

# Sika<sup>®</sup> CarboShear

## High Performance CFRP Shear Strengthening System

Construction

### Description

Sika CarboShear is a high performance CFRP shear strengthening system for reinforced concrete structures. It consists of two components: Sika Carboshear L shaped CFRP plates and Sikadur-30 adhesive.

Sika CarboShear complements the Sika CarboDur composite strengthening system used for structural strengthening. The efficiency of the Sika CarboShear strengthening system has been proven by tests performed in collaboration with the Swiss Federal Laboratories for Materials Testing and EMPA.

### Uses

The Sika CarboShear system can be used for external strengthening for shear forces due to:

- Higher live loads in buildings and on bridges.
- Changes of use in existing structures.
- Corrosion of the inner shear reinforcement.
- Impact damage.
- Fire damage.
- Serviceability requirements.
- Design or construction defects.

### Advantages

- Excellent shear strengthening capabilities.
- Can be used in conjunction with the Sika CarboDur and SikaWrap Systems.
- Low in weight.
- Easy to transport.
- Economical application.
- High in strength.
- Well defined anchoring system.
- High fatigue resistance.
- Can be overcoated.

### Test Reports

EMPA Test Report 169'219 E/1: Testing of CFRP shear strips on reinforced concrete T-beams T1 and T2.

EMPA Test Report 169'219 E/2: Testing of CFRP shear strips. Flexural beam T3.

### Storage and Shelf Life

When not exposed to direct sunlight, Sika CarboShear L shaped plates have unlimited shelf life. Sikadur-30, when stored in the original sealed containers within the temperature range of +5°C to +25°C will keep for a minimum of three (3) years.

### Instructions for Use

#### Surface Preparation

The concrete must be clean, dry, free from grease and oil, and have no loose particles or laitance. This can be prepared by blast cleaning, scabbling or grinding. The concrete age should be 3 to 6 weeks minimum, depending on thickness, curing conditions etc. The surface to be coated must be level, with steps and formwork marks not greater than 0.5mm. After cleaning remove all dust from the surface with an industrial vacuum cleaner. The edge of the web must be rounded to fit the inner radiations of the Sika CarboShear L plate. This can be done by grinding.

**Mixing**

Sikadur-30 is supplied in factory proportioned units comprising the correct quantities of Part A (Resin) and Part B (Hardener). Thoroughly stir both components separately using a low running drill/stirrer with a helical paste mixer (max. speed 600rpm). Decant all Part B into Part A and mix thoroughly together until a uniform colour is achieved (typically 3 minutes). A streaky colouration is indicative of inadequate or incomplete mixing. Apply immediately.

**Application**

The holes drilled into the compression slab are completely filled with Sikadur-30 adhesive. (See Design and Application Notes).

Prior to application, remove the peel fabric from both faces of the Sika CarboShear L plate. Apply Sikadur-30 in a roofshape to the inner face of the Sika CarboShear L plate, at the same time filling the grooves of the anchor length, prepared in advance to avoid air entrapment in the anchoring. 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 gaps in the layer of adhesive.

Holding the elements slightly oblique, push the long legs of the Sika CarboShear L plate of the first web side into the holes filled with Sikadur-30. When the anchor length is almost reached, press the element firmly onto the filler coat on the substrate, using a hard rubber roller. Subsequently, remove excess Sikadur-30 from the overlap zone on the underside of the web.

The Sika CarboShear L plates on the second side are applied exactly the same way as on the first side. The exposed surface of the shorter legs of the plates of the first web side have to be primed with Sikadur-30 first, in order to ensure that the plates remain in place.

Excessive adhesive can be removed with a spatula. The Sika CarboShear L surfaces can be overcoated using Sikagard-670W, Sikagard-680S or Sika Elastocolor W.

**Technical and Physical Data****A. Sika CarboShear L Plates**

<b>Colour</b>	Black
<b>Base</b>	Carbon fibre reinforced with an epoxy matrix
<b>Apparent Density</b>	1.6g/cm <sup>3</sup>
<b>Temperature Resistance</b>	Between 150°C and 500°C
<b>Ultimate Tensile Force</b>	126kN per 40mm width (minimum value)
<b>E-modulus (longitudinal)</b>	120,000 MPa per 1.4mm thick (mean value)
<b>Packaging</b>	Sika CarboShear L plates supplied to order in the standard leg lengths

**Geometry**

Sika CarboShear L is a CFRP L-shaped plate with a 90° bend

Type	Leg length (mm)	Widths (mm)	Thickness (mm)
4/20/50	200 by 500	40 min, 100 max	~ 1.4
4/30/70	300 by 700	40 min, 100 max	~ 1.4
4/50/100	500 by 1000	40 min, 100 max	~ 1.4

\*No product off the shelf. Please ask for expected delivery times.

**B. Sikadur-30 Adhesive for bonding reinforcements**

<b>Appearance</b>	Part A	White paste
	Part B	Black paste
	Part A + B	Light grey when mixed
<b>Mix Ratio</b>	A : B = 3 : 1	(parts by weight and volume)
<b>Density</b>	1.77 kg/L	(A+B)
<b>Pot Life*</b>	40 minutes	(at 35°C)
<b>Open Time*</b>	30 minutes	(at 35°C)
<b>Sag Flow*</b>	3-5 mm	(at 35°C)
<b>Shrinkage</b>	0.04%	

**Technical and Physical Data (continued)**

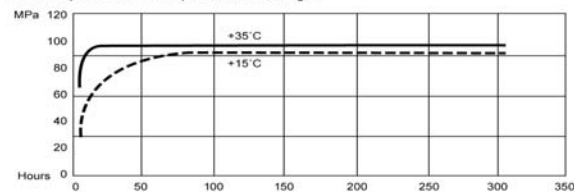
<b>Glass Transition Point*</b>	62°C	
<b>Static E-Modulus*</b>	12,800 MPa	
<b>Adhesive Strength (wet)</b>	4 MPa	(Concrete Failure)
<b>Shear Strength *</b>	15 MPa	(Concrete Failure)
<b>Coefficient of Expansion</b>	$9 \times 10^{-5}$ per °C	(-10°C to 40°C)
<b>Packaging</b>	5kg tins	Part A 3.75kg Part B 1.25kg

\*To F.I.P. Federation Internationale de la Precontrainte

**Note:** The values given may vary according to amount of air entrained during mixing.

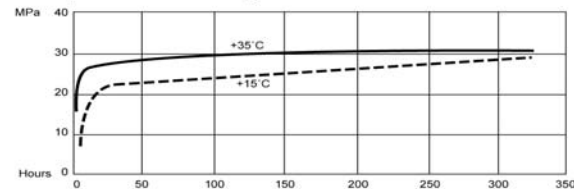
Compressive strength  
(DIN 1154.7)

Development of compressive strength



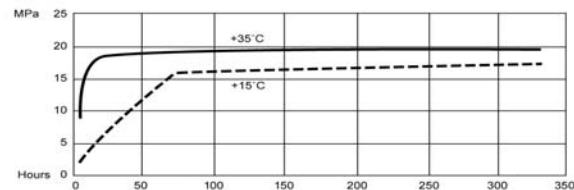
Tensile strength  
(DIN 43455)

Development of tensile strength



Tensile slant shear strength (Sika Test)

Development of tensile slant shear strength

**Design and Application Notes****Preparation of the Sika CarboShear L elements:**

Sika CarboShear L plates can be cut by saw or diamond cutter disk to fit the dimensions of the structure to be strengthened. Prior to this, peel-ply fabric must be carefully removed on both sides up to the cutting point. The day before the application of the L-shaped profile, the end to be anchored must be coated on both sides with Sikadur-30 to the required anchoring length plus an extra 10mm.

The adhesive should be applied with a tooth trowel (5mm). The grooves should be at right angles to the direction of the fibres. Prior to application the peel-ply fabric on both sides must be carefully removed to the required length.

**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)	Pull-out force (kN)	Rel. pull-out force (1% of breaking load)
100	~77	Approx. 60
150	~100	Approx. 80
200	~120	Approx. 95

**Anchorage Zone  
(continued)**

- A good way to execute the anchorage hole is as follows:
- cut holes with the specially designed chain saw.
  - Alternatively drill 3 parallel holes of 26mm diameter at 10 to 15mm intervals, forming a hole about 50mm in length.
  - Remove dust, dirt and moisture from the holes, and allow surface to dry.

**Bend Zone:**

The overlapping length of the two shorted ends bonded to each other in the beam soffit has the following influence on the breaking load:

Overlapping zone length (mm)	Average failure force (kN)	Efficiency (1% of ultimate tensile force of the plate)
150	67	53
225	69	55
300	74	59

**Important Notes**

- Do not apply Sikadur-30 to surfaces with standing water. Maximum moisture content of the concrete 10%.
- Always mix a full kit to avoid mix ratio error.
- Only mix as much material as can be applied within the stated potlife.
- Do not dilute the product with solvent as this will affect the cure and in service performance.
- Constant exposure to service temperatures >50°C may affect the performance of the product.
- Sika CarboShear can be fire-rated if required using standard fire rating materials.
- The temperature at which Sikadur-30 is stored at during the 24 hours before it is mixed will govern its potlife when mixed.
- Compressive strengths etc. of epoxy resins must be qualified by the testing method eg. Test Standard or size of specimen under test and the rate at which the test piece is loaded under test, as these factors will effect the result markedly. Faster loading rates will generally give higher ultimate loads and vice versa. Also, a specimen at lower temperature will show higher strengths and vice versa.
- Sikadur-30 Parts A and B are a water pollutant and should not be discharged into drains, waterways or soil.

**Handling Precautions**

- Avoid contact with skin and eyes.
- Wear protective gloves and eye protection during work.
- If skin contact occurs, wash skin thoroughly.
- If in eyes, hold eyes open, flood with warm water and seek medical attention without delay.
- A full Material Safety Data Sheet is available from Sika on request.

**Important Notification**

The information, and, in particular, the recommendations relating to the application and end-use of Sika's 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. 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 written recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject of our terms and conditions of sale. Users should always refer to the most recent issue of the Technical Data Sheet for the product concerned, copies of which will be supplied on request.

PLEASE CONSULT OUR TECHNICAL DEPARTMENT FOR FURTHER INFORMATION.

