



PRODUCT DATA SHEET

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COMPOSITE REINFORCING

Sika® CarboShear L

HIGH PERFORMANCE, SHEAR STRENGTHENING CFRP ELEMENTS

Description	<p>Sika® CarboShear L elements are used within a high performance CFRP shear strengthening system for reinforced concrete structures. The system components consist of:</p> <ul style="list-style-type: none"> ▪ Sika® CarboShear L shaped CFRP elements. ▪ Sikadur®-30 structural adhesive for externally-bonded CFRP. <p>Sika® CarboShear L complements the Sika® CarboDur® composite strengthening system, used for structural strengthening of bending moments. The efficiency of the Sika® CarboShear L strengthening system has been proven by full-size tests performed in collaboration with the Swiss Federal Laboratories for Materials Testing and Research, EMPA.</p>
Where to Use	<p>External strengthening against shear forces in cases of:</p> <p>Increased loads due to</p> <ul style="list-style-type: none"> ▪ Higher live loads in buildings and on bridges. ▪ Changes of building utilization. <p>Damaged structural parts due to</p> <ul style="list-style-type: none"> ▪ Corrosion of the inner shear reinforcement. ▪ Vehicular impact upon structures. ▪ Fire damage of reinforced concrete. <p>Improvement of serviceability</p> <ul style="list-style-type: none"> ▪ Stress reduction in steel reinforcement. ▪ Crack width and fatigue reduction. <p>Change in structural system</p> <ul style="list-style-type: none"> ▪ Removal of walls, columns or slab sections for openings. <p>Change in specification</p> <ul style="list-style-type: none"> ▪ Requirements in the event of earthquakes. ▪ Changed design philosophy. <p>Design and construction errors such as</p> <ul style="list-style-type: none"> ▪ Insufficient / inadequate reinforcement.
Advantages	<ul style="list-style-type: none"> ▪ Lightweight. ▪ Non-corrosive. ▪ Very high strength and durability. ▪ Well defined and tested anchorage system. ▪ Outstanding fatigue resistance. ▪ Low profile; can be coated. ▪ Low aesthetic impact.
Technical Data	
Packaging	Cartons of 20 elements or sold individually
Colour/Appearance	Black. Carbon fibre reinforced polymer with an epoxy matrix. L shaped elements with a 90° bend. Both faces of the element are covered with release agent-free peel-ply fabric
Shelf Life	Unlimited. Store in dry conditions and away from exposure to direct sunlight.
Density	1.55 g/cm ³ (0.89 oz/in ³)
Glass Transition Temperature	> 80 °C (160 °F)
Fibre Content	> 56 % by volume

Physical Properties

Sika® CarboShear L Element Dimensions	Sikadur®-30 ¹ Consumption	Leg Length		Width	Nominal Thickness without Peel-ply
		Short	Long		
4/20/50	0.5 kg (1.1 lb)	200 (8)	500 (20)	40 (1.57)	2 (0.0787)
4/30/70	0.6 kg (1.3 lb)	300 (12)	700 (28)	40 (1.57)	2 (0.0787)
4/50/100*	0.7 kg (1.5 lb)	500 (20)	1000 (39)	40 (1.57)	2 (0.0787)
4/80/150*	1.0 kg (2.2 lb)	800 (32)	1500 (59)	40 (1.57)	2 (0.0787)

* Consult Sika Canada for product availability

Leg length can be cut to measure (by saw or preferably by diamond disk). The inner radius of the bend zone is 25 mm (1 in).

1 Dependent on the size of anchorage hole, plane- and roughness, actual consumption of adhesive may differ. (anchor hole: assumption 150 mm depth).

Tensile Strength* > 1350 MPa (19.67 x 10⁴ psi)

E-Modulus of Elasticity* > 90 000 MPa (131.18 x 10⁵ psi)

Strain at Break* >1.30 %

*In direction of longitudinal fibres, considering a nominal thickness of 2 mm (0.0787 in).

Product properties are typically averages, obtained under laboratory conditions. Reasonable variations can be expected on-site due to local factors, including environment, preparation, application, curing and test methods.

Design

The design procedure may be undertaken in accordance with: the Canadian Building Code Standard, Design and Construction of Building Components with Fibre-Reinforced Polymers, CAN/CSA S806-02: ACI 440.2R-08: or the model described in the EMPA Test Report 116/7: 2002.

Additional considerations must include:

Procedure for Condition Determination:

Measurements (geometry, reinforcement, level and evenness of the surface to be strengthened), quality of the construction material, climatic conditions, use a zoning plan.

Anchorage Forces:

Anchorage zone: The longer leg of the plate is anchored with Sikadur®-30 in the compression slab of the structure. The anchorage length has the following influence on the pull-out force of the plate:

Anchorage length mm (in)	Pull-out force* kN (lbf)	Rel. pull-out force (% of breaking load)
100 (4)	approx. 77 (17310)	approx. 60
150 (6)	approx. 100 (22480)	approx. 80
200 (8)	approx. 120 (26977)	approx. 95

Bend Zone

The length of the two shorter ends bonded on each other to a « U » has the following influence on the breaking load:

Overlapping zone length mm (in)	Average failure force* kN (lbf)	Efficiency (% of ultimate tensile force of the plate)
150 (6)	67 (15062)	53
225 (9)	69 (15511)	55
300 (12)	74 (16635)	59

*These numbers are test results. For design values consult the above mentioned EMPA Test Report 116/7, 2002. A value of 45 kN (10116 lbf) per Sika® CarboShear L element can be chosen as estimation for feasibility study purposes.

HOW TO USE

Surface Preparation

Prepare the surface on the side and underside of the web by sandblasting or other appropriate mechanical means to provide an open roughened texture, conforming to ICRI CSP-5. Remove dust and loose particles by means of an industrial vacuum cleaner. The resultant concrete substrate must be clean, oil, grease-free and dry (max. surface moisture content 4% by weight).

The adhesive strength of the concrete must be verified after surface preparation by random pull off tests conducted to ACI 503R, at the discretion of the engineer. A mean tensile strength of 2 MPa (290 psi) and a minimum tensile strength of 1.5 MPa (218 psi) with concrete substrate failure is required before proceeding.

The evenness of the surface is checked with a straight edged ruler. The maximum permissible tolerance over a length of 0.5 m (1.64 ft) is 2.5 mm (0.098 in). Greater unevenness must be levelled using Sikadur®-30 structural adhesive and clean oven-dried silica sand (mixed in a ratio of 1:1 parts by volume).

The edge of the web (later the position of the bend in the Sika® CarboShear L element) must be levelled or rounded to fit the inner 25 mm (1 in) radius of the Sika® CarboShear L element. This can be done by grinding.

Sikadur®-30 Adhesive Preparation Consult Sikadur®-30 Product Data Sheet for information on mixing and application of the adhesive for bending reinforcement.

Sika® CarboShear L Preparation Peel-ply fabric must be carefully removed from both sides of the Sika® CarboShear L element up to the intended cutting point. Ensure that the profile remains clean and free from loose friable material and contaminants.
Sika® CarboShear L elements can then be cut using a saw or diamond cutting disk to suit the dimensions of the structure being strengthened.
The day before the installation of the L-shaped profile, CFRP surfaces must be wiped clean using a clean, lint free white cloth and acetone until all residual carbon dust and glue are removed (i.e. white cloth remains white after wiping the laminate).
The end to be anchored must then be coated on both sides with Sikadur®-30 to the required anchoring length plus 10 mm (3/8 in). The adhesive is applied with a tooth-trowel (5 mm [3/16 in]) with the grooves at right angles to the direction of the fibres.

Sika® CarboShear L Installation If anchoring into the compression slab, the pre-drilled holes must be completely filled with Sikadur®-30 structural adhesive, applied using a bulk caulking dispenser or from a cartridge gun, fitted with a hose or tube.
Alternatively, drill 3 parallel holes of 25 mm (1 in) diameter at 10 - 15 mm (3/8 to 5/8 in) intervals, forming an oblong hole of about 50 mm (2 in) in length.

Remove dust, dirt and moisture from the hole. Let the surfaces within the hole dry.
Take care to drill the holes close to the web to allow bonding of the Sika® CarboShear L shaped elements with an adhesive layer of minimal thickness.

Having removed the peel-ply fabric and acetone wiped the Sika® CarboShear L elements, apply Sikadur®-30 in an apex shape to the inner face of the CFRP element and at the same time to the grooves of the anchor length, prepared in advance to avoid air entrapment in the anchoring adhesive.

Spread a thin filler coat of Sikadur®-30 onto the prepared concrete surface. Apply a substantial amount of Sikadur®-30 to the edge of the structure in order to avoid any risk of gap in the layer of adhesive.

Holding the CFRP elements slightly obliquely, push the long Sika® CarboShear L legs of the first side of the web into the boreholes filled with Sikadur®-30. When the anchor length is almost reached, press the element firmly onto the filler coat on the substrate, using a rubber roller to bed the element and evacuate any air. Subsequently remove excess of Sikadur®-30 with a cloth and scraper from the overlap zone on the underside of the web.

Sika® CarboShear L elements on the opposite side are applied exactly the same way as on the first side. The exposed surface of the shorter leg of the plate of the web side have to be primed with Sikadur®-30 first, in order to ensure that the plates remain in place. Remove excessive adhesive with a tongue shaped spatula.

Do not disturb during the curing period. Once cured, the elements can be protected from ultra-violet light by over-coating, for example with Sikagard®-550 W Elastic or Sikagard® Color A-50 Lo-VOC.

- Limitations**
- Design calculations must be made and certified by an independent, licensed professional engineer. Sika Canada cannot and will not determine the locations, spacing nor orientation of the Sika® CarboShear L elements on the actual project. Design guidelines are available through contact with Sika Canada Technical Services.
 - The required mean adhesive (tensile) strength of the prepared concrete substrate must be 2 MPa (290 psi), with a minimum 1.5 MPa (218 psi).
 - Maximum admissible working temperature: 50 °C (122 °F).
 - Minimum application temperature: 10 °C (50 °F).
 - Maximum substrate moisture content: 4 % by weight.
 - Ambient and substrate temperature during application must be at least 3 °C (6 °F) above dew point.
 - Sika® CarboShear L systems must be protected against continuous exposure to direct sunlight.

Health and Safety Information For information and advice on the safe handling, storage and disposal of chemical products, users should refer to the most recent SAFETY DATA SHEET containing physical, ecological, toxicological and other safety-related data.

KEEP OUT OF REACH OF CHILDREN
FOR INDUSTRIAL USE ONLY

The Information, and in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions, within their shelflife. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any recommendations, or from any other advice offered. The information contained herein does not relieve the user of the products from testing them for the intended application and purpose. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request or may be downloaded from our website at: www.sika.ca

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