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Project References – North America



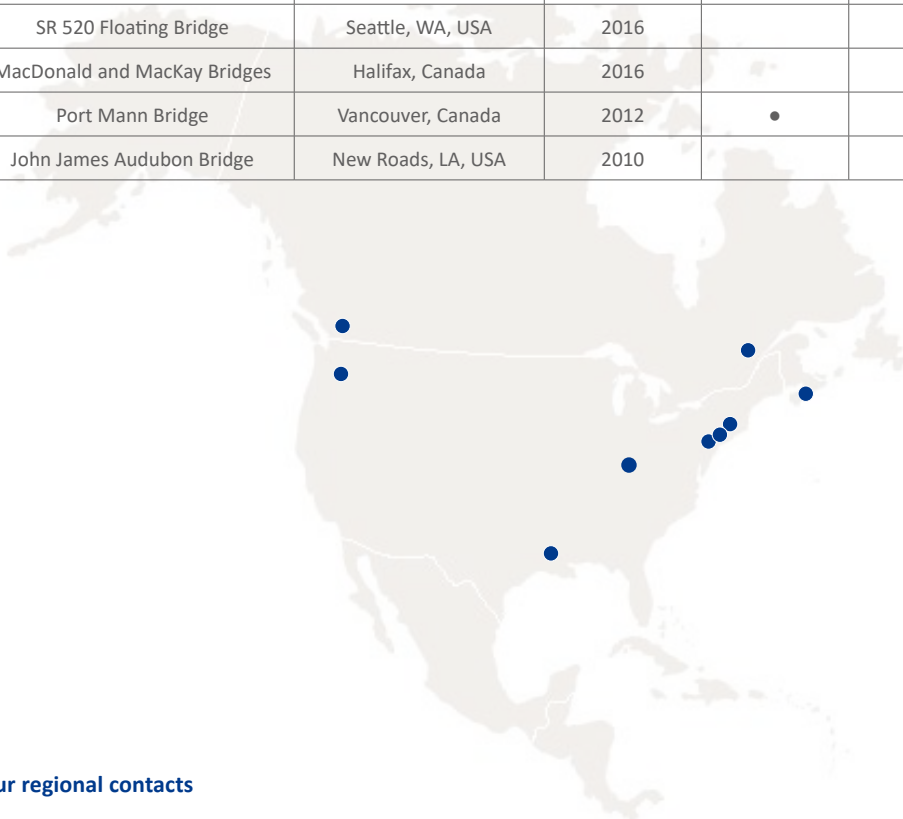
mageba



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mageba supports the following organizations:



International Joints & Bearings Research Council



American Segmental Bridge Institute



International Association for Bridge Maintenance and Safety



International Association for Bridge and Structural Engineers

Samuel De Champlain Bridge (Canada)



Project description

The Samuel De Champlain Bridge is located in Montreal, Canada, and replaced the old Champlain bridge over the St. Lawrence River. This crossing is one of the busiest in Canada with over 60 million vehicles and \$20 Billion in international trade passing over it on a yearly basis.

The \$4.2 billion project consisted of two main bridges – the New Bridge on the St-Lawrence and the Île-des-Soeurs Bridge – fully opened for the traffic on June 2019.

The bridge, 3.5 km long, is a stayed cable bridge designed for a 125 years long service life. This has been possible by taking into consideration the smartest forethoughts and high quality products and materials for a challenging project of a structure subjected to approx. 160,000 vehicles every day – sometimes in harsh weather conditions.

The new bridge is located in Montreal, Canada, and is part of the government’s extensive corridor project



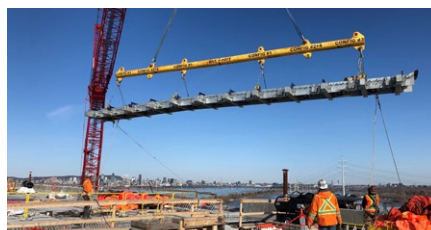
mageba scope

mageba provided Structural Health Monitoring service and modular joints for this iconic bridge.

In the course of the project duration, more than 50 embedded and 150 surface sensors are being installed on the bridge, allowing the Government of Canada to monitor displacement, corrosion, movements, temperature, stresses, strain and environmental conditions of the bridge over the next 30 years. This will most certainly optimize the maintenance supporting the owner to keep the structure at his best performances. Moreover, the ingenious system provides the ability to react instantly to changes and deterioration.

In parallel, the largest expansion supplied will span over 20 meters and cover upwards of 800 mm in movements (10 gaps).

A TENSA®MODULAR expansion joint typ LR8 is being lifted into place



Highlights & Facts

mageba products:

Type: ROBO®CONTROL permanent Monitoring System
 TENSA®MODULAR expansion joints types LR8, LR9 & LR10
 Features: approx. 200 sensors
 Installation: 2016–2019

Structure:

City: Montreal
 Country: Canada
 Type: Cable-stayed bridge
 Completed: 2019
 Owner: Infrastructure Canada
 Contractor: SNC Lavalin, Dragados, Flatiron Canada, TY Lin, MMM Group Preliminary
 Design: Arup

Corrosion Sensor installed on the pier starter reinforcement





Tappan Zee Bridge (USA)



Project description

The New Tappan Zee Bridge, also known as the New NY Bridge and officially named the Governor Mario M. Cuomo Bridge after the late former governor Mario Cuomo, is a twin cable-stayed bridge built to replace the original Tappan Zee Bridge over New York's Hudson River. The \$4.0 billion bridge structure, completed in June 2018, contains a total of eight lanes for vehicular traffic as well as a shared-use bicycle and pedestrian path.

Additionally, an allowance has been made for the future construction, between the two structures, of a rail line to assist with trans-Hudson public transportation.

The Tappan Zee Bridge is a critically important transportation link in the New York Metropolitan Area, with over 138,000 vehicles crossing it each day.

mageba scope

mageba North America Corp. supplied all 23 of the TENSA®MODULAR (type LR) expansion joints required for the new Tappan Zee Bridge, in fully continuous lengths, the longest of which is 105 feet (32 meters). The largest joints are type LR18, each with 18 individual movement gaps which accommodate total longitudinal movements of up to 54 inches (1.4 meters).

mageba also supplied 16 RESTON®STU shock transmission units (STU, also known as lock-up devices), with lock-up capacities of 800 kips (3,550 kN) and pressure release valves rated for 1,600 kips (7,100 kN). Each STU weighs 13,500 lbs (6,150 kg), and have been individually tested to ensure that the performance meets the required design criteria.

Highlights & Facts

mageba products:

Type: 23 TENSA®MODULAR LR expansion joints
16 RESTON®STU shock transmission units
Installation: 2015–2018

Structure:

City: New York
Country: USA
Type: Cable stay Bridge
Completed: 2018
Length: 3.0 miles (4,800 m)
Builder: Fluor Corporation, American Bridge Copany, Granite Construction Northeast & Traylor Bros

The Tappan Zee Bridge is located close to New York City



Installation of a TENSA®MODULAR expansion joint type LR8



Installed shock transmission unit



Bayonne Bridge (USA)



Project description

The Bayonne Bridge connects the City of Bayonne, NJ with Staten Island, NY. After its completion in 1931, the Bayonne Bridge was the longest steel arch bridge in the world, but today it sits in fifth place.

In 2013, prompted by the expansion of the Panama Canal, a \$743.3 million project was awarded to raise the bridge deck within the original steel arch in order to accommodate larger post-Panamax class ships.

The significance of this project cannot be overvalued as fully 12% of all US-bound international container ships currently pass under the Bayonne Bridge.

mageba scope

To support the newly raised deck, mageba is supplying 158 RESTON®DISC bearings. All of the approach span bearings are being specially fabricated with the capability to be temporally locked against longitudinal movements during the construction phase, but allowing free movement after construction is completed.

The new bridge deck will also be equipped with 18 TENSA®MODULAR expansion joints, designed with up to 6 gaps to accommodate 17.7 in (450 mm) of movement, and 4 TENSA®FINGER sliding finger joints to accommodate 31.5 in (800 mm) of movement. Additionally, mageba is supplying sliding plate expansion joints for the shared use pedestrian and cycle paths.

Highlights & Facts

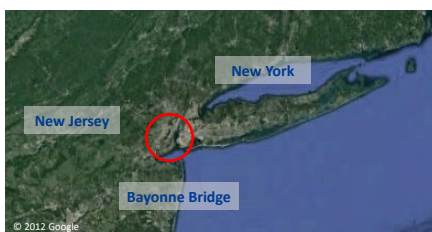
mageba products:

Type:	TENSA®MODULAR LR expansion joints, TENSA®FINGER GF sliding finger joints, RESTON®DISC bearings
Features:	Uplift Bearings
Installation:	2015–2017

Structure:

City:	Staten Island, NY
Country:	USA
Type:	Steel arch
Completed:	1931
Length:	5,780 ft (1,762 m)
Contractor:	Skanska Koch-Kiewit JV
Owner:	Port Authority of NY and NJ

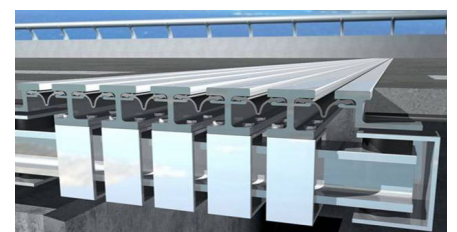
The bridge is one of three that connect Staten Island, New York to New Jersey



A finished Disc bearing before delivery



Deck movements will be facilitated by modular joints (as shown) and sliding finger joints





Ohio River Bridges – East End Crossing (USA)



Project description

The Ohio River Bridges Project in the Louisville–Southern Indiana region of the United States involves the construction of two bridges across the Ohio River – one in the metropolitan area’s Downtown neighborhood (equipped with mageba bearings), and one eight miles upstream in the area’s growing East End.

With a length of 2,500 feet (762 m), the bridge is just one part of the East End Crossing, which has a total length of 8.5 miles (13.67 km).

The overall project is financed by WVB East End Partners, a consortium involving VINCI Concessions, Walsh Investors and Bilfinger Berger PI International Holdings.

mageba scope

TENSA®MODULAR expansion joints of types LR8 and LR11 (with 8 and 11 gaps respectively) are being supplied by mageba USA, to facilitate deck movements at two bridge axes. At each bridge axis, three separate joints are required – one for each carriageway and one for a footway. The LR11 joints can accommodate longitudinal service movements of up to roughly 33 inches (838 mm), as well as transverse and vertical movements and multi-axial rotations.

The joints were designed and fabricated in accordance with AASHTO LRFD Bridge Construction Specifications, and hot-dip galvanized in accordance with ASTM A123.

Highlights & Facts

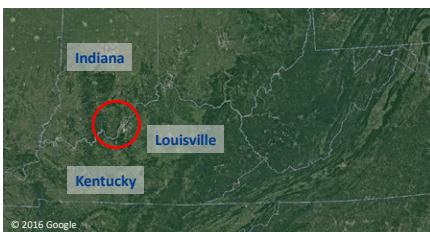
mageba products:

Type:	TENSA®MODULAR expansion joints of types LR8 and LR11
Movements:	Type LR8: 24 inches (610 mm) Type LR11: 33 inches (838 mm)
Installation:	2016

Structure:

City:	Louisville, KY
Country:	USA
Type:	Cable-stayed bridge
Completed:	2016 (projected)
Owner:	KY DOT
Contractor:	Walsh Construction Co. VINCI Construction
Engineering:	Jacobs Engineering

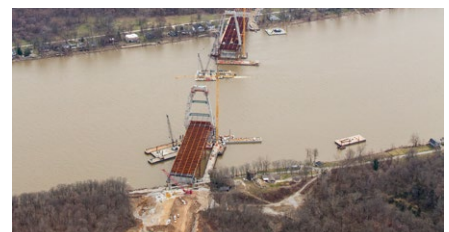
The bridge will connect Interstate 265 across the Ohio River, north of Louisville, Kentucky



3D rendering of a TENSA®MODULAR expansion joint



Bird's eye view of the construction site



Ohio River Bridges – Downtown (USA)



Project description

The Ohio River Bridges project involves the construction of two new bridges across the Ohio River between the states of Indiana and Kentucky. The Downtown Crossing will connect the downtown areas of the cities of Louisville in Kentucky and Jeffersonville in Indiana, and the East End Bridge is located eight miles upstream.

The Downtown Crossing project is a cable-stayed bridge with three sets of twin towers. When opened in 2016, it will be tolled to partially refinance its construction.

mageba scope

mageba is supplying 20 structural bearings to support the deck of the new bridge. 10 of these are LASTO®BLOCK elastomeric bearings, and 10 are RESTON®DISC disc bearings.

A number of the disc bearings will be installed vertically to primarily resist horizontal forces at the pylons.

With a service life of 50 years, the sliding bearings feature ROBO®SLIDE high-grade sliding material instead of the commonly used PTFE, to enhance resistance to wear and abrasion, and therefore maximize overall durability.

Highlights & Facts

mageba products:

Type: RESTON®DISC disc bearings
LASTO®BLOCK elastomeric bearings

Special: 50-year service life

Installation: 2015–2016

Structure:

City: Louisville, KY

Country: USA

Construction: Cable-stayed bridge

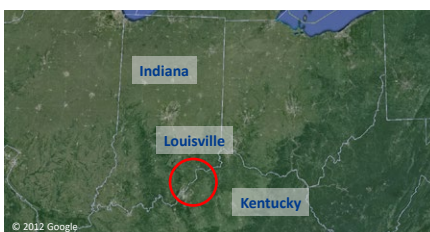
Type: Highway bridge

Built: 2013–2016

Contractor: Walsh Construction Co.

Owner: KY DOT

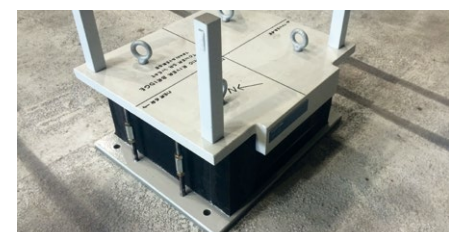
The Ohio River Bridges Downtown Crossing connects Louisville (KY) and Jeffersonville (IN)



A finished RESTON®DISC bearing with adjustable height and presetting



A finished LASTO®BLOCK elastomeric bearing





Verrazano Narrows Bridge (USA)



Project description

The Verrazano Narrows, a body of water which separates the New York boroughs of Brooklyn and Staten Island to the south of Manhattan, is the gateway to New York City's harbor. The bridge that spans the Narrows creates a vital connection for road traffic, carrying about 200,000 vehicles per day. The double-decked suspension bridge has a central span of 4,260 feet (1,298 m), and was the longest suspension bridge in the world from the time its upper level opened in 1964 until 1981.

Currently, it has the longest bridge span in the Americas.

mageba scope

The bridge's existing finger joints, each accommodating enormous deck movements of 2,700 mm (approx. 9 ft) are to be replaced with new finger joints. Due to the great length of the individual fingers, they will receive intermediate support at mid-span. The challenge of designing and supplying these exceptional joints is increased by the need to tailor them to precisely match existing geometry and conditions.

Various single gap joints, also tailored to suit the existing structure, are also being supplied to accommodate much smaller movements at other locations.

Highlights & Facts

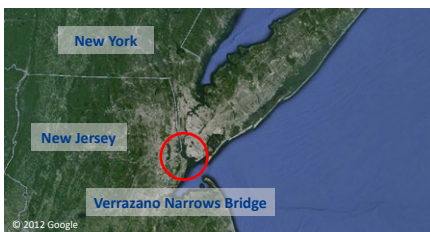
mageba products:

Type: Sliding finger joints
Features: Enormous movements
Installed: 2015–2016

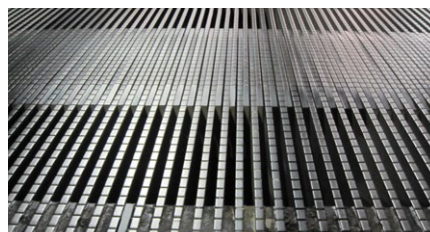
Structure:

City: New York, NY
Country: USA
Construction: Suspension bridge
Type: Road bridge
Built: 1959–1969
Length: 4,260 feet (1,298 m)
Contractor: Tutor Perini
Owner: City of New York

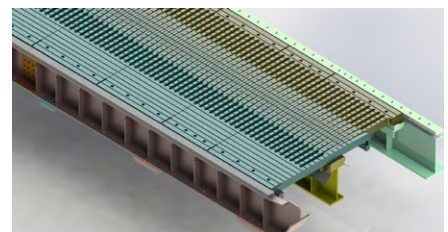
The bridge spans the Verrazano Narrows – the gateway to New York City's harbor



The bridge's sliding finger joints, designed for enormous movements, must be replaced



3D view of a new sliding finger joint, facilitating longitudinal movements of 2,700 mm (approx. 9 ft)



SR 520 Floating Bridge, Washington (USA)



Project description

The Governor Albert D. Rosellini Bridge-Evergreen Point, commonly called the SR 520 Bridge, is the longest floating bridge on the planet. At 7,580 ft. (2,310 m), it carries State Route 520 across Lake Washington from Seattle to Medina.

The four lane toll bridge was opened in 1963 after four years of construction.

Due to its age and deteriorated condition as well as increased traffic, the Evergreen Point Floating Bridge was replaced by a new floating bridge at the same site. The new bridge was opened in April 2016 and carries six lanes as well as a multi-use path for bicyclists and pedestrians. With its length of 7,708.49 feet (2,349.55 m) it is officially certified for the Guinness World Records.

mageba scope

mageba supplied nine TENSA®MODULAR expansion joints for the new bridge. The largest of these expansion joints has 16 gaps and allows 48.4 in (1,230 mm) of longitudinal movement, or 70.4 in (1,790 mm) of extreme limit state movement.

Smaller modular joints, with 2 and 6 gaps, and single gap joints, were also supplied by mageba.

These TENSA®MODULAR expansion joints will accommodate the significant transverse movements as well as the rotations about all axes that can be expected in a floating bridge.

Highlights & Facts

mageba products:

Type: TENSA®MODULAR joints, Types LR16, LR6, LR2
TENSA®GRIP, Type RS-B5

Features: Large rotations

Installed: 2015–2016

Structure:

City: Seattle, WA

Country: USA

Construction: Floating pontoon bridge

Type: Highway bridge

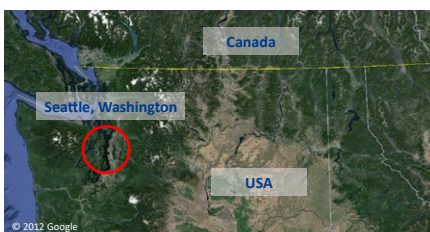
Built: 2013–2015

Length: 7,710 ft (floating)

Contractor: Kiewit/General/Manson

Owner: WSDOT

The bridge crosses Lake Washington between the cities of Seattle and Medina



TENSA®MODULAR expansion joint of types LR16 is ready for transportation



Installation of a 16-gap TENSA®MODULAR joint type LR16





Macdonald & MacKay Bridges (Canada)



Project description

The Angus L. Macdonald and A. Murray MacKay bridges are critically important structures for the city of Halifax, capital of the Canadian province of Nova Scotia. They were opened to traffic in 1955 and 1970 respectively, and several decades later, it was determined that both structures were in need of significant reconstruction / maintenance work in order to meet the demands of modern traffic for decades to come.

The Angus L. Macdonald Bridge, in fact, is receiving an entire new deck, and computer modelling of the deck, verified by measured data, is playing a key role in the design process.

The A. Murray MacKay Bridge, on the other hand, is retaining its existing deck, but is being subjected to significant renovation work.

mageba scope

Early in the project, it was determined that a fully automated ROBO®CONTROL structural health monitoring (SHM) system should be used to measure and record the movements and rotations of the bridge decks. The installed system has provided the data needed by the computer modelling of the new deck of one bridge, and assisted in the planning of remedial works of the existing deck of the other, enabling the bridge's engineers to optimize their designs and minimize the life-cycle costs of the bridges.

In 2015, it was decided to install new TENSA®MODULAR expansion joints with up to seven gaps each (type LR7) at four axes of the Angus L. Macdonald Bridge, replacing the existing joints. These joints were designed for steel connection, and feature noise-reducing "sinus plates" surfacing.

Highlights & Facts

mageba products:

Type: ROBO®CONTROL automated SHM system
TENSA®MODULAR expansion joints of type LR3 & LR7 LS
Installed: 2012 (SHM), 2015 (joints)

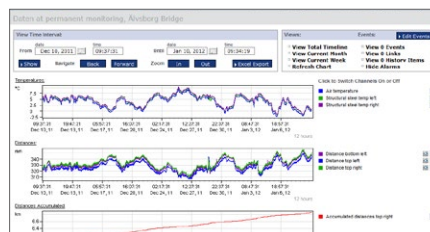
Structure:

City: Halifax
Country: Canada
Type: Suspension bridges
Angus L. MacDonalD Bridge
Built: 1955
Length: 4,265 ft (1,300 m)
Main span 1,447 ft (441 m)
A. Murray MacKay Bridge
Built: 1970
Length: 3,937 ft (1,200 m)
Main span 1,398 ft (426 m)

Location of the bridges in Halifax, Nova Scotia, Canada



Presentation of measured data (in graphic form) from the applied SHM system



Temporary plates at the point of future installation of the expansion joints



Port Mann Bridge (Canada)



Project description

The Port Mann Bridge is one of British Columbia's most significant bridge structures, carrying the Trans-Canada Highway (Canada's Highway 1) across the Fraser River to the west of Vancouver. As part of the major Port Mann Highway 1 project, which also includes the widening and upgrading of 23 miles (37 km) of highway, the bridge has been replaced with a new structure, and was opened to traffic at the end of 2012.

The new bridge is designed for 10 lanes of traffic, and with its main span of 1,542 ft (470 m), it is the second longest cable-stayed span in North America. At 164 ft (50 m) wide, the new bridge is also the widest span bridge of any type in the world.

mageba scope

mageba has delivered the modular expansion joints required for the entire bridge including both approaches. The joints have up to 11 movement gaps and thus can facilitate movements of up to 35 inches (880 mm). In noise-sensitive areas, several joints are equipped with noise-reducing "sinus plates" on the surface.

mageba also supplied, in cooperation with R.J. Watson Inc., disc bearings for the bridge. These are designed for loads of up to 19,000 kN and a number feature "double discs" to achieve this load capacity.

Highlights & Facts

mageba products:

Type: Modular expansion joints and disc bearings*

Features: Expansion joints with movements of up to 35 in (880 mm), some featuring "sinus plates"

Installation: 2012

Structure:

City: Vancouver

Country: Canada

Built: 2008–2012

Type: Cable stayed bridge

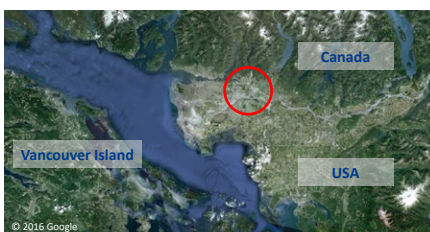
Length: 1.37 mi (2,200 m)

Maintained: Transportation Investment Corporation

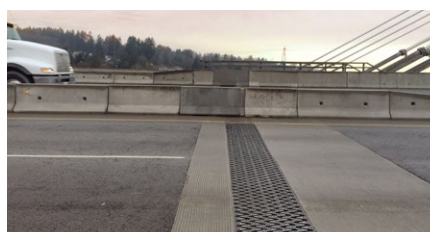
Contractor: Kiewit Flatiron General Partnership

* in cooperation with R.J. Watson Inc.

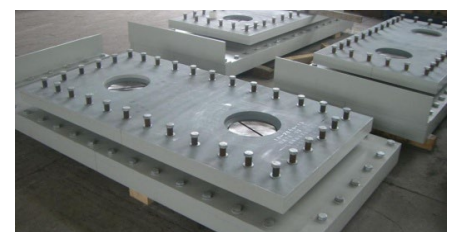
Location of the bridge in British Columbia



A modular expansion joint featuring noise-reducing "sinus plates" on its surface



Disc bearings (with double discs per bearing) ready for delivery





Audubon Bridge (USA)



Project description

In 2011, The John James Audubon Bridge opened in southern Louisiana. With a 1,581 ft (482 m) main span supported by two 492 ft (150 m) towers, and an overall length of 12,883 ft (3,927 m), the John J. Audubon Bridge became the longest cable stayed bridge in North America. The structure carries four lanes of traffic 65 ft (20 m) above the Mississippi River and replaces the unreliable ferry service. It is the only Mississippi crossing between Natchez and Baton Rouge, a distance of approximately 93 mi (150 km).

mageba scope

TENSA®FINGER sliding finger joints, type GF and type RSFD, were selected to fulfill the requirements of both the client and the designer. Finger joints were preferred by the client for their low maintenance demands,

and the specific type of finger joint was determined by the movement demands of the bridge at each joint location. Cantilever finger joints, type RSFD, were chosen to facilitate the smaller movements of 12 in (305 mm) at one bridge axis, while sliding finger joints, type GF, were chosen for the bridge axes requiring movements of 28 in (710 mm) and 49 in (1,240 mm).

The GF joints feature sliding support for the ends of the finger plates which span across the bridge gap, and a downward pre-tensioning of the finger plates to ensure that they remain in contact with the sliding surface below.

Weighing 24 tons each, the joints, which allow 49 in (1,240 mm) of movement, are the largest sliding finger joints of their type ever manufactured.

Highlights & Facts

mageba products:

Type: TENSA®FINGER joints of type GF (sliding) and type RSFD (cantilever)
Installation: 2010

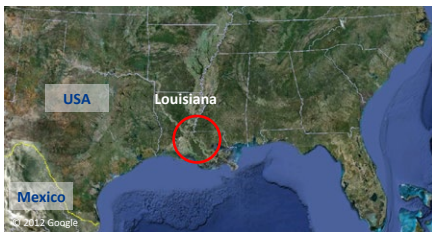
Structure:

City: New Roads, LA
Country: USA
Built: 2007–2011
Type: Cable stayed bridge
Length: 2.44 mi (3,927 m)
Main span 1,581 ft (482 m)

Contractor: Audubon Bridge Constructors (Flatiron and others)

Owner: LA DOT

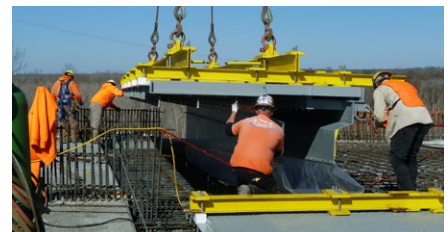
The bridge spans the Mississippi River in Louisiana, upriver from New Orleans



Sliding finger joint with transportation and installation frame, ready for delivery



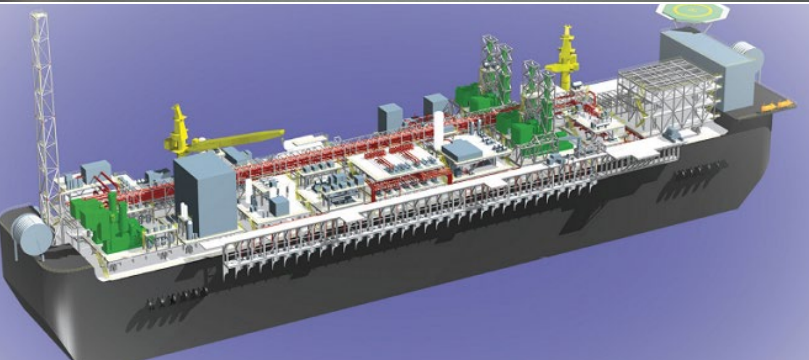
Installation of a TENSA®FINGER sliding finger joint





Project references

Project References – Latin America





Project references

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Petrobras FPSO units	Brazil	2015	•				6
Chilina Bridge	Arequipa, Peru	2014		•	•		7
Morelia-Lazaro Cardenas Highway	Michoacán, Mexico	2014		•			8
Tocumen Airport	Panama City, Panama	2014	•				9
Lerma Building – Telemex	Mexico City, Mexico	2014			•		10
Oil Refinery Seismic Isolation	Falcón State, Venezuela	2012			•		11
East West Corridor	Aranguez, Trinidad and Tobago	2009 + 2012		•			12



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mageba supports the following organizations:



Atlantic Bridge (Panama)



Project description

The world's busiest waterway – the Panama Canal – has been widened and deepened to allow for a second lane of traffic for larger containerships, the new “Panamax ships”.

Within the expansion project of this key conduit for international maritime trade, a new bridge was constructed on the Atlantic side of the canal, called the Atlantic Bridge.

The new third crossing across the canal is located just 1.8 miles (3 km) from the Gatun Locks in Colón. It spans 579 yards (530 m) and has a clearance of 82 yards (75 m) to allow the largest container ships in the world to navigate beneath, connecting the Pacific with the Atlantic Ocean through this man-made 48 mile (77 km) waterway.

mageba scope

For this project mageba delivered 16 RESTON®SPHERICAL bearings that feature uplift claws and designed according to AASHTO standards. Additionally, 4 LASTO®BLOCK lateral tower bearings for the tower level were also supplied.

All bearings face very large displacements up to +/-40 inches (+/-1,025 mm) as the bridge is seismically isolated. As a result, all bearings use mageba's patented ROBO®SLIDE sliding material.

ULS uplift loads are being resisted with mageba's uplift claws designed for two piers that feature an innovative external uplift device solution resisting loads up to 3,500 kN (ULS).

In addition, TENSA®MODULAR expansion joints of types LR2, LR3, LR4, LR5, LR6 and LR20 were supplied along with the bearings. The LR20 joints are now the largest modular joints made by mageba in the Americas.

Highlights & Facts

mageba products:

Type:	RESTON®SPHERICAL spherical bearings LASTO®BLOCK elastomeric bearings TENSA®MODULAR joints
Features:	ROBO®SLIDE high-grade sliding material according to AASHTO
Installation:	2016–2019
Structure:	
City:	Colón
Country:	Panama
Type:	Cable-stayed concrete bridge
Completed:	2019
Owner:	Autoridad Del Canal de Panamá (ACP)
Contractor:	VINCI Construction

LR20 modular joint being installed on site. Four joints of 10.4 m each were supplied for this project



Lateral bearing with ROBO®SLIDE and adjustable shim plates to be installed between the tower and the deck



Spherical bearing being tested according to AASHTO





Glass Melting Plant (Costa Rica)



Project description

The glass melting plant is located in Cartago, Costa Rica, and is one of the most significant glass melting furnaces in Central America.

Costa Rica is located in one of the most active areas in terms of earthquakes since it is surrounded by the boundaries of four tectonic plates.

In order to protect the melting furnace against earthquakes, its structure has been redesigned to consider the installation of seismic isolators at the base of the furnace. These devices will prevent seismic damage and hence avoid service interruption.

mageba scope

The solution chosen by the structural designer is based on the installation of 28 mageba LASTO®LRB (lead rubber bearing isolators) which support the furnace in order to isolate movements generated by earthquakes.

This project considers seismic isolators of 400 mm of diameter, with maximum displacement of 60 mm and vertical load capacity of up to 1,100 kN.

This bearing consists of internal layers of elastomeric material and vulcanized reinforcement steel plates, but features a lead core. The lead core deforms plastically under shear deformations while dissipating energy through heat.

Highlights & facts

mageba products:

Type: LASTO®LRB seismic isolators
Installation: 2016

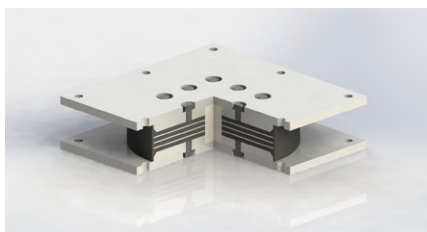
Structure:

City: Cartago
Country: Costa Rica
Completed: 2016
Owner: Vidriera Centroamericana S.A. (Vicesa)
Contractor: Hulera Costarricense Ltda

The glass melting plant is located in Cartago, the capital of Cartago province in Costa Rica



Illustration of one the isolators that will support the furnace



The lead rubber bearing isolator LASTO®LRB ready for installation



Sky Building, Guayaquil (Ecuador)



Project description

The Sky Building in Guayaquil Ecuador will be part of a commercial complex called Aerocity located near the Guayaquil International Airport.

This 15-floor building consists of 4 parking levels and 11 office floors. Sky Building has been designed with the latest advances in terms of seismic protection by the leading structural engineering company in Ecuador. The structure has been conceived to withstand severe earthquake without suffering damages that could jeopardize the serviceability of the building at any time.

mageba scope

The seismic protection strategy chosen for this building is based on the seismic isolation principle. 64 mageba LASTO®LRB (Lead Rubber Bearings) will be installed on top of the parking levels in order to isolate the severe movement at the ground level, this will provide a comfortable movement on the structure, and most importantly the protection against any seismic damage during the earthquake.

There were considered three different types of seismic isolator for different loading conditions. Additionally, 44 sliders will also contribute with the isolation system.

Highlights & facts

mageba products:

Type: LASTO®LRB Lead Rubber Bearings (Isolators)
RESTON®SPHERICAL structural bearings (seismic sliders)

Installation: 2014-2015

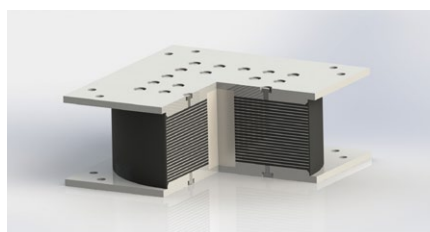
Structure:

City: Guayaquil
Country: Ecuador
Completed: 2014
Engineer: Consulsismica
Contractor: Construdipro S.A.

The building is located in Guayaquil, Ecuador



3D-View of one of the LASTO®LRB (seismic isolators) to be installed in the Sky Building



Full-Scale Sample LASTO®LRB prepared to be tested under actual seismic conditions in Italy





Petrobras FPSO units (Brazil)



Project description

A Floating Production Storage and Offloading (FPSO) unit is a floating vessel used by the offshore oil and gas industry for the processing of hydrocarbons and storage of oil.

An FPSO vessel was designed to receive hydrocarbons from the nearby platforms or subsea templates, process them, and store oil until it can be offloaded onto a tanker or less frequently, transported through a pipeline.

Petrobras, Brazil's semi-public multinational energy corporation, is the largest company in the Southern Hemisphere by market capitalization and a major user of FPSOs around the world.

mageba scope

6 Petrobras FPSO units, designated as P66, P67, P68, P69, P70 and P71, were fitted with new topside modules which required structural bearings to support and fix them in place while accommodating specified movements and rotations.

A large number of mageba structural bearings were used for this purpose, including 768 LASTO®BLOCK elastomeric bearings, with ROBO®SLIDE sliding material, 256 RESTON®POT HP pot bearings, some of them designed to resist uplift as well as downward forces, and 176 RESTON®SPHERICAL bearings, all of which were engineered to resist uplift forces.

RESTON®POT HP pot bearings were introduced as the new "High Performance" version of the well-proven RESTON®POT bearing.

Highlights & facts

mageba products:

- Type: RESTON®POT HP, LASTO®BLOCK and RESTON®SPHERICAL bearings
- Features: ROBO®SLIDE high-grade sliding material
Special internal seals
- Installation: 2014–2020
- Structure:**
- Country: Brazil offshore industry
- Completed: 2020
- Type: FPSO units
- Contractor: **P66 & P69**
Lindel PTE Ltd
P68 & P71
Jurong Shipyard PTE LTD
P67 & P70
COOEC
- Owner: Petrobras

Spherical bearings with clamps for non-frequent uplift forces



Illustration (exploded view) of a LASTO®BLOCK bearing with a sliding surface, installed vertically

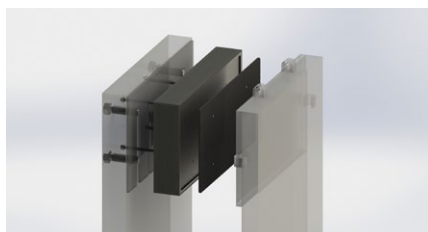
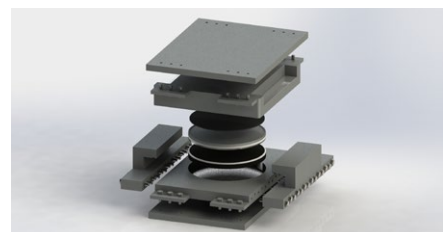


Illustration (exploded view) of a RESTON®POT HP bearing featuring uplift clamps



Chilina Bridge (Peru)



Project description

The Chilina Bridge in the Peruvian city of Arequipa, opening 2014, is a segmental continuous pre-stressed concrete viaduct. With an overall length of 562 m, it is the longest urban bridge in the country, with spans of up to 157 m. Its two 11.3 m-wide decks are box girders with variable depths. These were constructed by the balanced cantilever method with 5.1 m-long insitu segments built using form travellers. It is in a highly seismic area, requiring large seismic movements to be allowed for in the design.

mageba scope

The bridge is equipped with 4 TENSA®MODULAR expansion joints - two at each end, one per structure. These are of type LR7 (with 7 individual movement gaps), allowing service movements of up to 560 mm (80 mm per gap). The joints feature Fuse-Box seismic protection, designed to ensure that the expansion joint will break free of the deck in a controlled manner during an earthquake, avoiding serious damage to the deck or the joint itself. This will enable the bridge to be used in the immediate aftermath of an earthquake, when it might be needed most for emergency purposes.

Highlights & facts

mageba products:

Type: TENSA®MODULAR expansion joints (LR7)
 Features: Fuse-Box (seismic)
 Installation: 2014

Structure:

City: Arequipa
 Country: Peru
 Completed: 2014
 Type: Concrete viaduct
 Length: 562 m
 Contractor: Consorcio Constructor Puente Chilina

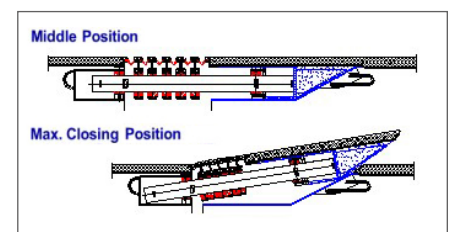
Arequipa is Peru's second most populous city, with a population 10 % that of the capital, Lima



Sectional view of a TENSA®MODULAR expansion joint with 5 gaps (Type LR5)



The joints feature Fuse-Boxes, enabling them to break free from the deck during an earthquake





Morelia-Lázaro Cárdenas highway (Mexico)



Project description

The highway connecting the cities of Morelia and Lázaro Cárdenas in Michoacán state in southern Mexico was subjected to significant maintenance works in 2013 – 2014, with many bridge structures along its length being renovated. A number of the bridges required new expansion joints at each end of their decks, to provide a suitable driving surface for traffic while protecting the deck ends and preventing the passage of water through the deck's movement gap.

mageba scope

mageba supplied 70 expansion joints for a large number of bridge structures on the highway: 36 TENSA®GRIP Type RS-B single gap joints (accommodating 110 mm of movement) and 34 TENSA®RSFD cantilever finger joints (allowing 160 mm of movement). The cantilever finger joints, in addition to facilitating greater movements, also minimize noise from traffic crossing the movement gap by providing continuous support to a vehicle's wheels and thus avoiding the impacts that can result in noise.

Highlights & facts

mageba products:

Type: TENSA®GRIP Type RS-B single gap joints and TENSA®RSFD cantilever finger joints

Installation: 2013–2014

Structure:

State: Michoacán

Country: Mexico

Type: Various highway bridges

Client: Grupo Concesa S.A. de C.V.

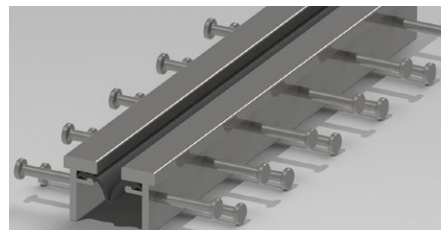
The highway connects the cities of Morelia and Lázaro Cárdenas in southern Mexico



An installed TENSA®RSFD cantilever finger joint prior to placing of asphalt road surfacing



Representation of a TENSA®GRIP Type RS-B single gap joint



Tocumen Airport Access Road (Panama)



Project description

Panama City's Tocumen International Airport is currently being extended with the addition of a new terminal. Designed by Foster & Partners, it will increase floor space by over 800,000 square feet, with 20 new boarding gates, a duty free area, a new control tower and a third runway.

Access to the new terminal from the Corredor Sur highway that bypasses the airport is provided by a four-lane road, part of which is elevated. The non-continuous elevated structure of each carriageway is supported by ten piers, requiring a bearing solution.

mageba scope

To support the structures' decks, mageba supplied 80 RESTON®POT HP bearings with uplift resistance. These bearings are based on the standard RESTON®POT bearing which has been a most popular bearing in mageba's range for many years, having proven its worth in countless applications. The recently developed version of the bearing, with "HP" standing for "High Performance", represents a major advance in the bearing's technology. Durability is much increased, thanks to the use of improved materials, and the increased strength enabled the bearings to be made small enough to suit the main structure's design.

Highlights & facts

mageba products:

Type: RESTON®POT HP (high performance) bearings
 Features: Uplift resistance
 Installation: 2014

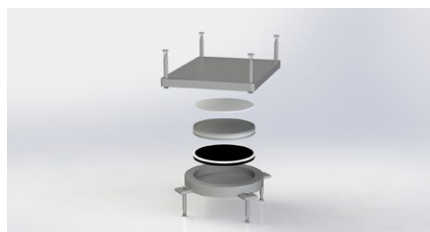
Structure:

City: Panama City
 Country: Panama
 Completed: 2014
 Type: Airport access viaduct
 Contractor: Construtora Norberto Odebrecht

The new viaduct provides access to Tocumen International Airport, Panama City, Panama



Exploded view of a typical RESTON®POT bearing, showing elastomeric pad at its core



A typical RESTON®POT bearing featuring uplift resisting clamps at sides, as fabricated





Lerma Building – Telmex (Mexico)



Project description

Telmex, the largest telephone company in Mexico, owns several buildings in Mexico City. One of these buildings is currently obsolete due to the new seismic specifications in the city. The Lerma Building is a 17-floor structure including 4 parking levels, 12 office floors and 1 penthouse. The building's dimensions is 25 m x 15.3 m with an area per floor plan of 393 m². The high risk of damaged in a highly likely earthquake, motivated the development of a retrofitting plan. After a detailed evaluation of the options, it was decided to add dampers in different levels in order to improve the dynamic response.

mageba scope

To improve the seismic response of the building, the engineers in charge of the seismic retrofitting studied multiple configurations of dampers, evaluating variations of loads, displacements and number of devices. After a detailed analysis of several configurations, it was decided to install 76 mageba RESTON®SA Shock Absorbers in strategic location along the building.

Two types of SA were chosen, one for 800 kN of maximum load (50 units), and another one for 600 kN (26 units). The displacement capacity of both types is 50 mm.

Highlights & facts

mageba products:

Type: RESTON®SA Shock Absorber (800 and 600 kN)
Installation: 2014

Structure:

City: Mexico City
Country: Mexico
Completed: 2014
Type: Office Building
Contractor: CTBR SA de CV (Telmex)

The structure is located in Mexico City, Mexico



View of part of the Lerma Building's façade, showing some of the 76 RESTON®SA shock absorbers



The seismic protection solution with retrofitted steel bracing featuring RESTON®SA shock absorbers



Oil refinery seismic isolation (Venezuela)



Project description

In the process of making an oil refinery in a seismically active part of Venezuela safe from the destructive effects of earthquakes, heat exchange tanks were seismically isolated from ground movements in 2012. The ongoing operation of such refineries is of great importance to the Venezuelan economy, with revenue from petroleum exports accounting for over 50 % of the country's GDP and roughly 95 % of total exports. Venezuela has the world's largest proven oil reserves (20 % of global reserves), and is one of the top four suppliers of foreign oil to the United States.

mageba scope

mageba supplied six LASTO®LRB lead rubber bearings with a diameter of 220 mm and height of 165 mm including 20 mm steel connection plates. Each bearing is designed for a vertical service load of 780 kN and to allow seismic displacements of up to 100 mm. The lead core at the bearing's vertical axis has a diameter of 44 mm and provides dissipation of seismic energy, while the natural rubber (NR) elastomer around it provides the desired re-centering after the earthquake. To ensure proper installation and functioning, mageba also supervised the installation.

Highlights & facts

mageba products:

Type: LASTO®LRB isolators
 Installation: 2012
 Supervision: Installation supervised by mageba

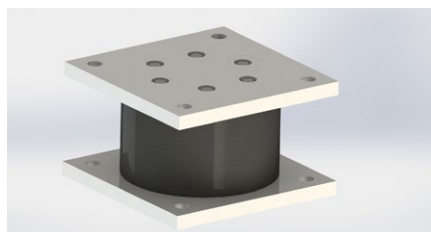
Structure:

Location: Falcón State
 Country: Venezuela
 Type: Oil refinery
 Client: PDVSA

The refinery is located in Falcón State, one of Venezuela's 23 states, in northern Venezuela



A LASTO®LRB lead rubber bearing of the type supplied – with 220 mm diameter



The LASTO®LRBs protect heat exchange tanks from ground vibrations during earthquakes





East-West Corridor (Trinidad and Tobago)



Project description

The Ministry of Works and Infrastructure (MOWI) of Trinidad and Tobago undertook a project to alleviate traffic congestion at one of the country's most important highway intersections between the Churchill Roosevelt Highway (CRH) and the Uriah Butler Highway (UBH).

The project included an 18 m high, 600 m long bridge over the CRH/UBH intersection, connecting the San Juan River Bridge to Grand Bazaar.

By providing a separate route across the junction, the new bridge reduces the amount of traffic using the junction, and thus the congestion at this key point on the two major highways.

mageba scope

Six expansion joints were required for a total of three new bridges constructed. Considering especially the relatively high transverse movements to be accommodated, mageba modular expansion joints were selected, due to their exceptional flexibility.

The two joints of the main bridge are of type LR4 (with four gaps), accommodating longitudinal movements of +/-160 mm and transverse movements of +/- 83 mm, while the four joints required by the other two structures facilitate longitudinal and transverse movements of +/-100 mm and +/-68 mm respectively.

Highlights & Facts

mageba products:

Type: TENSA®MODULAR LR expansion joints
Installation: 2009 + 2012

Structure:

City: Aranguez
Country: Trinidad and Tobago
Type: Highway

Infrastructure project at one of the country's most important highway intersections



Construction of one of the new bridges



Installation of a mageba TENSA-MODULAR LR2 expansion joint

