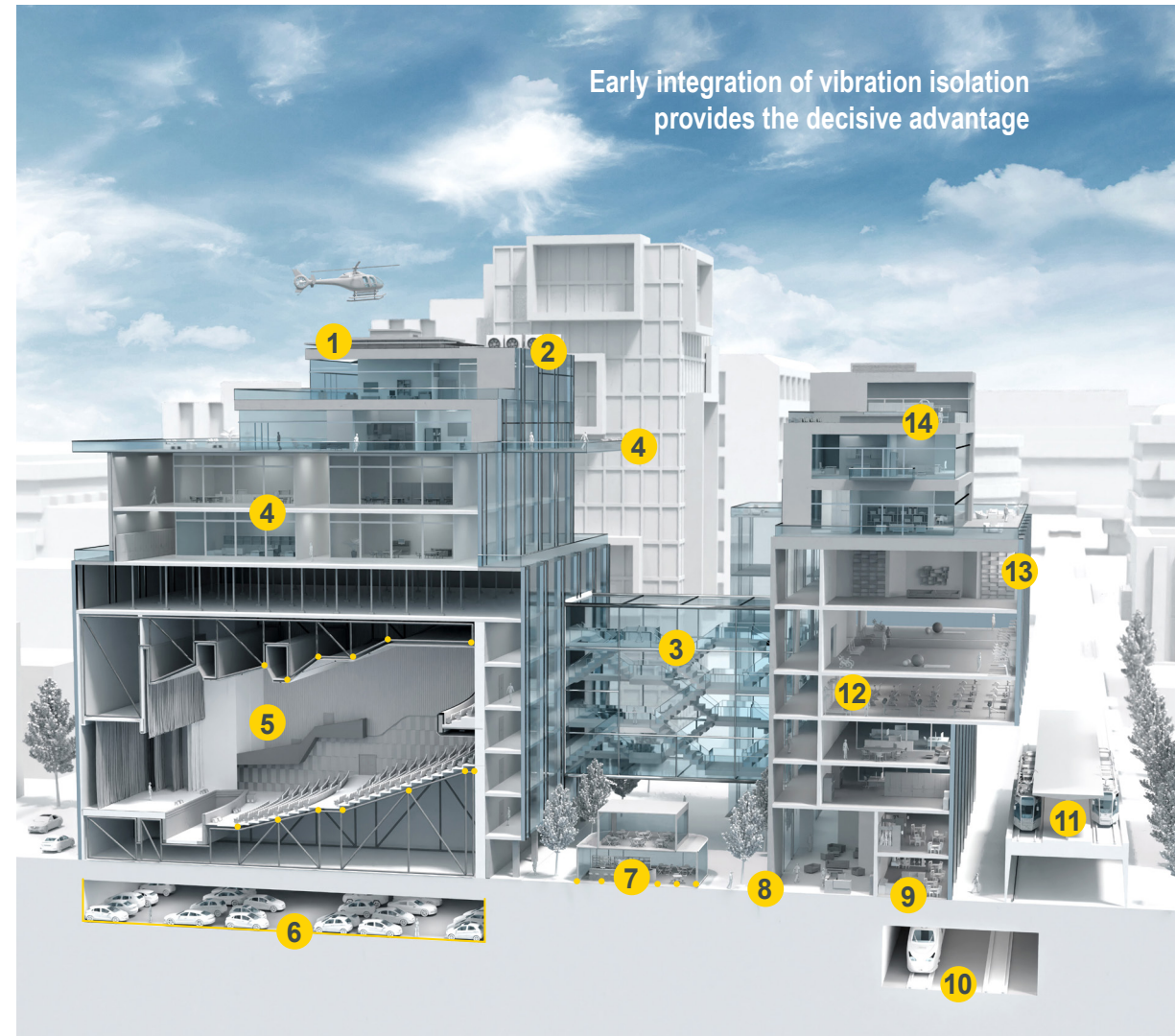
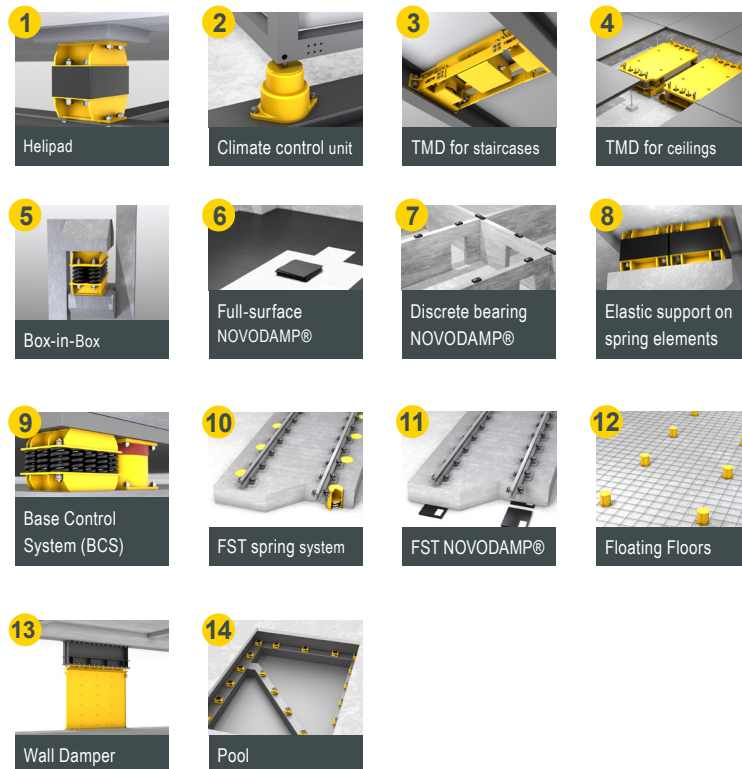
### Manufacturing

We maintain the highest quality standards in all of our 5 production facilities. We are able to produce according to various standards and requirements and hold the necessary quality certificates.

### Installation Supervision & Assembly

We offer installation of our elements and on-site supervision, as well as inspections of existing installations.

# GERB, your partner for vibration isolation in all areas of a building







Made in Germany.  
Since 1908.  
Worldwide.



## GERB Headquarters | GERB Schwingungsisolierungen GmbH & Co. KG

[GERB.COM](https://gerb.com) | [info@gerb.com](mailto:info@gerb.com)

Roedernallee 174 – 176  
13407 Berlin  
Germany  
+49 30 4191-0

Ruhrallee 311  
45136 Essen  
Germany  
+49 201 26604-0

Interested in detailed information or  
individual consulting service?  
Please contact us!

© GERB Schwingungsisolierungen GmbH & Co. KG | All rights reserved.

Certified: DIN EN ISO 9001 et al.

VIBRATIONS CAN BE CONTROLLED  
– WHEREVER THEY OCCUR