

**struc'tural**  
TECHNOLOGIES

# BRIDGE SEISMIC SOLUTIONS



# Bridge Seismic Solutions

STRUCTURAL TECHNOLOGIES has partnered with SHO-BOND, DYNAMIC ISOLATION SYSTEMS, and ORIENTAL SHIRAIISHI to deliver proven seismic solutions for both new construction and retrofit projects. Together, we offer a comprehensive range of products and systems, backed by expert engineering support.

Our in-house research and development team explores emerging technologies, improves existing systems, and creates custom solutions for seismic challenges.

We also collaborate with engineers and owners to design tailored structural strengthening and retrofit solutions for each project.

We offer a unique suite of seismic solutions designed to enhance resilience and safety:

- CSS V-Wrap™ Systems
- Below-Grade Strengthening Systems
- Seismic Isolation Systems
- Bearing Supplement System
- Rubber Chain Restrainer System



In addition to these seismic solutions, STRUCTURAL TECHNOLOGIES provides a wide range of systems aimed at restoring or enhancing the load-carrying capacity and seismic performance of both substructures and superstructures. These systems can be used individually or in

combination, depending on the specific needs of the project:

- Tstrata Enlargement Systems™
- DUCON® Micro-reinforced Concrete Systems
- VSL External & Internal Post-tensioning Systems





## CSS V-Wrap™ Systems

Through an alliance with Simpson Strong-Tie, STRUCTURAL TECHNOLOGIES offers state-of-the-art composite strengthening systems that use lightweight, durable, high-strength carbon and glass fibers bonded with adhesive resins.

CSS V-Wrap™ products are designed to increase or restore load-carrying capacity, ductility, and seismic resistance. Significant improvements in flexural, axial, or shear strength can be achieved with these easy-to-apply composite reinforcing systems

without adding significant weight or mass to the structure.

CSS V-Wrap™ Systems can be also utilized on a variety of structural elements including columns, beams, walls, and slabs to increase their load-carrying capacity and service performance.

CSS V-Wrap™ systems have been evaluated for code compliance by ICC-ES (ESR-4930), meeting or exceeding industry standards for long-term durability. Additional approvals on select products include HCAI, IAPMO, NSF-61, and UL.



### KEY ADVANTAGES

**ENHANCED PERFORMANCE:** Increases strength and ductility without changing stiffness because of high strength-to-weight and stiffness-to-weight ratios.

**VERSATILITY:** Works for a wide variety of structural elements, even those with limited access and/or complex geometries.

**DESIGN FLEXIBILITY:** Material properties can be customized for specific project needs.

**EASY INSTALLATION:** Simple to handle and install, reducing labor costs and time.

**CORROSION RESISTANCE:** Reduces maintenance costs by resisting corrosion.

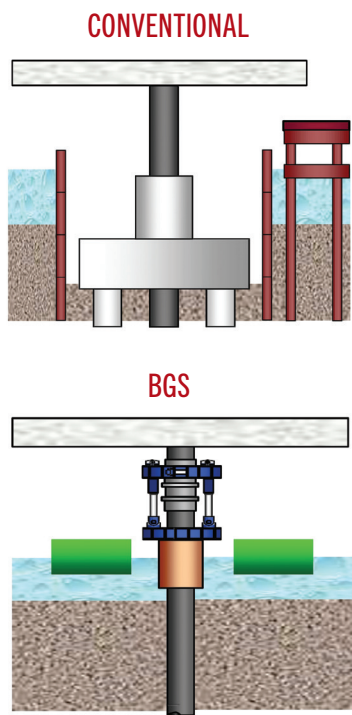
**LOW AESTHETIC IMPACT:** Low profile, compatible with most coatings and finishes.

# Below-Grade Strengthening Systems

Below-Grade Strengthening Systems (BGS) reinforce the underground sections of existing piles and piers.

BGS systems can be implemented in confined spaces beneath existing structures, without the need for extensive excavation or temporary structures such as trestles or large cofferdams.

As a result, BGS minimizes temporary construction costs and environmental impact.



STRUCTURAL TECHNOLOGIES supports owners and engineering firms by evaluating the feasibility of applying BGS to specific projects. This includes assessing soil conditions, determining optimal equipment placement, and exploring ways to eliminate the need for temporary structures.

## KEY ADVANTAGES

**COST SAVINGS:** Reduces costs and shortens timelines by minimizing excavation and temporary structures.

**HIGH CONSTRUCTABILITY:** Enables work in confined spaces, on slopes/embankments, or with low clearance to adjacent structures.

**ENVIRONMENTAL IMPACT:** Minimizes disruption to ecosystems and surrounding areas.

**VERSATILITY:** Applicable to various piles and piers.

**ENHANCED PERFORMANCE:** Increases design strength.

**REPAIRABILITY:** Sets plastic hinges above ground to allow for repairs in case of earthquake damage.



## RECORD OF LARGE PROJECTS

OBJECT	SIZE OF PILE/PIER	PRESS-IN DEPTH
Steel Pile	Φ 23inch (600mm)	60ft (18.5m)
Reinforced Concrete Pile	Φ 67inch (1,724mm)	63ft (19.3m)
Prestressed Concrete Pile	Φ 98inch (2,500mm)	<b>75ft (23.1m)</b>
Prestressed Concrete Pile	Φ 118inch (3,000mm)	46ft (14.0m)
Reinforced Concrete Pier	236 x 102inch (6,000 x 2,600mm)	<b>41ft (12.5m)</b>
Reinforced Concrete Pier	<b>866 x 106inch (22,000 x 2,700mm)</b>	8ft (2.4m)

# Seismic Isolation Systems – Lead Rubber Bearings

Lead Rubber Bearings (LRB) can reduce seismic load transfer to bridge substructures by up to 75%, reducing substructure size and reinforcing requirements.

LRBs are an excellent tool for reducing overall project and life-cycle costs. They can serve as a cost-efficient alternative to expensive substructure strengthening.

Our LRBs are pre-qualified by several DOTs, including Caltrans and WSDOT.

STRUCTURAL TECHNOLOGIES offers expert preliminary design services for LRB systems. Our team collaborates with owners and engineers to optimize systems, addressing factors like high service loads (wind, braking) and axial loads.

LRBs aren't just for large and complex bridges. Common bridge structures can also benefit from compact LRBs. Additionally, they can be a valuable tool for preserving small but historically significant bridges.

## KEY ADVANTAGES

**ENHANCED PERFORMANCE:** Reduces damage to the structure during seismic events, improving resiliency and lowering life-cycle costs.

**COST SAVINGS:** Reduces costs and shortens timelines by reducing substructure size.

**DESIGN OPTIMIZATION:** Redistributes seismic forces and balances stiffness.

**MAINTENANCE-FREE:** No degradation over decades, with sustained performance after earthquakes.

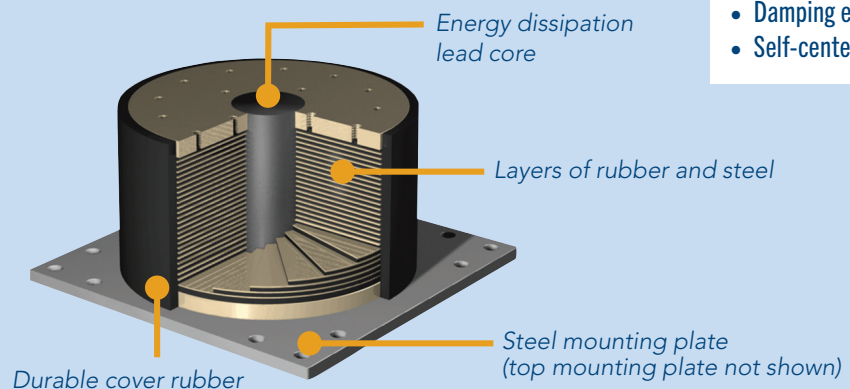
**RESERVE CAPACITY:** Resists design shear strains up to 250%, fracture strains beyond 350%, and uplift forces up to cavitation (3GA).

**NO VERTICAL DISPLACEMENT:** Does not rely on vertical displacement for isolation.

**COMPACT:** Requires a small area on the seats.



## LEAD RUBBER BEARING



### KEY FUNCTIONS

- Isolation effect
- Damping effect
- Self-centering



# Bearing Supplement System – Shearing Stopper

The Bearing Supplement System - Shearing Stopper prevents excessive displacement of the superstructure in three directions during seismic events.

This system offers a cost-effective alternative to full bearing replacement, making it ideal for

situations where existing bearings perform well under normal conditions but don't meet current seismic standards.

STRUCTURAL TECHNOLOGIES provides preliminary design assistance and system sizing based on the specific geometry and load requirements of the bridge project.

## KEY ADVANTAGES

**COST & TIME SAVING:** Eliminates bridge jacking and bearing removal.

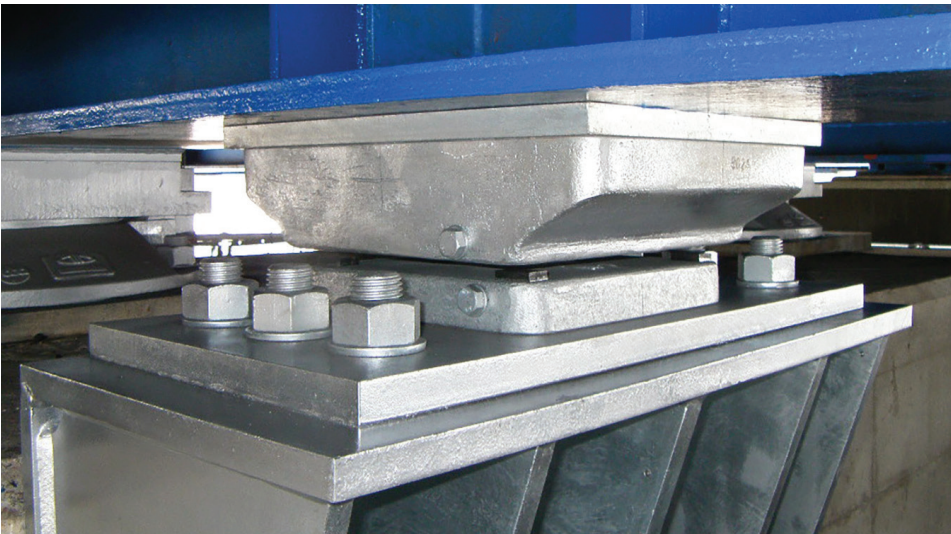
**3D RESISTANCE:** Resists transverse, longitudinal, and uplift forces with one system.

**POST-EARTHQUAKE FUNCTIONALITY:** Limits damage to bearings and bridge for faster recovery.

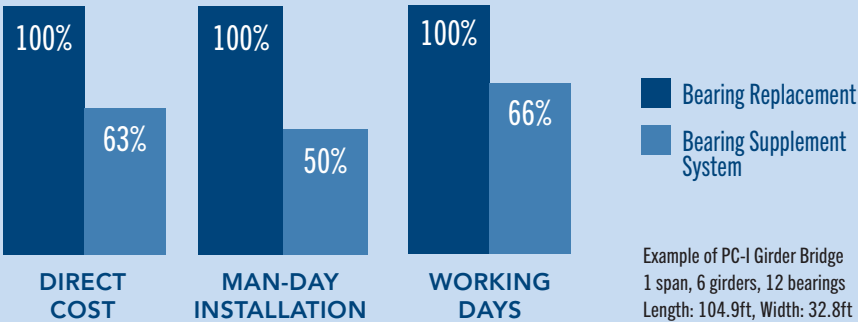
**SERVICE LIFE DESIGN:** Saves space for regular and post-earthquake inspections of bearings.

**VERSATILITY:** Can be added to various bridges, even those with difficult bearing replacement.

**MAINTENANCE-FREE:** Ensures long-term durability by galvanized components.



## COMPARISON WITH TRADITIONAL METHODS



## REPLACEMENT VS. SUPPLEMENT

	Cost	Constructability	Access to Bearings	Unseating Prevention	Excessive Displacement Prevention	Mitigation of Damage Caused by Displacement	Elevation Difference Prevention	Post Earthquake Functionality
Seat Extension	Low	✓✓	✓✓	✓	✗	✗	✗	✗
Catcher Block	Low	✓✓	⚠	✓	✗	✗	✓	⚠
Bumper Block	Low	✓✓	⚠	✓	⚠ 1 direction	⚠	✓	✗
Shear Key	Low	✓✓	⚠	✓	⚠ 1 direction	⚠	✗	✗
Bearing Supplement	Middle	✓	✓	✓✓	✓ 3 directions	✓	✓	✓
Bearing Replacement	High	⚠	✓✓	✓✓	✓	✓	✓	✓✓

# Rubber Chain Restrainer System – Restraining Chain



The Rubber Chain Restrainer System - Restraining Chain is a fail-safe system designed to prevent bridge unseating. It alleviates impact forces and accommodates transverse movements.

This system provides critical redundancy in two ways:

1. It serves as a last line of defense to prevent unseating if other systems, such as existing bearings, fail.
2. It mitigates impact forces that exceed the design seismic force, ensuring the chain system remains intact and operational during extreme events.

This innovative system enhances bridge resilience and ensures life safety.

STRUCTURAL TECHNOLOGIES offers preliminary design assistance and system sizing based on the specific geometry and load requirements of the bridge project.

The Restraining Chain has been extensively tested, including under impact loading. Compared to other components, it shows superior performance in alleviating impact forces:

- Chain (without rubber): 19%
- Steel cable: 13%
- Restraining Chain: 75%

## KEY ADVANTAGES

**IMPACT FORCE ALLEVIATION:** Prevents failure of the restrainer system during impact events.

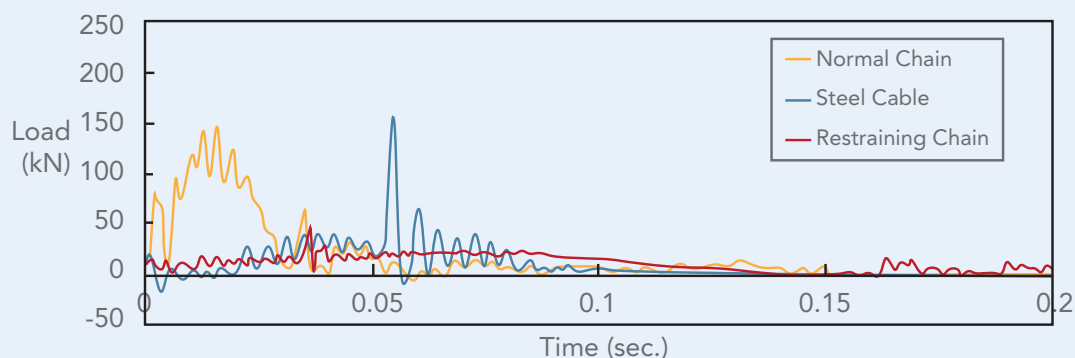
**HIGH DURABILITY:** Withstands repeated loading for long-term performance.

**TRANSVERSE MOVEMENT:** Adapts to transverse displacement.

**MAINTENANCE-FREE:** Galvanized components ensure long-term durability.

**MULTI-HAZARD PREPAREDNESS:** Protects against unseating caused by avalanches, tsunamis, and other impact events.

## RESTRAINING CHAIN IMPACT TEST





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