



Infrastructure products

# Project References – Seismic protection of hospitals and fire stations





Infrastructure products

# Introduction

## mageba – your one-stop partner

The Swiss company mageba is one of the world's leading suppliers of **structural bearings, expansion joints** and other **high quality products and services** for the transport infrastructure and building construction sectors. In the last 10 years, mageba has also significantly expanded its range of products and services relating to **earthquake protection and structural monitoring**.

## engineering connections® – since 1963

Whenever static and dynamic forces are transferred between structural elements, whenever forces interact with movements and rotations, whenever structural elements need to be protected against overstress, whenever vibrations and noise need to be reduced: **mageba provides systems with its wide range of engineered products and services.**

Originating decades ago from the bridge industry, mageba has continuously extended its expertise in engineered connections to different types of structures. As a provider of high-quality structural support systems, mageba **supports owners, engineers, designers, architects and main contractors** from **planning stage to project completion.**

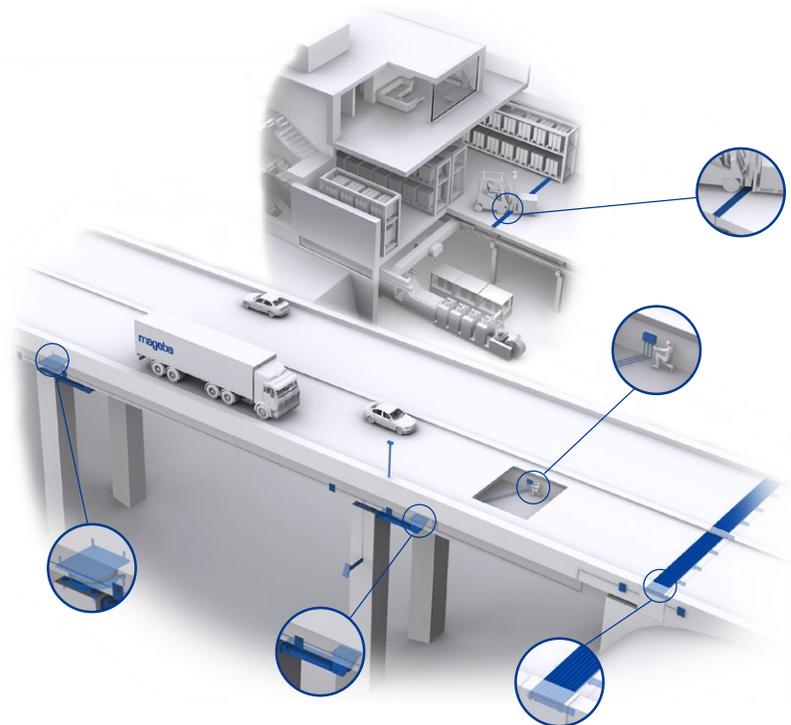
### The particular challenges presented by strategic building structures for first response

Hospitals and fire stations are key first response infrastructure that needs to satisfy the highest seismic safety standards in order to be fully operative in the event of an emergency.

Having supported a broad variety of renowned and challenging projects worldwide during the past five decades, mageba is your reliable partner in ensuring your structure's safety and durability.

The following is a brief overview of selected projects, highlighting some of their specific structural design challenges and developed solutions.

## Infrastructure, Industrial structure and Building products



## mageba's Systematic Quality Management and Technical Excellence:





# Index

Project	Location/Country	mageba's completion	Bearings	Expansion joints	Seismic devices	Monitoring & Services	Page
Leoben State Hospital	Leoben, Austria	2012			•		4
Taipei City Hospital	Taipei, Taiwan	2014			•		5
Muisne Hospital	Muisne, Ecuador	2017			•		6
SOLCA Hospital	Guayaquil, Ecuador	2015			•		7
Taichung Veterans Hospital	Taichung, Taiwan	2017			•		8
Sakarya State Hospital	Sakarya, Turkey	2017			•		9
Central Fire Station Basel	Basel, Switzerland	2010		•	•		10
Biberist Fire Station	Biberist, Switzerland	2012			•		11





# Leoben State Hospital (Austria)



## Project description

The Leoben General Hospital was founded in 1805 and moved to its current location in the city of Leoben, eastern Austria, in 1889. Considering the city's location in a seismically active part of Austria (at a place that has often been the epicentre of earthquakes in the past, and thus has no main earthquake direction), it was decided to assess the ability of the hospital's five main buildings to withstand a strong earthquake. Based on this assessment, it was determined that two structurally independent structures should be connected at roof level by shock absorbers to damp their movements relative to each other and thus reduce the risk of seismic damage.

## mageba scope

mageba supplied and installed the six RESTON®SA shock absorbers required to connect the building sections together. These were designed for forces of up to 1000 kN, each with a movement capacity of +/- 50 mm. Due to the exposed location of the devices on the building's roof, protective housings, also designed to accommodate movements, were erected around each one.

By damping the movements of one section of the building relative to the other, impacts can be prevented, enabling the hospital to remain in service following a serious earthquake, when it is most needed.

## Highlights & facts

### mageba products:

Product:	RESTON®SA shock absorbers
Force:	1000 kN
Movement:	+/- 50 mm
Installation:	2012, by mageba

### Structure:

City:	Leoben
Country:	Austria
Type:	Hospital building

The hospital building is located in the city of Leoben in eastern Austria



Two RESTON®SA shock absorbers during installation across a joint on the building's roof



A RESTON®SA shock absorber as fully installed, inside a protective housing



# Taipei City United Hospital, Heping Branch (Taiwan, China)



## Project description

Taipei City Hospital was formed by the merger of ten municipal hospitals into one unit, making it the largest healthcare organization in the city of 2.6 million residents and the whole of northern Taiwan.

One of the ten original units, now known as Taipei City Hospital – Heping Branch, was subjected to renovation works in 2013–2014, with the emergency ward building structurally strengthened to improve its ability to withstand an earthquake and thus remain in service when it is needed most.

## mageba scope

RESTON®SA shock absorbers (viscous dampers) were selected to provide the required damping and energy dissipation, greatly improving the building's chances of surviving a major earthquake.

40 of the units, designed for forces of 500 kN and movements of +/- 70 mm, were supplied by mageba and installed on the building's façades, held in place by specially added steelwork.

Prototype testing was carried out at Taiwan's National Center for Research on Earthquake Engineering (NCREE) in Taipei, while factory production control testing was carried out by SismaLab of Italy.

## Highlights & Facts

### mageba Products:

Type:	RESTON®SA shock absorbers
Force:	500 kN
Stroke:	+/- 70 mm
Testing:	At NCREE, Taiwan and SismaLab, Italy
Installation:	2013–2014

### Structure:

City:	Taipei
Country:	Taiwan, China
Type:	Hospital building
Renovated:	2013–2014

The hospital building is located in Taipei, capital of Taiwan



Two of the forty RESTON®SA shock absorbers installed on the façade of the building



Close-up view of a RESTON®SA shock absorber, as installed





# Muisne Hospital (Ecuador)



## Project description

Muisne Hospital in Ecuador’s Esmeraldas province is currently being built as part of the reconstruction of the town of Muisne following a destructive earthquake in April of 2016. It will provide the community with a wide range of medical services, including general medicine, emergency treatment, physiotherapy, rehabilitation and dentistry. In order to ensure that the hospital will continue to fulfil its important function when it is most needed - in the aftermath of a major earthquake - the new hospital is being built to withstand future seismic events, using modern seismic isolation techniques and products.

## mageba scope

The hospital’s main structure is supported on a number of special bearings which isolate it at basement level from the violent ground movements that may occur during an earthquake. The RESTON®PENDULUM isolator (also known as a curved surface slider) is based on the functional principle of a pendulum. It allows a structure to become horizontally displaced (and at the same time, lifted) during an earthquake, with seismic energy being dissipated by friction. 65 RESTON®PENDULUM isolators (of the type DUPLO, which features two primary curved sliding surfaces) were supplied by mageba and installed under mageba’s supervision in 2017. The isolators are designed for vertical loads of 750 kN and seismic movements of +/- 400 mm.

## Highlights & Facts

### mageba Products:

Type: RESTON®PENDULUM seismic isolators  
Features: 65 units  
Installation: 2017

### Structure:

City: Muisne  
Country: Ecuador  
Type: Hospital  
Completion: 2018  
Contractor: Arroyo & Arroyo Constructores  
Engineer: Sismica Ingenieros Consultores

The new hospital is located in Muisne on Ecuador’s Pacific coast



Lifting into position of a RESTON®PENDULUM seismic isolator during the construction of Muisne Hospital



Precise positioning and levelling of a RESTON®PENDULUM seismic isolator



# Solca Hospital (Ecuador)



## Project description

The Ecuadorian “Sociedad de Lucha Contra el Cancer” (SOLCA) was established in 1951 in order to treat and prevent cancer and has grown to become one of Ecuador’s most important health institutions, with facilities across the country. The society’s new hospital in Guayaquil, the country’s largest city, which is currently being constructed, has been designed to protect it from damage during earthquakes. This is being achieved by isolating the main above-ground structure from the kind of strong ground movements that might arise during an earthquake.

## mageba scope

In order to isolate the above-ground structure from violent ground movements, it is supported on an array of Lead Rubber Bearings (LRB), which function as regular bearings in normal circumstances but which provide critical seismic isolation properties (damping, energy dissipation and re-centering) during an earthquake, preventing the supported building from being destroyed. For this purpose, mageba has supplied sixteen LASTO®LRB seismic isolators, each with a movement capacity of 80 mm and a vertical load capacity of 1,000 kN.

## Highlights & Facts

### mageba Products:

Type: LASTO®LRB seismic isolators  
Installation: 2015

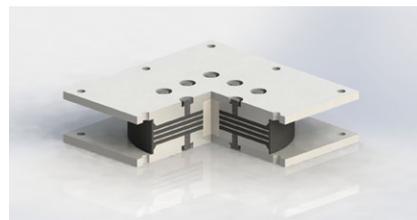
### Structure:

City: Guayaquil  
Country: Ecuador  
Type: Hospital  
Completion: 2017  
Engineer: Sismica Ingenieros Consultores

This facility of the Ecuadorian Cancer Society is located in Guayaquil, Ecuador’s largest city



Rendering (cut-out view) of a LASTO®LRB seismic isolator as designed for the SOLCA hospital



Precise installation of LASTO®LRB seismic isolator is an important element for the proper functioning of the system





# Taichung Veterans Hospital (Taiwan)



## Project description

Taichung Veterans General Hospital is a government-owned hospital in central Taiwan. It began offering medical services in 1982, with the main purpose of meeting the medical needs of veterans, but also serves the general public. It has 1,500 beds, and with around 3,700 employees it is also able to take care of 7,000 out-patients and 190 emergency room patients daily.

In order to ensure that this important health facility, and especially its emergency department, can function in the aftermath of a severe earthquake (when its services would be needed more than ever), it was decided to retrofit seismic protection in 2017.

## mageba scope

The approach adopted to seismically protecting the building in question involved the installation of shock absorbers (dampers) around the building's facade, with steel-work elements added to hold the dampers in place and enable them to function. This approach made it possible to carry out the work with minimal impact on hospital operations.

In total, mageba supplied 296 RESTON®SA dampers for this project, designed for loads of up to 800 kN and displacements of +/- 50 mm.

## Highlights & Facts

### mageba Products:

- Type: RESTON®SA shock absorbers
- Features: Retrofitting project, with 296 dampers
- Installation: 2017

### Structure:

- City: Taichung
- Country: Taiwan
- Type: Hospital
- Contractor: Dong Meng Construction Co., Ltd.

The hospital is located in Taichung City, Taiwan



A RESTON®SA shock absorber as installed at one location in the specially constructed frame around the building



All 296 RESTON®SA dampers were successfully tested before installation



# Sakarya State Hospital (Turkey)



## Project description

Sakarya State Hospital in the Turkish city of Sakarya is currently being built with a capacity of 200 beds. Considering the potential for seismic activity in this part of Turkey, a very strong focus was placed on designing the hospital to survive strong earthquakes. This is achieved by a combination of seismic isolation and damping. An array of seismic isolator bearings at basement level supports the hospital in normal circumstances while also isolating it from any seismic ground movements that may arise. And shock absorbers at strategic locations around the structure will dampen any movements that are nonetheless experienced by the supported structure, dissipating the seismic energy and further reducing the risk of damage.

## mageba scope

The isolation of the hospital's main structure from seismic ground movements is achieved by RESTON®PENDULUM seismic isolators – 198 in total. These isolators – also known as a curved surface sliders – are designed to accommodate displacements of +/- 450 mm, and to carry vertical loads of up to 12,400 kN.

The damping of seismic energy is achieved by 30 RESTON®SA shock absorbers, designed for maximum forces of 790 kN and with a stroke of +/- 450 mm.

## Highlights & Facts

### mageba Products:

Type: RESTON®PENDULUM seismic isolators, RESTON®SA shock absorbers

Features: 198 isolators and 30 dampers

Installation: 2017

### Structure:

City: Sakarya

Country: Turkey

Type: Hospital

Completion: 2018

Owner: Turkish Ministry of Health

Contractor: Gökyol Construction and Industry A.Ş.

The new hospital is located in north-western Turkey, close to Istanbul



Testing of a RESTON®SA shock absorber in SISMALAB



Precise levelling of a RESTON®PENDULUM seismic isolator before grouting of anchors to hold in place





# Central fire station Basel (Switzerland)



## Project description

Basel city's main fire station was built in 1943 to the design standards of the day, but was more recently determined to be susceptible to damage by earthquake. To ensure that fire and rescue services remain fully operational at all times, including in the immediate aftermath of a large earthquake, the structure had to be modified. It was decided to isolate the structure from the ground using bearings and expansion joints. All of the building's walls and columns were cut horizontally at basement level, and elastomeric bearings and isolators were placed within this cut.

## mageba scope

mageba supplied 50 LASTO®BLOCK elastomeric sliding bearings (Type KGa, with  $V_{max} = 300 \text{ kN}$ ) to support the structure, inserted in the cut basement walls. These allow the ground and the structure beneath the horizontal cut to move during an earthquake without destroying the building. To isolate the building above the cut from the ground beside the building also, an isolation corridor was constructed between cut level and ground level. To avoid a hazard and to enable fire trucks to drive in and out, mageba also supplied TENSA®SLIDE expansion joints to bridge this gap at ground level.

## Highlights & facts

### mageba products:

Type: LASTO®BLOCK sliding bearings of type KGa  
TENSA®SLIDE sliding plate expansion joints

Installation: 2010

### Structure:

City: Basel  
Country: Switzerland  
Type: Fire station building  
Completed: 1942  
Area: 44 m x 15 m

The fire station is centrally located in the city of Basel (Switzerland)



LASTO®BLOCK sliding bearings isolate the building from seismic ground movements



A TENSA®SLIDE sliding plate expansion joint bridges the gap along the building's foundations



# Biberist Fire Station (Switzerland)



## Project description

The fire department building of the town of Biberist in Switzerland was first built in the 1960s, and extended with the addition of a new part in the late 1980s. Due to the building's location on a slope, ground settlements during the next 25 years resulted in a 3-centimetre gap between the older and newer parts. To prevent the parts colliding and becoming destroyed during an earthquake, it was decided to install some form of seismic protection to control and damp their movements relative to each other.

## mageba scope

The responsible engineers decided to install RESTON®SA shock absorbers to damp the relative movements of the older and newer building sections. Since the gap between the structures was far too narrow to install the devices, complete with connections, it was decided to pass the devices through new holes in the walls of each structure and connect them to internal floor slabs at each side. Five RESTON®SA shock absorbers, designed for maximum forces of 125 kN and movements of up to +/- 20 mm, were supplied and installed by mageba in 2012.

## Highlights & facts

### mageba products:

Type:	RESTON®SA shock absorbers
Force:	125 kN
Movement:	+/- 20 mm
Installation:	2012

### Structure:

City:	Biberist
Country:	Switzerland
Type:	Fire station building
Built:	1960s
Extended:	Late 1980s

The fire station is located in the town of Biberist in northwestern Switzerland



One end of a RESTON®SA shock absorber as installed, passing through a wall



Internal view of a room in which one end of a number of shock absorbers are to be fixed



# engineering connections® – since 1963



- Locations
- Representatives

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