



# CONCRETE CANVAS

## INSTALLATION GUIDE:

### DITCH LINING



RAIL



ROAD



MINING



PETROCHEM



AGRO



UTILITIES



MUNICIPAL



DEFENCE



DESIGN



2014 Fast Track 100  
16th fastest growing  
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2014 Queen's Award  
for Enterprise in  
Innovation



2013 MacRobert Award  
Finalist



2013 Innovation Award Winner  
Railtex Exhibition



2012 R&D 100 Award winner  
R&D Magazine



2011 Expert's Choice Winner  
Most Innovative Product



2011 Brit Insurance  
Designs of the Year Nominee



2009 Winner  
Material Connexion Medium Award  
Material of the Year



2007 Winner  
D&AD Yellow Pencil Award  
Product Design

## Concrete Canvas® GCCM Installation Guide: Ditch Lining

Concrete Canvas® is part of a revolutionary new class of construction materials called Geosynthetic Cementitious Composite Mats (GCCMs). It is a flexible, concrete impregnated fabric that hardens on hydration to form a thin, durable, water proof and fire resistant concrete layer. Essentially, it's concrete on a roll.

The following guide provides useful information for installers, customers and specifiers of Concrete Canvas® GCCM (CC) and provides an overview of installation techniques for the lining of ditches. The versatile nature of CC means that this document is not exhaustive and is intended for guidance purposes only.

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

### Which thickness?

CC is available in 3 thicknesses, CC5™ (5mm), CC8™ (8mm) and CC13™ (13mm).

- CC5™ can be used to line ditches with a solid substrate such as when relining an existing concrete channel or laying over a hard substrate such as rock. CC5™ may also be used for temporary works.
- CC8™ is the standard thickness specified for ditch lining and is recommended unless either of the conditions above or below apply.
- CC13™ should be considered where a channel is to be trafficked, is exposed to high levels of debris, where water flow rates are above 8.6m/s or where the ground is particularly steep or unstable.

### Which format?

CC is available as large bulk rolls (1.5T to 1.6T) or as smaller man-portable batched rolls (60kg to 70kg). See the product table below for exact specifications. Installation is fastest using bulk rolls dispensed from a spreader beam (available to 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.

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



CC bulk roll being laid using a spreader beam

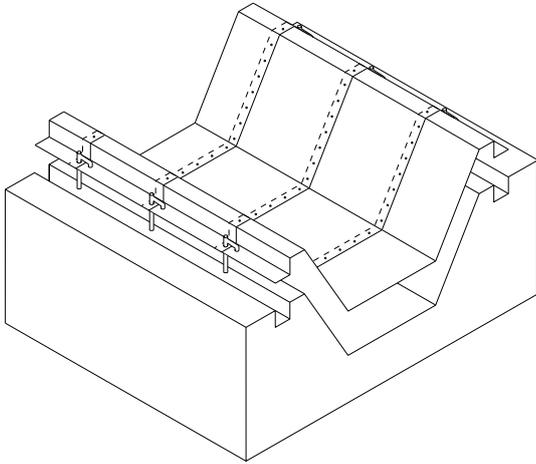
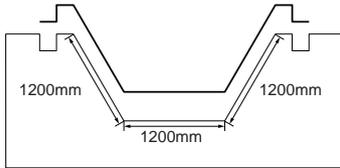


CC being laid using batched rolls

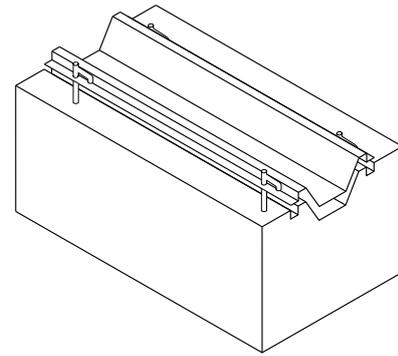
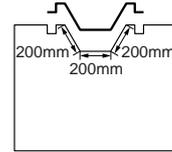
## Which layup?

CC can be laid along the length of the ditch (longitudinal) or across the width (transverse). CC5™ is supplied in roll widths of 1.0m, CC8™ and CC13™ in roll widths of 1.1m. Consideration should be given to the channel profile design in order to minimise wastage. Some example profiles are given below based on a standard overlap of 100mm between adjacent layers. Care should be taken to position the overlap in the direction of water flow (like shingled roof tiles).

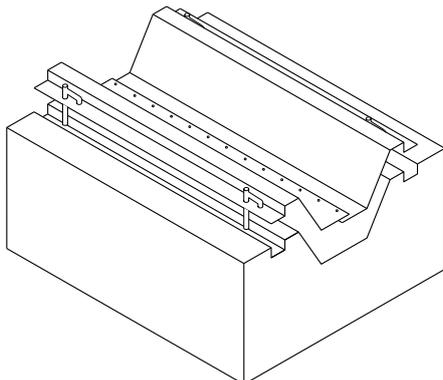
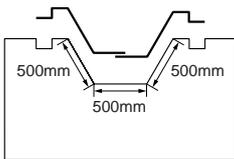
CC in a Transverse Layup



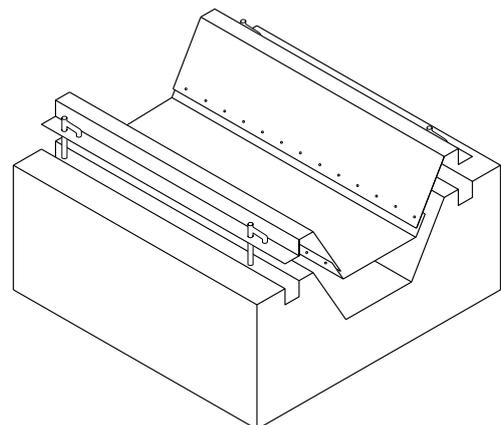
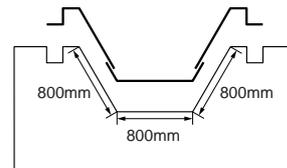
1 Layer of CC in a Longitudinal Layup



2 Layers of CC in a Longitudinal Layup

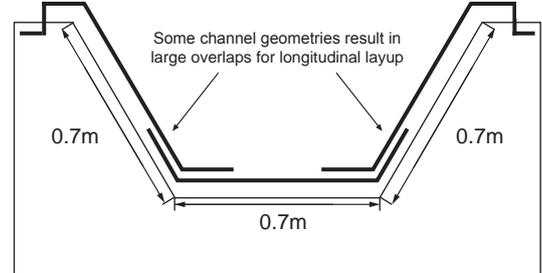
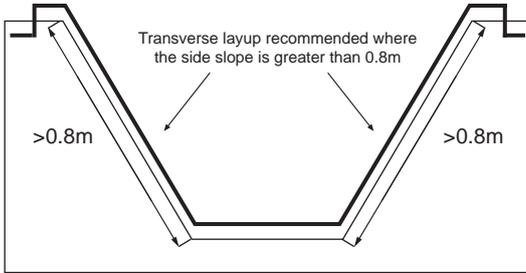


3 Layers of CC in a Longitudinal Layup



Laying longitudinally is typically faster than laying transversely. However a transverse layup may be preferable if:

- the channel side slope is greater than 0.8m as this makes securing the CC difficult when using a longitudinal layup.
- or
- the channel geometry means that longitudinal layup is materially wasteful.

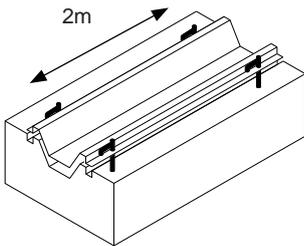


## Which fixing method?

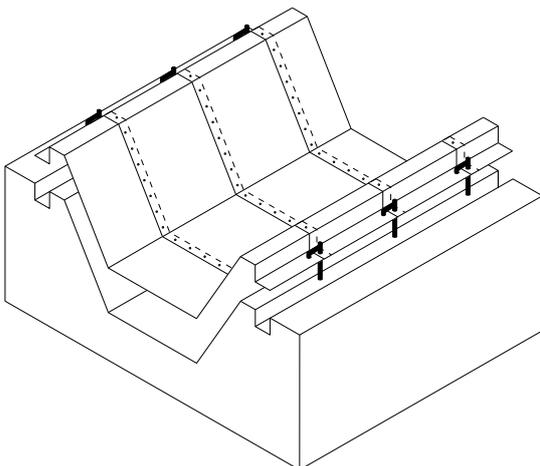
CC can be fixed down along the shoulder of the ditch using pegs, an anchor trench, or preferably both. Concrete Canvas® Ltd can provide pegs in lengths of 250mm and 380mm suitable for different ground conditions. Peg spacing will differ depending on loading and flow conditions. However, for a longitudinal layup pegs are typically spaced every 2m in the anchor trench, whilst for a transverse layup pegs are normally applied at every joint (1m spacing).

In addition to pegging the edge of CC we recommend burying the material along the shoulder using an anchor trench to prevent undermining from surface water; this is particularly important for interceptor drains that collect water runoff along their edge. Burying CC also provides a neat aesthetic transition to the surrounding landscape. A typical anchor trench used to prevent undermining can be between 150-300mm deep depending on the ground conditions.

A properly designed anchor trench can be used as a substitute to pegging but would normally only be used on low flow-rate applications or where pegs are unsuitable due to the location of sensitive underground infrastructure such as power cables.



Pegging for a Longitudinal layup

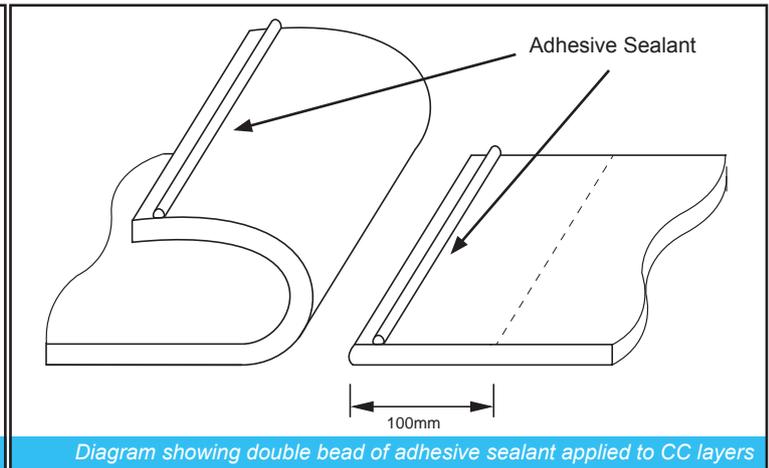
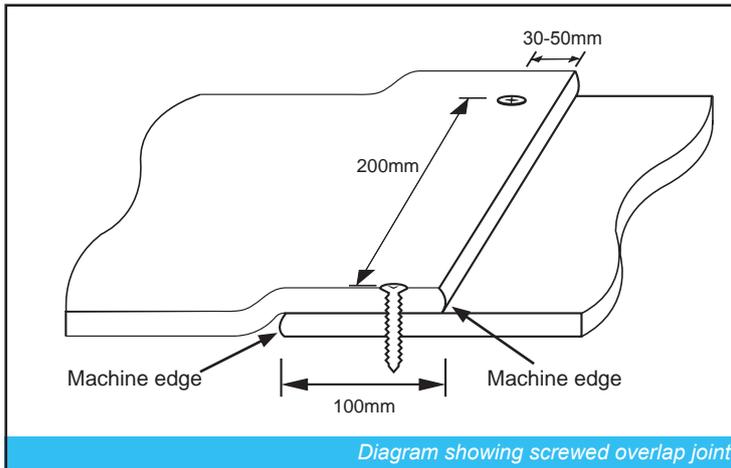


Pegging for a Transverse layup



## Which jointing method?

CC can be jointed along the overlap by screws, sealants, grout or thermal welding. The vast majority of ditches use a screwed joint which provides a good mechanical bond and sufficient impermeability for most drainage applications. We recommend using stainless steel screws inserted at 200mm intervals along the overlap. The screws should be positioned between 30-50mm from the edge of the joint and applied prior to hydration or directly afterward. The concrete within CC will then set around the thread of the screws. Please see the *CC User Guide: Jointing & Fixing* for a full range of jointing methods available.



## Installation

### 1. Ground Preparation

CC will conform closely to the underlying surface contours of a ditch profile, therefore any vegetation and sharp or protruding rocks should be removed. The ditch should have a uniform profile for ease of future maintenance and where possible a shallow anchor trench should be cut into the shoulders of the ditch.



### 2. Laying CC

The procedure for laying bulk and batched rolls is largely the same. Remove the packaging and unroll the CC into the ditch profile ensuring the fibrous top surface faces upwards, with the PVC membrane in contact with the ground. For a transverse layup, tuck the leading edge of the CC into the anchor trench before cutting to length.



### 3. Positioning and Fixing CC

When positioning subsequent layers ensure there is at least a 100mm overlap between layers in the direction of water flow. Peg the CC in the anchor trench of the ditch, at each overlap joint for transverse layups, or at 2m intervals for longitudinal layups.



## 4. Hydrating Overlaps

Hydrate the material under the overlapped sections of the CC. Once hydrated, the material remains workable for 1 to 2 hours.

## 5. Jointing CC

Insert stainless screws at 200mm centres, 30 – 50mm from the edge of the joint. These can be applied using an auto-fed collated screw driver, suitable collated screws are available from Concrete Canvas® Ltd. The impermeability of the joint can be improved by applying an adhesive sealant between the layers, prior to screwing.

For more information on alternative jointing methods, please refer to the *CC User Guide: Jointing and Fixing*.

## 6. Hydrating CC

After fixing and jointing, spray the CC with water to hydrate. A minimum volume of water equal to 50% of the material weight is required. For example, CC8™ requires 6 litres of water per square meter. It is not possible to over hydrate CC. To check proper hydration, the CC should feel wet to the touch several minutes after hydration.

Re-spray the CC after 1 hour if installing CC5™, installing on steep slopes or installing in warm climates. Refer to the CC Hydration Guide for instructions on the correct hydration procedure. Please note that you should not rely on rainfall to hydrate the material.

## 7. Junctions, Baffles and Terminals

CC is easy to shape before setting and can be manipulated to form ditch junctions and terminals. Baffles can be formed by laying CC over fabricated structures such as sandbags. CC can be joined to existing concrete infrastructure using concrete anchor bolts or poured concrete.

## 8. Setting

CC hardens to 80% strength in 24 hours and is ready for use.

## 9. Maintenance

CC lined ditches require minimal maintenance, provide long term scour protection, reduce silt generation and provide effective weed suppression.



## Detailing Examples



CC can be easily manipulated to form ditch junctions and terminals



CC can be installed around existing infrastructure



A suitable mortar can be used to join and seal CC to existing infrastructure



CC can also be used to reline existing concrete water channels



CC will closely follow the profile of any ditch or embankment



Sand bags can be used to compress joints during setting

## 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 (unwet) (kg/m²)	Density (unwet) (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 when 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 there 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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