SEISMIC PROTECTION SYSTEMS

mageba seismic isolation and energy dissipation systems for safe and reliable structures even under the most demanding earthquake conditions.

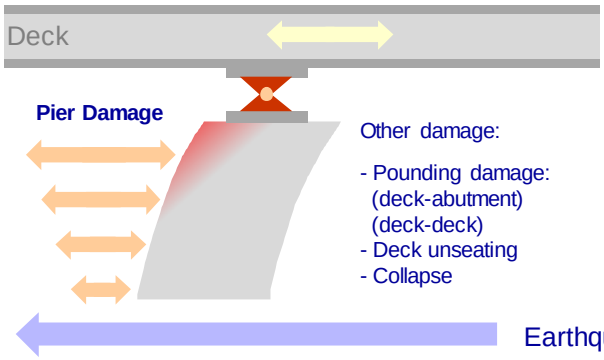
Main benefits and applications

The use of mageba protection systems not only ensures the safety of structures during the occurrence of an earthquake, but also allows the design of slender and significantly more economical structures. Other conventional protection methods, such as strengthening, result in heavy and expensive structures. Additionally, mageba seismic protection systems ensure the full serviceability of the structure in the aftermath of an earthquake, allowing the crossing of emergency services, which becomes essential to ensure the safety of the population.

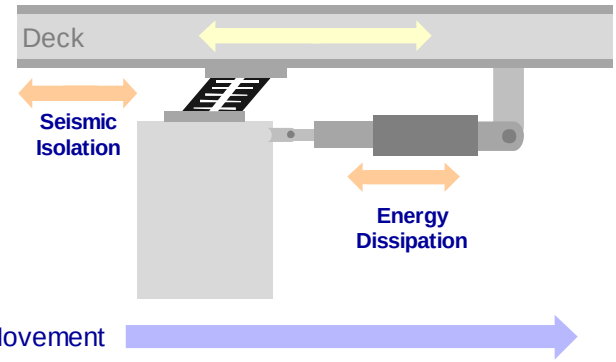
Application in Bridges

The use of seismic protection in bridges ensure the proper functioning of the structure during all service condition such as effects of temperature, wind, braking forces, impacts, etc. In the occurrence of an earthquake, the protection system will ensure the safety of the structure, by avoiding damage to structural elements.

Unprotected structure



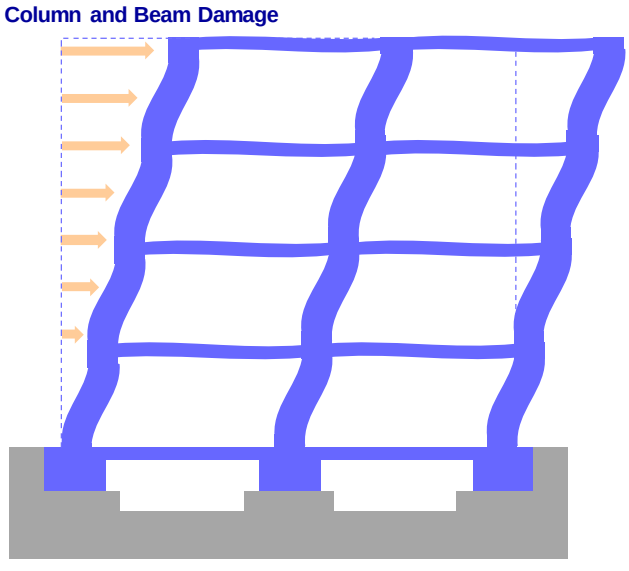
With seismic protection



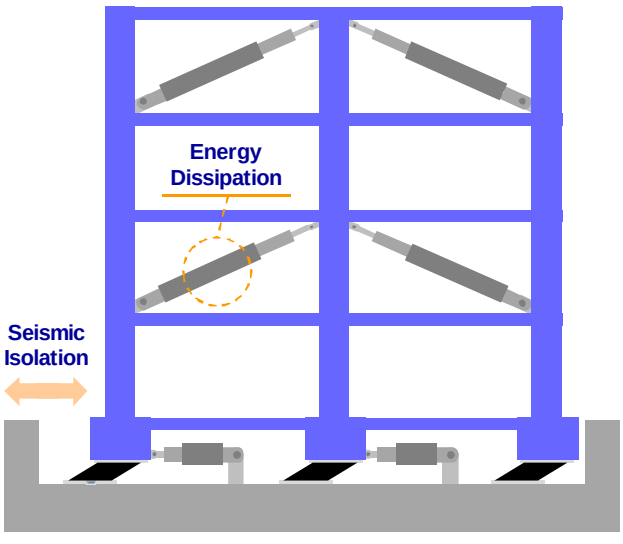
Application in Buildings

The seismic protection of buildings has been a successful strategy for the past 30 years. mageba seismic protection systems ensure the safety of any type of building even under most severe earthquakes. mageba seismic devices not only protect the buildings against earthquake damage, but also provide comfortable movement of the whole structure, helping to keep the people calm and safe.

Unprotected structure



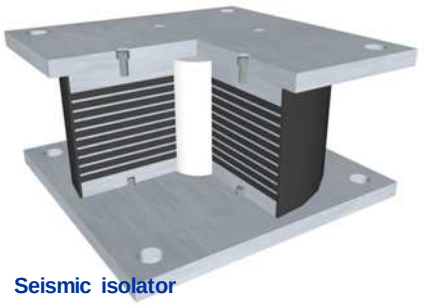
With seismic protection



Seismic isolation

Seismic isolation is the decoupling of the structure from ground motions induced by earthquake motions, which could damage the structures. To reach such decoupling, the isolation system consists of different seismic devices called “isolators” that are strategically installed in specific parts of the structures, allowing them to perform properly during an earthquake. Seismic isolators provide the structure with enough flexibility so the natural period of the structure differentiates as much as possible from the natural period of the earthquake. This prevents the occurrence of resonance, which could lead to severe damage or even collapse of the structures. An effective seismic isolation system shall provide the following four functions:

•Performance under all service loads, vertical and horizontal, shall be as effective as conventional structural bearings.
•Provide enough horizontal flexibility in order to reach the target natural period for the isolated structure.
•Re-centering capabilities even after a severe earthquake so that no residual displacements could disrupt the serviceability of the structure.
•Provide an adequate level of energy dissipation: in order to control the displacements that otherwise could damage other structural elements.



Seismic isolator

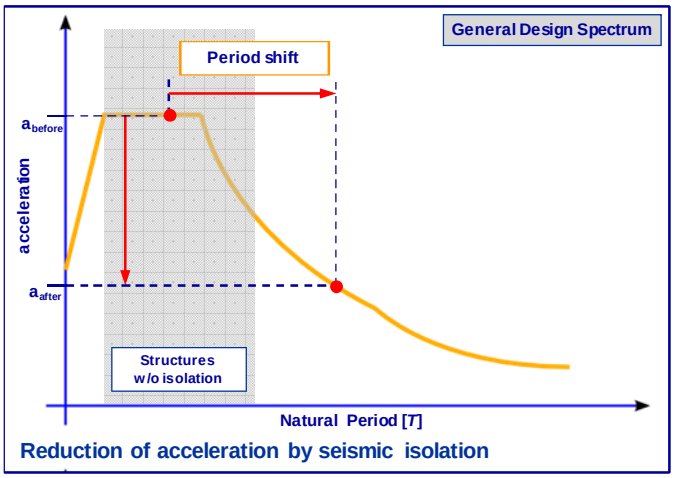
Damping device

Energy dissipation / Damping

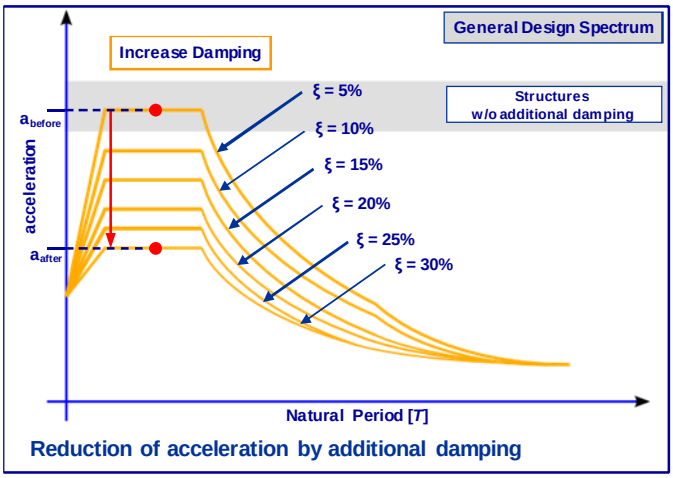
Energy dissipation becomes essential in terms of seismic protection. The use of effective devices able to dissipate high amounts of energy ensures that other structural elements do not undergo excessive demands that could cause significant damage. While seismic isolation is a proven strategy to mitigate seismic damage, the complex dynamic response of the structure often requires additional devices in order to control the horizontal displacements.

The best way to ensure a safe structure is by combining seismic isolation and energy dissipation. This allows to provide the structure with a higher damping, and therefore a better dynamic response during a seismic event. In structures where seismic isolation is not a recommendable solution (e.g. soft soils), damping systems with high dissipation capabilities become the best seismic protection alternative.

Seismic isolation and damping principle



Reduction of acceleration by seismic isolation



Reduction of acceleration by additional damping

Advantages of mageba protection systems

- Ensure the safety of the population by providing safe bridges and buildings even under severe earthquake conditions.
- Proven seismic protection technology throughout the years in structures all over the world.
- Reduction of the dynamic impact on structural elements, which leads to slender and more economical structures.
- Simplicity in the design and adaptability to any type of structure (bridges, buildings, water tanks, special structures, etc.).
- Isolators with high load bearing capabilities, reaching values of vertical loads up to 50,000kN with compact geometries.
- Damping devices with high energy dissipation capacity that allow an effective dynamic response to high horizontal displacements.
- Excellent re-centering capabilities that allow the structure to return to the original position even after severe earthquakes.
- Ease of installation due to an advanced design of connection and anchoring systems.
- Virtually maintenance free due to the high durability of high performance materials and applied corrosion protection.


Installed seismic isolator


Isolators equipped with ROBO®SLIDE

Principal seismic protection devices

Seismic Isolators

LASTO®LRB

Elastomeric isolator equipped with a lead core for initial stiffness and high damping of up to 30%

LASTO®HDRB

Elastomeric isolator made up of a special rubber mixture that provides damping of up to 16%

RESTON®PENDULUM

Curved surface slider with ROBO®SLIDE sliding material that provides damping over 30%.

Damping Devices

RESTON®SA

Fluid viscous damper design for energy dissipation and displacement control

RESTON®STU

Temporary connection devices that provide a rigid connection under high velocity movements

RESTON®PSD

Fluid viscous damper designed with a spring function, which allows re-centering after a seismic event

Application of Seismic Protection

Civil engineering structures


Bridges


Highways


Tanks


Power plants


Offshore platforms

Building structures


Hospitals


Schools


Commercial


Historical


Housing

CE certification and testing

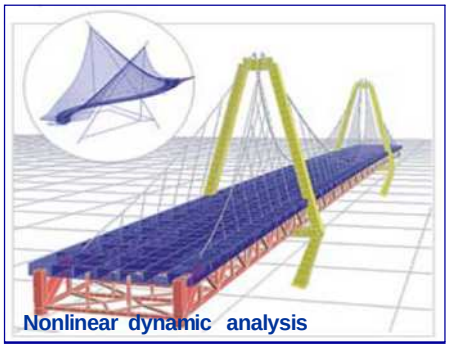
mageba seismic devices are designed and manufactured in accordance with European Standard EN 15129, EN 1337 and with European Technical Approval ETA-08/0115. Bearings are marked with the CE mark of conformity, which confirms that they satisfy all requirements of these Standards and Approval, without exception. mageba seismic devices can also be designed, manufactured and tested in accordance with other international specifications, such as the “AASHTO Guide Specification for Seismic Isolation Design”, Japanese Specifications, National Norms, etc. For special projects, customised testing can also be performed, if requested by the structural engineer.

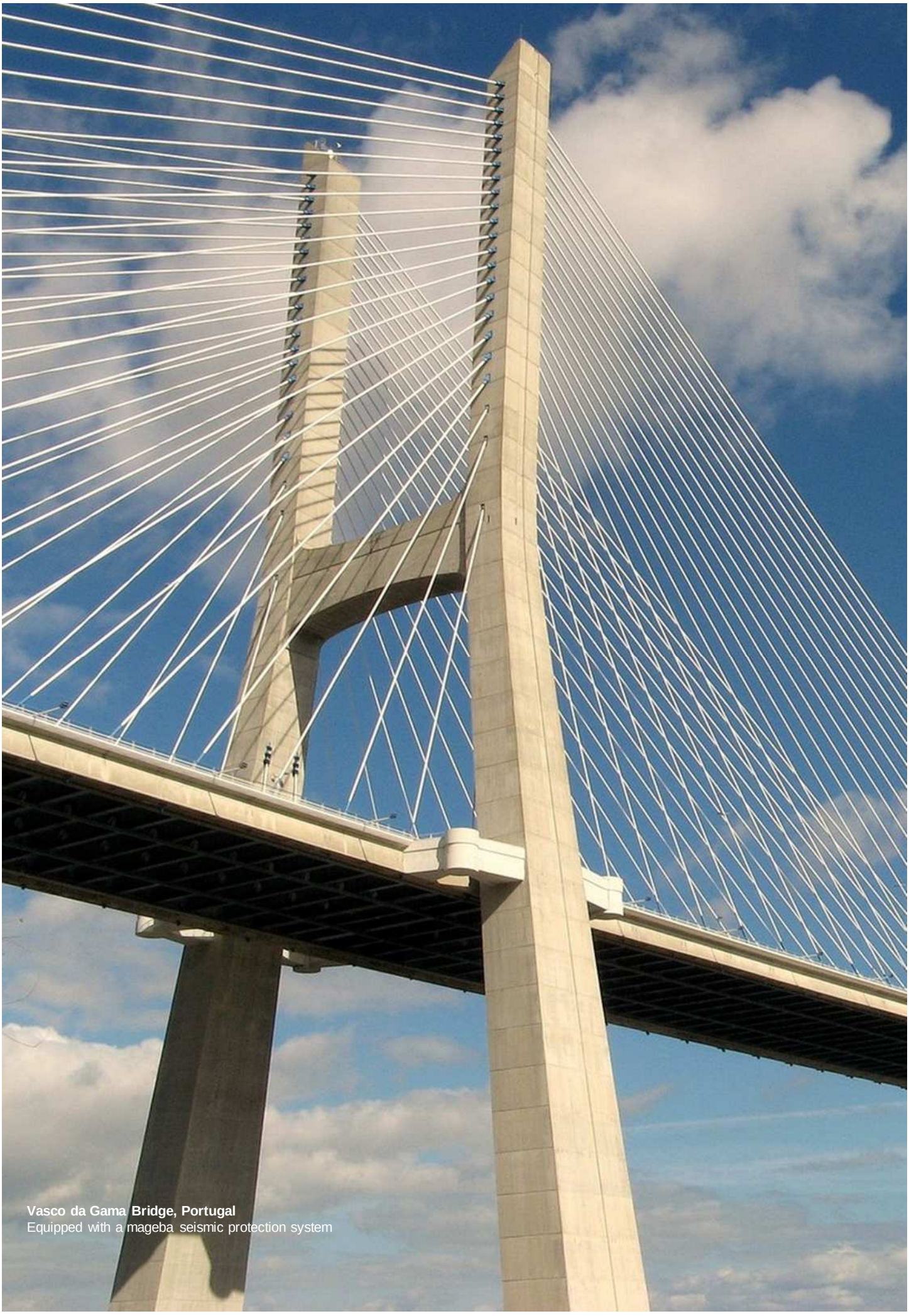

Type Testing at EUCENTRE, Italy.

Consulting services

In order to assess the best protection solution, mageba offers, at request, a nonlinear seismic analysis of structures and recommends the most effective seismic protection system. The advanced optimization process performed by mageba offers safe and economical structures. Such analysis can be performed in accordance with any seismic norm (EN, AASHTO, JSCE, IBC, BS, JPN, etc.)

A nonlinear seismic analysis allows the precise calculation of forces and displacements that could potentially occur during a determined earthquake. The detail seismic analysis performed by mageba also offers an important verification tool for the analysis carried out by the structural engineer.


Nonlinear dynamic analysis



Vasco da Gama Bridge, Portugal
Equipped with a mageba seismic protection system

Chong Ming (China)
Modular expansion joint
type LR22 (1'760mm)

Run Yang – Bei Cha Bridge (China)
Modular expansion joint type LR10 (800mm)

Run Yang - Nan Cha Bridge (China)
Modular expansion joint
type LR27 (max. 2'160mm)

Øresund Bridge (Denmark-Sweden)
Pot bearings Vmax = 96'000 kN

Storebælt West Bridge (Denmark)
Pot bearings Vmax = 49'000 kN
Modular expansion joint type LR15 (1'200mm)

Viaduct Albrechtsgraben (Germany)
Modular expansion joint type LR9 (585mm)

Tähtiniemen Silta (Finland)
Modular expansion joint type LR10 (800mm)

Pont de Normandie (France)
Modular expansion joint type LR10 (800mm)
Modular expansion joint type LR9 (720mm)

Tsing Ma Bridge (HongKong)
Modular expansion joint
type LR25 (max. 2'000mm)

Kalyani Bridge (India)
Modular expansion joint type LR2 (160mm)

Golden Ears Bridge (Canada)
Modular expansion joint
type LR17 (max. 1'360mm)

Krka Bridge (Croatia)
Modular expansion joint type LR6 (480mm)

Tauern Motorway (Austria)
Sliding finger joints type GF600 (600mm)

Bridge in Plock (Poland)
Sliding finger type TensaFlex 700.R (700mm)

Vasco da Gama Bridge (Portugal)
Pot bearings Vmax = 39'000 kN
Modular expansion joint type LR9 (720mm)

Uddevalla Bridge (Sweden)
Pot bearings Vmax = 15'300 kN

Viaduc de Mentue (Switzerland)
Sliding finger type TensaFlex 400.R (400mm)

Črni Kal Viaduct (Slovenia)
Modular expansion joint type LR9 (720mm)

Incheon Grand Bridge (South Korea)
Modular expansion joint
type LR24 (max. 1'920mm)

Audubon Bridge (USA)
Sliding finger joints type GF1240 (1'240mm)

8 Product range and references

mageba

Bridge Bearings

- Pot Bearings
- Elastomeric Bearings
- Spherical Bearings
- Incremental Launch Bearings
- Rocker Bearings
- Special Bearings



Expansion Joints

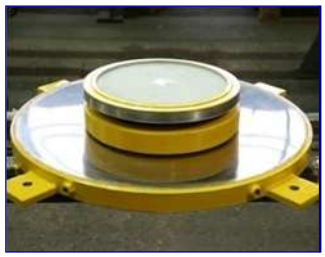
- Single Gap Joints
- Modular Expansion Joints
- Sliding Finger Joints
- Cantilever Finger Joints
- Mat Joints
- Railway Joints
- Architectural Joints



Seismic protection

- Elastomeric Isolators (LRB/HDRB)
- Pendulum Isolators (PM/PD)
- Shock Absorbers
- Rigid link Devices (STU)
- Preloaded Spring Dampers
- Spring Disc Dampers
- Modular Expansion Joints with *Fuse-Box*





Monitoring & Services

- Remote Monitoring Systems
- Inspections
- Tests
- Installations
- Refurbishments
- Cleaning



More information on mageba and its products can be found at **www.mageba.ch**.

Worldwide references

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mageba Switzerland www.mageba.ch

mageba sa
Solistrasse 68
8180 Bülach
Switzerland
Tel.: +41-44-872 40 50
Fax: +41-44-872 40 59
info@mageba.ch

mageba gmbh
Fussach, Austria
Tel.: +43-5578-75593
Fax: +43-5578-73348
oesterreich@mageba.ch

mageba gmbh
Uslar, Germany
Tel.: +49-5571-9256-0
Fax: +49-5571-9256-56
uslar@mageba.ch

mageba Bridge Products (Pvt.) Ltd.
Kolkata, India
Tel.: +91-33-22900250 to -253
Fax: +91-33-22900254
info@mageba.in

mageba sa
Cugy VD, Switzerland
Tel.: +41-21-731-0710
Fax: +41-21-731-0711
suisse@mageba.ch

mageba gmbh
Esslingen a.N., Germany
Tel.: +49-711-758844-0
Fax: +49-711-758844-56
stuttgart@mageba.ch

mageba Bridge Products Pvt. Ltd.
Shanghai, China
Tel.: +86-21-5740 7635
Fax: +86-21-5740 7636
info@mageba.cn

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