

Sika CarboDur®

Carbon fiber laminate for structural strengthening

Description	Sika CarboDur is a pultruded carbon fiber reinforced polymer (CFRP) laminate designed for strengthening concrete, timber and masonry structures. Sika CarboDur is bonded onto the structure as external reinforcement using Sikadur 30 epoxy resin as the adhesive.
Where to Use	<p>Load increases</p> <ul style="list-style-type: none"> ■ Increased live loads in warehouses ■ Increased traffic volumes on bridges ■ Installation of heavy machinery in industrial buildings ■ Vibrating structures ■ Changes of building utilization <p>Damage to structural parts</p> <ul style="list-style-type: none"> ■ Aging of construction materials ■ Steel reinforcement corrosion ■ Vehicle impact ■ Fire <p>Serviceability improvements</p> <ul style="list-style-type: none"> ■ Decrease in deformation ■ Stress reduction in steel reinforcement ■ Crack width reduction <p>Change in structural system</p> <ul style="list-style-type: none"> ■ Removal of walls or columns ■ Removal of slab sections for openings <p>Design or construction defects</p> <ul style="list-style-type: none"> ■ Insufficient reinforcements ■ Insufficient structural depth
Advantages	<ul style="list-style-type: none"> ■ Very high strength ■ Lightweight ■ Non-corrosive ■ Unlimited lengths ■ Minimal preparation of laminates ■ Very easy to install, especially overhead ■ High modulus of elasticity ■ Outstanding fatigue resistance ■ Alkali resistant ■ Simple laminate intersections or crossings

Typical Data

RESULTS MAY DIFFER BASED UPON STATISTICAL VARIATIONS DEPENDING UPON MIXING METHODS AND EQUIPMENT, TEMPERATURE, APPLICATION METHODS, TEST METHODS, ACTUAL SITE CONDITIONS AND CURING CONDITIONS.

Base	Carbon fiber reinforced polymer with an epoxy resin matrix.
Shelf Life	Unlimited (no exposure to direct sunlight).
Color	Black
Tensile Strength	
Mean Value	4.49 x 10 ⁵ psi (3,100 MPa)
Design Value	4.06 x 10 ⁵ psi (2,800 MPa)
Modulus of Elasticity	
Mean Value	23.9 x 10 ⁶ psi (165,000 MPa)
Design Value	23.2 x 10 ⁶ psi (160,000 MPa)
Elongation at Break	1.69%
Design Strain	0.85%
Thickness	0.047 in. (1.2 mm)
Temperature Resistance	>300°F (>150°C)
Fiber Volumetric Content	>68%
Density	0.058 lbs./in ³ (1.60 g/cm ³)

Physical Properties

Product	Thickness (mils)	Width (inches)	Cross Sectional Area	Tensile Strength
Type S 512	47.2 (1.2 mm)	1.97 (50 mm)	0.093 sq. in. (60 mm ²)	37.8 x 10 ³ lbs. (168 kN)
Type S 812	47.2 (1.2 mm)	3.15 (80 mm)	0.149 sq. in. (96 mm ²)	60.4 x 10 ³ lbs. (269 kN)
Type S 1012	47.2 (1.2 mm)	3.94 (100 mm)	0.186 sq. in. (120 mm ²)	75.5 x 10 ³ lbs. (336 kN)

Coverage	Coverage of Sikadur 30 epoxy resin with CarboDur: Type S 512: approx. 50 LF/gallon. Type S 812: approx. 32 LF/gallon. Type S 1012: approx. 22 LF/gallon.
Packaging	Available in any length up to 250 m (820 ft.). Type S 512 width 50 mm (approx. 2"). Type S 812 width 80 mm (approx. 3"). Type S 1012 width 100 mm (approx. 4").
How to Use	
Surface Preparation	<p>Surface must be clean and sound. It may be dry or damp, but free of standing water and frost. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, disintegrated materials and other bond inhibiting materials from the surface. Existing uneven surfaces must be filled with an appropriate repair mortar (e.g. mixed Sikadur 30 epoxy with the addition of 1 part oven-dried sand). The adhesive strength of the concrete must be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength, 200 psi (1.4 MPa) with concrete substrate failure.</p> <p>Surface Levelness/Irregularities: Maximum allowable deviation in 6 ft. shall be limited to 1/4" (6 mm) but no greater than 1/8" (3 mm) per foot. Any sharp edges (i.e. fins, form-marks, etc.) must be ground smooth and flush.</p> <p>Preparation Work: Concrete - Blast clean, shotblast or use other approved mechanical means to provide an open roughened texture.</p> <p>CarboDur - Wipe clean with appropriate cleaner (e.g. MEK).</p> <p>Cutting the CarboDur Laminate:</p> <p>Preferred: CarboDur laminates should be cut with tools using a "shearing" force (e.g. guillotine or heavy duty shears). Care must be taken to support both sides of the CarboDur laminate to avoid splintering.</p> <p>Alternate: A hack saw or other abrasive cutting method may be used. However, extra care must be taken to support the CarboDur laminate on both sides to avoid splintering. In addition, extra care must be taken to avoid exposure to carbon dust (see Caution).</p>
Mixing	Consult Sikadur 30 technical data sheet for information on epoxy resin.
Application	Apply the neat mixed Sikadur 30 epoxy onto the concrete with a trowel or spatula to a nominal thickness of 1/16" (1.5 mm). Apply the mixed Sikadur 30 epoxy onto the CarboDur laminate with a "roof-shaped" spatula to a nominal thickness of 1/16" (1.5 mm). Within the open time of the epoxy, depending on the temperature, place the CarboDur laminate onto the concrete surface. Using a hard rubber roller, press the laminate into the epoxy resin until the adhesive is forced out on both sides. Remove excess adhesive. Glue line should not exceed 1/8 inch (3 mm). The external reinforcement must not be disturbed for a minimum of 24 hours. The epoxy will reach its design strength after 7 days.
Limitations	Design calculations must be made and certified by an independent licensed professional engineer. Design guidelines are available from Sika Corporation.
Caution	<p>CarboDur strips are non-reactive and fully cured. They do not require a material safety data sheet. However, caution must be used when handling the CFRP laminates since a fine "carbon dust" may be present on the strips. Gloves must therefore be worn to protect against skin irritation.</p> <p>Caution must also be used when cutting CarboDur laminates to protect against airborne carbon dust generated by the cutting procedure. Use of an appropriate, properly fitted NIOSH approved respirator is recommended.</p>

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1-800-933-SIKA NATIONWIDE

Regional Information and Sales Centers. For the location of your nearest Sika sales office, contact your regional center.

Sika Corporation
201 Polito Avenue
Lyndhurst, NJ 07071
Phone: 800-933-7452
Fax: 201-933-6225

Sika Canada Inc.
601 Delmar Avenue
Pointe Claire
Quebec H9R 4A9
Phone: 514-697-2610
Fax: 514-694-2792

Sika Mexicana S.A. de C.V.
Carretera Libre Celaya Km. 8.5
Fracc. Industrial Balvanera
Corregidora, Queretaro
C.P. 76920
Phone: 52 442 2385800
Fax: 52 442 2250537



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