CONCRETE CANVAS®
*Concrete on a Roll*

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MADE IN UK


CCX™
*Innovation on a Roll*

# USER GUIDE: CCX™ JOINTING

The Queen's Awards for Enterprise: International Trade 2019

Board of Trade Winner 2018

Ground Engineering Awards 2017 Winner Technical Innovation Award

ice award winner 2017
ICE Wales Cymru Project Awards
Innovation Award ICE Wales Cymru Awards 2017

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CCX™ is part of a revolutionary new class of construction materials called Geosynthetic Cementitious Composite Mats and Barriers (GCCM/Bs). It is a flexible, concrete filled geosynthetic, that hardens on hydration to form a thin, durable, water proof layer. Essentially, it's Concrete on a Roll™. Three variants of CCX™ are currently available: CCX-UTILITY™ (CCX-U™), CCX-MAT™ (CCX-M™) and CCX-BARRIER™ (CCX-B™). Each have different intended uses and joint methods. The following guide provides an overview of methods for jointing the three variants of CCX™ material. The versatile nature of CCX™ means that this document is not exhaustive and is intended for guidance purposes only. For details on cutting, edge fixing and intermediate fixing detailing for CCX™, consult the Concrete Canvas® Specification Guides.

## 1.0 General Guidance

### 1.1 Overlapping

CCX™ must always be overlapped by a minimum of 100mm and jointed to form a continuous GCCM/B structure. When used in hydraulic applications, the overlaps must be shingled in the direction of water flow so that water flows over the joints rather than in to them (see Figure1).

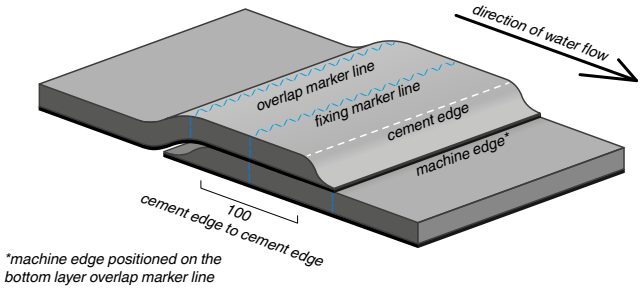


*Figure 1. Direction of CCX™ overlap*

### 1.2 Marker Lines

CCX™ is manufactured with two blue marker lines parallel to each machine edge to assist in alignment and correct jointing of CCX™ layers. The 'overlap marker line' is used to position overlapping layers, ensuring there is a minimum cement edge to cement edge overlap of 100mm. When lapping, the machine edge of the top CCX™ must be aligned with the overlap marker line as shown in Figure 2. The 'fixing marker line' is used to ensure that any adhesive sealants and/or mechanical fixings specified for CCX-U™ and CCX-M™ joints (see Section 2) are positioned in the centre of the 100mm overlap for optimum joint strength.

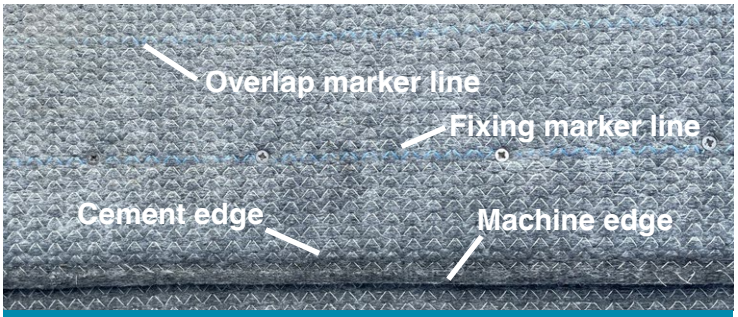


*Figure 2. Marker lines on CCX surface*

### 1.3 Joint Methods

CCX-U™ and CCX-M™ must always be jointed using mechanical fixings. The permeability of the joints can be reduced with the use of adhesive sealants or by thermal bonding of the overlapped material.

CCX-B™ must always be jointed as a 2 stage process. Firstly, the 1mm thick LLDPE backing layer must be thermally welded together to provide impermeability. Secondly, the overlapping cementitious layer must be jointed together, either with adhesive sealants or by thermal bonding.

### 1.4 Hydration of the Overlaps

**When jointing CCX™ using screws and adhesive sealants it is important to hydrate under the overlap prior to jointing.** This is necessary to provide sufficient moisture for curing of both the cementitious layer and the adhesive (if used). Adhesive sealants benefit from pre-hydration as this cleans the jointing surface of dry cement dust prior to the application of adhesive and the moisture helps to cure the adhesive during setting. When adhesive sealant is used, joints may be damp during installation, but should have no standing water.

In some circumstances it may not be possible to hydrate underneath the overlap prior to fixing. This is not generally advised, as the underlap material will only be partially hydrated, however it may be acceptable if certain conditions exist. For example, if the joint is going to be continually exposed to water due to the nature of the application, the underlap material will slowly hydrate through infiltration. Please be aware, that in these instances, the joint strength may be compromised. For example a screwed joint relies on the CCX™ setting around the thread of the screw, therefore the short-term strength will be significantly lower until full hydration is achieved. If the CCX™ underlap is not hydrated prior to screwed/screwed and sealed jointing, the joints will typically achieve a long-term strength which is 30-40% lower than if the underlapped CCX™ is hydrated prior to jointing.



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When planning a CCX™ installation, the installer must ensure water resources are available for hydration of underlaps. 1.5 litres of water is needed to hydrate a 200mm wide, 1m length of CCX™ underlap. For small projects or when water is not freely available on site, water can be stored in jerry cans which can be used to hydrate the underlaps until the entire structure is hydrated at the end of the day using a larger scale water supply.

Note that when thermally bonding CCX-U™, CCX-M™ or thermally welding CCX-B™, the CCX™ **material must be dry and protected from exposure to water.**

### 1.5 Suitability of Adhesive Sealants

It is important that only adhesive sealants that have been tested and approved by Concrete Canvas Ltd are used. Soudaseal 250XF is stocked at CCHQ, but a number of other products have also been approved for use and a full list of approved CCX™ sealants can be provided on request. Concrete Canvas Ltd's approval of a particular adhesive sealant is based on the long-term mechanical durability, and the designers/installer should check that it is suitable for site specific conditions such as risk of contamination or harm to aquatic life. It is recommended that when considering specifying an adhesive sealant, the safety data sheet and technical data sheet are reviewed and approved by the designer/client as being suitable for their project.

Adhesive sealants have a shelf life and it is not recommended to use products past their expiry date.

*Figure 3. Cutting CCX™ using a 'snap-off blade' utility knife*

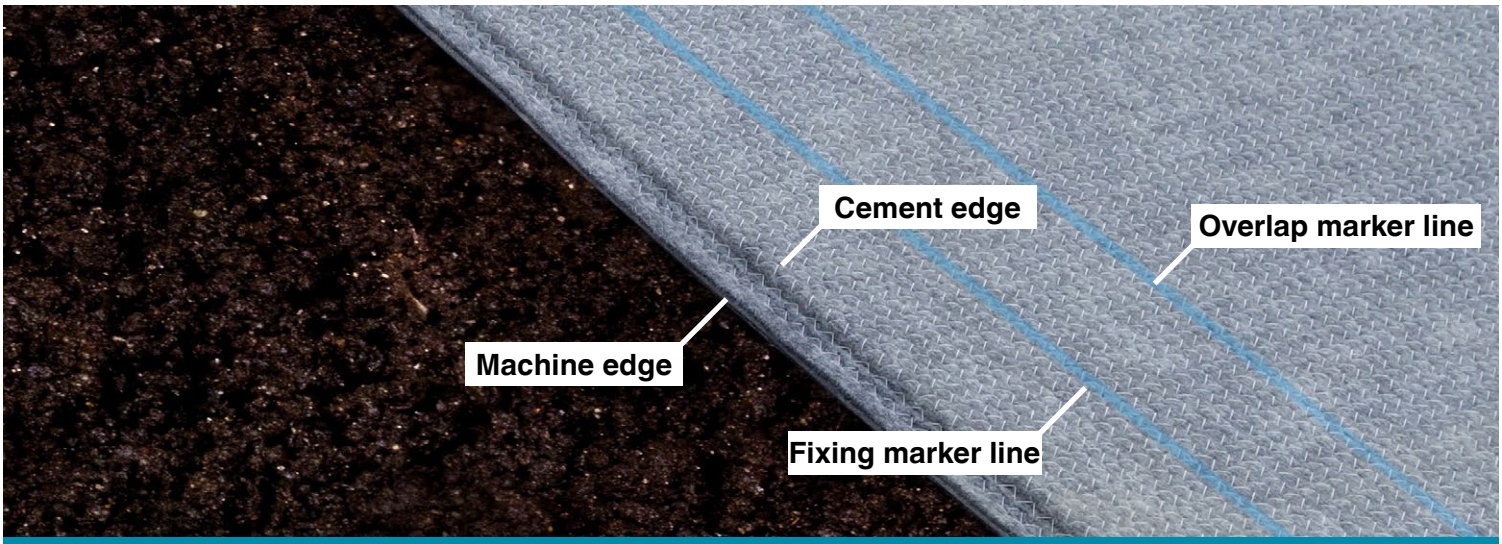


*Figure 4. Machine edge, cement edge*



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## 2.0 CCX-U™ and CCX-M™ Jointing Specifications

### 2.1 Installing on Soil Substrates

#### 2.1.1 Screwed Overlap Joints

Impermeability Rating: • ○ ○ ○ ○

Mechanical Strength: • • • ○ ○

This joint is suitable for the majority of CCX-U™ and CCX-M™ applications. It is fast and simple to apply, providing good mechanical strength but has limited impermeability.

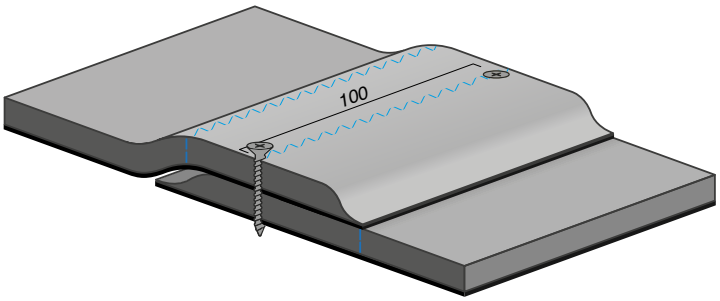


*Figure 5. Screwed overlap joint*

The following equipment is required:

- 30mm long stainless steel screws, minimum 4mm diameter with a coarse fully threaded shank, collated screws are recommended for large projects (available from Concrete Canvas Ltd)
- Battery powered screwdriver or autofed screwdriver for large projects
- Supply of water for hydration under the overlaps

Procedure:

1. Joint Alignment: Overlap in the direction of water flow, with the machine edge of the top layer positioned on the overlap marker line of the bottom layer. Ensure that the two layers are in contact along the length of the joint.
2. Overlap Preparation: The overlap should be lifted so that the CCX™ material underneath can be hydrated. Once hydrated, fold back the top CCX™ layer to ensure both layers are aligned in contact again.
3. Installation of Screws: Once hydrated CCX™ has a working time of approximately 30 minutes in ambient temperatures of 20°C. Screws must be applied before setting begins so the concrete within CCX™ will set around the thread of the screws. The screws should be applied at a maximum of 100mm spacing along the fixing marker line, see Figure 5.

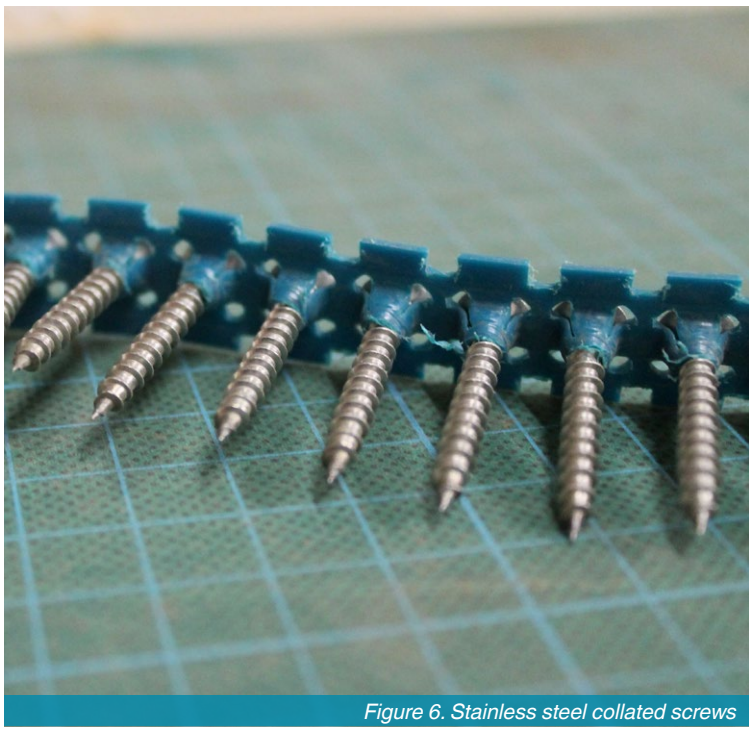

*Figure 6. Stainless steel collated screws*

*Figure 7. Screws inserted through fixing marker line*



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## 2.1.2 Screwed & Sealed Overlap Joint

Impermeability Rating: • • • ○ ○

Mechanical Strength: • • • ○ ○

For applications where improved impermeability is required, the screwed overlap joint can be installed in combination with a Concrete Canvas Ltd approved adhesive sealant.

The following equipment is required:

- 30mm long stainless steel screws, minimum 4mm diameter with a coarse fully threaded shank, collated screws are recommended for large projects (available from Concrete Canvas Ltd)
- Battery powered screwdriver or autofed screwdriver for large projects
- Supply of water for hydration of the underlaps
- Concrete Canvas Ltd approved adhesive sealant and applicator (e.g. cartridge or barrel caulking gun depending on the format of the adhesive sealant)

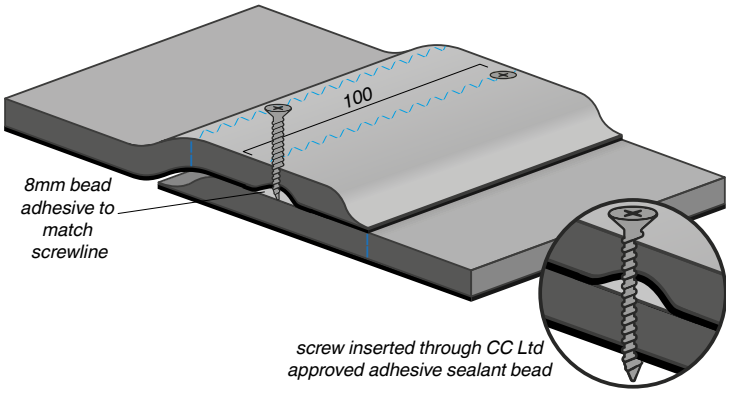


*Figure 8. Screwed and Sealed overlap joint*

*Figure 9. Sealant applied along fixing marker line*

Procedure:

1. Joint Alignment: Overlap in the direction of water flow, with the machine edge of the top layer positioned on the overlap marker line of the bottom layer. Ensure that the two layers are in contact along the length of the joint.
2. Overlap Preparation: The overlap should be lifted so that the CCX™ material underneath can be hydrated. **It is important to hydrate under the overlap prior to applying the adhesive sealant in order to remove excess dust, ensuring contact with the fibrous top surface of the bottom CCX™ layer and to provide moisture for curing.** Surfaces may be damp during installation, but should have no standing water.
3. Adhesive Sealant: Apply as an 8mm continuous bead along the fixing marker line of the CCX™ underlap layer. An 8mm bead is equivalent to a coverage of 50ml/m which is equivalent to 5.8m of joint from a 290ml cartridge or 12m of joint from a 600ml cartridge.
4. Installation of Screws: Once hydrated and sealant has been applied, fold back the top CCX™ layer to ensure both layers are aligned with the overlap marker line and the adhesive sealant is compressed. Once hydrated CCX™ has a working time of approximately 30 minutes in ambient temperatures of 20°C, screws must be applied before setting begins so the concrete within CCX™ will then set around the thread of the screws. The screws should be applied at a maximum of 100mm spacing along the fixing marker line, through the sealant bead to minimise leakage, see Figures 8 and 9.



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## 2.1.3 Screwed & Thermal Bond Overlap Joint

Impermeability Rating: ● ● ○ ○ ○

Mechanical Strength: ● ● ● ● ○

Where the use of adhesive sealants to reduce permeability is not suitable, Thermal Bonding can be used. The joint is formed using a hand-held heat gun to form a bond between the underside of the CCX™ and the polyester top surface.

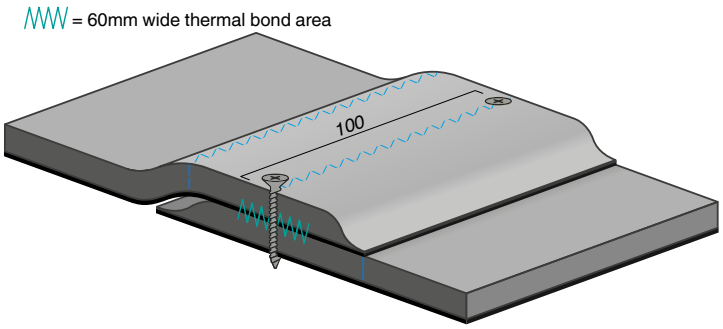
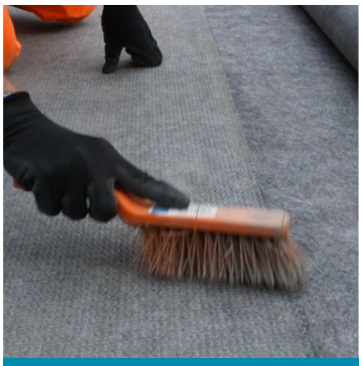



*Figure 10. Screwed and Thermal Bond overlap joint*

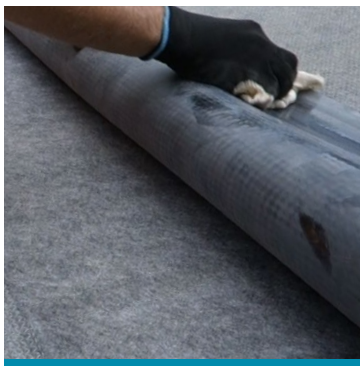
The following equipment is required:

- Hand-held heat gun with closed loop temperature control (e.g. Leister Triac AT) with a 60mm perforated slot nozzle
- Power supply sufficient to provide uninterrupted power to the heat gun (check heat gun manufacturers recommendations)
- Seam Roller 45mm (or similar)
- Stiff Brush for cleaning the CCX™ surface
- Wire Brush for cleaning the equipment nozzles
- Cleaning rags for wiping the LLDPE backing of CCX-M™
- Safety Gloves
- Mask (A2P3 filter or equivalent)
- 30mm long stainless steel screws, minimum 4mm diameter with a coarse fully threaded shank, collated screws are recommended for large projects (available from Concrete Canvas Ltd)
- Battery powered screwdriver or autofed screwdriver for large projects

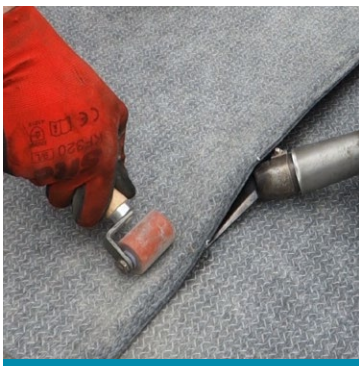
*Leister TRIAC AT*



*Brush to ensure fibres are visible*



*Wipe clean the LLDPE backing*



*Thermal Bonding with the Leister Triac AT*

*Figure 11. Thermal bonding procedure*

Procedure:

1. Joint Alignment: Overlap in the direction of water flow, with the machine edge of the top layer positioned on the overlap marker line of the bottom layer. Ensure that the two layers are in contact along the length of the joint. NOTE: unset material can be bonded to both set and unset material, but the uppermost layer must be unset.
2. Overlap Preparation: The fibrous surfaces should be cleaned of any surface dust using a stiff brush and the LLDPE backing of CCX-M™ should be clean and dry.
3. Tool Preparation: The hand-held heat gun (fitted with the 60mm perforated slot nozzle) should be adjusted to achieve the required joint strength using the calibration guidance in step 5 below (500°C on CCX-M™ and 450°C on CCX-U™ is a good starting temperature) to create a 'Trial Joint'. Leave the gun on for approximately 5 minutes to reach temperature. If using a tool with a digital read-out this should be indicated on the display. Wear heavy gloves and a mask as the heat gun will be hot and give off fumes. Only thermal bond in a well ventilated area.
4. Thermal Bonding: Once up to temperature, position the heat gun nozzle in the centre of the overlap (20mm from each cement edge, see Figure 12), with the nozzle perforations upper-most. Working your way from one end of the joint to the other, follow the welder with the 'Seam Roller' to apply pressure to the layers to form a bond. It is recommended that the roller be applied perpendicular to the direction of thermal bonding. The bond rate for CCX-M™ is approximately 0.6-1.0m/min and the bond rate for CCX-U™ is approximately 1.5-2m/min.



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5. Trial Joint / Calibration: Prior to bonding a field joint, it is necessary to conduct a 'Trial Joint' to set the heat gun to the correct temperature and weld rate. As a rule of thumb the following can be used as a guide:

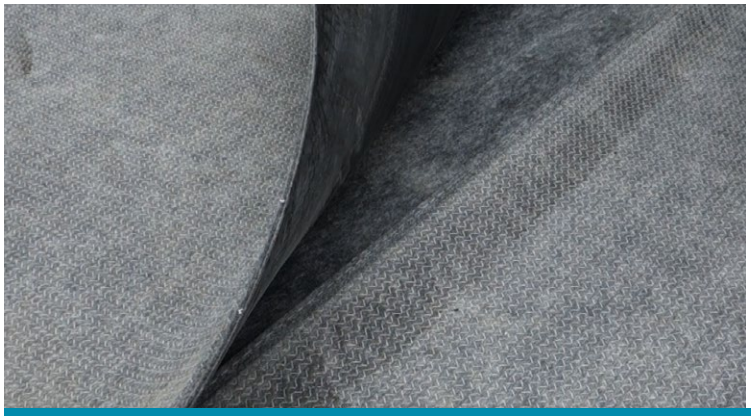

*Figure 12. Trial joint calibration*

**Too fast / Too cold:** Joint will pull apart after cooling without causing destruction of the LLDPE Backing.

**Correct Speed / Temperature:** Some smoke produced during welding. Joint will pull apart after cooling with destruction of the LLDPE.

**Note that once hydrated, the cementitious material from both CCX™ layers will cure together to increase joint strength.**

6. Installation of Screws: The screws should be applied at a maximum of 100mm spacing along the fixing marker line.
7. Hydrate the CCX™ as described in the CCX™ User Guide: Hydration. Particular attention should be paid to the overlap area to ensure sufficient hydration through wicking.

Other useful guidance:

- When powering down the automatic or manual thermal welders it is recommended to turn down the heating element whilst allowing the air to remain running in order to cool the element and avoid damage.
- Routine maintenance of the welding equipment is required and particular attention should be paid to the hot air nozzle which should be regularly cleaned with a wire brush to prevent the build-up of LLPDE residue.
- On uneven ground, sandbags may be used to ensure joints are in contact with the substrate and prevent voids beneath the CCX™.
- A stiff brush can be used to clean the surface of the CCX™ prior to hydration in order to remove footprints, dust accumulation and prevent staining on the set material.
- For containment critical applications, CCX-B™ should be used.
- When installing on solid subgrades that cannot be penetrated by standard screws, 'short' screws can be used instead. The short screws must be stainless steel, 4mm diameter with a fully threaded shank and 19mm long with a blunt tip, so that the cement can set around the shank but the screw does not significantly penetrate the bottom LLDPE backing layer as shown in figure 12. It is recommended to use a stub or flat ended screw to limit potential penetration of the LLDPE, when using CCX-M™.

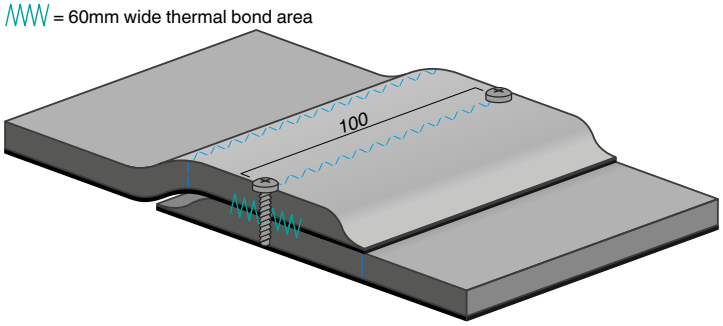


*Figure 13. Short screw and Thermal Bond overlap joint*


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## 2.2 Installing on Solid Substrates (e.g. concrete or rock)

### 2.2.1 Mechanical Fixings

When installing on solid substrates where screws cannot penetrate the surface, such as concrete or rock, the screws can be replaced with other suitable mechanical fixings, such as stainless steel concrete screw anchors or through bolts. The mechanical fixings must have a minimum head/ washer diameter of 15mm and installed a maximum spacing of 500mm along the fixing marker line as shown in figure 15. The permeability of the mechanical fixing joint can be reduced using adhesive sealant or by thermal bonding as described in sections 2.1.2 and 2.1.3 above. Note that the use of shot fired nails is not recommended.

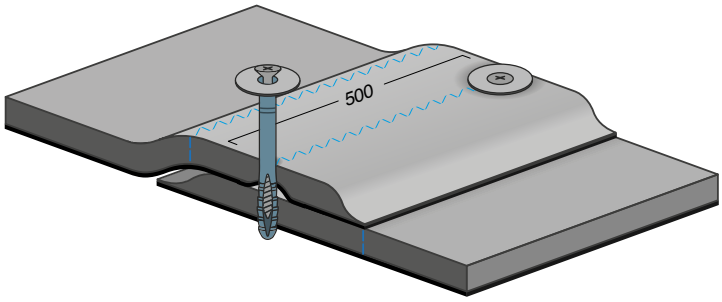


*Figure 14. Mechanical fixing overlap joint*

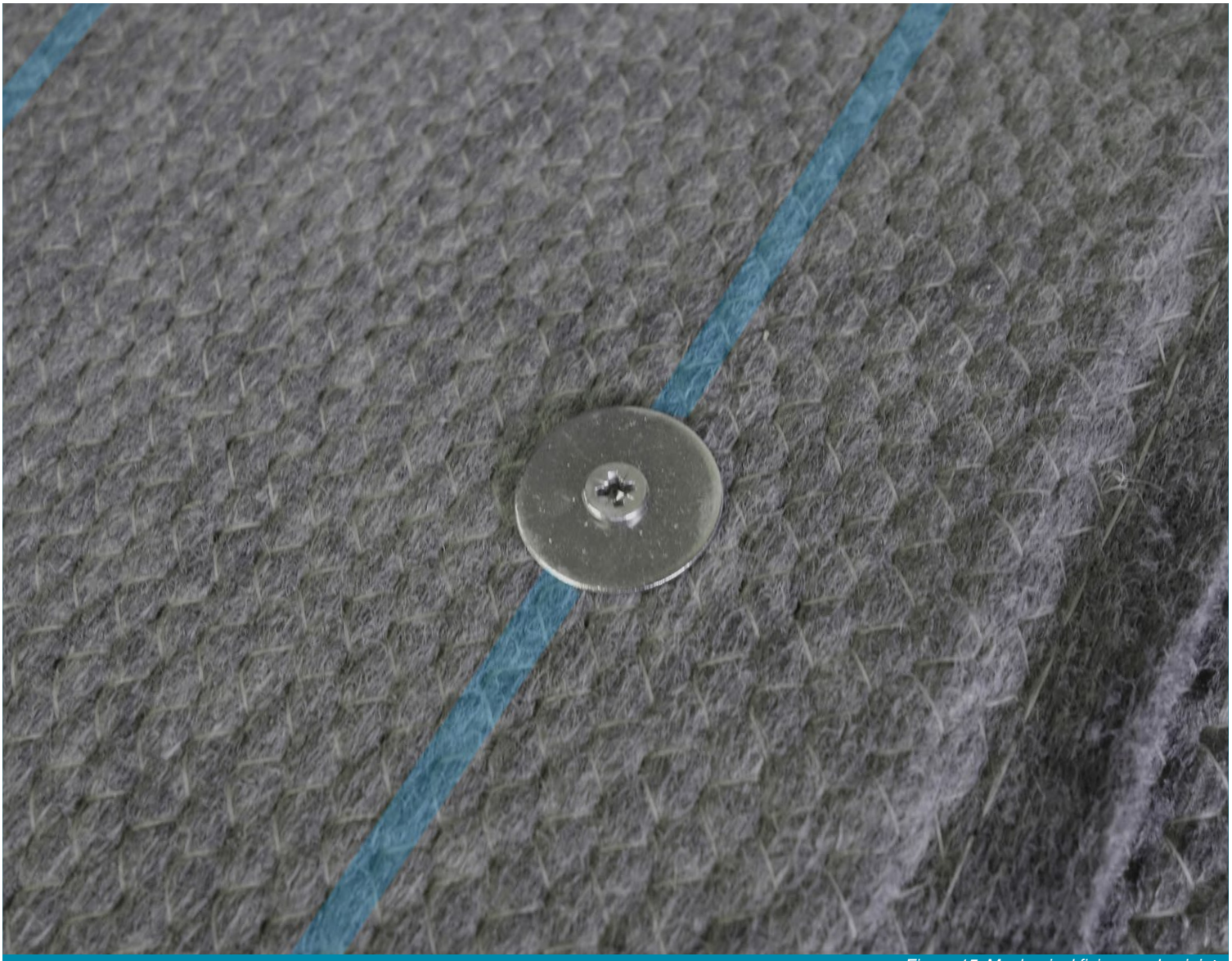

*Figure 15. Mechanical fixing overlap joint*



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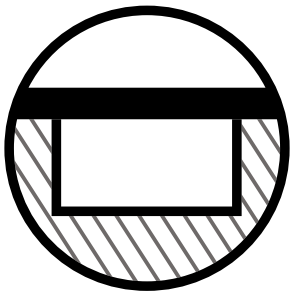
## 3.0 Installation Principles

The unique material properties of CCX™ mean that it can be used for a variety of applications. Following the Four Installation Principles below will help ensure a successful installation.



Avoid Voids

### 1. Avoid Voids

Prepare the substrate so it is well compacted, geotechnically stable and has a smooth and uniform surface.

- For soil substrates, remove any vegetation, sharp or protruding rocks and fill any large void spaces. Ensure the CCX™ makes direct contact with the substrate to minimise soil bridging or potential soil migration under the layer.
- For concrete substrates, remove any loose or friable material, cut away any protruding exposed re-bar and fill any large cracks or voids.
- When installing CCX-B™ the surface must be covered with a suitable protection geotextile.

Secure Canvas

### 2. Secure Canvas

It is important to ensure that the CCX™ is **Jointed** at every overlap between layers and that those layers are **Fixed** to the substrate.

- **Jointing:** Overlapped CCX™ layers should be securely jointed together. For CCX-U™ and CCX-M™, typically this is achieved using stainless steel screws applied with an auto-fed screw gun at regular intervals. Correct screw placement will help ensure intimate contact between CCX-U™ and CCX-M™ layers, prevent washout of the substrate, and limit potential weed growth. An adhesive sealant can be applied between the layers to improve the joint impermeability.

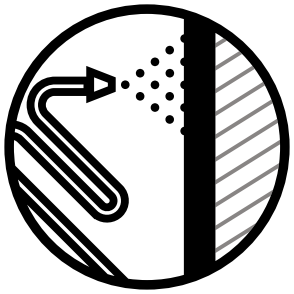
  For CCX-B™ the LLDPE backing must be thermally welded together. The cementitious layers can then be jointed using either a thermal bond or adhesive sealant.
- **Fixing:** When fixing to a soil substrate, ground pegs (e.g. J-pegs) are typically used. On rock or concrete substrates, CCX™ layers can be jointed together and fixed to the substrate using masonry bolts, or concrete screw anchors. Stainless steel fixings with washers are recommended.

Prevent Ingress

### 3. Prevent Ingress

It is important to prevent water or wind ingress between the CCX™ and the substrate, both around the perimeter of the installation and along the joints.

- For soil substrates, this is typically achieved by capturing the entire perimeter edge of the CC within an anchor trench.
- On rocky or concrete substrates, the perimeter edge should be secured using mechanical fixings and washers or clamping bar, sealed with a gasket or adhesive sealant and finished with an optional grout fillet.
- All overlapped CCX™ layers should be lapped in the direction of water flow.



Fully Hydrate

### 4. Hydrate Fully

It is critical to properly hydrate CCX™, taking into account the quantity of material used and ambient temperature conditions.

- Always ensure hydration through the fibrous top surface.
- Ensure to hydrate any overlapped areas and anchor trenched material prior to backfilling.
- Spray the fibre surface with water until it feels wet to touch for several minutes after hydration (the 'Thumb Test'). Rinse hands immediately after the touch test. Consult the CCX™ SDS document.
- Always respray within 30 minutes of initial hydration.
- Follow the *CCX™ User Guide: Hydration*.



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