BRIDGE STRENGTHENING
FRP 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 fibres. 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.

SHEAR
STRENGTHENING

FLEXURAL
STRENGTHENING

BRIDGE
DECKS
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.
BRIDGE STRENGTHENING
FRP COMPOSITE SYSTEMS

CFRP PLATES - SYSTEM COMPONENTS

<table>
<thead>
<tr>
<th>Sika® CarboDur® CFRP plates</th>
<th>Type S</th>
<th>Type M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic modulus:</td>
<td>165,000 N/mm²</td>
<td>210,000 N/mm²</td>
</tr>
<tr>
<td>Tensile strength:</td>
<td>2,800 N/mm²</td>
<td>2,900 N/mm²</td>
</tr>
</tbody>
</table>

Sika® Prestressing Systems

Prestressing of Sika® CarboDur® plates with Sika® CarboStress prestressing system.

Sika® CarboHeater Heating device

Fast application (2 – 3 hrs) of Sika® CarboDur® plates

Sika® CarboShear® L-shaped CFRP plates

<table>
<thead>
<tr>
<th>L. Min. tensile load:</th>
<th>126 kN/40 mm width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic modulus:</td>
<td>150,000 N/mm²</td>
</tr>
</tbody>
</table>

Sikadur® Epoxy adhesives and mortars

<table>
<thead>
<tr>
<th>Sikadur® Product:</th>
<th>Sikadur®30</th>
<th>Sikadur®30 LP</th>
<th>Sikadur®41 CFN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application temp.</td>
<td>8 – 35 ºC</td>
<td>25 – 55 ºC</td>
<td>10 – 30 ºC</td>
</tr>
<tr>
<td>Elastic modulus:</td>
<td>11,200 N/mm²</td>
<td>10,000 N/mm²</td>
<td>9,000 N/mm²</td>
</tr>
<tr>
<td>Bond strength:</td>
<td>&gt; 4 N/mm² (concrete failure)</td>
<td>&gt; 4 N/mm² (concrete failure)</td>
<td>&gt; 4 N/mm² (concrete failure)</td>
</tr>
<tr>
<td>Use:</td>
<td>Plate adhesive</td>
<td>Plate adhesive</td>
<td>Repair mortar</td>
</tr>
</tbody>
</table>

FRP FABRICS - SYSTEM COMPONENTS

SikaWrap® FRP Fabrics

Several types of SikaWrap® FRP fabrics are available to meet the requirement of specifier and contractor. Uni-directional woven and non-woven fabrics made of glass, aramid and different types of carbon fibres are available. Bi-directional types can be offered with carbon and glass fibres. The range of areal weight is between 200 and 600 g/m² for carbon, 400 to 1,000 g/m² for glass and 300 to 600 g/m² for aramid fibre fabrics. Further possibilities and fibre 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.

TEST REPORTS

Fatigue and Failure Test
Test beams B1 and B2
SikaCarboDur Structural Strengthening
Test beams B3
SikaCarboDur Structural Strengthening System, Bonding of CFRP strips under dynamic load
Bonding of CarboDur CFRP plates under dynamic load

EMPA Test Report No. 402/07/E/2 1999
EMPA Test Report No. 415/05/E/1 2001
EMPA Test Report No. 170 563/e-1 1999
EMPA Test Report No. 418 931/E 2001

APPROVALS

General construction approval for steel plate strengthening with Sikadur-30 and load 277
SikaCarboDur, Plates Typ S
Bonding of CarboDur CFRP plates under dynamic load

German Institute of Construction No. 7-36-1-30, Germany 07.04.95
German Institute of Construction No. 7-36-12-29, Germany 11.11.97
Sikadur Test Report No. 10H0823, France 07.08.00
Evaluation Report for Sikadur FRP Systems KBD No. ER-5558, California, U.S. 01.04.00

SIKA (NZ) LTD
PO BOX 19192
Avondale, Auckland
1746, New Zealand

Contact
Phone  0800 745 269
Fax    0800 745 232
www.sika.co.nz

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