



TECHNICAL INFORMATION MANUAL  
Sika CarboDur®  
Near Surface Mounted Reinforcement

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## 1 INTRODUCTION

This Technical Information Manual is written as a guideline for the use of the Sika CarboDur<sup>®</sup> Near Surface Mounted (NSM) system. This document must be used and referred to, in combination with all other relevant Product Data Sheets (PDS), Material Safety Data Sheets (MSDS) and the specific Project Specifications.

Structural strengthening must only be carried out by trained and experienced specialists, if additional clarification or advice is needed, please contact Sika Technical Services Team.

## 2 SYSTEM DESCRIPTION

The Sika CarboDur<sup>®</sup> NSM system is a high performance structural strengthening system consisting of Sika CarboDur<sup>®</sup> plates or rods and Sikadur<sup>®</sup>-30, Sikadur<sup>®</sup>-330 or Sikadur<sup>®</sup> 33 adhesives. It is used for the post construction reinforcement of buildings and civil engineering structures and their structural elements.

Alternatively to the CarboDur<sup>®</sup> plates and rods, the SikaWrap<sup>®</sup> FX can be used as a flexible NSM strengthening material.

### 2.1 REFERENCES

The Technical Information Manual has been written in accordance with the recommendations contained in **ACI 440.2R-08**.

### 2.2 LIMITATIONS

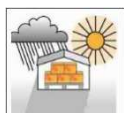
- The products must only be used for their intended applications.
- Local differences in some products may result in performance variations. The most recent and relevant **country** Product Data Sheets (PDS) and Material Safety Data Sheets (MSDS) shall apply and must be referred to.
- For any other specific construction / build information refer to the Architect's, Engineer's or Specialist Contractor's details, drawings, specifications and risk assessments.
- All of the works must be carried out as directed by a suitably qualified Structural Engineer as the Supervising Officer.

### 3 PRODUCTS

Sika Brand	Description
Sika CarboDur® plates	Sika CarboDur® plates are pultruded carbon fibre reinforced polymer (CFRP) laminates designed for strengthening concrete, timber and masonry structures. The plates come in different widths and can be obtained pre-cut or as a coil to be cut on site.
Sika CarboDur® BC rods	Sika CarboDur® BC rods are pultruded carbon fibre reinforced polymer (CFRP) laminates. They are designed for strengthening concrete, masonry and timber structures. The bars come with different diameters and can be obtained pre-cut or as a coil to be cut on site.
SikaWrap® FX	SikaWrap® FX is a unidirectional carbon or glass fibre string, encased in plastic.
Sikadur® -330	Sikadur® -330 is a two part, thixotropic, epoxy resin based, impregnating resin / adhesive.
Sikadur® -300	Sikadur® -300 is a two part, epoxy resin based, impregnating resin. It is clear and liquid when mixed.
Sikadur® -30	Sikadur® -30 is a thixotropic, structural two part adhesive, based on a combination of epoxy resins and special fillers.
Sikadur® - 33	Sikadur® - 33 is a solvent-free, thixotropic, two part, epoxy resin-based, cartridge gun applied structural adhesive.

For more detailed information on the products, refer to the corresponding PDS.

#### 3.1 MATERIAL STORAGE



Materials must be stored properly in undamaged original sealed packaging, in dry and cooled conditions. Refer to specific information contained in the Product Data Sheets regarding minimum and maximum storage temperatures. Protect the products from direct sunlight.

Sika CarboDur® plates and BC rods may only be transported in their original packaging or otherwise adequately protected against any mechanical damage.

## 4 EQUIPMENT

### 4.1 TOOLS



Diamond saw



High pressure cleaner



Vacuum cleaner



Brush



Trowel



Adhesive gun & cartridges



Mixing Container



Mixer Spindle



Mixing Paddle  
(for larger quantities)



Paintbrush

### 4.2 CLEANING

Clean all tools and application equipment with *Sika® Thinner C*, immediately after use. Hardened material can only be removed mechanically.

## 5 HEALTH AND SAFETY

### 5.1 RISK ASSESSMENT



The risks to health and safety from everything including any defects in the structure, working procedures and all of the chemicals used during the materials installation must be properly assessed and safely accommodated.

Any working areas on platforms and temporary structures must also provide a stable and safe area to work. All work and working procedures must be carried out fully in accordance with the relevant local health and safety legislation.

### 5.2 PERSONAL PROTECTION

#### Work Safely!

Safety shoes, gloves and other appropriate skin protection should be worn at all times. The use of disposable or new / clean protective clothing during the materials preparation and application is strongly recommended.

Always wear nitrile based protective gloves when handling epoxy adhesives as they can cause skin irritation.

Apply barrier cream to hands and any unprotected skin before starting work.

Appropriate eye protection should be worn at all times whilst handling, mixing and installing the products. Carrying an eye wash with you at all times is recommended.

Always wash hands with suitable soap and clean water after handling the products and before food consumption, smoking, visiting the toilet and after finishing work.

The work area needs to be well ventilated and operatives should take frequent breaks in fresh air to avoid any other health issues.

Silica dust produced by the grinding or blast cleaning of concrete can be hazardous. Protect yourself and others by using a vacuum grinder or vacuum blast cleaning equipment with dust extraction and abrasive recycling attachments respectively. Always wear a dust mask/respirator when grinding concrete. Do not inhale the concrete dust.



**For more detailed health and safety information, refer to the relevant Material Safety Data Sheet (MSDS)**

### 5.3 FIRST AID



If the epoxy resin based adhesive products come into contact with eyes or mucous membranes, remove any glasses or contact lenses and rinse with clean warm water for 10 to 15 minutes then seek medical attention.

Any chemical spillages on skin must be cleaned immediately and rinsed thoroughly with clean warm water.

For more detailed health and safety information, please refer to the relevant Material Safety Data Sheet (MSDS).

## 5.4 WASTE DISPOSAL



Do not empty any surplus material into drainage or water systems; dispose of all waste materials and packaging responsibly through licensed waste disposal facilities or contractors, fully in accordance with local legislation and the authorities' requirements. Also avoid any chemical materials run-off into soil or into waterways, drains or sewers.

Any uncured adhesive waste or spillages must be disposed of as hazardous waste. Waste and / or residual Sika® Thinner C must be disposed of according to local regulations. Cured adhesive waste can be disposed of safely as normal building materials waste according to the relevant

local regulations.

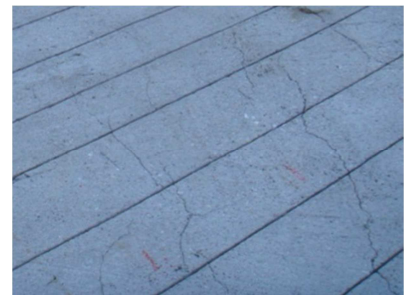
For more detailed health and safety information, please refer to the relevant Material Safety Data Sheet (MSDS)

## 6 SUBSTRATE PREPARATION

*Note: This Section only treats the preparation of concrete substrates for the installation of the Sika CarboDur® NSM system. For other substrate types, please refer to the appendix of this document (Section 9.2).*

Unlike in other applications, installation of the NSM system into cracked (see picture below) or slightly damaged concrete is possible and independent of the surface tensile strength of the concrete.

To prepare the concrete surface, the concrete has to be checked for the depth of reinforcements and care must be taken not to cut through existing reinforcing steel, steel tendons, embedded ducts, or other materials within the substrate. Grooves are cut with a depth and width according to the table below. The surface must be clean and sound. It may be dry or damp, but free of standing water and frost. Remove dust, laitance, grease, curing compounds, impregnations, waxes, or other foreign particles, together with any damaged concrete or other bond inhibiting materials from the surface.



In addition, immediately prior to installation, clean the cut groove with high pressure water and remove the excess water with oil-free compressed air.

Sika CarboDur®	Groove size		Groove size	
	Sika minm Recommendation		According to ACI 440.2R-08	
Bar type	Width	Depth	Width	Depth
BC6	9 mm	9 mm	≥9 mm	≥9 mm
BC8	11 mm	11 mm	≥12 mm	≥12 mm
BC10	13 mm	13 mm	≥15 mm	≥15 mm
BC12	15 mm	15 mm	≥18 mm	≥18 mm
Plate type				
S1.030	6 - 8 mm	15 mm	≥9 mm	≥15 mm
S1.525	6 - 8 mm	20 mm	≥7.5 mm	≥22.5 mm
S2.025	6 - 8 mm	25 mm	≥7.5 mm	≥30 mm
SikaWrap® FX fibre connector	≥15 mm	≥15 mm	≥15 mm	≥15 mm

The table above lists the recommended groove sizes for standard application conditions in reinforced concrete. Specific site or structural conditions or standards may require different groove sizes.

## 7 APPLICATION

Before starting the works on site, we always recommend that you prepare a checklist (an example is given in Section 9.3 to ensure that all of the necessary tools and materials are available on site ready for the installation works. Review the ambient conditions and confirm that the most appropriate type of Sikadur<sup>®</sup> adhesive is available for the conditions on site, the specified program and the desired performance and exposure in service.

### 7.1 ADHESIVE

Dependent on the application requirements (substrate quality, application type, groove width), different adhesives can be used for the installation of the Sika<sup>®</sup> CarboDur<sup>®</sup> NSM system, see below.

The most common adhesive is Sikadur-330<sup>®</sup>, which is suitable for most applications as outlined in the table below.

Layout	Groove Width	Product
Horizontal	≤12 mm	Sikadur <sup>®</sup> -330
	≥12 mm	Sikadur <sup>®</sup> -30, Sikadur <sup>®</sup> -33*
	all	Sikadur <sup>®</sup> -300
Vertical	≤12 mm	Sikadur <sup>®</sup> -330
	≥12 mm	Sikadur <sup>®</sup> -30, Sikadur <sup>®</sup> -33*
Overhead	≤12 mm	Sikadur <sup>®</sup> -330
	≥12 mm	Sikadur <sup>®</sup> -30, Sikadur <sup>®</sup> -33*

\* **PLEASE NOTE:** Sikadur<sup>®</sup> 33 has a short open time and may not be suited for large applications / long grooves

The adhesives can be supplied and mixed in their pre-batched units, or supplied and mixed from bulk packaging, according to the volumes required and the practical situation on site:

Sika Sikadur<sup>®</sup>-33 is always supplied in pre-packaged cartridges and does not need to be mixed or filled into a different cartridge for application. For more details on the respective and comparative performance of the different adhesives, their pot life and other characteristics, refer to the relevant Product Data Sheets.

#### Pre-batched packs:

Add component B to component A and stir with a mixing spindle fitted to an electric low speed mixer (max. 500 rpm) to avoid entrapping air. Mix thoroughly for about 3 minutes to a homogeneous mix with a uniform grey color and appearance. Then, pour the whole mix into a clean container and stir again for approx. one more minute, again at low speed to keep air entrapment at a minimum.

#### Bulk packing, not pre-batched:

Stir the material components well in their individual containers. Measure and add the components together, in the correct proportions, in a suitable mixing container, then stir using an electric low speed mixer and continue as stated above for the pre-batched packs. For larger quantities use a mixing paddle (jiffy mixer) instead of a mixing spindle.

The adhesive pot life begins when the resin and hardener are mixed. It is shorter at high temperatures and longer at low temperatures. Additionally the greater the quantity / volume of material mixed together at one time, the shorter the pot life. To obtain longer workability at high temperatures, the mixed adhesive may subsequently be divided into portions; alternatively another method is to chill the components A and B before mixing them.





After mixing, the adhesive is filled into cartridges for application with the adhesive guns (see picture left). If metal barrel guns or cartridges are used, such as professional 'sausage' sealant guns, then they must be cleaned immediately after use with *Sika® Thinner C* as any hardened adhesive can only be removed mechanically. As an alternative, disposable single-use plastic cartridges can be used.

The table in the appendix (section 9.1) summarizes the approximate consumption of adhesive per metre for the different combinations of products. Actual adhesive consumption achieved is not only dependent on the specific groove dimensions, but also on the filling levels, any over-filling, loss and wastage.

## 7.2 INSTALLATION

After cutting and cleaning of the grooves, the dew point must be measured prior to the system installation to make sure no condensed water impairs the application. The ambient temperature must be at least 3° above the dew point. The installation should then be performed as follows:

- Rods and plates may be supplied pre-cut or cut to an appropriate length on site with a diamond blade on a chop saw, or with a grinding disc. The cutting zone should be wrapped with adhesive tape to minimize any splintering.
- Immediately prior to installation, all rod or plate surfaces should be wiped with *Sika® Thinner C* to remove any possible contaminants. The rods and plates may only be installed if the surface is completely dry before applying the adhesive.
- A suitable adhesive is selected and prepared according to the relevant PDS
- The adhesive is filled into an empty cartridge / barrel gun and the grooves are filled from the bottom up, with the tip of the nozzle squeezed flat (see image A, right), in order to reach the bottom of the groove. Special care shall be taken that the grooves are filled completely and that no air is entrapped.
- Within the open time of the epoxy (dependent on the temperature), the CarboDur® rods or plates are pressed into the adhesive in the grooves (see image B, right). If necessary, additional adhesive can be applied to fill the grooves, or any excess adhesive is removed. Do not re-use the excess adhesive.
- Strike the surface with a trowel to force out any air and provide a clean installation. For optimum adhesion of any possible additional layers, the adhesive may be broadcast and covered lightly with quartz sand, (see image C, right). Note that any sand must be graded, clean and kiln dried.



### 7.3 FLEXIBLE NSM STRENGTHENING

For the application of the SikaWrap® FX fibre connector as a near surface mounted reinforcement, the substrate is prepared and cleaned as described above. The SikaWrap® FX is then cut to length with special scissors and impregnated with Sikadur®-300 or Sikadur®-52 resin on a plastic sheet. The excess resin is squeezed out of the fibres and the connector is fixed with a cable tie every 40 – 50 cm. The fibres will stick together with the help of the resin. Only work in fibre direction during impregnation in order to keep the fibres aligned and untangled.

The grooves are then filled up to 2/3 with a suitable adhesive (see table in section 7.1) and the fibre connector is placed in the groove. It must be pushed into the adhesive gently and special care has to be taken that the fibres remain undisturbed and aligned in parallel. If a long connector needs to be installed, the impregnated string can be wound on a cardboard cone for transportation and handling.

After placing the SikaWrap® FX into the groove, it is covered with additional adhesive as necessary to fill the groove and may be sanded with quartz sand if specified.

## 8 INSPECTION AND TESTING

Visual assessment and recording of the installation is necessary during every stage. Check the filled grooves for any air voids or premature drying of the adhesive before insertion of the rods, plus always ensure that the plates or rods are completely embedded in the adhesive.

If necessary, the compressive strength and air content of the adhesive can also be tested according to *EN 196*.

## 9 APPENDIX

### 9.1 RESIN CONSUMPTION

Sika® CarboDur®			
Groove size			
Rod type	Width	Product	Consumption
BC6	9 mm	Sikadur® -30	~ 0.09 kg/m
		Sikadur® -300	~ 0.06 kg/m
		Sikadur® -330	~ 0.07 kg/m
		Sikadur® -33	~ 0.06 l/m
BC8	11 mm	Sikadur® -30	~ 0.16 kg/m
		Sikadur® -330	~ 0.13 kg/m
		Sikadur® -33	~ 0.10 l/m
BC10	13 mm	Sikadur® -30	~ 0.23 kg/m
BC12	15 mm	Sikadur® -30	~ 0.30 kg/m

SikaWrap®			
Plate type	Width	Product	Consumption
S1.030	6 - 8 mm	Sikadur® -30	~0.13 kg/m
		Sikadur® -300	~0.04 kg/m
		Sikadur® -330	~0.05 kg/m
		Sikadur® -33	~0.04 l/m
S1.525	6 - 8 mm	Sikadur® -300	~0.06 kg/m
		Sikadur® -330	~0.07 kg/m
S2.025	6 - 8 mm	Sikadur® -300	~0.08 kg/m
		Sikadur® -330	~0.09 kg/m

#### SikaWrap FX Impregnation

FX Type	Product	Consumption
FX-50C	Sikadur® -30	~0.30 kg/m
	Sikadur® -52	

## 9.2 USE IN TIMBER AND MASONRY

In addition to reinforced concrete, the NSM system can also be used on timber and masonry structures.

**Timber:** Cut grooves into the timber and remove all dust with oil-free compressed air and / or vacuum immediately before application of the adhesive. The surface must be sound and reasonably flat, so the whole Sika® CarboDur® rod or plate can be completely embedded. Proceed as described for concrete in Section 7.2.

**Masonry:** Make sure that the masonry structure is sound and fit for the installation of the Sika® CarboDur® NSM system. It is possible to install the system into a slightly cracked surface, but crumbling bricks and deteriorated material will impair the quality and effectiveness of the reinforcement system. The responsible Structural Engineer must make the necessary inspection and calculations.

To install, cut grooves into the masonry and remove all dust with oil-free compressed air and / or vacuum immediately before application of the adhesive. Proceed as described for concrete in Section 7.2.

## 9.3 ON-SITE CHECKLISTS

- |   |                                 |
|---|---------------------------------|
| ○ Diamond saw for concrete                | ○ Sika CarboDur® plates or rods |
| ○ High pressure cleaner                   | ○ SikaWrap® FX                  |
| ○ Vacuum cleaner                          | ○ Cutting equipment             |
| ○ Compressed air                          | ○ Adhesive                      |
| ○ Mixing container                        | ○ Quartz sand                   |
| ○ Mixer                                   |                                 |
| ○ Mixing paddle                           | ○ Nitrile gloves                |
| ○ Adhesive gun<br>(with empty cartridges) | ○ Hard hat                      |
| ○ Trowels                                 | ○ Safety goggles                |
|   | ○ Dust mask                     |
| ○ Dew point measuring device              | ○ Ear protection                |

	YES	NO
Does the air and surface temperature exceed 5°C?		
The actual average temperature is: [°C]		
Is the ambient temperature at least 3° above the dew point?		
Is the moisture content of the concrete below 4%?		
Is there standing water on the surfaces?		
Have there been any deviations from or changes of the initial Engineer's specification?		
If Yes, describe and detail further:		

## 10 LEGAL NOTE

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 products 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.

## 11 KEY WORDS

Structural strengthening, negative moments, NSM, near surface mounted, CarboDur S plates, CarboDur BC Rods, SikaWrap FX, Sikadur resin, Sikadur-30, Sikadur-330, Sikadur-300, Sikadur-52, Sikadur-33



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### TECHNICAL INFORMATION MANUAL

Sika CarboDur® Near Surface Mounted Reinforcement Sika Ltd – Mark Shaw  
11.07.2017, VERSION 1  
850-41-007