Product Data Sheet
Edition 13/6/2006
Identification no:
02 04 01 01 004 0 000002 System
Sika® CarboDur® Plates

Construction

Sika®CarboShear L

Carbon Fiber 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 169'219 E/2: Testing of CFRP shear strips. Flexural beam T3
EMPA Test Report 116/7, 2002: Shear strengthening with prefabricated CFRP L-shaped plates, Test beams S1 to S6
Meier, H., 1998: CFRP L-shaped Plates, Reprinted from Schweizer Ingenieur und Architekt, No. 43, 22. October 1998
Czaderski, Ch., 1998: Shear Strengthening with CFRP L-shaped Plates, Reprinted from Schweizer Ingenieur und Architekt, No. 43, 22. October 1998
Meier, H., Bleibler, A., 1999: The latest R&D in structural strengthening with bonded CFRP plates. Int. conference „Structural Faults and Repair" London, July 1999.

Product Data

Sika® CarboShear L shear links

Form

Appearance / Colour

Carbon fiber 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.

Type	Leg length	Widths	Nominal thickness
Sika CarboShear L 4/20/50	200 resp. 500 mm	40 mm	1.4 mm
Sika CarboShear L 4/30/70	300 resp. 700 mm	40 mm	1.4 mm
Sika CarboShear L 4/50/100	500 resp. 1000 mm	40 mm	1.4 mm

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 shelf life if stored in original unopened packaging in a dry area between 5°C and 35°C. Do not expose to direct sunlight.

Technical Data

Density

1.55 g/cm^3

Temperature Resistance

> 150°C

Fiber Volume Content

> 56%

Mechanical / Physical Properties

CarboShear L Properties

E-Modulus* (mean value)	120'000 N/mm^2
Tensile Strength* (min. value)	> 2'250 N/mm^2
Strain at break* (min. value)	> 1.7%
Design strain**	0.6%

* Mechanical values obtained from longitudinal direction of fibers.

** These values shall be used for design at ULS as maximum strains in the CFRP links and must be adapted to design rules and local design codes. Dependent upon quality of the structure, anchorage and load situation, they have to be decreased.

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:

Anchorage length	Pull-out force*	Rel. pull-out force (% of breaking load)
100 mm	≈ 77 kN	≈ 60
150 mm	≈ 100 kN	≈ 80
200 mm	≈ 120 kN	≈ 95

Bend zone:

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

*These numbers are test results. For design values consult the above mentioned EMPA Test Report 116/7, 2002

System Information

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

Application Details

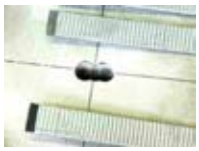
Consumption

Type of link	Sikadur®-30*	or Sikadur®-30* & Sika AnchorFix®-3**
Sika® CarboShear L 4/20/50	0.5 kg	(0.25 kg & 0.25 kg)
Sika® CarboShear L 4/30/70	0.6 kg	(0.35 kg & 0.25 kg)
Sika® CarboShear L 4/50/100	0.7 kg	(0.45 kg & 0.25 kg)

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 these values can not be reached, see the SikaWrap® Fabric Data Sheets for alternative solutions. Concrete must be older than 28 days.
Substrate Preparation	Concrete: Substrates must be sound, dry, clean and free from laitance, ice, standing water, grease, oils, old surface treatments or coatings and all loosely adhering particles to achieve a laitance and contaminant free, open textured surface. Repairs and levelling must be undertaken with structural repair materials such as Sikadur®41 repair mortar or Sikadur®-30 adhesive, filled max. 1 : 1 by weight with Sikadur®-501 quartz sand. If levelling has been conducted more than 2 days before applying the plates, the levelled surface has to be grind again to ensure a proper bond between Sikadur®-41 and Sikadur®-30 (see the relevant Product Data Sheets). The edge of the web (later position of the bend of the **Sika® CarboShear L** link) must be levelled or rounded to fix the inner radius of the **Sika® CarboShear L** link (R = 25 mm). Ie by grinding. Anchorage zone: The longer leg of the plate is anchored with Sikadur®-30 in the compression zone of the structure. (The influence on the anchoring force / -length is described in the Sika® CarboShear design information). A good way to prepare the anchorage holes is as follows:  Cut holes with a specially designed chain saw. Ask your Sika company for details.  Alternatively drill 3 parallel holes of 26 mm diameter at 10 to 15 mm intervals, forming an oblong hole of about 50 mm length. Remove dust, dirt and moisture from the holes. Let the hole‘s surface dry. Take care to drill the holes close to the web to allow bonding of the **Sika® CarboShear L**- shaped plates with an adhesive layer of minimal thickness. **Sika® CarboShear L** CFRP link preparation: **Sika® CarboShear L** links can be cut by saw or diamond disk to fit the dimensions of the structure to be strengthened. If the links are peel-ply protected, these must be carefully removed on both sides up to the cutting point. Pre-treat the **Sika® CarboShear L** links with Sikadur®-30 applied with a (5 mm) serrated trowel to the vertical leg. Finish off to form grooves running across the width of the top of the link for a height of 100-200 mm (dependent on anchorage length design). Allow to dry for 24 hours. Immediately prior to the application of Sikadur®-30, remove the peel ply or solvent wipe bonding surface with Sika® Colma Cleaner if links are not peel-ply protected. Wait until the surface is dry before applying adhesive.

Application Conditions / Limitations

Substrate Temperature	See Product Data Sheet of Sikadur®-30.
Ambient Temperature	See Product Data Sheet of Sikadur®-30.
Substrate Humidity	See Product Data Sheet of Sikadur®-30.
Dew Point	See Product Data Sheet of Sikadur®-30.

Application Instructions

Mixing

See Product Data Sheet of Sikadur®-30.

Mixing Time

See Product Data Sheet of Sikadur®-30.

Application Method / Tools

Fill the holes (anchorage zone) with Sikadur®-30 structural adhesive ie. squeezed out from a cartridge fitted with a tube. Sika AnchorFix®-3 can also be used instead.

Prior to application, clean the bracket with Sika® Colma Cleaner. If there is any peel-ply fabric, remove it from both faces of the **Sika® CarboShear L** link.
Apply Sikadur®-30 in a “dome”-shape to the inner face of the **Sika® CarboShear L** link. Take care with the grooves of the prepared anchor length to avoid any air entrapment in the anchoring.

Spread a thin layer of Sikadur®-30 as a filler coat onto the prepared concrete surface. Apply an excessive amount of Sikadur®-30 to the edge of the structure to avoid any risk of gaps in the adhesive.
Holding the elements slightly angled, push the long legs of the **Sika® CarboShear L** of the first web side into the bore-holes filled with Sikadur®-30. When anchor length is almost reached, press the element firmly onto the filler coat on the substrate, using a Sika® CarboDur® rubber roller. Subsequently remove the excess Sikadur®-30 from the overlap zone on the underside.
The **Sika® CarboShear L** link on the second side are applied exactly the same way as on the first side. The exposed surface of the shorter leg of the links of the first side have to be primed with Sikadur®-30 first, in order to ensure that the plates remain in place.

Quality assurance:
Samples must be made up on site for quality control of curing rate and final strength. Measure the compressive and flexural tensile strength after curing.
Average standard values after curing 7 days at +23°C are:

- Compressive strength > 75 N/mm²
- Flexural tensile strength > 35 N/mm²

These values can differ up to 20% dependent on the circumstances. The following are the most important factors which can have an influence on the final mechanical properties:

- Mixing ratio (A : B = 3 : 1 exactly)
- Air entrapping (from mixing or filling into the mould!)
- Curing temperature / time
- Contamination in the adhesive!

Application Tools:
Sika® Colma Cleaner:
For cleaning of Sika® CarboDur® plate before bonding, cleaning of application tools.
In 1 and 5 kg pails, 20 kg mini drum and 160 kg drum.
Sika® CarboDur® Rubber Roller:
For pressing the Sika® CarboDur® plate onto the surface.
Sales unit 1 piece.
Sika® Mixing Spindle:
For minimizing air entrapment.
Sales unit 1 piece.

Cleaning of Tools

Clean all tools and application equipment with Sika® Colma Cleaner immediately after use. Cured material can only be mechanically removed.

Potlife

See the Product Data Sheets of Sikadur®-30 and Sikadur®-30 LP.

Construction

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 contractors. 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. Maximum permissible service temperature is approx. +50°C. The instructions in the Product Data Sheet must be strictly adhered to 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. When the Sikadur®-30 has cured, test for voids by tapping surface of plates with a hammer or impulse thermography. Overcoating: The exposed plate-surface can be painted with a coating material such as Sikagard®-550W Elastic or Sikagard®-ElastoColor W.
Notes	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 should refer to the most recent Material Safety Data Sheet containing physical, ecological, toxicological and other safety-related data.

Legal Notes

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