CONCRETE CANVAS®

Concrete Impregnated Fabric

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MADE IN UK

CONCRETECANVAS

INSTALLATION GUIDE: REMEDIATION

RAIL ROAD MINING PETROCHEM AGRO UTILITIES MUNICIPAL DEFENCE DESIGN

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2009 Winner Material Connexion Medium Award Material of the Year

2007 Winner D&AD Yellow Pencil Award Product Design

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CONCRETE CANVAS INSTALLATION GUIDE: REMEDIATION

Concrete Canvas® GCCM* (CC) can be used to create a hard wearing surface as an effective remediation for old or damaged concrete. CC is typically used where existing concrete structures have experienced cracking or spalling, and would otherwise require extensive repair or complete replacement.

The following guide provides information for installers, customers and specifiers of CC and an overview of the installation techniques required for using CC for concrete remediation. The versatile nature of CC means that this document is not exhaustive and is intended for guidance purposes only.

Here are some key questions you may need to consider before specifying or purchasing CC.

Which Thickness?

CC is available in three thicknesses; CC5™ (5mm), CC8™ (8mm), and CC13™ (13mm).

- CC5™ is most commonly used to line concrete structures that will not be regularly trafficked (e.g. by maintenance contractors). CC5™ is the most commonly specified thickness for concrete remediation projects.
- CC8 and CC13™ are recommended for remediating water courses with high flow rates, areas of highly turbulent flow (e.g. the base of a weir), where there is expected to be regular traffic, or when lining access points.

Which Format?

CC is available as large bulk rolls (1.5T to 1.6T) or as smaller man-portable batched rolls (60-70kg CC5™ & CC8™ only). Installation is fastest using bulk rolls dispensed using a spreader beam (available for hire/purchase from Concrete Canvas Ltd). For sites where heavy lifting equipment is not available or access is limited the batched, man-portable rolls should be used. See the table below for exact specifications.

CC Type	Thickness (mm)	Roll Width (m)	Dry Weight (kg/sqm)	Batched Roll Coverage (sqm)	Batched Roll Length (m)	Bulk Roll Coverage (sqm)	Bulk Roll Length (m)
CC5™	5	1.0	7	10	10	200	200
CC8™	8	1.1	12	5	4.55	125	114
CC13™	13	1.1	19	N/A	N/A	80	73

Table 1

Batched rolls

Bulk roll

*Geosynthetic Cementitious Composite Mat

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Which Fixing Method?

When installing over a smooth, rigid substrate such as poured/pre-cast concrete or asphalt, CC must be firmly anchored to the substrate to mitigate the potential effects of drying shrinkage. The most secure method for fixing the end of a length of CC is with a poured concrete anchor trench. Where this is not practical, appropriate concrete fixings such as fired concrete 'Hilti' nails, wedge anchors or masonry bolts can be used (see figure 1).

CC captured with a poured concrete curb

CC anchored using a fired concrete nail with a 20mm washer

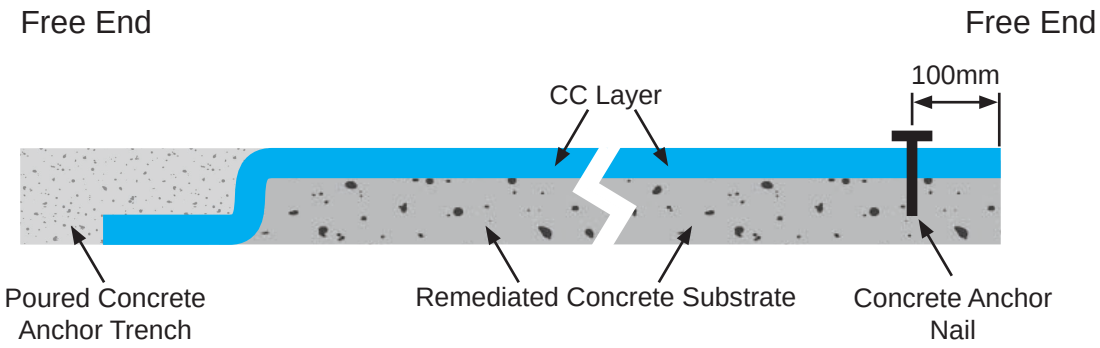

Figure 1. Typical installation of a continuous long section of CC over an extensive concrete substrate. Where anchoring is required either poured concrete anchor trenching or concrete anchor nailing may be used as appropriate

The following rules should be followed to determine the location of fixings:

1. Fixings are required at the 'free-ends' of all lengths of CC.

2. Intermediate fixings are required at a 'concave profile change' when the distance from the profile change to the next fixing is greater than 5m. The fixings should be located approximately 100mm from the profile change (see examples below).

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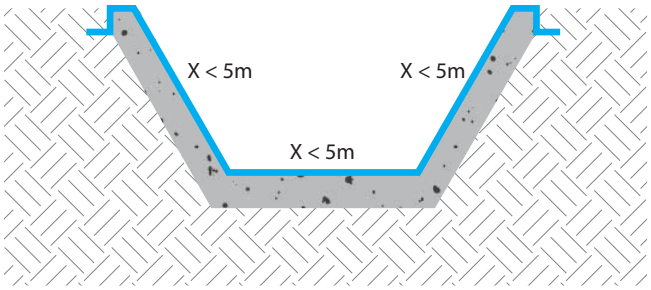

Figure 2.1 Fixing only of free ends.

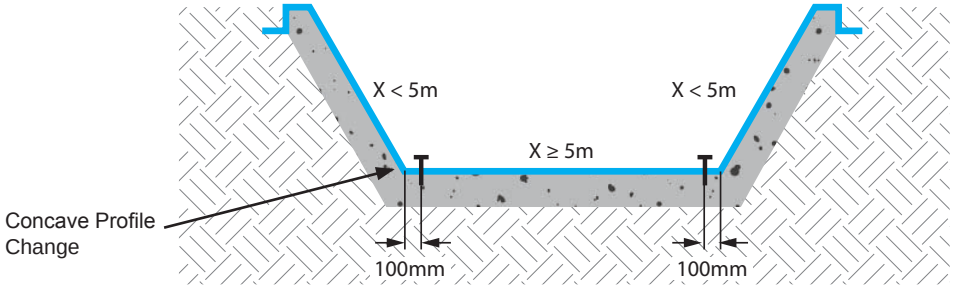

Figure 2.2 Base ≥ 5m fixing at 100mm from concave profile change.

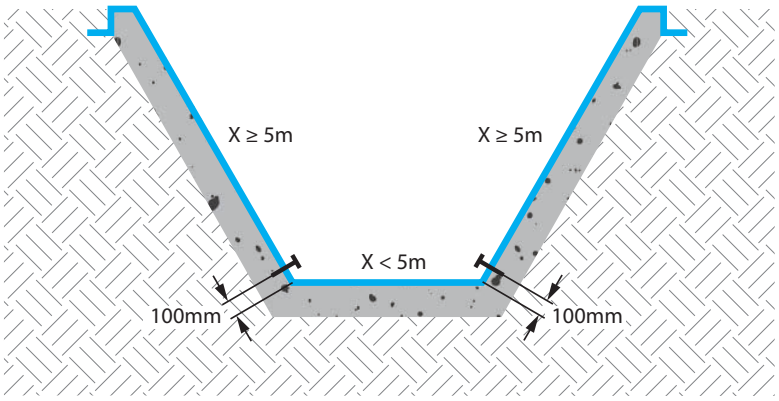

Figure 2.3 Sides ≥ 5m fixing at 100mm from concave profile change.

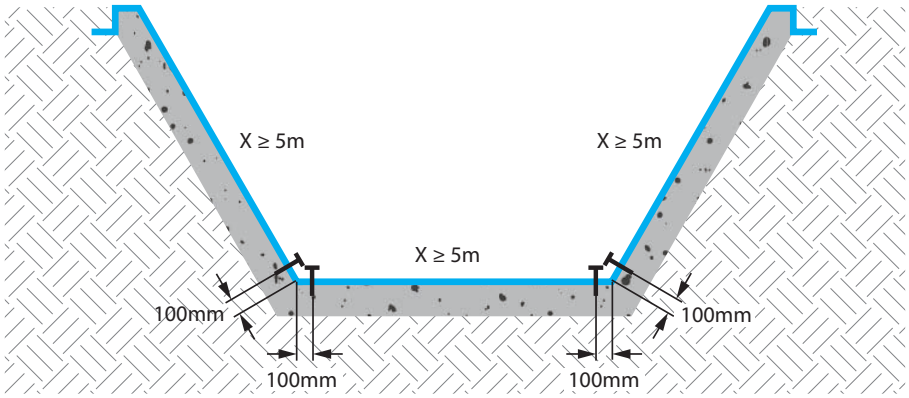

Figure 2.4 Sides and base ≥ 5m fixing at 100mm from both sides of concave profile change.

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Fixing Specification

- CC must always be fixed with a poured concrete anchor trench or in accordance with the following:
- The fixings must have a shank Ø>3mm, washer Ø>16mm.
- The minimum number of fixings required for a given thickness of CC is shown in table 2.
- More fixings may be required as a sufficient number of fixings must be used to withstand a total shear force (V_{REC}/m) per 1m width of CC, as shown in the table 2 below. See fixing manufacturers specification for V_{REC} per fixing in a given strength of concrete.
- The fixings should be 100mm from the end of the CC or the apex of the concave profile change.

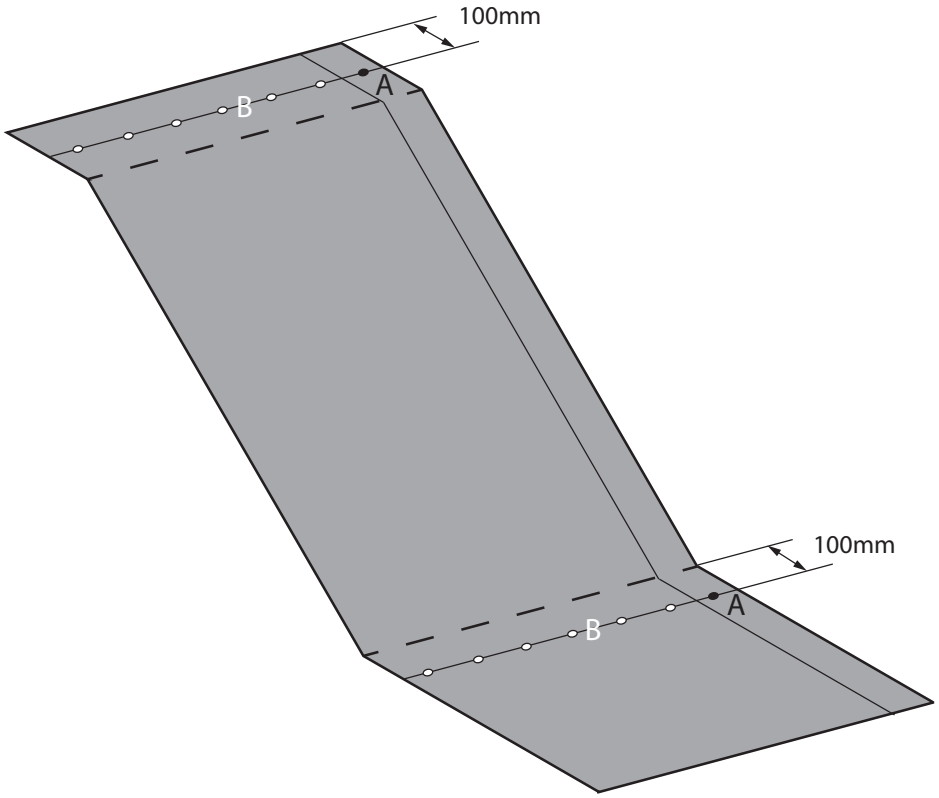
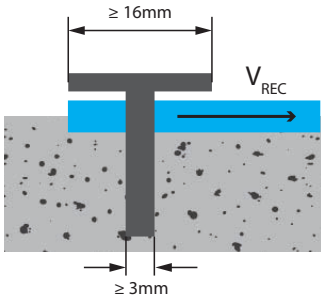


Figure 3. Anchoring at terminal ends and at concave profile changes, should include a fixing through the overlap joint abutting the adjacent strip of CC (A) and the number of fixings (B) shown in the table 2 below for the thickness of CC, equally spaced across the remaining width.

	Number of Fixings (A)	(B)	V_{REC}/width (total shear force per width of CC - A + B)
CC5™	1	5	8 kN
CC8™	1	7	16 kN
CC13™	1	9	25 kN
Total profile length <3.0m (CC5, CC8, CC13)	1	3	N/A

Table 2. Minimum bolt requirements for the three CC thicknesses', and their total shear capacity. Ensure sufficient fixings are used to resist hydraulic sheer forces resulting from peak designed flow velocity (Mannings No. n = 0.011). Additional fixings may be required in areas of turbulent flow.



For example: to fix a width of CC8™ to a 20MPa concrete structure. Table 1 shows a minimum of 1 fixing through the 100mm overlap joint (A) and a minimum of 7 fixings through the body of the CC. It is proposed to use Hilti DBZ 6/35 Wedge Anchors as these have a 6mm shank and a 16mm washer. The Design Resistance (V_{REC}) of this fixing in 20MPa concrete is 2.2kN and table 2 shows a total shear force requirement of 16kN per 1.1m width of CC. Therefore: 16kN/2.2kN = 7.3 fixings required per width of CC8™. 7.3 is rounded up to give a total of 8 fixings that will be required: 1 through the joint (A) and 7 evenly spaced through the body of the CC (B).

Ensure sufficient fixings are used to resist the hydraulic shear force resulting from the peak design flow velocity. (mannings no n=0.011). Additional fixings may be required in areas of turbulent flow.

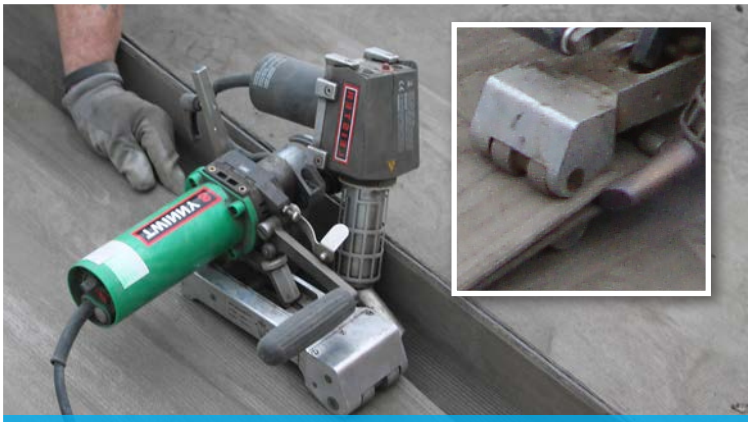
Which Jointing Method?

Adjacent layers of CC should be overlapped by a minimum of 100mm in the direction of water flow and CC can be jointed in the in the length or width direction along the overlap using masonary fixings, adhesive sealant, grout or by thermal welding. Typically an adhesive sealant joint is used for remediation applications. Please see the CC *User Guide: Jointing and Fixing* for the full range of jointing methods available.


Masonry fixings


Double bead of adhesive sealant


Grouted joint applied using a hand tool


Automatic thermal welding machine

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INSTALLATION GUIDE: REMEDIATION

Installation

1. Ground Preparation

Failing concrete must be cleaned and mortar applied to larger cracks (typically anything larger than 50mm in any direction) to eliminate voids under the CC. Any loose soil, rocks, concrete debris, and vegetation should be removed.

2. Laying CC

Unroll the CC onto the surface to be remediated, with the fibrous surface facing up and the PVC membrane in contact with the ground. Tuck the CC into any corners, ensuring there is intimate contact with the substrate - once in position cut the material to length.

3. Positioning and Fixing

Ensure a minimum overlap of 100mm in the direction of water flow when jointing adjacent layers of CC. Apply fixings as per the guidance above.

4. Jointing

Adhesive sealant is the most commonly used method of jointing for remediation projects. *See CC User Guide: Jointing and Fixing* for detailed instructions and alternative jointing methods. Where possible CC should be hydrated under the overlaps prior to jointing.

5. Hydration

Once positioned, CC should be hydrated by spraying with water (sea water may be used). Refer to the CC *Hydration Guide* for full hydration and setting instructions.

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CONCRETE CANVAS

DATA SHEET

Concrete Canvas® GCCM Material Data

Concrete Canvas® GCCM Physical Properties*

Product	Thickness (mm)	Batch Roll Size (sqm)	Bulk Roll Size (sqm)	Roll Width (m)
CC5™	5	10	200	1.0
CC8™	8	5	125	1.1
CC13™	13	N/A	80	1.1

Product	Mass (unset) (kg/m²)	Density (unset) (kg/m³)	Density (set) (kg/m³)
CC5™	7	1500	+30-35%
CC8™	12	1500	+30-35%
CC13™	19	1500	+30-35%

Pre-Set Concrete Canvas® GCCM Properties

Setting

Working Time

1-2 hours subject to ambient temperature

CC will achieve 80% strength at 24 hours after hydration.

Method of Hydration

Spray the fibre surface with water until it feels wet to touch for several minutes after spraying.

Re-spray the CC again after 1 hour if:

- Installing CC5™
- Installing on a steep or vertical surface

Notes:

- An excess of water is always recommended. CC will set underwater and in seawater.
- CC must be actively hydrated. For example do not rely on rainfall or snowmelt.
- Use a spray nozzle for the best results (see CC equipment list). Do not jet high pressure water directly onto the CC as this may wash a channel in the unset CC.
- CC has a working time of 1-2 hours after hydration. Do not move or traffic CC once it has begun to set.
- Working time will be reduced in hot climates and increased in very cold climates.
- CC will set hard in 24 hours but will continue to gain strength over time.
- If CC is not sufficiently wetted, or dries out in the first 5 hours, the set may be delayed and strength reduced. If the set is delayed avoid trafficking the material and re-wet with an excess of water.

Refer to the *Concrete Canvas Hydration Guide* for installation in low temperatures or drying conditions.

- Low Temperature Conditions occur the ground surface temperature is between 0 and 5°C and rising or is expected to fall below 0°C in the 8 hours following hydration.
- Drying Conditions occur when there is one or more of: high air temperature (>22°C), wind (> 12km/h), strong direct sunlight or low humidity (<70%).

Post Set Concrete Canvas® GCCM Properties

Based on Concrete Canvas GCCM ® hydrated in accordance with the Concrete Canvas® Hydration Guide.

Strength

Very high early strength is a fundamental characteristic of CC. Typical strengths and characteristics are as follows:

Compressive tests based on ASTM C109 – 02 (initial crack)
- 10 day compressive failure stress (MPa) 40

Bending tests based on BS EN 12467:2004 (initial crack)
- 10 day bending failure stress (MPa) 3.4

Tensile data (initial crack)

	Length direction (kN/m)	Width direction (kN/m)
CC5™	6.7	3.8
CC8™	8.6	6.6
CC13™	19.5	12.8

Reaction to Fire

CC has achieved **Euroclass B certification**:
BS EN 13501-1:2007+A1:2009 B-s1, d0

Flame Resistance: **MSHA ASTP-5011**
Vertical and Horizontal Certification Passed

Age Testing (minimum 50 year expected life)

Freeze-Thaw testing (ASTM C1185) 200 Cycles
Freeze-Thaw testing (BS EN 12467:2004 part 7.4.1) Passed
Soak-Dry testing (BS EN 12467:2004 part 5.5.5) Passed
Heat-Rain testing (BS EN 12467:2004 part 7.4.2) Passed
Water impermeability (BS EN 12467:2004 part 5.4.4) Passed**

Other

Abrasion Resistance (ASTM C-1353)
Approximately 7.5x greater than 17MPa OPC Passed

Manning's Value (ASTM D6460) n = 0.011

Root Resistance (DD CEN/TS 14416:2005) Passed

Chemical Resistance (BS EN 14414)
- Acid (pH 1.0) (56 day immersion at 50°C) Passed
- Alkaline (pH 13.0) (56 day immersion at 50°C) Passed
- Hydrocarbon (56 day immersion at 50°C) Passed
- Sulfate Resistance (28 day immersion at pH 7.2) Passed

Impact Resistance of Pipeline Coatings
ASTM G13 (CC13™ only) Passed

Permissible Shear & Velocity CC8™ (ASTM D-6460)
- Shear (Pa) 1200
- Velocity (m/s) 10.7

Product exceeded large scale testing capabilities and was not tested to failure.

To achieve these permissible values, the CC material must be properly anchored with a system designed to meet or exceed these values.

Other Information

* Occasionally there will be a Beam Fault (fabric imperfection under 100mm wide running across the width) in a Bulk Roll. This fault is unavoidable due to the manufacturing process and the fault will be clearly marked with a white tag, there will be a maximum of (1) one Beam Fault in any Bulk Roll. A joint may need to be made on site where there is a Beam Fault as the material at a fault will not reach the performance specified in this Data Sheet. The maximum un-useable material due to any Beam Fault will be 100mm. There are no beam faults in standard batched rolls.

* Indicative values

** For containment applications it is recommended to use CC Hydro™

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EN12467:2004
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Fibre cement sheet
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Oversize sheets
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