

# EARTHQUAKE PROTECTION



# EARTHQUAKE PROTECTION FOR MACHINERY, BUILDINGS AND EQUIPMENT

Numerous countries have to live with the constant threat of earthquakes. Not only are machines, technical equipment, buildings in danger of being damaged or destroyed, but life-essential facilities and human life itself are also at risk. GERB has taken up the challenge of providing solutions that protect against such natural disasters. Engineering, project development, suitable devices and all necessary support can be supplied from a single-source.

## Benefit from Experience of Many Decades

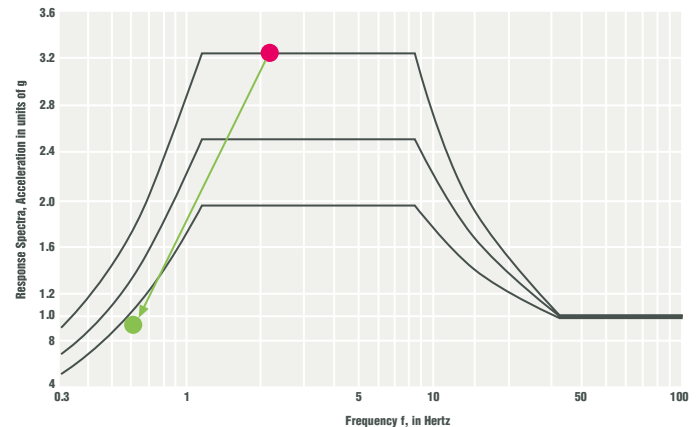
GERB has been supplying earthquake-proof, visco-elastic devices for heavy machinery of various kinds for decades. For example, appropriately designed elastic supports have been protecting turbo generators in both conventional and nuclear power plants in many countries against damage from earthquakes. These ideas have been developed consequently, and nowadays efficient seismic protection strategies can be provided for machinery, technical equipment, buildings and many other kinds of structures. Spring elements and dampers are effective against ground settlements, vibrations and structure borne noise and can successfully be used for earthquake protection purposes. During many years, it has been proven that machines, equipment and buildings with such devices have survived powerful earthquakes in many seismically prone areas of the world.

## Protecting Highly-Sensitive Facilities

GERB's fields of activities include providing solutions for reliable protection against earthquakes for conventional, nuclear and petrochemical facilities as well as high-voltage installations such as substation equipment and other fields. Natural earthquakes – with combined horizontal and vertical excitation – frequently produce very high stress and strain levels in structures as well as unacceptable accelerations. Systems comprising helical spring elements and Viscodampers® have proven to be particularly suitable against these effects.



Spring Viscodamper® Combination



High Voltage Reactors with Earthquake Protection – California, USA



Transformer Platform on BCS – California, USA

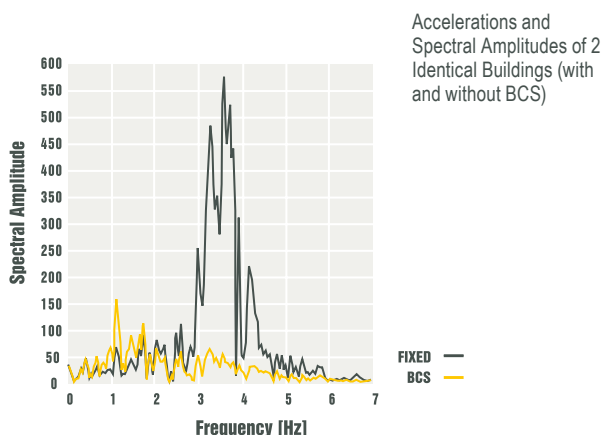
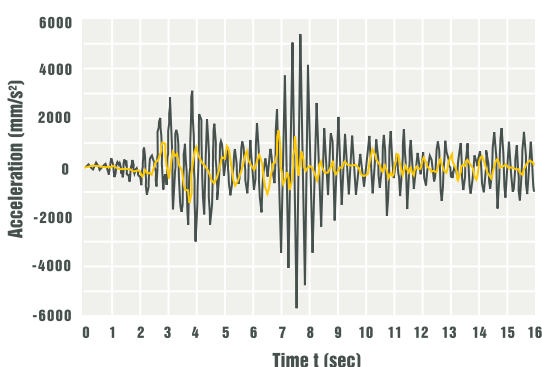


# Building Protection Featuring the 'Base Control System'

GERB offers diverse solutions for the protection of buildings against earthquakes. The most effective is the 'Base Control System' (BCS). Providing 3-dimensional elastic support for buildings this system not only offers protection against horizontal forces but shows all its efficiency against the combination of horizontal and vertical excitation (natural earthquakes). This protection is made possible through the utilisation of helical coil springs with large deflection characteristics and complementary Viscodampers® that have been specially developed for this task.

The solution incorporates GERB's extensive experience gained from providing elastic building supports against soil-subsidence and vibration by underground rail and road traffic. First applications of the 'Base Control System' have now been in use for more than 20 years – they have proved their efficiency, for instance, during the Northridge earthquake, California in 1994.

In addition to the protection of human lives the Base Control System provides the possibility to achieve defined performance levels of the building for potential earthquake scenarios. Prevention of damage and corresponding repair cost can also be a possible objective as well as the full functionality of the building after a major earthquake event.



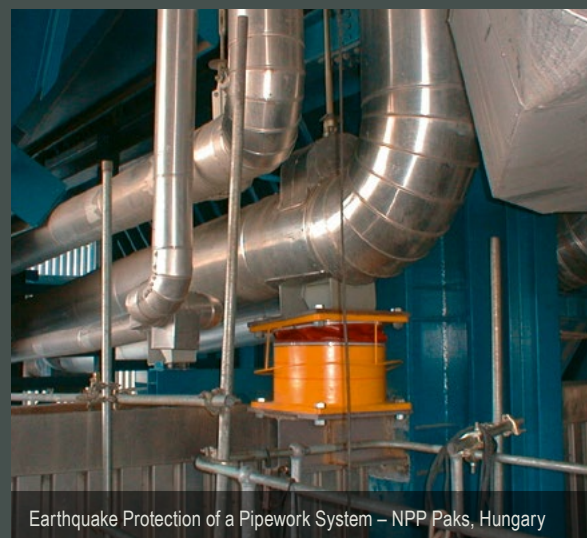
Spring Supported Students Home  
– Mendoza University, Argentina



Spent Fuel Storage Tank with BCS – NPP Gösgen, Switzerland



Spring Viscodamper® BCS



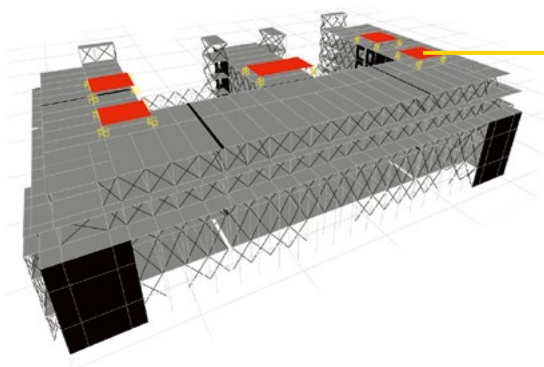
Earthquake Protection of a Pipework System – NPP Paks, Hungary

# Tuned Mass Control Systems put Safety First

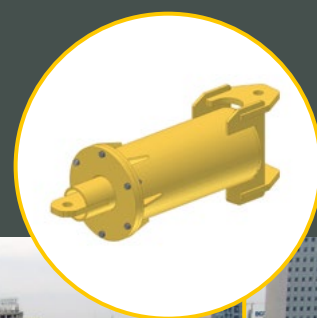
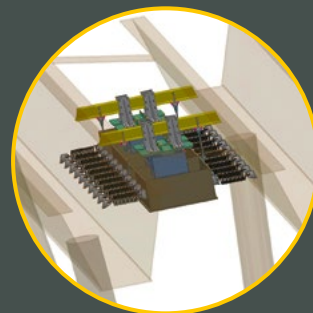
Tuned Mass Control Systems (TMCS) provide passively working earthquake protection. They absorb horizontal forces and are practically maintenance-free. Requiring no electrical power supply or any other form of drive or control mechanism they are immediately effective when an earthquake strikes. They are particularly easy to install in existing buildings – without interrupting the use of the building.

The development of seismically efficient TMCS is based on the vast experience from Tuned Mass Damper systems working against wind and men-induced vibration world-wide. International co-operations and acknowledged researchers in the field of seismic protection made it possible that today GERB can provide Tuned Mass Control Systems for many applications. Herewith, new buildings can be improved in their seismic resistance and the TMCS can also be used for the upgrade of the seismic performance in existing buildings.

In this context it is a very interesting possibility for sensitive buildings such as hospitals, office and residential buildings as well as industrial structures.



Earthquake Protection of a Bridge with TMCS – Puente Oriente, Mexico



Palatul Victoria with TMCS – Bucharest, Romania



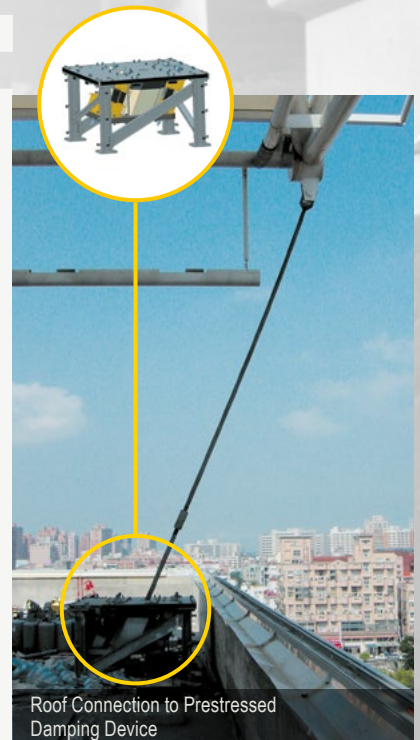
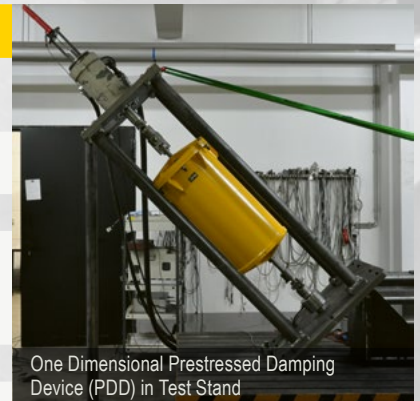
Model of Palatul Victoria with TMCS



## Reference List (Selection)

### Earthquake Protection Systems

Country	Project	Structure
Argentina	Students Building, Mendoza	Apartment Building
Bulgaria	Rabotnitschesko Delo, Sofia Economedia, Sofia	MAN-Roland Printing Machine KBA Printing Machine
Chile	MTU	Diesel Engine Test Stand
China	HVOC Transmission Line Xiàn Capacitor Works Tangshan Nokian Capacitors	AC Filter Capacitor Banks Capacitor Banks Waldrich Siegen Roll Grinder Capacitor Banks
Colombia	Barranquilla	2 Steam Turbines 71 MW
Dominican Republic	Monte Rio Union Fenosa	Caterpillar Motors MAN Diesel-Gensets
Germany	Enrichment Plant	Various Pumpsets
Greece	Concert Hall, Athens Meliti Achlada Megalopolis	Studio Room Alstom Coal Mill Steam Turbine Deck 300 MW
Honduras	Elcatex	Diesel-Gensets
India	Barh Power Plant	Steam Turbine Deck 500 MW
Indonesia	Medan	Alstom Steam Turbines 65 MW
Italy	Toranto Tavazzano	Schiele Fans Steam Turbines 320 MW
Japan	Fuji Tecnica Kikuchi Press Toyota Motomachi	3-D Measuring Machine AIDA 2500 t Press Komatsu 2400 t Tandem Press
Korea	Nuclear Power Plant Lotti Jamsil Mando	Emergency Diesel Generator Niigata Diesel-Gensets Hydro Pulse Shaking Platforms
Mexico	VW Mexico Mexico-City Puente Oriente	Müller-Weingarten Cross Bar Press MAN-Roland Printing Machine Bridge
New Zealand	Spezielektra	Air Core Reactor
Peru	Tintaya	Diesel-Gensets
Romania	Palatul Victoria	Government Building
Switzerland	NPP Gösgen NPP Leibstadt	Spent Fuel Storage Tank Turbine Deck 900 MW
Taiwan	Hsinchu Lungmen Nuclear Plant QRDC Building China Times	Glas Fiber Draw Towers DG Sets, Control Boards + Panels PDD for a Steel Roof Heidelberg Printing Press
Turkey	Coskunöz, Bursa Seyitömer Power Plant Zonguldak Power Plant	20 Presses, 400, 800, 1200 tons Coal Mills Boiler Structure
USA	Lowe Residence, Los Angeles Sylmar Converter Station, California Los Angeles NPP Vogtle NPP V.C. Summer	Residential Buildings Air Core Reactors Steam Turbine Steam Turbines + Condensers, 2 x 1000 MW Steam Turbines + Condensers, 2 x 1000 MW
Venezuela	AEG-Telefunken Cadafé	Control Switchboards Steam Turbine Decks 400 MW





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GERB engineers are pleased to offer you their support and advice on earthquake protection strategies. Contact us.

Earthquake protection is not an off-the-shelf product. GERB offers optimised solutions to meet your individual needs.

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