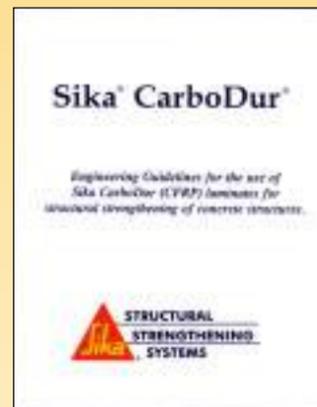


Complete Range Of Composite Materials

	Description	Laminate Properties				Tensile Strength per inch width
		Tensile Strength	Tensile Modulus	Elongation	Nominal Thickness	
SikaWrap Hex 103C	Carbon fiber fabric (wet lay-up)	139,000 psi (960 N/mm ²)	10.60 msi (73,100 N/mm ²)	1.33%	0.040 in. (1mm)	5,560 lbs./layer (24.7 kN)
SikaWrap Hex 100G	E-Glass Fabric (wet lay-up)	87,000 psi (600 N/mm ²)	3.79 msi (26,100 N/mm ²)	2.24%	0.040 in. (1mm)	3,480 lbs./layer (15.5 kN)
SikaWrap Hex 230C	Carbon fiber fabric (dry lay-up)	139,000 psi (960 N/mm ²)	10.60 msi (73,100 N/mm ²)	1.33%	0.013 in. (0.33mm)	1,807 lbs./layer (8.0 kN)
Sika Wrap Hex 320G	E-Glass Fabric (dry lay-up)	87,000 psi (600 N/mm ²)	3.79 msi (26,100 N/mm ²)	2.24%	0.013 in. (0.33mm)	1,131 lbs./layer (5.0 kN)
Sika CarboDur Strips (Type S)	Pultruded carbon fiber laminate	406,000 psi (2,800 N/mm ²)	23.9 msi (165,000 N/mm ²)	1.9%	0.047 in (1.2mm)	19,082 lbs./layer (84.8 kN)

SikaWrap® Composite Fabrics for Structural and Seismic Strengthening

Also available from Sika



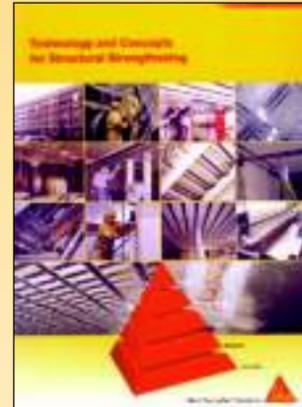
Engineering Guidelines



Strengthening of Structures with Carbon Fiber Reinforced Polymer Strips or Steel Plate



Case Studies



Technology and Concepts for Structural Strengthening

1-800-933-SIKA NATIONWIDE

Regional Information and Sales Centers

For the location of your nearest Sika sales office, contact your regional center.

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For further information:

Visit our website at www.sikausa.com

Or, call our Fax-Back System at: 740-375-0063



Sika CarboDur® Composite Strengthening Systems
A global alliance between Sika and Hexcel





Sika Worldwide

A recognized world leader in specialty chemicals and products specifically engineered for the construction industry, Sika has been answering the needs of owners, specifiers and contractors with unmatched service since 1910. With an international network of research and development, production and marketing companies in over 50 countries around the world, Sika is able to reach new levels of excellence in finding and implementing innovative solutions that meet the ever-changing demands of our customers.



Hexcel Corporation

The Hexcel Corporation is the leading international developer and manufacturer of advanced, lightweight, high-performance fibers and fabrics, composite materials and structures. Hexcel products are widely used in the aerospace, infrastructure, space and defense, naval transportation, recreation and general industrial markets. Hexcel Civil Engineering and Construction Systems were designed to help provide viable alternatives to traditional methods through the application of composite materials science since 1991.



A Global Partnership

The special alliance formed by the association of Sika and Hexcel offers unique and exclusive advantages to the construction industry in the vital areas of structural strengthening and reinforcement. The shared expertise of these two industry leaders provides for proven products and techniques that allow for new economy, ease of application and enhanced levels of performance in the field. From product availability to on-the-job know-how, technical support and service, the marriage of Hexcel and Sika brings you exclusive benefits and unparalleled results.

Sika CarboDur®

Comprehensive Composite Strengthening Systems

Sika's systematic approach to structural strengthening incorporates the latest advances in applied technology. Designed to meet critical requirements for strength and durability, Sika CarboDur composite strengthening systems offer innovative solutions for structural upgrading, repair and protection.

These products include:

- * Carbon fiber strips
- * Carbon fiber fabrics
- * Glass fiber fabrics
- * Structural adhesives
- * Concrete repair and protection systems
- * Corrosion inhibitors

The Case for Structural Strengthening

The reasons for strengthening of reinforced concrete structures are numerous.

- * Unsafe conditions for current use
- * Increased live and wheel loads
- * Installation of heavy machinery
- * Modifications such as elimination of walls/columns or openings cut through slabs
- * Code changes
- * Seismic conditions or vibrations
- * Structural damage
- * Corrosion of steel reinforcement
- * Errors in planning, design or construction

External Reinforcement with Steel Plates

A proven method of strengthening since the 1960's, external reinforcement with steel plates and shells offers many advantages. Sikadur epoxies helped pioneer this strengthening method which is still widely used today. Still, use of steel plates does present a number of drawbacks. These include:

- * Heavy weight
- * Potential for corrosion
- * Limited lengths
- * Difficult handling
- * High installation costs



Shear strengthening of concrete bridge beam with steel plates and special Sikadur epoxy.

External Reinforcement with Sika CarboDur Composite Systems



Used with increasing effectiveness since their introduction in the aerospace industry in the early 1960's, composite materials offer a number of distinct advantages for structural strengthening.

In addition to their high strength and flexibility, benefits include:

- * Lightweight
- * Non-corrosive
- * Very high tensile strength
- * Available in any laminate length



Sikadur structural adhesives are jobsite proven in critical applications like segmental bridge construction.

Sika CarboDur® Composite System Components

Sika CarboDur® Strips

Sika's pioneering research into carbon fiber reinforced pultruded strips began in 1984 with our first product trials at EMPA (the Swiss Federal Laboratories for Materials Testing & Research) in Switzerland. The first commercial application of Sika CFRP strips took place at The Sins Bridge, also in Switzerland, in 1991. Just three years after that, Sika launched its CarboDur System into the global market.



SikaWrap® Fabrics

SikaWrap composite systems have been tested under seismic load conditions at the Charles Lee Powell Structural Research Laboratory at the University of California, San Diego as part of the Caltrans bridge column retrofit program. The first commercial installation of the Hexcel composites was in 1991 for strengthening columns in Los Angeles' Griffith Park. Since then, this remarkable product has gained a rapidly growing acceptance industry-wide for its exceptional properties and capabilities.



Sikadur® Epoxy Resins

At the heart of these systems are the Sikadur epoxy resins. Proven for over 40 years in critical construction applications such as Segmental Bridge construction, these structural adhesives are well recognized as the best in the industry.

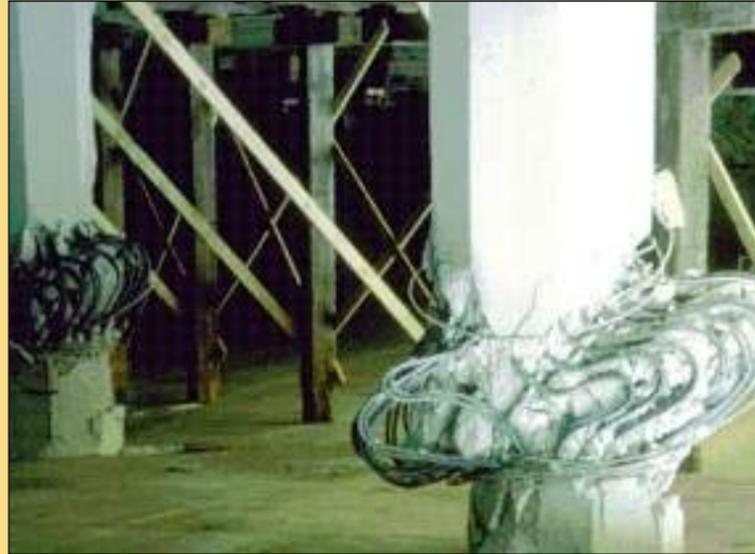
SikaWrap® For Seismic Upgrades of Concrete Columns and Unique Structures

SikaWrap Fabrics

SikaWrap carbon and glass fiber fabrics are high strength materials that are bonded to structures for strengthening purposes. Sharing the attributes of composite strengthening as previously listed, SikaWrap also offers the additional benefits of being able to conform to almost any complex or geometric shape.

The perfect high-tech answer to structural strengthening under these conditions, SikaWrap's unique benefits include:

- * Ease of handling
- * High strength, lightweight
- * Non-corrosive
- * Significant gain in load-bearing capacity
- * Minimal change to structures weight, shape and appearance
- * Minimum structure downtime
- * Economical to use
- * Effective for both wet and dry lay-up applications
- * Conform to irregular shapes and surfaces
- * Minimal clearance needed to install



Unstrengthened column buckled from Northridge, CA earthquake of 1994.

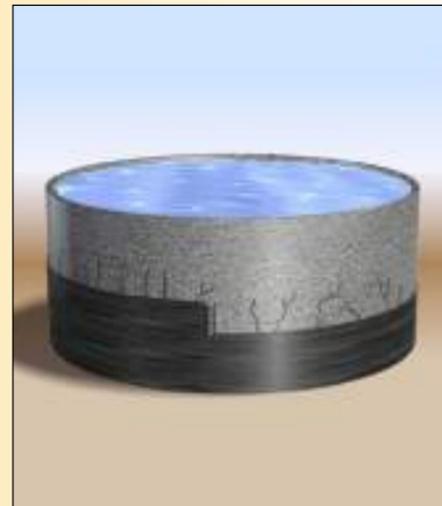


Column Wrapping

- * Seismic strengthening
- * Confinement
- * Flexural Strengthening
- * Increased ductility up to tenfold
- * Increased axial load carrying capacity
- * Shear strengthening

Tank Strengthening

- * Confinement (bursting stress)
- * Minimizes crack propagation
- * Seismic stabilization



Tanks, pipes or chimneys can be strengthened from the inside or outside depending on the jobsite requirements and logistics.

Other Structures

- * Chimneys/silos
- * Piles
- * Pipes
- * Tunnels
- * Poles



Bridge column tested for ductility at the Charles Lee Powell Structural Research Laboratory - UCSD.

SikaWrap® For Structural Strengthening of Beams, Slabs and Walls

Beam/Slab Strengthening

- * Shear
- * Flexure
- * Provides ductility to structural members
- * Reduces deflection in members
- * Limits cracking

Wall Strengthening

- * In-plane shear/flexural retrofit
- * Out-of-plane flexural retrofit
- * Concrete shear walls
- * Unreinforced masonry (URM) walls
- * Compressive load increases

Substrates

- * Concrete
- * Steel
- * Masonry
- * Timber



Shear strengthening of spandrel beam with CFRP fabric.



Sika's wide range of composite materials can meet all your strengthening needs

APPLICATION PROCEDURE

WET

For Large Projects



1 Priming the concrete with Sikadur epoxy resin

- seals the concrete and promotes adhesion.



2 Impregnation of fabric using saturator machine

- controls resin distribution and increases productivity on large-scale projects.



3 Wet fabric is laid-up onto primed concrete surface

- flexible to accommodate the shape of any structure.



4 Topcoat applied over fabric

- Sika's wide range of coatings can be applied for protective or aesthetic purposes.

DRY

For Small Projects



1 Priming and saturating the concrete with Sikadur epoxy resin

- seals the concrete and promotes adhesion.



2 Dry fabric is laid-up directly onto the saturated concrete surface

- quick installation on small-scale projects.



3 Fabric smoothed with plastic roller

- air voids eliminated and fabric saturated.



4 Topcoat applied over fabric

- Sika's wide range of coatings can be applied for protective or aesthetic purposes.

* These two methods of application give the contractor maximum flexibility, quality control, and productivity for large or small jobs.

Selection Chart for Sika CarboDur® and SikaWrap® Composites

	WET LAY-UP		DRY LAY-UP		CarboDur Strips (Type S)
	SikaWrap Hex 103C	SikaWrap Hex 100G	SikaWrap Hex 230C	SikaWrap Hex 320G	
Beam Strengthening					
Flexure	✓✓	✓	✓	✓	✓✓✓
Shear	✓✓✓	✓✓	✓✓	✓✓	
Limited Access	✓	✓	✓✓	✓✓	✓✓✓
Slab Strengthening					
Small Scale			✓✓✓	✓✓	✓
Large Scale	✓✓✓	✓✓			✓✓
Limited Access	✓	✓	✓✓	✓✓	✓✓✓
Column Wrapping					
Seismic (passive)	✓✓	✓✓✓	✓	✓	
General Strengthening (active)	✓✓✓	✓✓	✓✓	✓✓	
Small Scale	✓	✓✓	✓✓	✓✓✓	
Wall Strengthening					
Seismic (passive)	✓✓	✓✓✓	✓	✓	✓
General Strengthening (active)	✓✓✓	✓✓	✓✓	✓	✓
Small Scale	✓	✓✓	✓✓✓	✓✓	✓
Tanks/Chimneys/Pipes/Silos	✓✓	✓✓✓	✓	✓	✓
Cost Performance					
Tensile strength per inch width per layer	5,560 lbs. (24.7 kN)	3,480 lbs. (15.5 kN)	1,807 lbs. (8.0 kN)	1,131 lbs. (5.0 kN)	16,356 lbs. (72.7 kN)
Relative Cost	\$\$	\$	\$\$	\$	\$\$\$

✓ better methods available

✓✓ acceptable method

✓✓✓ best method

Contractor Training and Quality Control



CarboDur System training includes:

- ▲ Objectives of the repair system
- ▲ Surface preparation requirements
- ▲ Epoxy mixing and application
- ▲ Wet and Dry lay-up procedures
- ▲ Hands-on applications to structural concrete members
- ▲ Quality Control on-site
- ▲ Bills of Quantities/Estimating

Make your Specification Complete - Specify Sika-approved CarboDur Composite System Contractors.

As of part of Sika's ongoing commitment to total customer satisfaction, we maintain a national network of Approved Contractors. These carefully-selected professionals are available to ensure that Sika's exclusive CarboDur Composite Systems are properly specified, and applied to meet the critical demands of a challenging marketplace.

