

CONCRETE CANVAS®

Concrete on a Roll

Concrete Canvas®
for Roadbridge
and HS2



www.concretecanvas.com



Project Info



2019 - 2020



CC8™ Bulk Rolls



10,436m²



Transverse layers



England, United Kingdom



Roadbridge



A comprehensive look into Concrete Canvas Ltds partnership with Roadbridge for HS2

HS2



Introduction

Between 2019 - 2020, the BBA Certified Concrete Canvas® CC8™ material was used to line drainage channels around the perimeter of the Align Compounds 0 and 1, located near West Hyde, Hertfordshire and Chalfont St Peter, Buckinghamshire, respectively.

Align is a joint venture of three leading construction companies delivering the Central 1 portion of HS2.

The original designs included over 5,000 linear metres of drainage channel that were specified to be lined in 100mm of ST4 poured concrete on each site.

The drainage channels were designed to be temporary and would be removed when use of the compound was no longer required.

Concrete Canvas Ltd were approached by Align's contractor Roadbridge to provide a quotation for an alternative to the specified conventional concrete lining solutions.

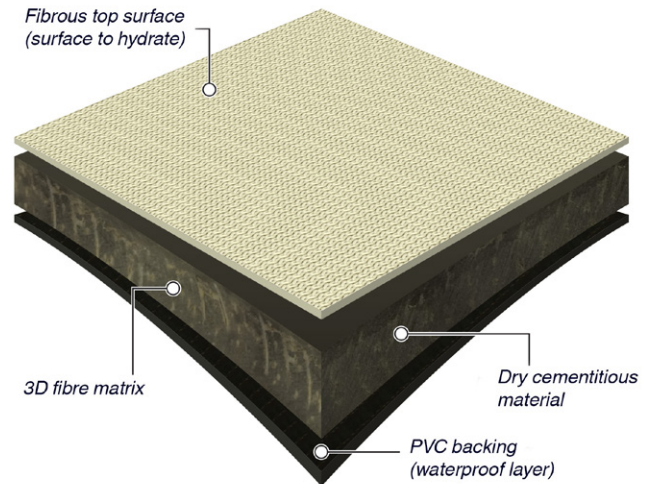


Concrete Canvas® GCCM continued...

CC consists of a geosynthetic top surface, containing a specially formulated dry cementitious material in a 3-dimensional fibre matrix at its core, with a PVC backing to ensure the material is water proof. CC can be hydrated by spraying or full immersion in fresh or salt water. Once set, the fibres reinforce the cementitious material, preventing crack propagation and providing a safe plastic failure mode.

CC is available in 3 thicknesses: CC5™, CC8™ and CC13™, which are respectively 5, 8 and 13mm thick.

Used for erosion control applications such as channel lining, slope protection and concrete remediation, the material is widely used within the Civils sector in the UK; clients include Network Rail, Highways England, Transport Scotland and the Environment Agency.



Conventional concrete vs. Concrete Canvas®

There were a number of factors taken into consideration when comparing traditional concrete options and CC. When installing poured or precast concrete of this quantity, there are a number of significant associated works that increase installation costs.

Precast concrete requires a high tolerance in ground preparation to ensure that the segments rest on the subgrade to achieve the required channel fall. Preparing the subgrade to this tolerance can be time consuming. By contrast CC has excellent drape characteristics and does not require the same level of ground surface preparation, saving both time and money.

Poured concrete channels typically requires formwork to install side slopes, which is not required with CC. Poured concrete is also susceptible to wet weather working as the water:cement ratio must be controlled to achieved performance specifications. This is not an issue for CC as it is manufactured so that the material cannot be over hydrated and will cure under fully immersed conditions, making it an ideal 'rainy day' project.

CC is BBA Certified with a durability of 120 years and provides effective weed suppression and root penetration resistance according to DD CEN/TS 14416:2005. When used for channel lining applications, CC encapsulates the invert and slopes providing effective erosion control preventing the generation and accumulation of silt. The low manning's value of the fibrous top surface of CC assists with the self-cleaning properties of a channel. These properties mean that long term maintenance is typically not required on CC lined channels.

The end of life cost for traditional options is much greater than CC due to the high volumes and high mass of the material that needs to be removed from site and the disposed of or recycled. One square metre of 100mm thick ST4 concrete weighs approximately 240kg, whereas cured CC8 material weighs approximately 16kg per square metre, a saving of 93%.

HS2 Aims

The contract for this compound is in accordance with one of the three core aims of the overall HS2 project: Carbon.

Below, we discuss how the specification of Concrete Canvas® GCCM (CC) as an alternative to conventional ST4 concrete for channel lining enables Align to support HS2's aim to create a low carbon transportation network, even during the construction phase.

Embodied Carbon

CC offers significant carbon reductions compared to traditional concrete methods. In 2020 Ricardo Energy and Environment undertook an independent Life Cycle Assessment of the Global Warming Potential (GWP) for CC8™. They then compared this to the GWP of using 150mm of ST4 poured concrete to line a hypothetical channel located in Birmingham (200km from the Concrete Canvas Ltd. factory and only 20km from the ST4 batching plant), to understand which solution has the lower GWP from cradle to grave (sourcing raw materials, manufacture, transport, installation, use and end of life). The report found that constructing the channel in **CC8™ results in a GWP that is 55% lower than the ST4 poured concrete alternative**. Sensitivity analysis also showed that CC8™ still provides GWP savings even when the thickness of ST4 is reduced below 100mm.

Transportation

One pallet of CC can directly replace two 17-tonne ready-mix concrete trucks. CC is also available in pre-cut, man-portable batched rolls. The bulk and batched roll formats allow CC to be much more easily transported to and on-site, while vehicle movements are drastically reduced. Therefore, CC is often specified for projects on remote sites where use of traditional methods is implausible. Assuming that CC will therefore be transported five-times further to site than a locally sourced concrete supply, CC offers more than 50% reduction in transportation carbon costs.

Installation

CC is typically installed at ten-times the rate of poured concrete so significant carbon savings are expected when considering Construction Installation Process carbon costs but will vary from project to project.

Environmental Impact

The unique composition of CC means it can be installed and hydrated within live watercourses with minimal loss of fines at around 3% compared to the average of 10-15% experienced when using specialist underwater concretes (see CC Environmental Data document).

CC uses a specialist high early strength concrete with a limited alkaline reserve. Unlike most concretes, it is not classed as an irritant, and the PVC backing is a high grade, phthalate-free compound chosen to minimise the product's impact on the environment. As a result, CC can safely be installed on environmentally sensitive sites without any adverse effects on wildlife or the local ecology.

CC's eco-friendly properties have led to its use on numerous sensitive sites and specification by several environmental agencies around the world, including Environment Agency, National Resources Wales and Scottish Environmental Protection Agency in the UK.

Specification of Concrete Canvas®

An 8mm thick variant of CC known as CC8™ was recommended in the technical proposal provided by Concrete Canvas Ltd. Works on this project were carried out by Roadbridge on behalf of Align, with consultancy services also provided by Align.

CC was chosen over the poured and precast solutions due to the associated cost savings for the overall project as a result of faster installation speeds, reduced time on site and reduced labour requirements and end of life disposal.

CC's main benefits on this project, which led to its specification, are:

- **Erosion protection:** CC has been tested to ASTM C-1353 and was found to be approximately five-times more abrasion resistant than ST4 concrete.
- **Durability:** CC now has a durability of 120 years as certified by the BBA. The material has been used on projects for Network Rail, Highways England and Local Authorities and provides freeze-thaw, soak-dry, heat-rain resistance and is water impermeable to BS EN 12467:2004. CC has excellent chemical resistance, weathering performance and UV resistance.
- **Flow rates:** CC has been independently tested for permissible shear forces and flow velocities to ASTM D-6460 by third parties. The product exceeded test house capabilities. CC8™ withstands shear forces in excess of 575Pa and flow rates over 8.62m/s.
- **Eco-friendly concrete alternative:** CC has a low washout rate and low alkaline reserve, eliminating the requirement for treatment of washout prior to discharging into adjacent watercourses. The cement content in CC has no significant affect on water pH levels.
- **Approved by the EA:** CC has been specified by the UK's Environment Agency for use on environmentally sensitive sites, and has also been specified by various other environmental agencies around the world.
- **Reduced ground preparation:** CC is flexible and has excellent draping characteristics, allowing it to conform to and accommodate the existing channel profile. This means less excavation and profiling is required prior to installation.
- **Can be installed in wet weather:** CC cannot be overhydrated and has a working time of 1-2 hours following hydration, allowing works to continue in wet weather and adverse conditions. This means wet weather conditions do not cause delays when installing CC, unlike conventional poured and sprayed concretes.
- **Reduced future maintenance:** CC is an effective weed suppressant. CC's Manning's value helps sustain flow rates and prevent blockages often otherwise caused by vegetation growth in the invert.



CC has been used on several Network Rail projects



CC has been specified by the EA for use on environmentally sensitive sites

Compound 0, Hertfordshire

The CC8™ material was installed during weather events that would otherwise have delayed progress had poured concrete been used, leading to further time and cost savings for the client.

Prior to installation of the CC material, the channel was excavated using a small excavator and V bucket. The material was delivered to site in bulk rolls which were mounted on a spreader beam hung from an excavator and deployed transversely. The leading and trailing edges of the material secured within pre-dug anchor trenches using ground pegs.

Subsequent layers were positioned so as to overlap the last by 100mm in the direction of water flow (shingled). These overlaps were then jointed using 30mm stainless steel screws positioned at 200mm centres along the joint. Where the channels terminate, anchor trenches were dug at the sides and terminating edge and the CC material pegged in place.

Following installation, CC was hydrated using a bowser and hose and the anchor trenches then backfilled, providing a neater termination.

A total of over 8900m² of CC8™ were installed by a team of five during this project phase.



Channel was excavated using excavator with V bucket



CC was laid transversely across channel profile



CC edges secured in anchor trenches with ground pegs



Overlapping layers of CC jointed using SS screws



Hydration was given via bowser and hose



Ground on channel shoulders later compacted

Re-visit of Compound 0 - September 2020



Completed perimeter channel 1 year after installation



Corner detail of perimeter channel



CC termination into concrete headwall



Junction detail

Compound 1, Buckinghamshire

The ground on this site was heavily saturated, with the substrate mostly consisting of cohesive soil. These conditions would have made a traditional concrete installation more complex as the ground preparation would have been more time consuming, leading to additional time on site for the contractors and greater cost for the client.

Prior to installation of the CC material, the channel was excavated using an excavator and V bucket and anchor trenches prepared on each shoulder of the channel. The material was delivered to site in bulk rolls which were mounted on a spreader beam hung from an excavator and deployed transversely. The leading and trailing edges of the material secured within pre-dug anchor trenches using 250mm ground pegs.

Subsequent layers were positioned so as to overlap the last by 100mm in the direction of water flow (shingled). These overlaps were then jointed using 30mm stainless steel screws positioned at 200mm centres along the joint. At either end of the channel, the CC was secured within an anchor trench. Following installation, CC was hydrated using a bowser and hose and the anchor trenches then backfilled, providing a neater termination. Inlet and outlet pipes were then fitted and further backfill material was placed on top to prevent ingress.



Align's Compound 1 site



Channel profile following excavation using V bucket



Installation of first CC length



CC cut to length in the anchor trench using disc cutter



Securing CC edges in anchor trench with ground pegs



Overlapping layers of CC were joined using stainless steel screws



Hydration of CC using hose and bowser



CC was able to easily accomodate bends in the channel



Inlet pipe upstream



Completed section of channel



The CC installation was carried out as other works on site permitted to avoid disruption

A total of 1481m² of CC8™ were installed by a team of five during this project phase despite wet weather and difficult ground conditions. The works were carried out when other activity on the site allowed, a significant advantage with using CC compared to ST4 concrete as the material can be easily stored until it is required for installation.

Outcome

The client was happy with the outcome of both projects. CC will provide effective drainage measures for the site while the compound is in use.

All installation images were taken in 2019 prior to the COVID-19 pandemic. All works carried out during the pandemic were done so with the construction teams adhering to social distancing and government guidelines.