Sika® CarboShear L
Carbon fibre shear links for structural strengthening

System Description
Sika® CarboShear L are corrosion resistant carbon fiber shear links, designed for strengthening concrete structures in shear and to anchor Sika® CarboDur® plates at their end. They are part of the Sika® CarboDur® CFRP Strengthening System.

Sika® CarboShear L shear links are bonded as external reinforcement using Sikadur®-30 epoxy resin. For the anchorage holes, Sika AnchorFix®-3+ can be used (for details on the adhesive see the relevant Product Data Sheet).

Uses
To strengthen the shear resistance of structures. Including:

Load increase:
- Increasing the load capacity of beams.
- Installation of heavier machinery.
- Changes of building use.

Damage to structural elements:
- Deterioration of construction materials.
- Steel reinforcement corrosion.
- Vehicle impact.
- Fire.

Service improvements:
- Stress reduction in steel reinforcement.
- Crack width reduction.
- Reduces fatigue.

Change in structural system:
- Removal of walls or columns.
- Removal of slab sections for openings.

Change of specification:
- Earthquakes.
- Changed design philosophy.

Design or construction defects:
- Insufficient / inadequate reinforcement.
Characteristics / Advantages

- Tested anchorage system.
- Non corrosive.
- Very high strength.
- Excellent durability.
- Shear and bursting enhancement.
- Well defined anchoring.
- Lightweight.
- Low overall thickness, can be coated.
- Easy transportation.
- Easy installation – no heavy handling and installation equipment.
- Outstanding fatigue resistance.
- Minimal preparation of links.
- High alkali resistance.
- Low aesthetic impact.

Tests

Approval / Standards

- EMPA Test Report 169'219 E/1: Testing of CFRP shear strips on reinforced concrete T-beams T1 and T2
- EMPA Test Report 116/7, 2002: Shear strengthening with prefabricated CFRP L-shaped plates, Test beams S1 to S6

Product Data

Sika® CarboShear L shear links

Form

Appearance / Colour
Carbon fibre reinforced polymer with an epoxy matrix, black.
With- and without peel-ply available.

Packaging
Refer to latest price list.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Leg length</th>
<th>Widths</th>
<th>Nominal thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sika CarboShear L 4/20/50</td>
<td>200 resp. 500 mm</td>
<td>40 mm</td>
<td>1.4 mm</td>
</tr>
<tr>
<td>Sika CarboShear L 4/30/70</td>
<td>300 resp. 700 mm</td>
<td>40 mm</td>
<td>1.4 mm</td>
</tr>
<tr>
<td>Sika CarboShear L 4/50/100</td>
<td>500 resp. 1000 mm</td>
<td>40 mm</td>
<td>1.4 mm</td>
</tr>
<tr>
<td>Sika CarboShear L 4/80/150</td>
<td>800 resp. 1500 mm</td>
<td>40 mm</td>
<td>1.4 mm</td>
</tr>
</tbody>
</table>

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

Storage

Storage Conditions / Shelf Life
Unlimited (no exposure to direct sunlight, dry).

Technical Data

<table>
<thead>
<tr>
<th>Density</th>
<th>1.55 g/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Resistance</td>
<td>&gt; 150°C</td>
</tr>
<tr>
<td>Fiber Volume Content</td>
<td>&gt; 56%</td>
</tr>
</tbody>
</table>
### Mechanical / Physical Properties

#### CarboShear L Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Modulus* (mean value)</td>
<td>150'000 N/mm²</td>
</tr>
<tr>
<td>Tensile Strength* (min. value)</td>
<td>&gt; 2'150 N/mm²</td>
</tr>
<tr>
<td>Strain at break* (min. value)</td>
<td>&gt; 1.30%</td>
</tr>
</tbody>
</table>

*Mechanical values obtained from longitudinal direction of fibers.

#### Design

The design procedure may be done according to the model described in the EMPA Test Report 116/7, 2002

**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:

<table>
<thead>
<tr>
<th>Anchorage length</th>
<th>Pull-out force*</th>
<th>Rel. pull-out force (% of breaking load)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mm</td>
<td>≈ 77 kN</td>
<td>≈ 60</td>
</tr>
<tr>
<td>150 mm</td>
<td>≈ 100 kN</td>
<td>≈ 80</td>
</tr>
<tr>
<td>200 mm</td>
<td>≈ 120 kN</td>
<td>≈ 95</td>
</tr>
</tbody>
</table>

Bend zone:

<table>
<thead>
<tr>
<th>Overlapping zone length</th>
<th>Average failure force*</th>
<th>Efficiency (% of ultimate tensile force of plate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 mm</td>
<td>≈ 67 kN</td>
<td>≈ 53</td>
</tr>
<tr>
<td>225 mm</td>
<td>≈ 69 kN</td>
<td>≈ 55</td>
</tr>
<tr>
<td>300 mm</td>
<td>≈ 74 kN</td>
<td>≈ 59</td>
</tr>
</tbody>
</table>

*These numbers are test results. For design values consult the above mentioned EMPA Test Report 116/7, 2002. A value of 45kN per CarboShear bracket can be chosen as estimation for feasibility study.

### System Information

**Sika® CarboShear L & Sikadur®-30 (Sika AnchorFix®-3*)**

#### Application Details

**Consumption**

<table>
<thead>
<tr>
<th>Type of link</th>
<th>Sikadur®-30* or Sikadur®-30* &amp; Sika AnchorFix®-3**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sika® CarboShear L 4/20/50</td>
<td>0.5 kg (0.25 kg &amp; 0.25 kg)</td>
</tr>
<tr>
<td>Sika® CarboShear L 4/30/70</td>
<td>0.6 kg (0.35 kg &amp; 0.25 kg)</td>
</tr>
<tr>
<td>Sika® CarboShear L 4/50/100</td>
<td>0.7 kg (0.45 kg &amp; 0.25 kg)</td>
</tr>
<tr>
<td>Sika® CarboShear L 4/80/150</td>
<td>1.0 kg (0.75 kg &amp; 0.25 kg)</td>
</tr>
</tbody>
</table>

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

*When using Sikadur®-30 for bonding of the links as well as for filling the anchor hole

**When using Sikadur®-30 for bonding of the links and Sika AnchorFix®-3* for filling the anchor hole
Substrate Quality

Evenness / plan:
The surface to be strengthened must be levelled, with variations and formwork marks not greater than 0.5 mm. The evenness of the substrate has to be checked with a metal batten. Tolerance for 0.5 m length is max. 2.5 mm.

Substrate strength (concrete, masonry, natural stone) must be verified in all cases: Mean adhesive tensile strength of the prepared concrete substrate is 2.0 N/mm², min. 1.5 N/mm². If this values can not be reached, see the SikaWrap® Fabric Data Sheets for alternative solutions.

Concrete must be older than 28 days.

<table>
<thead>
<tr>
<th>Substrate Preparation</th>
<th>See the Method Statement of Sika CarboShear L</th>
</tr>
</thead>
</table>

Application

Conditions / Limitations

<table>
<thead>
<tr>
<th>Substrate Temperature</th>
<th>See Product Data Sheet of Sikadur®-30.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature</td>
<td>See Product Data Sheet of Sikadur®-30.</td>
</tr>
<tr>
<td>Substrate Moisture Content</td>
<td>See Product Data Sheet of Sikadur®-30.</td>
</tr>
<tr>
<td>Dew Point</td>
<td>See Product Data Sheet of Sikadur®-30.</td>
</tr>
</tbody>
</table>

Application Instructions

<table>
<thead>
<tr>
<th>Mixing</th>
<th>See Product Data Sheet of Sikadur®-30.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixing Time</td>
<td>See Product Data Sheet of Sikadur®-30.</td>
</tr>
<tr>
<td>Application Method / Tools</td>
<td>See the Method Statement of Sika CarboShear L</td>
</tr>
<tr>
<td>Cleaning of Tools</td>
<td>Clean all tools and application equipment with Sika® Colma Cleaner immediately after use. Cured material can only be mechanically removed.</td>
</tr>
<tr>
<td>Potlife</td>
<td>See the Product Data Sheets of Sikadur®-30 and Sikadur®-30 LP.</td>
</tr>
</tbody>
</table>

Notes on Application / Limitations

A suitably qualified Engineer must be responsible for the design of the strengthening works.

This application is structural and great care must be taken in selecting suitably experienced and trained specialist labour.

Only apply the plates within the open time of Sikadur®-30.

Site quality control should be supported / monitored by an independent testing authority.

Care must be taken when cutting plates. Use suitable protective clothing, gloves, eye protection and respirator.

The Sika® CarboShear L system must be protected from permanent exposure to direct sunlight.

Coating:
The exposed plate-surface can be painted with a coating material such as Sikagard®-550 W Elastic for UV protection.

Maximum permissible service temperature is approx. +50°C.

The instructions in the Technical Data Sheet must be followed when applying Sikadur®-30 adhesive.

Note:
Detailed advice on the above must always be obtained from Sika Services AG.

Fire Protection

If required Sika® CarboShear L links may be protected with fire resistant material.
### Value Base

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

### Local Restrictions

Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

### Health and Safety Information

For information and advice on the safe handling, storage and disposal of chemical products, users shall refer to the most recent Material Safety Data Sheet containing physical, ecological, toxicological and other safety-related data.

### Legal Notes

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 in accordance with Sika’s recommendations. 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 user of the product must test the product’s suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. 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 access on the Internet under [www.sika.co.za](http://www.sika.co.za).