

Construction



Bridge Strengthening Sika[®] CarboDur[®] Composite Systems



System Solutions for reinforced and prestressed Concrete, Timber, Steel and Masonry Arch Bridges

Reasons for Strengthening

- Corrosion of the reinforcement
- Corrosion of prestressing cables
- Increased traffic loads
- Inadequate design
- Modified standards/codes
- Excessive cracking of concrete
- Seismic retrofitting

Materials used

FRP Fabrics

Uni- and/or bidirectional fabrics with carbon, glass and aramid fibers. Mostly used for seismic retrofitting and shear strengthening.

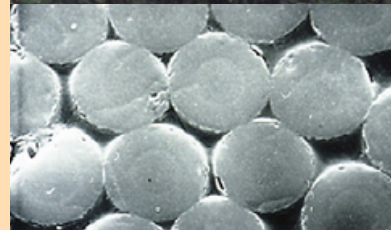
CFRP Plates

Carbon fibre plates produced by pultrusion process with precise material properties. Mostly used for flexural and shear strengthening of dynamic loaded structures such as bridges, etc.

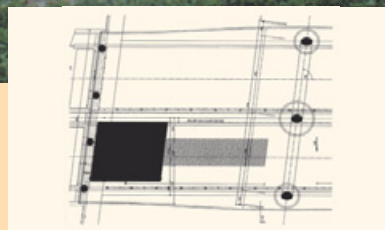
Cover Pictures: Prestressed concrete bridge Sika® «World record» in composite-plate length, Australia Steel-concrete bridge Sika® «Tailor made» Composite-plate, United Kingdom



Heavy truck crossing the bridge, Slovenia



CFRP plate magnification 1:2000



Bridge deck: Design of plates

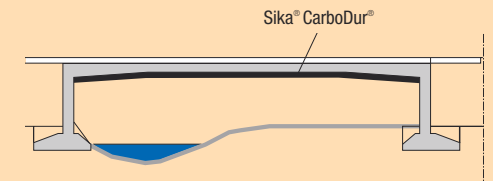
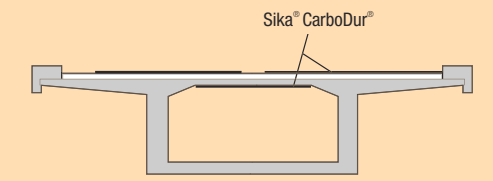


Applied CarboDur CFRP plates

Sika® Systems

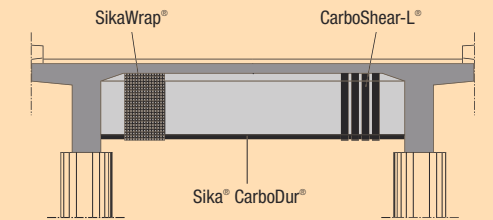
Flexural Strengthening with

- Sika® CarboDur® CFRP plates
- Sika® CarboHeater, heating device for rapid application
- Sika® CarboDur® prestressed CFRP plates
- SikaWrap® FRP fabrics



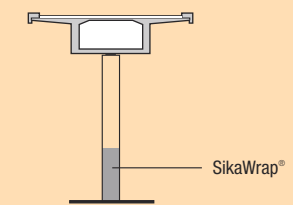
Shear Strengthening with

- Sika® CarboShear® L CFRP plates
- SikaWrap® FRP fabrics



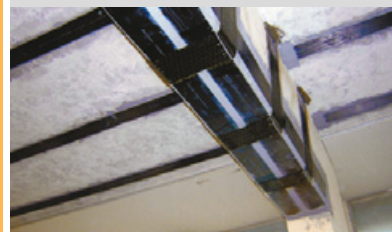
Seismic Retrofitting with

- SikaWrap® FRP fabrics



All Sika® Composite materials are bonded with Sikadur® High strength epoxy adhesives

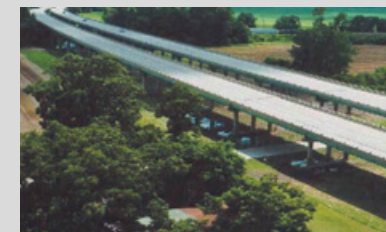
Shear Strengthening



Flexural Strengthening



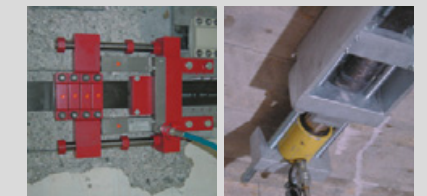
Seismic Retrofitting



Timber and Steel Bridges



Prestressed Strengthening



Bridge Strengthening

Sika® CarboDur® Composite Systems

System Components

CFRP Plates System Components

Sika® CarboDur®		Type S	Type M	Type H
CFRP plates	Elastic modulus	165 000 N/mm ²	210 000 N/mm ²	300 000 N/mm ²
	Tensile strength	2800 N/mm ²	2800 N/mm ²	1350 N/mm ²
Sika® Prestressing Systems	Prestressing of Sika® CarboDur® plates over 200 kN (20 tons) with Sika® StressHead or Sika® LEOBA CarboDur® prestressing system			
Sika® CarboHeater	Fast application (2 – 3 hrs) of Sika® CarboDur® plates			
Heating device				
Sika® CarboShear® L	Min. tensile load	126 kN/40 mm width		
L-shaped CFRP plates	Elastic modulus	120 000 N/mm ²		
Sikadur®		Sikadur®-30	Sikadur®-30 LP	Sikadur®-41
Epoxy adhesives and mortars	Application temperature	10 – 35 °C	25 – 55 °C	10 – 35 °C
	Elastic modulus	12 800 N/mm ²	10 000 N/mm ²	9 000 N/mm ²
	Bond strength	> 4 N/mm ²	> 4 N/mm ²	> 4 N/mm ²
		(concrete failure)	(concrete failure)	(concrete failure)
	Use	Plate adhesive	Plate adhesive	Repair mortar

Fabrics System Components

SikaWrap® FRP Fabrics	Several types of SikaWrap® FRP fabrics are available to meet the requirement of specifier and contractor. Unidirectional woven and non-woven fabrics made of glass, aramid and different types of carbon fibers are available. Bi-directional types can be offered with carbon and glass fibers. The range of areal weight is between 200 and 600 g/m ² for carbon, 400 to 1000 g/m ² for glass and 300 to 600 g/m ² for aramid fiber fabrics. Further possibilities and fiber combinations are available on request.
Sikadur® Epoxy impregnating resins	All SikaWrap® fabrics can be impregnated with the system tested Sikadur® impregnating resins that are all suited for the most common substrate types. are all suited for the most common substrate types.

For additional information see corresponding Product Data Sheets.

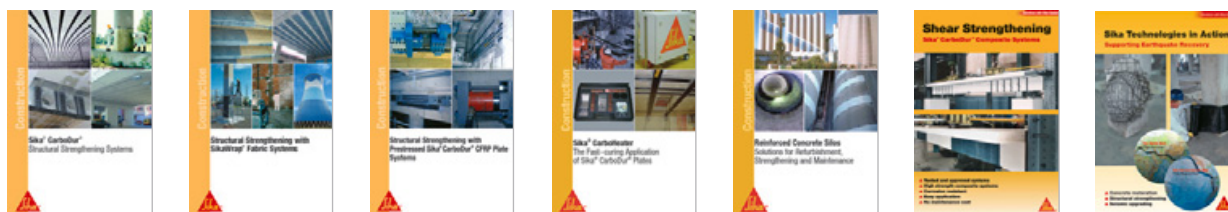
Test Reports

Fatigue and Failure Test Test beams B1 and B2	EMPA Test Report No. 402017E/2	1999
Sika CarboDur Structural Strengthening System, Fatigue and Failure Test, Test beam B3	EMPA Test Report No. 415053E/3	2001
Sika CarboDur Structural Strengthening System, Bonding of CFRP strips under dynamic load	EMPA Test Report No. 170569e-1	1999
Bonding of CarboDur CFRP plates under dynamic load	EMPA Test Report No. 418931E	2001

Approvals

General construction approval for steel plate strengthening with Sikadur®-30 and Icosit® 277	German Institute of Construction No. 7-36.1-30, Germany	07.04.95
General construction approval for Sika® CarboDur® , Plates Typ S	German Institute of Construction No. 7-36.12-29, Germany	11.11.97
Report/Technical Investigation for CarboDur® , Plates Typ S and SikaWrap®-230C fabric	SOCOTEC No. HX0823, France	07.08.00
Evaluation Report for SikaWrap® FRP Systems	ICBO No. ER-5558, California, U.S.	01.04.00

Also available from Sika



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