



PROVEN SEISMIC SOLUTIONS

FOR TRANSPORTATION STRUCTURES
NEW CONSTRUCTION & RETROFIT

- ✔ Innovation through lessons learned
- ✔ Increased resiliency to ensure functionality
- ✔ Decades of demonstrated field performance
- ✔ Extensively tested



WE MAKE BRIDGES STRONGER AND LAST LONGER

In partnership with SHO-BOND and DYNAMIC ISOLATION SYSTEMS, STRUCTURAL TECHNOLOGIES integrates innovative products with specialty design expertise to deliver the industry's highest performing seismic solutions.

PRODUCTS AND ENGINEERING SUPPORT

STRUCTURAL TECHNOLOGIES delivers value-added solutions by developing and integrating unique products and engineering support with repair and construction services. We are the exclusive supplier of VSL post-tensioning and stay cable products in the US. With national coverage, STRUCTURAL TECHNOLOGIES has addressed the structural needs of projects in all 50 states.



COMPREHENSIVE SOLUTIONS:

- ▀ Inspection support
- ▀ Product systems
- ▀ Engineering support



PARTNERSHIP WITH SEISMIC SPECIALISTS

STRUCTURAL TECHNOLOGIES has partnered with SHO-BOND and DYNAMIC ISOLATION SYSTEMS to deliver proven seismic solutions for new construction and retrofit projects.

SHO-BOND

Japan's largest infrastructure repair and reinforcement specialty company, repairing a total of 100,000 bridges in the last 60 years.

Prominent Japan projects include:

- ▀ Kobe Ohashi
- ▀ Nanadaru Spiral Bridge
- ▀ Higashi Kobe Ohashi



DYNAMIC ISOLATION SYSTEMS

Pioneer in seismic isolation technology, providing over 27,500 isolators for over 500 projects worldwide in the last 40 years.

Prominent US bridge projects include:

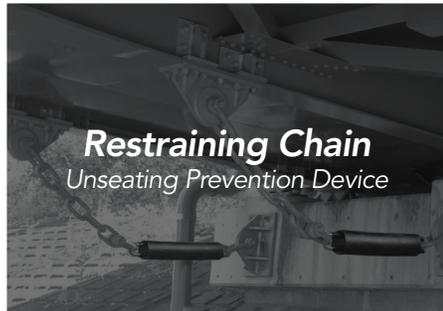
- ▀ Golden Gate Bridge
- ▀ Coronado Bridge
- ▀ Woodrow Wilson Bridge



STATE-OF-THE-ART SEISMIC SOLUTIONS

PRODUCTS

STRUCTURAL TECHNOLOGIES provides clients with innovative technologies aimed at enhancing the resilience of bridges and ensuring their functionality and serviceability after an earthquake.



PROBLEM SOLVING

While a primary objective of bridge seismic retrofit projects is safeguarding lives by preventing collapse of the structure, maintaining or quickly restoring operation of the bridge for emergency vehicles and the traveling public is another important goal.

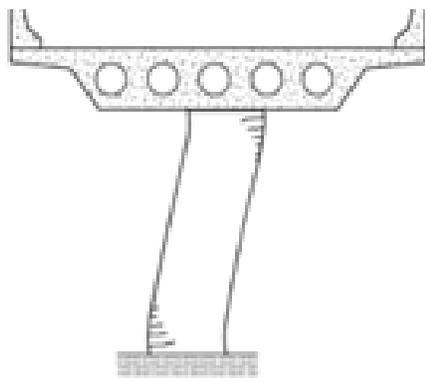
It's essential to reinforce the bridge's substructure; however, even if the substructure is sturdy, there is still a risk of the superstructure unseating from it. Additionally, if the superstructure experiences excessive movement, it could cause severe damage to the structure, which would render the bridge unusable for an extended period after an earthquake, as evidenced in past earthquakes.

To address this, Shearing Stoppers and Restraining Chains are used to restrict excessive movement of bridge girders and prevent unseating of the superstructure.

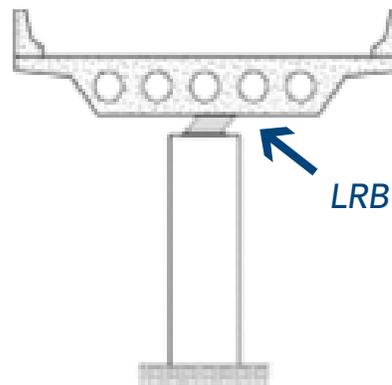




Conventionally designed structures rely on an inelastic response in select structural elements to dissipate earthquake energy, which results in permanent damage to the structure. STRUCTURAL TECHNOLOGIES offers an alternative design approach that incorporates isolation technology to safeguard the structure against the devastating effects of an earthquake.



Conventional Design



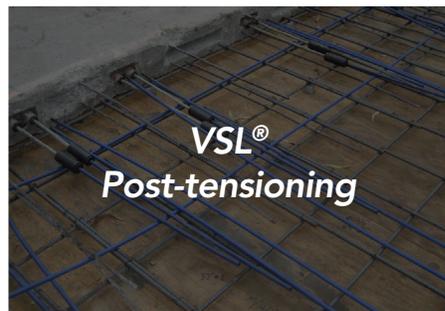
Isolation Technology

COMBINED OFFERINGS

STRUCTURAL TECHNOLOGIES upgrades bridges that are susceptible to large earthquakes.

Alongside our Shearing Stopper, Restraining Chain, and Lead Rubber Bearing solutions, STRUCTURAL TECHNOLOGIES offers an extensive line of products to restore or enhance the load carrying capacity and seismic performance of the substructure and superstructure, including carbon fiber FRP jacketing to improve plastic hinge ductility and reinforcement lap splice confinement.

Our systems can be used standalone or combined together to solve nearly any project requirement.



DISPLACEMENT AND STEP PREVENTION DEVICE SHEARING STOPPER

SHO-BOND

The Shearing Stopper is able to resist excessive displacements of the superstructure and secure post-earthquake functionality in case an existing bearing fails and is a superior alternative to the previous Shear Key & Bumper Block solutions.

Over 28,000 Shearing Stoppers have been installed on bridges over the past 15 years.



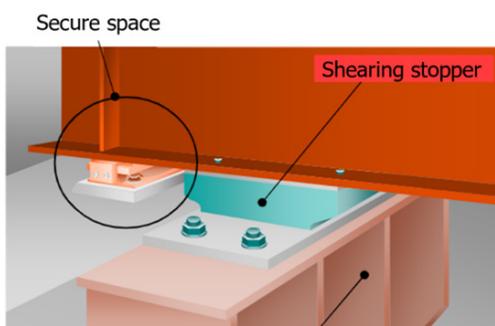
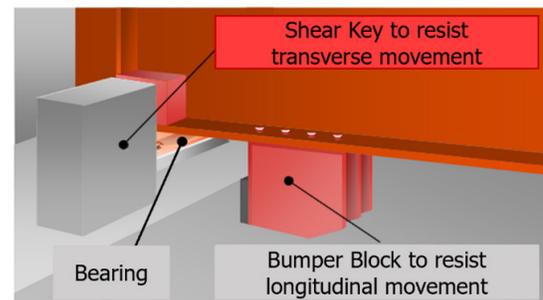
Features

- Restrains horizontal force in two directions
- Restrains upward force
- Alleviates impact force
- Limits gaps and the elevation differences
- Saves space around the bearing
- Maintenance free

CONVENTIONAL METHODS

The previous solution for restraining displacement involved installing separate devices to resist forces in only the horizontal (transverse and longitudinal) directions.

This previous method then hindered routine inspection and maintenance as well as post-earthquake inspection and repair of bearings.



Steel bracket or widening with concrete

SHEARING STOPPER

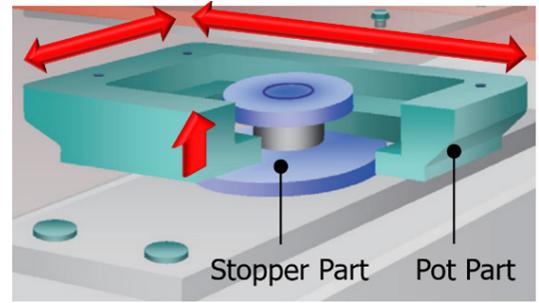
At each bearing location, a maximum of one Shearing Stopper needs to be installed to control lateral and vertical movements. This will save space around the bearing and still allow access for inspection and repair. The Shearing Stopper also restrains uplift force.

To ensure post-earthquake functionality, the device limits gaps and "steps" which are the elevation differences between the deck and interior spans or abutments when bearings fail.

STRUCTURE

The Shearing Stopper is an engineered device that consists of a pot part and a stopper part. Project-specific gaps are provided between the stopper and the pot components to allow for the normal service condition movements and rotations of the superstructure.

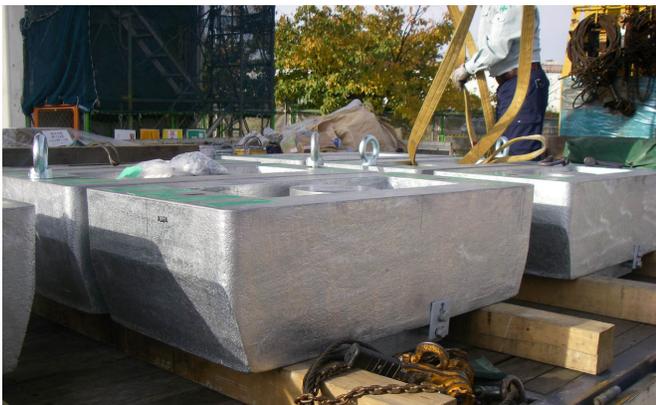
When the bearing fails in an earthquake, the Shearing Stopper engages and the pot hits the stopper. Impact force is alleviated by a special rubber on the stopper. The Shearing Stopper is able to resist excessive movements in all three directions and prevent unseating of the superstructure.



While bridges without proper unseating prevention devices may have excessive longitudinal movement that could cause unseating, even bridges that only see excessive transverse movement and uplift force could have seriously damaged and deformed girders, which would make the bridge unusable after an earthquake. Only one unusable bridge could disrupt a vital lifeline for countless lives and impede rescue services when needed most. The Shearing Stopper is able to ensure post-earthquake functionality of the bridge.

Below is a summary of why the Shearing Stopper is a superior supplemental bearing device when compared to other methods for restraining displacement:

	Shearing Stopper	Shear Key & Bumper Block
Restrain horizontal force	✔️ (two directions)	⚠️
Restrain upward force	✔️	✘️
Alleviate impact force	✔️	✘️
Prevent "steps"	✔️	✘️
Access for inspection & repair	✔️	✘️
Removable	✔️	✘️



RESTRAINER ALLEVIATING IMPACT FORCE RESTRAINING CHAIN

SHO-BOND

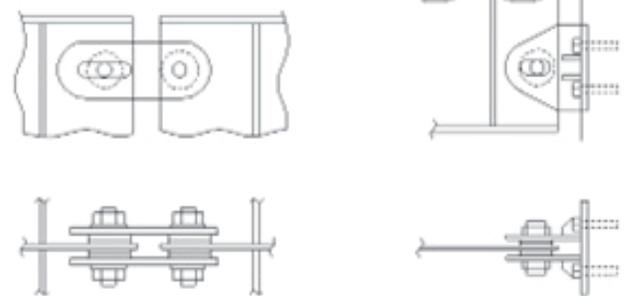
With 33,000 installed in Japan over the last 10 years, the Restraining Chain is an unseating prevention device capable of alleviating impact force and following transverse movements, and has been demonstrated to performing well under repeated loading.



CONVENTIONAL METHODS

Previous unseating prevention devices consisted of pins, connecting plates, and reinforcing plates to be used at girder-to-girder or girder-to-abutment connections.

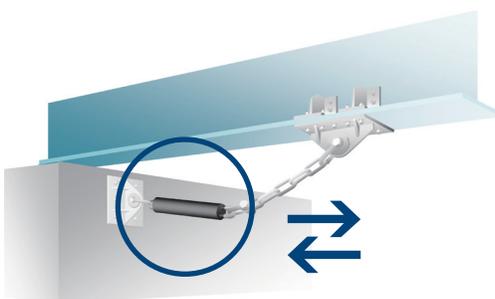
This method did not perform well against earthquakes as it did not alleviate impact forces and it did not follow transverse movements.



RESTRAINING CHAIN

By using a shock-absorbing chain covered with special rubber, the Restraining Chain reliably alleviates impact forces and follows the transverse movements of the superstructure.

The Restraining Chain endures shocks from larger masses and to provides a reliable back up system to prevent bridge unseating.

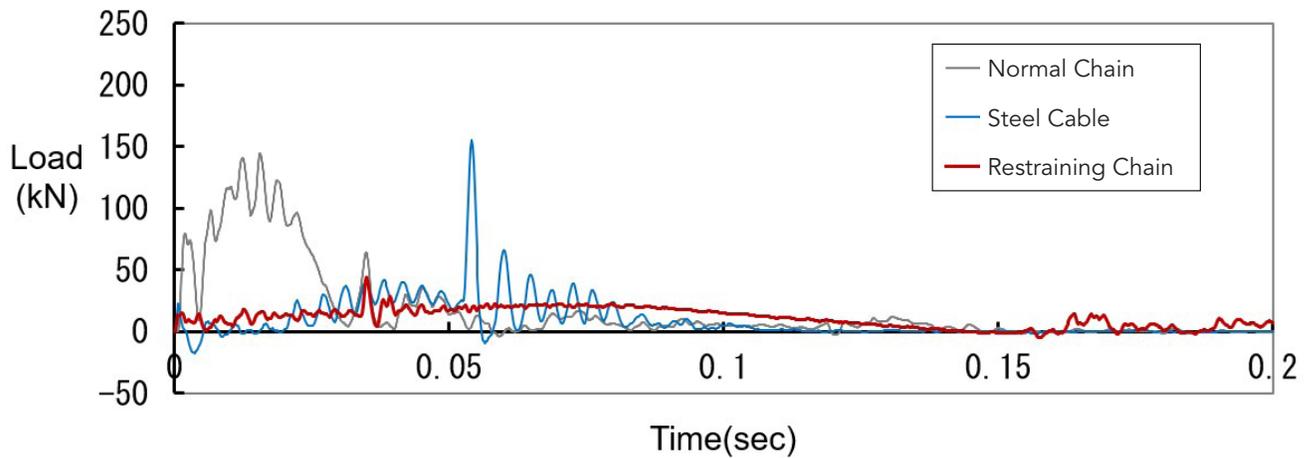


EXTENSIVELY TESTED

The Restraining Chain has been extensively tested including an impact test with comparison to systems without rubber shock absorbers, such as typical chains as well as cables made of steel strand wire. The Restraining Chain showed far superior performance in its ability to reduce impact forces.

During the test, a load of 179 kN (40 kip) was applied. The response of the tested elements and reduction rate in maximum forces are shown below:

- Chain (without rubber shock absorber): 19% impact reduction
- Steel cable: 13% impact reduction
- Restraining Chain: 75% impact reduction

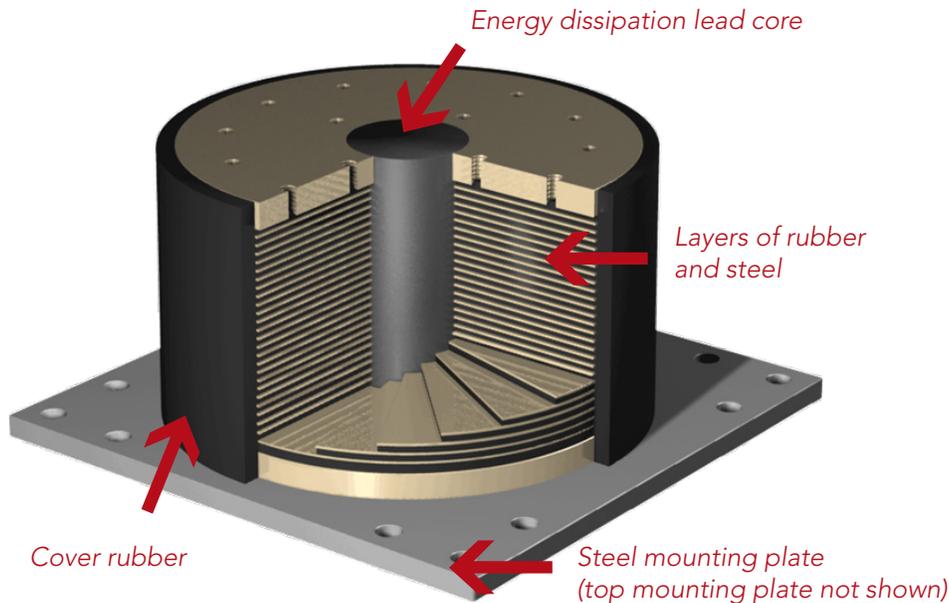


DURABLE SEISMIC ISOLATOR LEAD RUBBER BEARING



The **Lead Rubber Bearing** seismic isolator decouples the superstructure from the substructure and absorbs the seismic energy transferred to the substructure to protect a bridge from the destructive effects of earthquakes.

There have been 27,500 isolators provided in the last 40 years, including over 170 bridge projects worldwide.

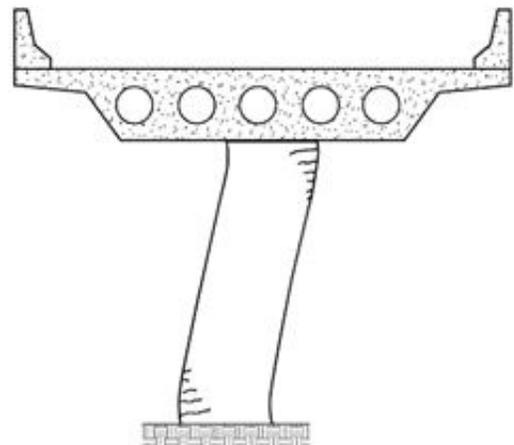
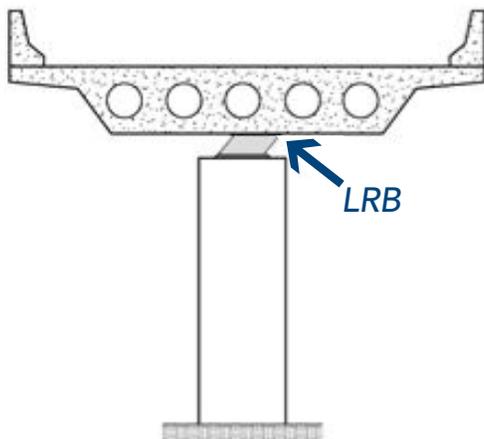


Features

- ▶ Decouples superstructure from substructure
- ▶ Absorbs seismic energy
- ▶ High durability
- ▶ Stable long-term performance
- ▶ Maintenance free

CONVENTIONAL METHODS

Conventionally designed bridges rely on the inelastic response in selected structural elements to dissipate the earthquake energy, permanently damaging the structure.



LEAD RUBBER BEARING

The Lead Rubber Bearing physically decouples the superstructure from the substructure and absorbs the earthquake energy, which reduces the energy transferred to the structure. It thereby protects the bridge from the destructive effects of an earthquake.

COST SAVINGS

An isolated bridge has superior performance and can result in lower total construction and lifecycle costs.

Lead Rubber Bearings reduce the foundation forces by up to 75% in bridges. This enables designers to make foundations smaller which translates to direct cost savings.

HIGH DURABILITY

The cover rubber is strong and protects the Lead Rubber Bearing from water, chemical contamination, and ultra-violet rays. The Lead Rubber Bearing has no moving parts that can be degraded by road salts or the environment.

The Lead Rubber Bearing is durable. A Lead Rubber Bearing installed 40 years ago only shows a 5% change in properties when compared to a new one.



CASE STUDIES



The Richmond San Rafael Bridge benefits from Lead Rubber Bearings as forces can be redistributed throughout the structure. Without the Lead Rubber Bearing, the significant height differences of the piers would cause the shorter, stiffer piers to attract the majority of the lateral force. The structure required a higher than normal level of initial strength because of high wind loads.



The elevated JFK Light Rail System connects JFK Airport to the New York subway system. The bridge is 10 miles long and is supported by 1,364 DIS isolators. The design-build contractor chose isolation to save on foundation costs. As the foundations were smaller, significant other cost savings were realized by minimizing the relocation of underground services at the airport and along the Van Wyck Freeway.



Woodrow Wilson Bridge spans the Potomac River near Washington, DC. This critical bridge, which carries over 250,000 vehicles each day, is in a low seismic zone. However, the redistribution of forces and performance under service-load conditions made seismic isolation an appealing option for the designers.



STATE-OF-THE-ART PRODUCTS

Along with its assessment and durability engineering services, STRUCTURAL TECHNOLOGIES' products protect and enhance existing structures in order to extend life against seismic occurrences. For new construction, our products and solutions can improve the performance, protect, and extend the life of structures, as well as correct construction defects.

SOLUTION BUILDING AND DESIGN ASSIST SERVICES

STRUCTURAL TECHNOLOGIES works closely with our clients to consider all aspects of a project. Our *Solution Building* teams have the experience to assist engineers in selecting the proper product, providing design assist services as well as cost and constructability consulting to ensure the best possible solution.

Products & Services

- ▶ Shearing Stopper
- ▶ Restraining Chain
- ▶ Lead Rubber Bearing
- ▶ Post-tensioning
- ▶ Stay cable systems
- ▶ Carbon fiber strengthening
- ▶ Corrosion control
- ▶ Concrete spall protection
- ▶ Construction systems
- ▶ Heavy lifting

Engineered Product Support

- ▶ Budget development
- ▶ Specification assistance
- ▶ Application engineering
- ▶ Design assistance

struc'tural TECHNOLOGIES

STRUCTURAL TECHNOLOGIES is firmly committed to its mission of making structures stronger and last longer. In 2023, we established a partnership with SHO-BOND and DYNAMIC INSULATION SYSTEMS. Together, we work to develop and integrate products, engineering support, repair, and maintenance services to deliver value-added solutions to owners, engineers, and contractors. For more information about this partnership, visit www.structuraltechnologies.com/sho-bond.

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