Dependable Joining Technology

www.cecobearings.com | www.hirun.eu

CECO HIRUN

We are a professional design, production, testing and installation company of structural devices with over 50 years of experience in the field. CECO-HIRUN has been involved in the design of bearings, antiseismic devices, post-tensioning and expansion joints for the most important infrastructure lines of the world and for strategic buildings like hospitals schools and administrative compounds.
CECO-HIRUN is an engineering company having its roots in the deep heart of the most modern and advanced civil engineering technologies.
The core of the company is composed of pioneers that in the last 50 years had a leading position in developing worldwide very important technologies such as structural bearings, expansion joints, post-tensioning systems, anti-vibration and anti-seismic systems. The Directors of the company in the past years were proudly involved in the definition of international standards or key specifications such as EN1337 (European standard for structural bearings), EN15129 (European standard for antiseismic devices), special bearings for Highspeed railway lines (as examples in Italy, Taiwan and China) and Metro lines (as an example the Bangkok metro system).

In the past years, the evidence of the strong innovation attitude is represented by several patents issued and this aim is still well alive in the company. Patents and customized unique solutions such as special dampers, new materials for different applications, customized combinations and applications of different structural devices. This attitude is pushing the company to a never-ending improvement.

We are now a specialized company for the application, design, production, installation and testing of all the following engineering technologies: Structural bearings, Seismic devices, Expansion joints, Post-tensioning systems, and Anti-vibration devices.

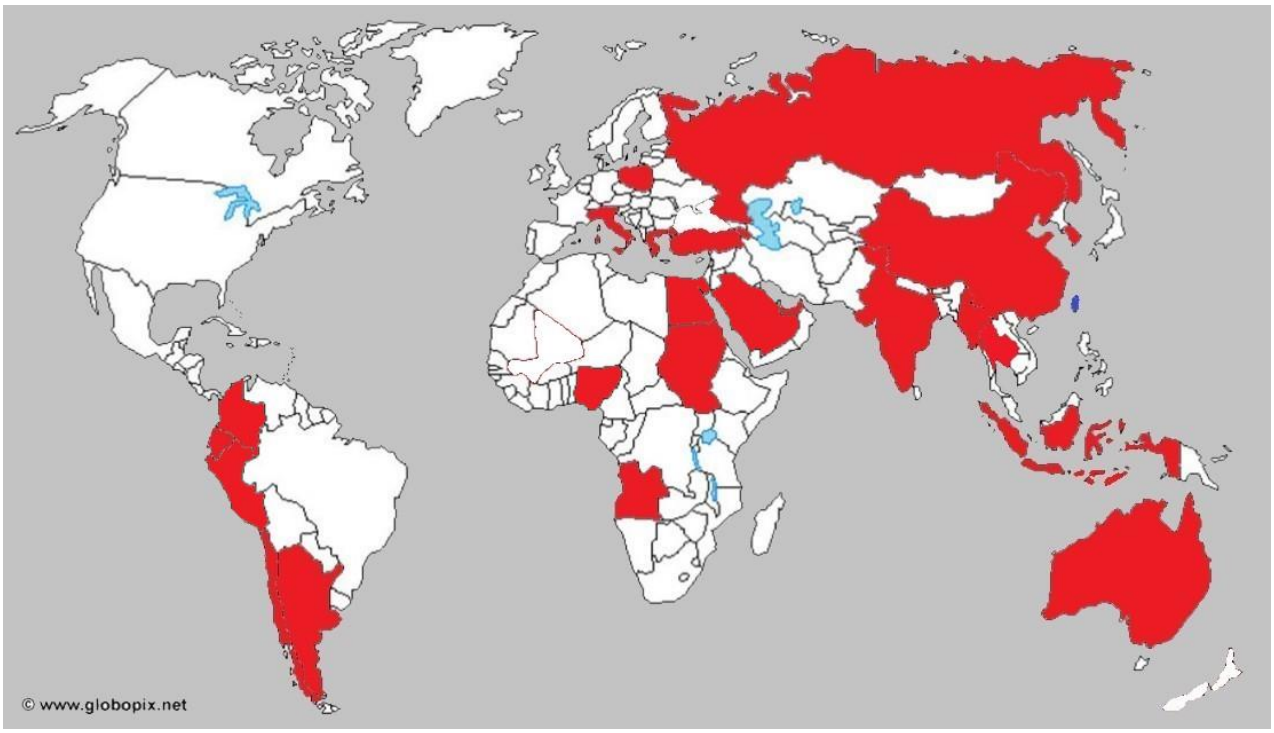
Special attention is dedicated to the quality of the products.

We design and produce starting from the control of the internal process; we are qualified ISO:9001 and we have several international qualifications such as the CE marking certificate for our products.

To achieve the above-mentioned targets we created very successful cooperation with partners in many fields such as industries producing innovative materials, factories, universities and seismic laboratories in many parts of the world. Our partners are diverse in location and capacity to create an active and efficient network that can cooperate to match the most challenging needs of all the clients.

We aim to become the leading specialized company for the most peculiar and important civil engineer projects in the world:
THE ENGINEERING SOLUTION.

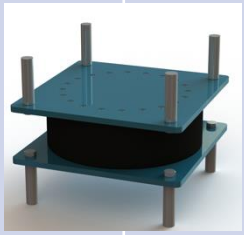
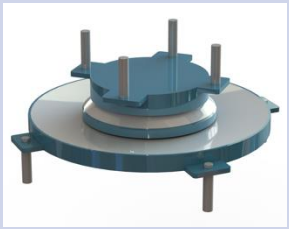
CECO Hirun India
Market Development



CECO HIRUN PRODUCT LINES

HIFLOW – Spherical structural bearings
HIRUBBER – Elastomeric structural bearings
HISLIDE - Curved surface slider isolators
HIDAMP - High damping rubber isolators
HILEAD - Lead rubber isolators
HIFLUID - VDD - Viscous dampers
HIFLUID - LUD – Lock-up devices
HITUNE - Tuned mass dampers
HIPAD - Hysteretic dampers
HIJOINT – Modular joint, Finger joint
HIPOST – Post tensioning system

TYPES of ANTISEISMIC DEVICES

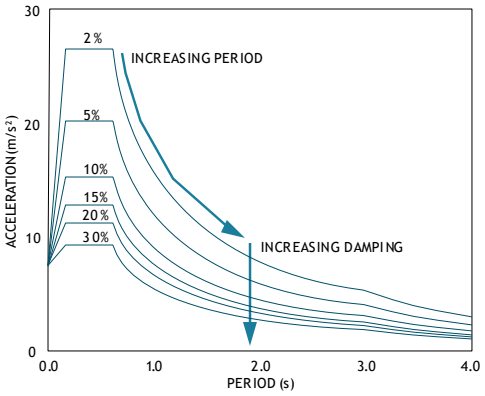
BASE ISOLATORS		
HDRB	LRB	Pendulum
		
THEY APPLY BOTH STRATEGIES: • PERIOD SHIFT • INCREASING DAMPING BASE ISOLATORS, WHEN APPLICABLE, ARE THE MOST EFFECTIVE SOLUTION!		

DAMPERS	DYNAMIC LINKS
VISCOUS DAMPER	SHOCK TRANSMISSION UNIT
	
THEY APPLY ONE STRATEGY: • INCREASING DAMPING	THEY DO NOT MODIFY THE SEISMIC ACTION: THEY CREATE SUPPLEMENTARY CONNECTIONS IN CASE OF DYNAMIC ACTIONS LIKE EARTHQUAKE, BRAKING FORCE OR WIND

Basic principles of the base isolation and the seismic protection of structures

A response spectrum is a diagram giving the response of a structure forced into motion in function of its natural frequency. The response can be given in terms of displacement, velocity or acceleration,
The acceleration response spectrum is a very useful tool for the seismic design of structures.
Normally the acceleration response spectrum is given by the relevant seismic codes and provides to the designer all the useful information allowing designing the structure.
In the response spectrum in particular are given the information about the intensity of the earthquake and the effect of the soil properties
In the following figures are shown as an example the acceleration response spectra given by the European Standard in function of the damping.

Looking at the typical feature of a response spectrum it appears quite evident which strategy shall be used to reduce the seismic action in a structure:
- Increase the natural period
- Increase the damping, or the energy dissipation



The strategies for the reduction of the seismic action in a structure shown on a typical response spectrum

We can divide the anti-seismic devices in three main categories:

1. Base Isolators
They apply both strategies: increasing the period and the damping

2. Dampers
They apply one strategy: increasing the damping

3. Dynamic Connections
They do not modify the seismic action: they create supplementary links in case of dynamic actions like earthquake, braking force or wind.

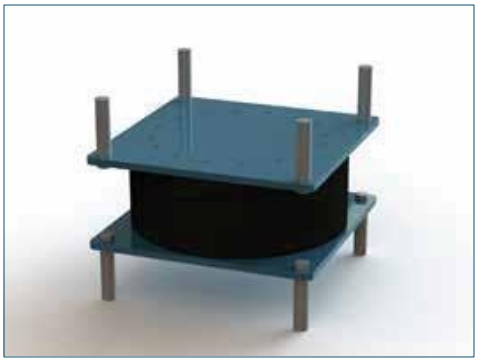
Base isolators

Base isolators, as defined in the EN 15129 are the devices or the combination of devices providing the following four functions:
1. Support the weight of the structures.
2. Provide lateral displacement capability.
3. Provide re–centring capability
4. Dissipate energy

They apply the two strategies for the reduction of the seismic action:
- Increasing the natural period of the structure
- Increasing the damping of the structure by dissipating energy.

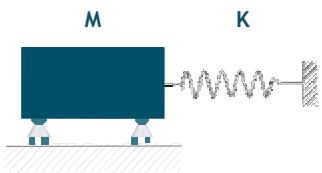
How can the isolators increase the natural period of a structure?
- They shall be placed between the structure and the foundations
- They force the structure to swing according to their own natural period

The natural period T of the isolators is the following



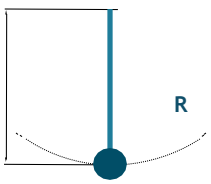
High Damping Rubber Bearing

Rubber isolators (HDRB and LRB) are equivalent to a spring-mass system with stiffness K and mass M

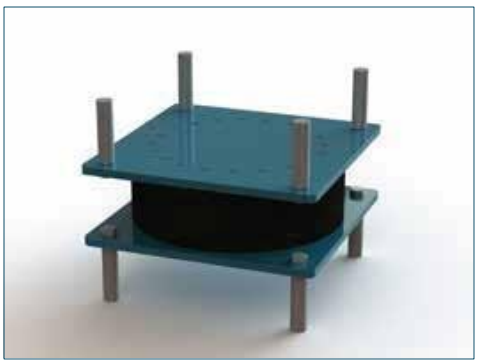


$$T = 2\pi\sqrt{\frac{M}{K}}$$

Sliding Pendulum isolators are equivalent to a pendulum with length R.
G is the gravity constant.



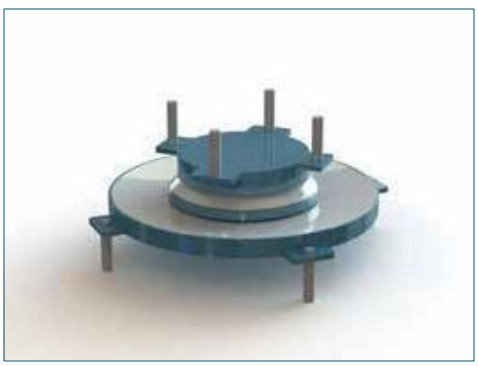
$$T = 2\pi\sqrt{\frac{R}{g}}$$



Lead Rubber Bearing

How can the isolators increase the damping of a structure?
They dissipate the energy by one of the following principles
- Friction (Sliding Pendulum Isolators)
- Yield of metals (Lead Rubber Bearings)
- Viscosity of rubber (High Damping Rubber Bearings)

In any case, an amount of heath equivalent to the dissipated energy is generated.



Sliding pendulum

HIDAMP HIGH DAMPING RUBBER BEARINGS

The economical solution for low to medium seismic areas.

In these isolators the re-centering capacity is given by the rubber elasticity, the energy dissipation is given by the viscosity of the special rubber compound.

HDRB also are an alternation of rubber and steel layers providing a very high vertical stiffness and a low horizontal stiffness hence providing a large vertical bearing capacity and a large horizontal displacement capacity. However they utilize a special rubber compound with additives that can provide energy dissipation when subjected to shear deformation.

- The spring effect is given by the rubber elasticity (elastic energy storage)
- The energy dissipation is given by the rubber viscosity

Main Field

Any kind of bridges and building

INSTALLATION	Requires trained team
DURABILITY	> 60 years
MAINTENANCE	Corrosion protection after 15 years
COST	AVERAGE

VERTICAL LOAD

HORIZONTAL DISPLACEMENT

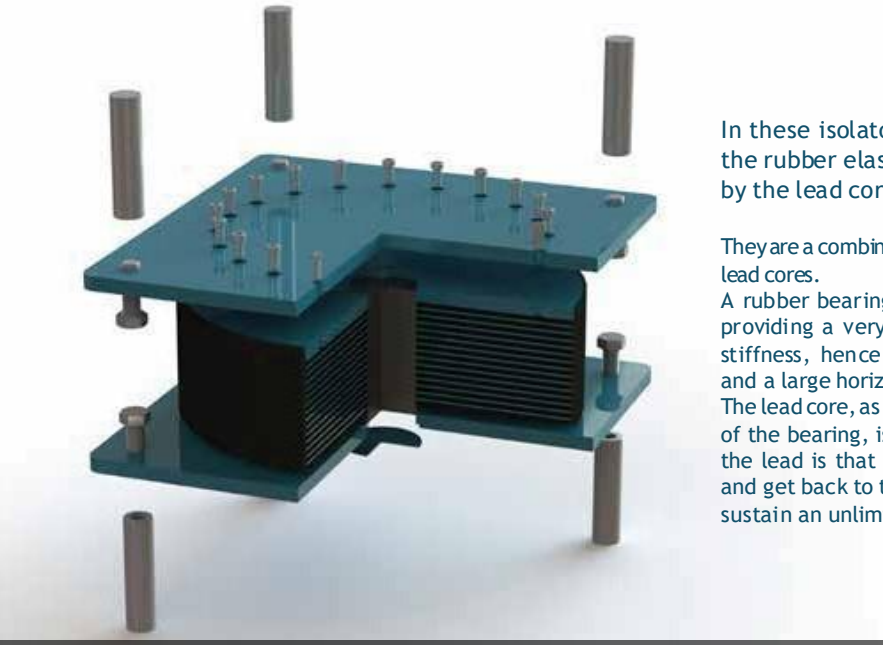
RE-CENTERING CAPACITY

DAMPING

FIRE RESISTANCE

HILEAD LEAD RUBBER BEARINGS

The high amounts of energy dissipation solution.



In these isolators the re-centering capacity is given by the rubber elasticity and the energy dissipation is given by the lead core that is stressed over the yield limit.

They are a combination of a rubber bearing and a single or multiple lead cores.
A rubber bearing is an alternation of rubber and steel layers providing a very high vertical stiffness and a low horizontal stiffness, hence providing a large vertical bearing capacity and a large horizontal displacement capacity.
The lead core, as a consequence of the horizontal displacement of the bearing, is subjected to yield. One peculiar property of the lead is that after several yield cycles it can re-crystalize and get back to the initial properties. So in principle they could sustain an unlimited number of yield cycles.

Main Field

Bridges and building located in medium and high level earthquake areas

INSTALLATION	Requires trained team
DURABILITY	> 60 years
MAINTENANCE	Corrosion protection after 15 years
COST	AVERAGE

VERTICAL LOAD

HORIZONTAL DISPLACEMENT

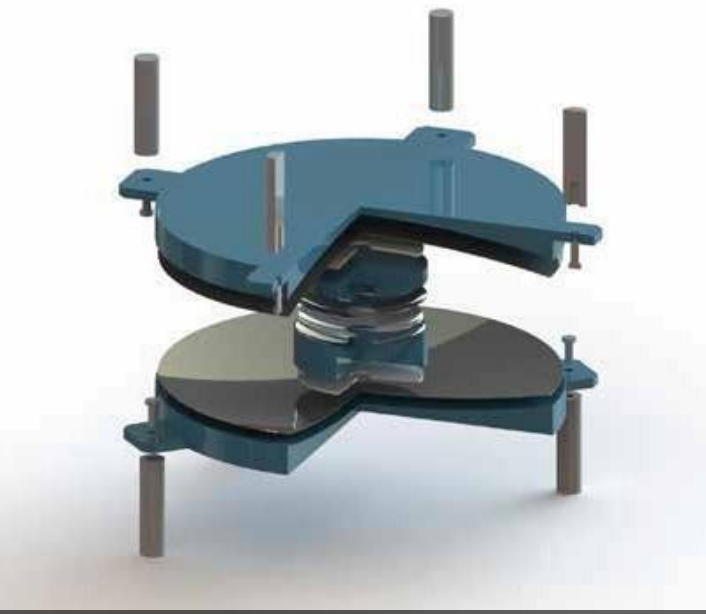
RE-CENTERINC CAPACITY

DAzPINC

FIRE RESISTANCE

HISLIDE SLIDING PENDULUM ISOLATORS

The efficient solution in high seismic areas



These isolators can dissipate very large amounts of energy. The dissipation is given by the friction of the sliding material. The re-centering capacity is given by the pendulum effect. The vertical component of the earthquake greatly amplifys the re-centering capacity.

They are suitable for any kind of structure, up to the most important bridges. They are not sensitive to fire action and can grant a very long service life with negligible maintenance.

Sliding pendulum isolators are very often the most cost/performance effective devices.

Main Field

Any kind of bridges and building

INSTALLATION	Requires trained team
DURABILITY	> 100 years
MAINTENANCE	Corrosion protection after 15 years
COST	Best cost/performance ratio

VERTICAL LOAD

HORIZONTAL DISPLACEMENT

RE-CENTERINC CAPACITY

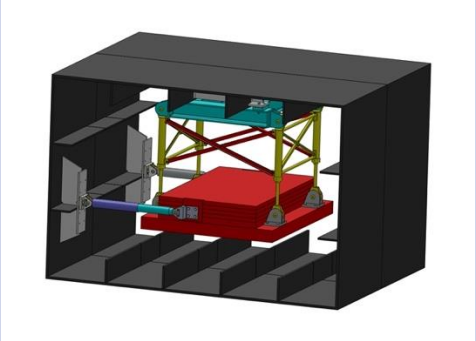
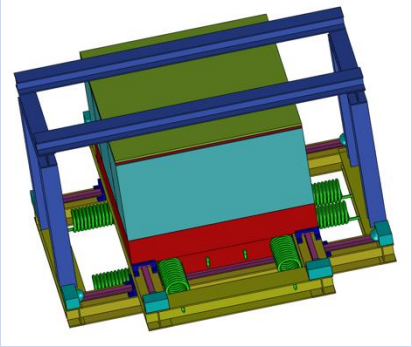
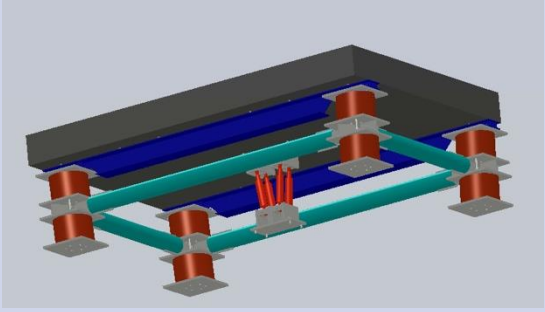
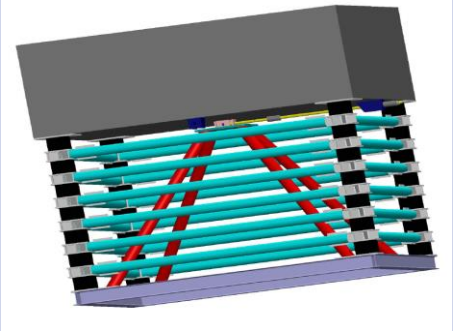
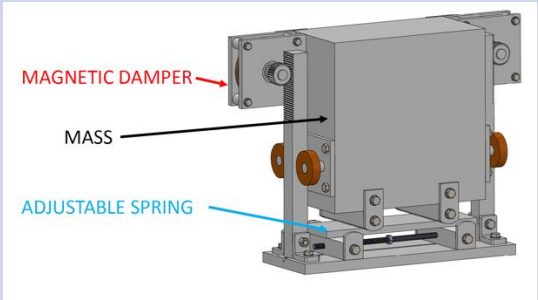
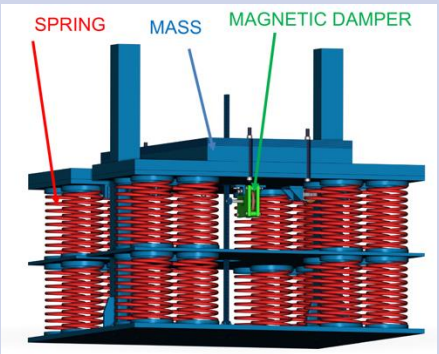
DAzPINC

FIRE RESISTANCE

The Viscous Dampers and Dynamic Links

They are commonly grouped as Hydraulic devices
Hydraulic devices cannot be considered base isolators because they do not provide two of the required functions: they do not support the vertical load of the structure and they don‘t have re–centering capacity. When incorporated in a structure the re-centering capacity shall be provided by the structure itself or by other isolators working in parallel.
Under the name of hydraulic devices a wide variety of devices may be considered that utilize the viscosity properties of a Ɥuid to reach some positive effect on the structures in order to improve their resistance against the effects of an earthquake.
Common feature of the different types of hydraulic dampers is the presence of a cylinder filled with oil. The cylinder is divided into two chambers by a piston. The device is fixed to the structure, normally through spherical hinges, in such a way that the relative movement of the structure causes the piston to move inside the cylinder. The movement of the cylinder causes the oil to Ɥow from one chamber to the other through a Hydraulic circuit. The Ɥow of the oil causes the behavior of the device that is depending from the viscosity of the Ɥuid and the properties of the hydraulic circuit.

MAIN TYPES OF TMD

HORIZONTAL	HORIZONTAL
	
HORIZONTAL	**HORIZONTAL**
	
VERTICAL	**VERTICAL**
	

SERVICES THAT CAN BE PROVIDED BY HIRUN FOR THE SUPPLY OF TMD

1. Dynamic analysis of the structure
2. Study of the required performances of the TMD
3. Design and manufacturing of the TMD
4. Preliminary tests of the TMD in factory
5. Installation of the TMD
6. Tests of the TMD on the structure

TESTING IN FACTORY

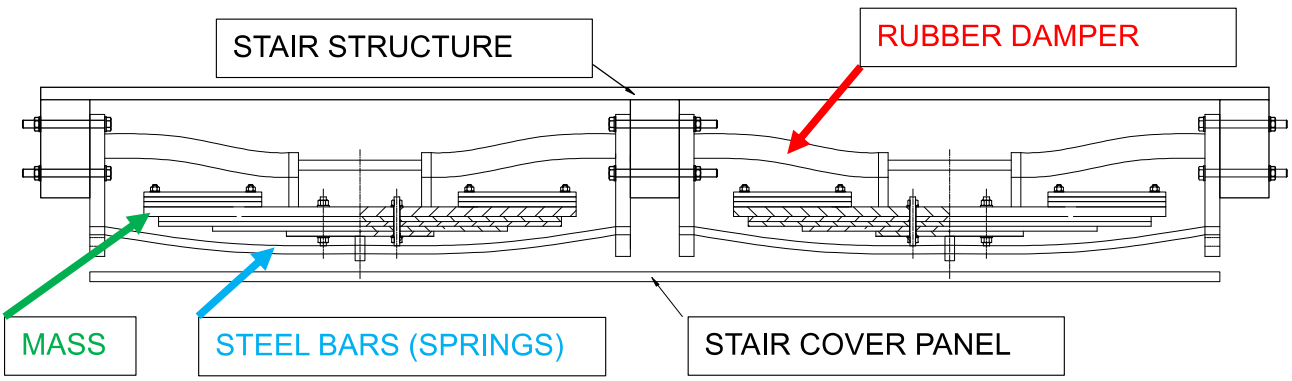
- The TMD will be provided with suitable devices that allow applying a deformation up to the design displacement.
- For the execution of the snap-back tests, the TMD will be assembled at the factory with the nominal mass as appropriate.
- The necessary force will be applied through a hydraulic jack.
- Once deformed the TMD will be blocked in the deformed position by connections that can be easily and suddenly removed.
- After releasing the connections, the TMD is free to have damped oscillations. The displacement in function of the time will be recorded utilizing an accelerometer.
- From the plot is easy to verify the natural frequency, the logarithmic decrement and the damping of the TMD.

The TMD for Taipei Apple store

PERFORMANCES

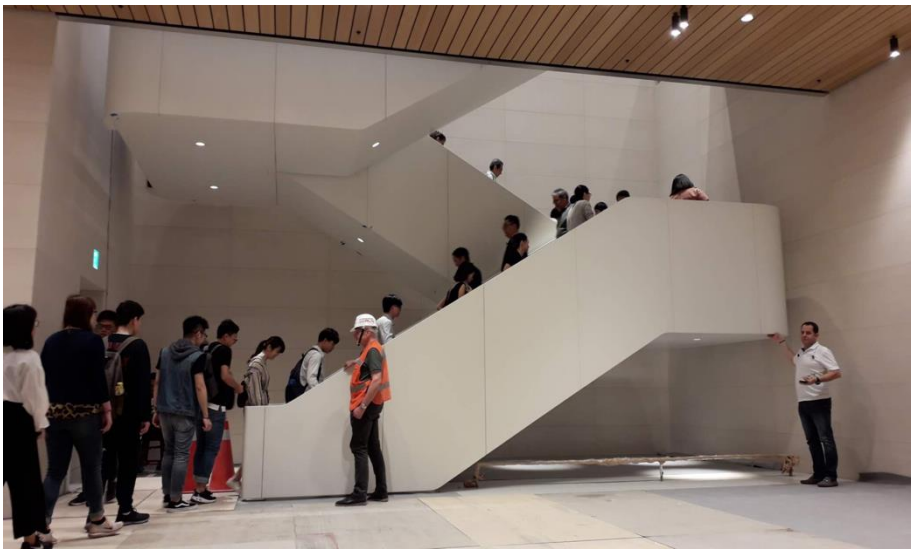
- Frequency: 4.2 Hz ±0.63 Hz
- Mass: 200 kg
- Vertical displacement: ± 30 mm
- TMD damping: 9%
- Structure damping > 3.5%
- Maximum height: 400 mm

THE VERY SMALL HEIGHT REQUIREMENT GAVE THE CONDITIONS FOR THE DESIGN



To fit the limited vertical space:

- The springs consist of high tensile Chrome Nickel steel bars working in bending
- The dampers consist of high damping rubber prisms

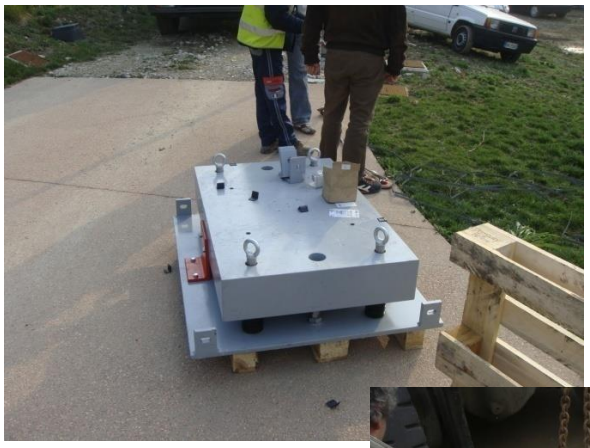


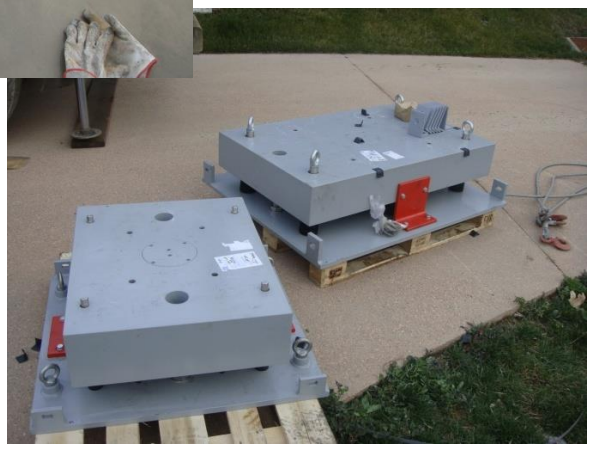
Design verification of the comfort of the stairs.

MAIN REFERENCES

DESCRIPTION	ACTIVITY	YEAR
TMD for the Macao, Zhuhai, Hong Kong Bridge	Supply, Testing, Installing	2013 - 2015

TMD SYSTEM: VERTICAL DIRECTION
Spring-Mass system
TMD FOR A PEDESTRIAN BRIDGE IN MILANO EXPO 2015 TMD





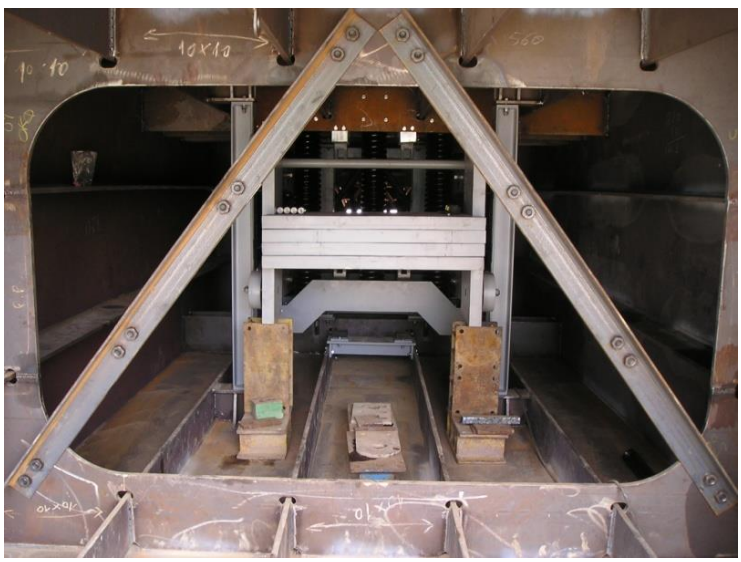
MAIN TMD REFERENCE:

TMD SYSTEM: HORIZONTAL DIRECTION
Solution 2: pendulum system
TMD for Arch Bridges MILANO EXPO 2015

TMD SYSTEM: HORIZONTAL DIRECTION

Solution 2: pendulum system

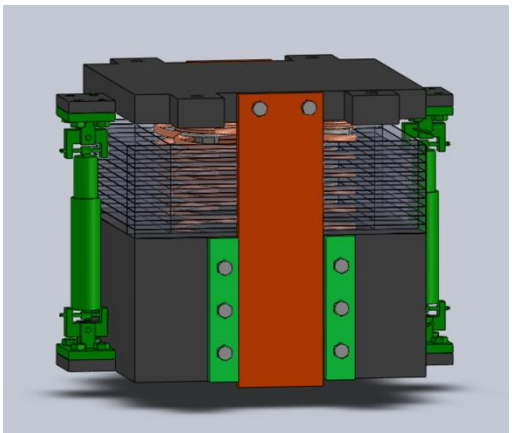
TMD for Arch Bridges MILANO EXPO 2015

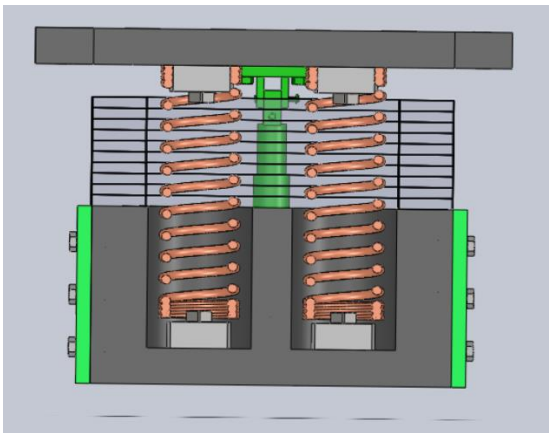


TMD FOR IKEA PROJECT - WUHAN

TECHNICAL PROPERTIES - TMD IKEA PROJECT

Mark	Stiffness (kN/m)	Mass (kg)	Frequency (Hz)	Parameters		
				Damping	Displacement (mm)	Load (kN)
TMD1	120.14± 15%	450	2.6259	6.3%	± 30	1.164
TMD2	160.18± 15%	600	2.6259	6.3%	± 30	1.552
TMD3	120.14± 15%	450	2.6259	6.3%	± 30	1.164
TMD4	135.9± 15%	600	2.4190	6.3%	± 30	1.432
TMD5	86.09± 15%	380	2.4190	6.3%	± 30	0.908
TMD6	116.35± 15%	380	2.8126	6.3%	± 30	1.052
TMD7	36.74± 15%	120	2.8126	6.3%	± 30	0.332





References

Asan Cheonan Expressway
South Korea

Bursa Hospital
Turkey

Dintai Building
Taiwan

Green Museum
Taiwan

References

Cibubur LRT
Jakarta, Indonesia

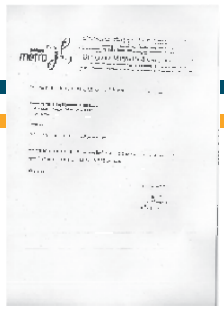
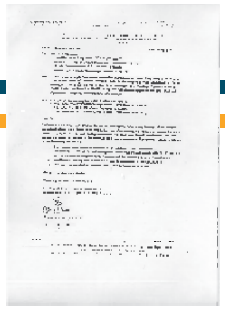
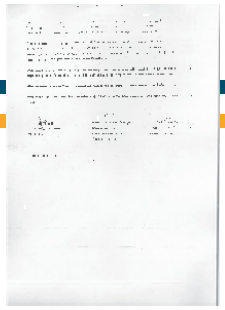
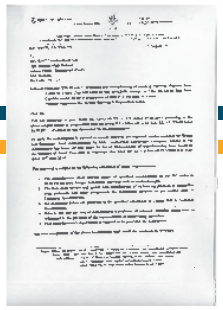
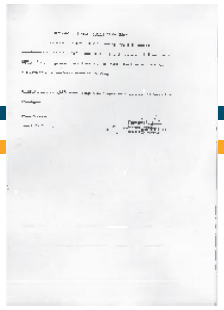
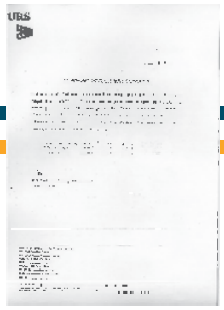
Holtekamp bridge
Turkey

Kerch bridge
Russia, Crimea

Casaclima
Rimini, Italy

APPROVALS, APPRECIATIONS

CECO has long list of approvals, appreciation letters and satisfactory perfomance repotrs issued from various goverment agencies, many Indian & International cunsultants those who are working in India.

QUALITY CERTIFICATIONS

Hirun International and its partners cooperate with important international institutions in order to guarantee the test performances and the advanced research on materials and products

QUALITY | EUROPEAN CERTIFICATION – CE MARK

EUROPEAN CERTIFICATION - ETA

HIRUN INTERNATIONAL is actively working with its partner to obtain the European Technical Assessment for all its advanced products like special sliding materials, post tensioning kit, expansion joints

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