



METHOD STATEMENT

Sika® CarboDur®

Near Surface Mounted Reinforcement

03.01.2023 / VERSION 2.5 / SIKA® LIMITED / ROB DOHERTY

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Method Statement

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1 INTRODUCTION

This Method Statement is written as a guideline for the use of the Sika® CarboDur® 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 do not hesitate to contact your local Sika® Technical Service Department who will be pleased to assist you.

2 SYSTEM DESCRIPTION

The Sika® CarboDur® NSM System is a high-performance Structural Strengthening System consisting of Sika® CarboDur® Plates or Rods and Sikadur®-30, Sikadur®-330 or Sika® Anchorfix®-3030. It is used for the post construction reinforcement of buildings and civil engineering structures or elements.

As an alternative to Sika® CarboDur® Plates and Rods, the SikaWrap® FX-50 can be used as a flexible NSM strengthening material.

2.1 REFERENCES

This Method Statement has been written in accordance with the recommendations contained in **ACI 440.2R-17** and **TR55 – Design Guidance for Strengthening Concrete Structures Using Fibre Reinforced Composite Materials**.

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 local 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.

3 PRODUCTS

Sika® Brand	Description
Sika® CarboDur® Plates	<p>Sika® CarboDur® Plates are pultruded carbon fibre reinforced polymer (CFRP) laminates designed for strengthening concrete, timber and masonry structures.</p> <p>The Plates come in different widths and can be obtained pre-cut or as lengths to be cut on site.</p>
Sika® CarboDur® BC Rods	<p>Sika® CarboDur® BC Rods are pultruded carbon fibre reinforced polymer (CFRP) laminates. They are designed for strengthening concrete, masonry and timber structures.</p> <p>The Rods / Bars come with different diameters and can be obtained pre-cut or as a coil to be cut on site.</p>
SikaWrap® FX-50	SikaWrap® FX-50 is a unidirectional carbon fibre string, encased in plastic.
Sikadur®-330	Sikadur®-330 is a two-part, thixotropic, epoxy resin based, impregnation resin / adhesive.
Sikadur®-300	Sikadur®-300 is a two-part, epoxy resin based, impregnation 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®-52	Sikadur®-52 Injection Normal is a two-part, solvent-free, low viscosity injection-liquid based on high strength epoxy resin.
Sika® Anchorfix®-3030	Sika® Anchorfix®-3030 is a solvent-free, thixotropic, two-part, epoxy resin-based, very high performance anchoring adhesive.

For more detailed information on the products, please refer to the corresponding Product Data Sheet.

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.

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4 EQUIPMENT

4.1 TOOLS



Diamond Saw



High Pressure Cleaner



Vacuum Cleaner



Brush



Trowels



Hand-Held Mixer



Adhesive Gun & Cartridges



Mixing Container



Mixer Spindle



Mixing Paddle
(for larger quantities)



Paintbrush



Scraper

4.2 CLEANING

Clean all tools and application equipment with Sika® Thinner C (or an Isopropanol based cleaner), immediately after use. Hardened material can only be removed mechanically.

5 HEALTH AND SAFETY

5.1 RISK ASSESMENT



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 boots, 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.



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.

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 leftover 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).

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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 Method Statement 850-41-10 Substrate Preparation for Sika® Rigid Bonding and Structural Strengthening Systems.

Unlike in other applications, installation of the NSM System into cracked (see picture on the right) 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 reinforcement 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 matt 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.



Bar Type	Sika® Recommendation		TR 55 (§6.4.5)	
	Width	Depth	Width	Depth
Sika® CarboDur® BC 6	9 mm	9 mm	10 - 14 mm	≥ 10 mm
Sika® CarboDur® BC 8	11 mm	11 mm	12 - 16 mm	≥ 12 mm
Sika® CarboDur® BC 10	13 mm	13 mm	14- 18 mm	≥ 14 mm
Sika® CarboDur® BC 12	15 mm	15 mm	16 - 20 mm	≥ 16 mm
Plate Type				
Sika® CarboDur® S1.030	6 - 8 mm	15 mm	≥ 9 mm	≥ 14 mm
Sika® CarboDur® S1.525	6 - 8 mm	20 mm	≥ 7,5 mm	≥ 19 mm
Sika® CarboDur® S2.025	6 - 8 mm	25 mm	≥ 7,5 mm	≥ 24 mm
Connector Type				
SikaWrap® FX-50 C	≥ 15 mm	≥ 15 mm	14- 18 mm	≥ 14 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 shown 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® 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® CarboDur® NSM System - see below.

The most common adhesive is Sikadur®-330, which is suitable for most applications as outlined in the Table below.

Layout	Groove Width	Product
Horizontal	≤ 12 mm	Sikadur®-330
	≥ 12 mm	Sikadur®-30, Sika® Anchorfix®-3030*
	all	Sikadur®-300
Vertical	≤ 12 mm	Sikadur®-330
	≥ 12 mm	Sikadur®-30, Sika® Anchorfix®-3030*
Overhead	≤ 12 mm	Sikadur®-330
	≥ 12 mm	Sikadur®-30, Sika® Anchorfix®-3030*

***PLEASE NOTE:** Sika® Anchorfix® products have shorter open times and may not be suitable for large applications / long grooves.

The adhesives are supplied and mixed in their pre-batched units. Sika® Anchorfix® products are supplied in pre-packaged cartridges for ease of use, and do 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, please 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 (maximum 500 rpm) to avoid entrapping air. Mix thoroughly for about 3 minutes to a homogeneous mix with a uniform color and appearance. Then, pour the whole mix into a clean container and stir again for approximately one more minute, again at low speed to keep air entrapment at a minimum.

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 is. 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.

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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 (or an Isopropanol based cleaner), 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) summarises the approximate consumption of adhesive per metre for the different combinations of products. Please keep in mind that the 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°C above the dew point. The installation should then be performed as follows:

- Rods and Plates are easily 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 minimise any splintering.
- Immediately prior to installation, all Rod or Plate surfaces should be wiped with Sika® Thinner C (or an Isopropanol based cleaner) 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 Product Data Sheet.
- 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 Sika® 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 removed. Do not re-use the excess adhesive.
- Strike the surface with a trowel or scraper 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.



Flexible NSM Strengthening

For the application of the SikaWrap® FX-50 C fibre connector as a near surface mounted reinforcement, the substrate is prepared and cleaned as described in Section 6 above. The SikaWrap® FX-50 C is then cut to length with suitable scissors and impregnated with Sikadur®-300 or Sikadur®-52 Injection Normal 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 the 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 must 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-50 C 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, and 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 **BS EN 196**.

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9 APPENDIX

9.1 RESIN CONSUMPTION

Rod Type	Groove Size (width x depth)	Product	Consumption
Sika® CarboDur® BC 6	9 mm × 9 mm	Sikadur®-30	~0.09 kg/m
		Sikadur®-330	~0.07 kg/m
		Sikadur®-300	~0.06 kg/m
Sika® CarboDur® BC 8	11 mm × 11 mm	Sikadur®-30	~0.12 kg/m
		Sikadur®-330	~0.09 kg/m
		Sikadur®-300	~0.08 kg/m
Sika® CarboDur® BC 10	13 mm × 13 mm	Sikadur®-30	~0.15 kg/m
		Sikadur®-330	~0.10 kg/m
		Sikadur®-300	~0.06 kg/m
Sika® CarboDur® BC 12	15 mm × 15 mm	Sikadur®-30	~0.18 kg/m
		Sikadur®-330	~0.15 kg/m
		Sikadur®-300	~0.13 kg/m

Plate Type	Groove Size (width x depth)	Product	Consumption
Sika® CarboDur® S1.030	8 mm × 15 mm	Sikadur®-30	~0.15 kg/m
		Sikadur®-330	~0.12 kg/m
		Sikadur®-300	~0.10 kg/m
Sika® CarboDur® S1.525	8 mm × 20 mm	Sikadur®-30	~0.20 kg/m
		Sikadur®-330	~0.16 kg/m
		Sikadur®-300	~0.14 kg/m
Sika® CarboDur® S2.025	8 mm × 25 mm	Sikadur®-30	~0.25 kg/m
		Sikadur®-330	~0.20 kg/m
		Sikadur®-300	~0.17 kg/m

SikaWrap® FX-50 C Impregnation

FX Type	Groove Size (width x depth)	Product	Consumption
SikaWrap® FX-50 C	15 mm × 15 mm	Sikadur®-300	~0.23 kg/m
		Sikadur®-52 Injection Normal	~0.20 l/m

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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; the local Sika® Technical Services Department is available to assist you.

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 / angle grinder / chasing blade for concrete
- High pressure cleaner
- Vacuum cleaner
- Compressed air
- Mixing container
- Mixer
- Mixing paddle
- Adhesive gun (with empty cartridge)
- Trowels and / or scrapers
- Dew point measuring device
- Sika® CarboDur® Plates or Rods
- SikaWrap® FX-50 C
- Cutting equipment
- Adhesive
- Quartz sand
- Nitrile gloves
- Hard hat
- Safety goggles
- Dust mask
- Ear protection
- Safety boots

	YES	NO
Does the air and surface temperature exceed the minimum temperature stated on the Product Data Sheet?		
The actual average temperature is: [°C]		
Is the ambient temperature at least 3°C above the dew point?		
Is the moisture content of the concrete below 4% (percentage by weight)?		
Is there standing water on the surface?		
Have there been any deviations from or changes of the initial Engineer's specification?		
If Yes, please 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.

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