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CONCRETE CANVAS®

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INSTALLATION GUIDE: WARMER CLIMATES

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INSTALLATION GUIDE: WARMER CLIMATES

1.0 Introduction

1.1 Background

Concrete Canvas® (CC) GCCM* is a versatile product that has been successfully used in extreme environments worldwide. There are some climatic conditions that require special measures to ensure a successful installation and enable material to set to its required strengths and performance criteria.

This document has been prepared to provide specific advice for warmer climate conditions such as parts of Africa, the Middle East and Oceania. For the purposes of this document, a warmer climate is considered to be Arid, Tropical or Mediterranean, but also covers projects where the material will be installed when drying conditions are present and there is a potential for drying shrinkage to occur.

1.2 Scope

This document provides guidance procedures for the installation of CC in warm climates to avoid serviceability issues associated with drying conditions while maximising safety, efficiency, and the physical integrity of the material.

The versatile nature of CC means that this document is not exhaustive and is intended for guidance purposes only. Exceptions to this guideline may be required to address site-specific and/or product-specific conditions. Contact your local CC representative for project specific advice.

The performance of CC is dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines where applicable and to the project specification and drawings.

Slope protection installation incorporating warm climate installation guidance

*Geosynthetic Cementitious Composite Mat

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1.0 Introduction Continued...

1.3 What are Drying Conditions?

A drying condition can happen to CC in a climate that causes an excessive loss of hydration water in CC. Drying conditions occur when there is one or more of:

- Ambient air temperature >22°C
- Wind speed >12km/h
- Sustained strong direct sunlight
- Humidity <70%

Drying conditions reduce the volume of water held within the core of the CC after hydration and to activate setting of the cementitious blend. Under-hydrated CC will have a water: cement ratio that is too low to enable the material to reach the specified initial break flexural strength gain. A material with a lower initial break flexural strength does not have the same resilience to differential ground movement and is less likely to provide the same working life as a fully hydrated material. Special hydration measures are required for projects where drying conditions occur as detailed in section 3.6. Adequately hydrated material can still be subject to shrinkage, particularly in drying conditions.

1.4 Shrinkage

Most cementitious or concrete materials are at risk of drying shrinkage, where the concrete mixture contracts due to the loss of capillary water. For GCCMs there are two shrinkage processes that are possible:

- Hydration shrinkage - occurs during the curing process and causes the CC to contract by approx-imately 0.1-0.15%.
- Drying shrinkage - can occur in drying conditions and after the CC has hardened. CC may contract up to 0.4% in the most extreme drying conditions.

CC lined structures must be designed so that shrinkage is accommodated internally through the 3D fibre matrix or transferred to the substrate, rather than by cumulative material movement and deformation at joints, profile changes and around the perimeter edge.

By adhering to the following Warmer Climate guidance, the adverse effects of drying conditions and shrinkage can be prevented.

2.0 Installation Procedure - Warmer Climate Specific Details

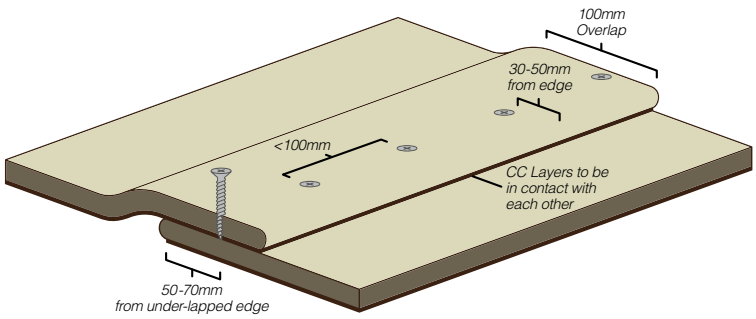
2.1 Subgrade Preparation

Installing a suitable geotextile on the prepared surface (before installing the CC) can prevent washout of fines through unwanted seepage paths and is recommended for most erosion control projects.

2.2 Jointing

2.2.1 Screwed Joint

Screwed joints are suitable for permeable applications. It provides good mechanical strength but has limited impermeability. In warmer climates the screws should be applied at 100mm spacings (50mm and combined with sealant for bund lining - see section 2.1.2) and 30-50mm from the edge of the CC. The screws should be applied immediately after hydration of the under-lap but prior to setting, so the concrete within CC will then set around the thread of the screws. For this reason, it is important that the screws have a fully threaded shank.



Screwed overlap joint for use in dry climates

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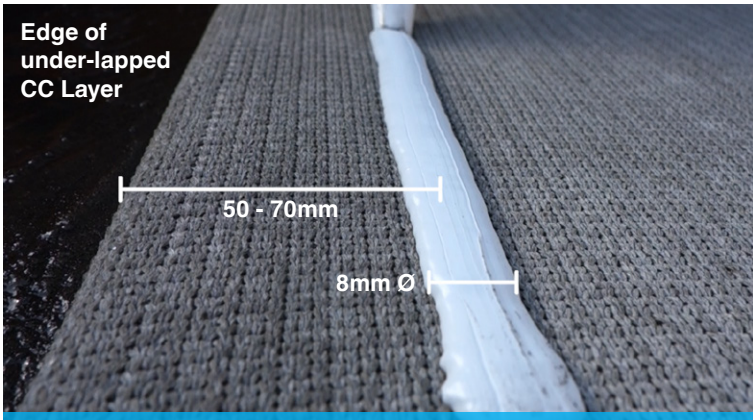
2.0 Installation Procedure - Warmer Climate Specific Details

2.2.2 Screwed and Sealed Joint

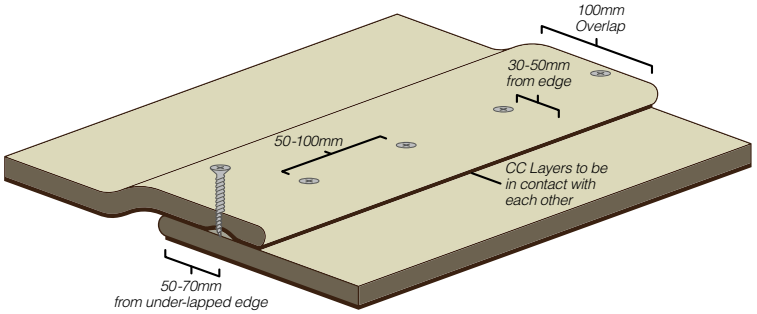
For applications where increased joint strength and reduced permeability is required, the material can be jointed with a CC approved adhesive sealant using a caulking gun. This is applied as a single 8mm bead located 50-70mm from the edge of the under-lapped CC layer. An 8mm bead is equivalent to a coverage of 50g/m which is equivalent to 5.8m of joint for a 290ml cartridge or 12m of joint from a 600ml foil.

In drying conditions, a maximum screw spacing of 100mm is suitable for most applications, 50mm is required for bund lining. Screws should be inserted through the sealant bead where possible to minimise leakage.

It is important to hydrate under the overlap prior to applying the adhesive sealant in order to remove excess dust, ensuring adhesive sealant contact with the fibrous top surface of the bottom CC layer and to provide moisture for curing. Surfaces should be damp during caulking but have no standing water.



Sealant applied to under-lapped CC layer using caulking gun



Screwed and sealed joint for use in dry climates

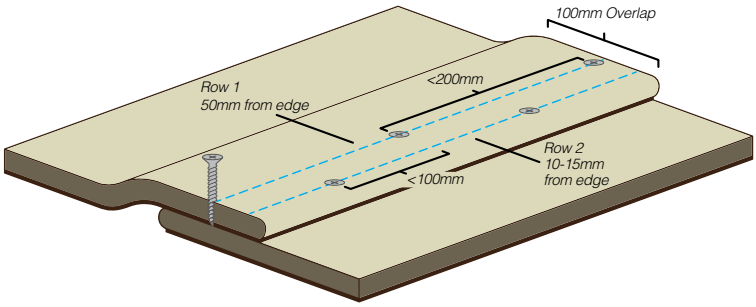
2.2.3 Alternative Methods of Reducing Joint Permeability

Thermal bonding can be specified as a replacement for adhesive sealants in instances where thermal welding equipment and expertise are available. This should be discussed with the local Concrete Canvas® representative and the CC Thermal Bonding guidelines adopted.

2.2.4 Edge curling

In some warmer climate conditions the edge of the CC layers can curl upwards as the material dries. Edge curling is most common on applications in high temperature drying conditions. Although the strength of the joint is unaffected, the curling can affect the aesthetics of a structure and act as a trap for wind-blown debris.

Edge curling can be prevented by either ballasting the overlap joint for 24 hours after hydration (such as by using sandbags), or by staggering the screws to create a 'Zigzag' pattern. The first row of screws should remain at 50mm from the edge of the top CC layer and the second row of should be 10-15mm from the edge. The maximum screw spacing on each row should be 200mm, so that the maximum staggered screw spacing along the CC edge is 100mm.



Zigzag joint to prevent edge curling

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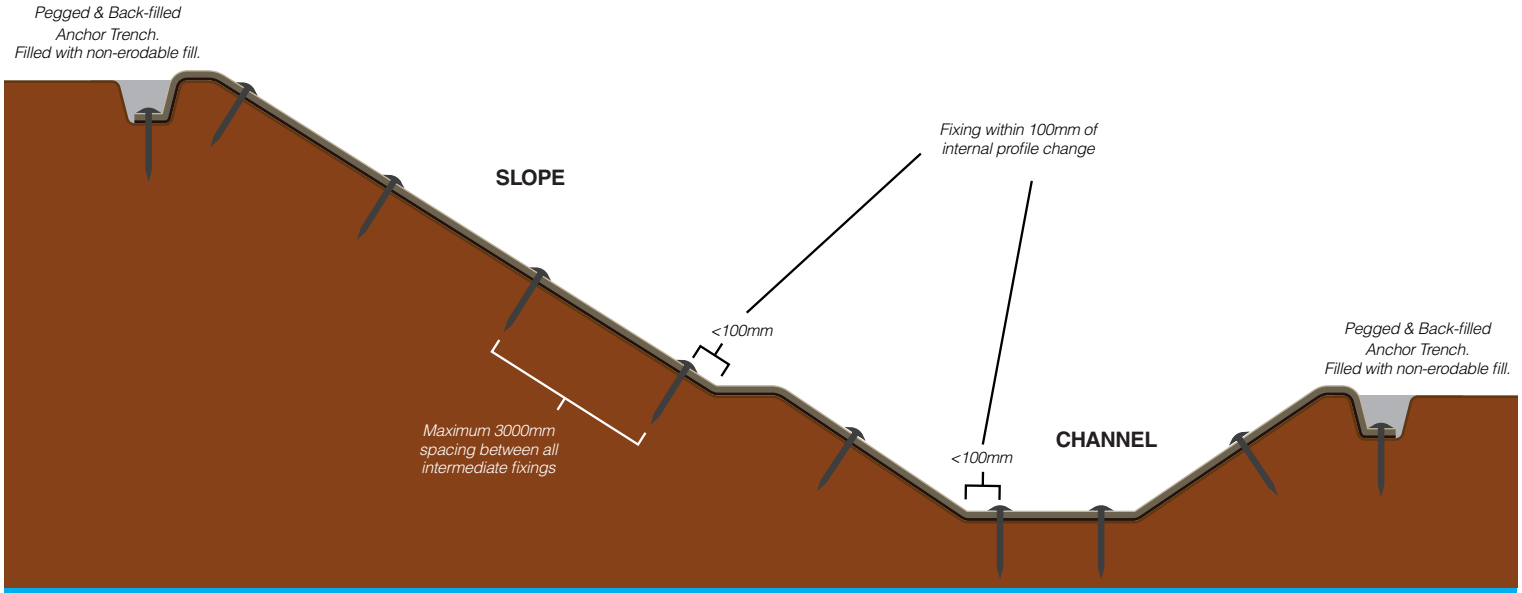
2.0 Installation Procedure - Warmer Climate Specific Details

2.3 Intermediate Fixings

In warm climates, **intermediate fixings are required on all CC layers greater than 3m in length** in order to prevent overlap joint movement. It is recommended that suitable 'exposed pegs' are positioned through each overlap joint at 3m centres, on large structures they can be staggered on each adjacent overlap panel to form a diamond pattern. Intermediate fixings transfer the load from hydration shrinkage into the underlying substrate, rather than relying on the CC and joint to accommodate the loading.

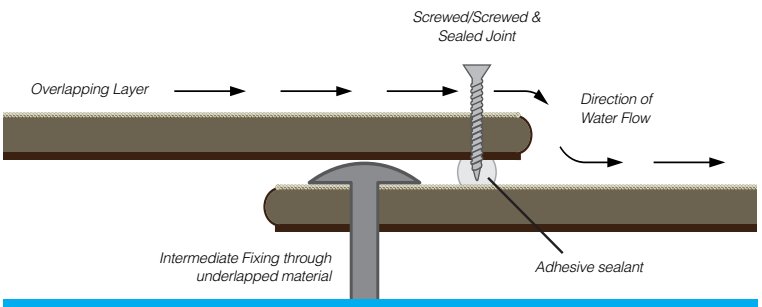
It is also recommended to install intermediate fixings within 100mm from each internal profile transition and to minimise void space when profiling on uneven substrates.



Typical intermediate fixing detailing - drawing not to scale

When applying intermediate fixings in channels it is important to reduce the potential for water ingress through openings created by the fixing. Some exposed pegs can incorporate a washer or rebate which allows adhesive sealant to be applied in order to limit water ingress. Alternatively, the fixings can be installed into the under-lap of a joint so that the head of the fixing is protected from impact by the overlapping CC layer. It may be necessary to reduce fixing spacing in this case, contact your local Concrete Canvas® representative for advice.

'Exposed Peg' intermediate fixing positioned through overlap joints



Intermediate fixing installed through under-lapped CC layer

In hydraulic applications, intermediate fixings can also take the form of check slots, which are recommended to be incorporated in designs on large structures - see *CC Hydraulic Design Guidance Notes* for more information.

Additional intermediate fixings may be required to resist hydraulic loading or wind loads and may require greater pull-out strength than pegs can offer. Please contact Concrete Canvas Ltd for advice.

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2.0 Installation Procedure - Warmer Climate Specific Details

2.4 Hydration

The Concrete Canvas® should be hydrated each day by following our *User Guide – Hydration & 4 Principles* and taking account of our recommendations for hydration in drying conditions:

- Hydrate at dusk where possible.
- Hydration Methods:
  - Option 1 - Hydrate and respray as soon as the surface ceases to be wet to the touch, with at least one respray at 2-3 hours. Continue monitor for the first 5 hours from initial hydration and respray as necessary.
  - Option 2 - Hydrate with 3 passes at maximum 20 to 30 minute intervals. Continue monitor for the first 5 hours from initial hydration and respray as necessary.
  - Option 3 - Hydrate and respray at hourly intervals for the first 5 hours.
- Other methods to reduce evaporation (such as covering the material) may also be used.
- Water should be applied over the **entire** CC surface, do not allow water to run down the surface in rivulets only.
- On slopes it is best to hydrate with one pass from top to bottom, then alternate bottom to top on the second pass, then alternate again for the third pass.
- Once hydrated, the CC typically remains workable for 1 to 2 hours. This may be reduced to approximately 40 minutes in hot climates or when hot/saline water is used.
- If installation continues the following working day the edge of the last layer needs to be kept dry, so that it remains in its flexible state for jointing to the next layer deployed on return to work. Protect the edge of the last layer with a waterproof sheeting prior to hydrating the structure (see image below).
- It is also recommended to give all installed CC a final hydration prior to completion of the days work.
- In drying conditions the CC should be inspected after 24 hours. If it is suspected that the material has over-dried, re-wet, in accordance with these instructions. This will normally enable the CC/CCH to gain the specified strength, provided the CC has not been heavily trafficked or mechanically damaged prior to full set.

2.5 Installation Sequence

Planning of CC installations is necessary to ensure tools and materials (e.g. hydration water) is available when required. An example install sequence is described below:

- Morning - Deploy CC panels and secure along the perimeter edges.
- Early afternoon - Jointing of panels (e.g. hydrate under-lap, apply sealant, screw joints), install intermediate fixings.
- Late afternoon - Hydration following 'Option 2' as described in section 2.3.

Protection of edge of last CC layer before hydration

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