



 **CONCRETE CANVAS®**
Concrete on a Roll

RAIL CASE STUDIES



RAIL



ROAD



MINING



PETROCHEM



AGRO



PUBLIC WORKS



UTILITIES



DEFENCE



DESIGN



SHELTER

Concrete Canvas® is part of a revolutionary new class of construction materials called GCCMs. It is a flexible, concrete filled geosynthetic that hardens on hydration to form a thin, durable and water proof concrete layer. The material is predominantly used for erosion control applications such as channel lining and slope protection, offering a faster, lower carbon alternative to conventional concrete.

Concrete Canvas® User Benefits

Rapid Install

CC can be laid at a rate of 200m²/hour, up to 10 times faster than conventional concrete solutions. CC has a working time of 2 hours after hydration and can be installed in wet weather conditions, reducing programme disruption. CC cures in 24 hours, a fraction of the time it takes for conventional concrete to cure, enabling structures to be returned to service quicker.

Easy to Use

The concrete is pre-mixed so there is no need for mixing, measuring or compacting. Just add water.

Low Project Cost

The speed and ease of installation mean CC is more cost-effective than conventional concrete, with less logistical complexity.

Eco-Friendly

CC is a low mass, low carbon technology which uses up to 95% less material than conventional concrete for many applications. Up to 200m² can be delivered on a single pallet; replacing two full mixer trucks. The material has a low alkaline reserve and washout rate and can be successfully installed in natural watercourses without adversely affecting the water quality.

Concrete Canvas® Key Properties

Erosion Protection

CC prevents surface erosion from weathering and is up to 5 times as abrasion resistant as standard OPC concrete.

Conforms to Profile

CC has excellent drape characteristics, allowing the material to conform to the organic profile of the substrate making it more homogeneous with the surrounding environment.

Roll Formats to Suit Site Conditions

CC can be supplied in 1.5 tonne bulk rolls with a lifting beam for deployment, the fastest method of installing the material. CC can also be supplied in man-portable batched rolls eliminating plant requirements and allowing for installation in restricted access areas. Prior to hydration, CC can be cut to length using basic hand tools, eliminating wastage.

Reduced Maintenance

CC acts as an effective weed inhibitor, preventing costly maintenance required for unlined channels.

Ageing

Moss can grow on the fibrous top surface of CC resulting in it 'greening over', helping the CC to blend in with its surroundings. CC has a minimum design life of 50 years when installed correctly.

The following pages contain a collection of case studies highlighting the advantages of using Concrete Canvas® GCCM for a range of applications in the rail industry.



Project Info

 JUN 7 June 2017

 CC8™ Bulk Rolls

 # 1,950m²

 Transverse layers

 Fosse Way, Sherston, Phase 2, Wiltshire

 BAM Nuttall

 Concrete Canvas® used to line a drainage channel along rail cutting to prevent erosion and prevent washout failures.



Completed second channel section in Sherston, Wiltshire

In June 2014, Concrete Canvas® GCCM* (CC) was used to line a drainage channel located at the top of a railway embankment in Sherston, Wiltshire.

The works, carried out by BAM Nuttall with consultancy from Network Rail and ADAS (the Agricultural Development Advisory Service), took place as part of the Great Western Electrification programme (GWEP). GWEP involved raising and replacing various bridges, upgrading tunnels and carrying out safety improvement work to parapets between London and Cardiff. In this instance, local rail bridges were being elevated which resulted in the need to remove a nearby aqueduct which couldn't be repositioned. The drainage channel was designed to replace this loss of water management capacity and to prevent slip of the embankment through surface erosion and saturation.

Site access was limited due to the close proximity of the rail line and plant was only accessible via rented farm space, so speed of install was paramount. CC was specified due to its ease and speed of install, which significantly reduced time on site and cost of access.

The install was deemed a huge success due to the time savings and cost effectiveness of using CC8™ over conventional concreting methods. So much so, BAM Nuttall installed CC once again on a second section of the channel three years later in June 2017.



Original CC lined channel installation three years after completion



Unlined channel showing 3m deep scour and erosion



First layer of CC placed on existing concrete channel



Installed CC prior to hydration and backfilling of anchor trench



Headwall detail



Completed installation



Completed second CC lined channel section in 2017 in Sherston, Wiltshire

The section of CC lined in 2017 was situated downstream of the original CC installation and beyond a culverted section of drainage, which had eroded away and created a 3m deep scour pocket occurring as water discharged from a headwall into the unlined channel. The scour resulted in flooding of neighbouring fields and concern that future storm events could also flood the track.

The 750mm diameter culvert was extended for 80m before a new headwall was formed. The open channel was regraded and lined with CC8™ material, continuing for 350m before terminating into an existing sprayed concrete channel. Due to the restricted access and a need for end on working, the contractor's team excavated 30m sections of the channel using a ditching bucket, then installed the CC in a transverse layup. The team began downstream at the existing concrete channel, working upstream towards the headwall, lapping adjacent layers of CC so that they were shingled in the direction of water flow. Overlap joints were screwed together to prevent erosion between layers. To prevent water ingress beneath the material, the edges of the CC were pinned in an anchor trench which was backfilled.

The CC material was laid underneath the headwall before it was placed on top. The wing walls to the headwall were backfilled to ensure the CC tightly captured between the soil and concrete wingwall. All joints between the headwall and Concrete Canvas were finished with an adhesive sealant to prevent water ingress and potential scour. At times the installation was carried out in 30 degree heat and to ensure adequate hydration was achieved, more than 6 litres of water was used for every m² of CC installed. Even with restricted access and by end on working, 1950m² of CC8™ was installed in 3 weeks by a team of three.

"The installations at Fosse Way set the benchmark for all future Concrete Canvas channel lining works."

Mark Howells
Senior Drainage Engineer Western Route, Network Rail

Project Info

-  January 2017
-  CC5™ Bulk Rolls
-  2787m²
-  Vertical layers
-  Rossville, Tennessee, USA
-  Hulcher Services Inc.
-  CC5™ was used to provide protection to a slope previously lined with riprap at a rail intermodal facility

MILLIKEN INFRASTRUCTURE™
A Milliken COMPANY



Installation of CC5 on a slope in Rossville, Tennessee

In January 2017, Concrete Canvas® GCCM* (CC), branded Concrete Cloth™ in the US, was used to provide slope protection in Rossville, TN in the USA.

A rail intermodal facility in the southeast had an existing steep slope armoured with riprap which had deteriorated over time. A section of the slope had become difficult to maintain, with standard practices falling short of regulatory requirements. As a result, the client began to look for alternative solutions which could not only protect the slope but provide stability to its surface and prevent saturation. Having previously heard of CC, the client opted to use the material for the project, determining that it would provide the slope with the protection required while reducing overall maintenance and regulatory concerns. The works were carried out by Hulcher Services Inc., with design support from Milliken Infrastructure.

CC5 was specified for the project and was delivered to the site in bulk rolls. The material was laid longitudinally down the slope, from crest to toe. Subsequent layers of CC were overlapped by 100mm and jointed using percussion earth anchors, which were also used to fix the material edges. The edges were then captured in anchor trenches prior to backfilling.

In total, approximately 2787m² of CC5™ were installed at rates of around 557m² per day. The client is very pleased with the installation and has acknowledged CC as a viable option for use in future projects.

Project Info

 05 / 05 / 18

 CC5™ Bulk Rolls

 195m²

 Vertical layers

 South London, UK

 Seva Rail on behalf of Balfour Beatty Rail

 CC5™ used to provide weed suppression to slopes around existing signalling infrastructure alongside sections of rail track



Section of completed CC installation

In May 2018, Concrete Canvas (CC) GCCM* was used to provide weed suppression on sections of slope around signal systems as part of the Thameslink Programme F525 Angerstein Signal Renewals Works in South London.

Poured concrete would typically be used but would likely over-run a Sunday line possession. Additional groundwork would also be required, as well as a larger volume of materials on site, increasing logistical requirements. CC provided a faster, easier installation, material savings and reduced line possession, also providing the client with significant cost savings. The works were carried out by Seva Rail on behalf of Balfour Beatty Rail for their client, Network Rail.

Six slope sections required lining, but first had to be cleared of vegetation and the slope profiles graded. The CC5™ material was delivered in bespoke-length bulk rolls to minimise wastage, transported via rail trolleys and dispensed using a spreader beam hung from a track-mounted excavator.

The material was laid vertically, with edges pinned at 1m intervals in perimeter anchor trenches for a flush finish around formwork and overlapped layers jointed using stainless steel screws. Where the material had to be fitted around folding post signal structures, formwork was created around the post which was later filled with poured concrete. Following installation, the material was hydrated via bowser.

Each of the six sections of slope were completed in a single shift, without surpassing the Sunday line possession window, minimising disruption for rail users.

Due to the success of the installation, the client has specified CC for installations around four further junction boxes elsewhere. The contractor and client were impressed by the speed of install and the durable and effective weed suppression solution provided by CC. CC will provide much-needed weed suppression around important and sensitive infrastructure, while also mitigating future maintenance of the slopes, preventing damage to the signalling system and associated health and safety risks for maintenance crews.



Ground works prior to installation



Deploying first length of CC



Hydration



Installation following hydration



CC installed around framework



Poured concrete installation completed

Project Info



December 2017



CC8™



180m²



Longitudinal layers



Redbank Station,
Queensland, Australia



Queensland Rail
Engineers



CC used to line a drainage channel constructed as part of a scheme to protect a slope from erosion



Completed channel lining installation in Queensland, Australia

In December 2017, Concrete Canvas® GCCM* (CC) was used to line a drainage channel adjacent to a rail line in Queensland, Australia. The slope was inspected in early 2017 and was found to be suffering from erosion caused by heavy sub-tropical rainfall, its moderately steep nature of the slope, and a highly erodible soil substrate. Along with limited access due to the proximity of the slope to the rail line, there were a number of service pits at the toe, to which access was becoming compromised due to the eroded soil.

Concrete Canvas Ltd's Australian partner, Geofabrics worked with the client, Queensland Rail (QR), to find a solution which could be installed without line possession, despite access restrictions and could accommodate a newly constructed catch drain. The finalised design incorporated gabion baskets, non-woven geotextiles, erosion control matting, a geoweb cellular confinement system and CC. The works were carried out by QR engineers.

After clearing the bank of vegetation, a single course of Gabions was installed along the length of the embankment to form a permanent toe from which the slope could be re-graded, while ensuring underground services were protected and accessible. The slope was then protected using a three-layer system of the non-woven geotextile, the geoweb system, which was then filled with ballast materials, and the erosion control matting. A 'V' drain was created at the crest, shaped and lined with CC material which was secured using ground pegs at the edges, which were then buried in an anchor trench. Overlaps were jointed using screws and sealant.





Slope prior to works



Slope following re-grading and gabion placement

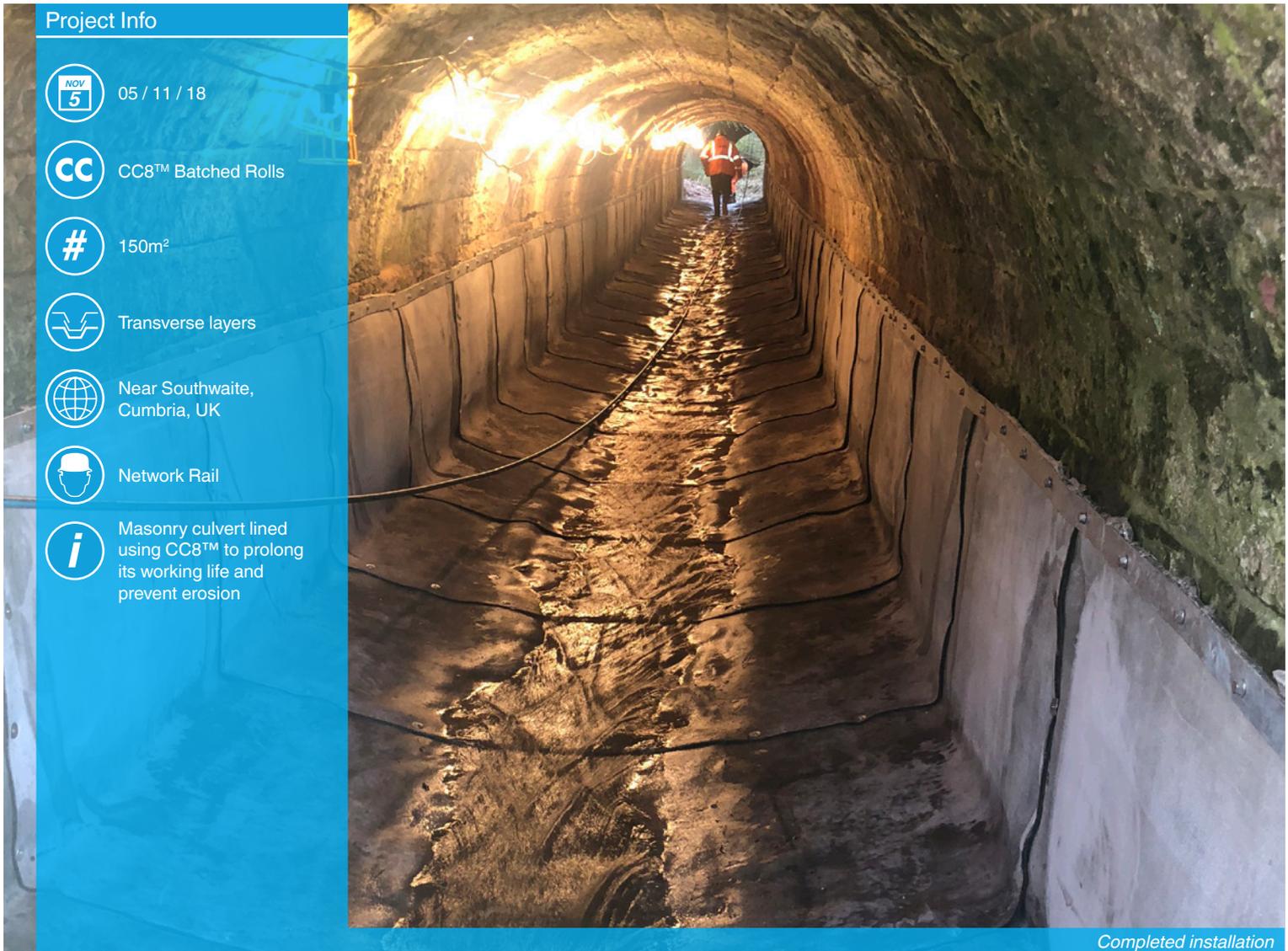


Completed installation



Completed CC lined channel at slope crest

A total of 180m² of CC8™ were installed by 4 people. The use of CC allowed for easy installation despite the limited access on site. Had CC not been used, the process of lining the drainage channel would have been considerably more complex due to the limitations of using alternatives such as shotcrete, which would also produce rebound and require line closures.



Completed installation

Project Info

-  05 / 11 / 18
-  CC8™ Batched Rolls
-  150m²
-  Transverse layers
-  Near Southwaite, Cumbria, UK
-  Network Rail
-  Masonry culvert lined using CC8™ to prolong its working life and prevent erosion

In November 2018, Concrete Canvas® (CC) GCCM* was specified as a culvert lining solution for a masonry culvert below the west coast mainline, owned by Network Rail, near Southwaite in Cumbria.

While the culvert was in fair condition, it was a masonry structure which had become overgrown with weeds and was in need of a lining solution to prevent erosion and prolong its working life. CC was chosen by Network Rail due to its ease of installation, use and transportation. The site's limited access meant any materials had to be transported down a muddy slope via wheelbarrows or trolleys. As a result, man-portable batched rolls were specified. Network Rail, carried out the works, with support from internal design engineers.

Prior to installation, large voids were filled to prevent water ingress below the material. Vegetation was removed, and repairs and repointing were carried out where required. The batched rolls were cut to 3.5 linear metre lengths which covered the invert of the culvert and the walls above the high-water line. Batching the material to the exact required lengths minimised wastage and made the material easier to handle in the culvert. The CC was fixed with a mixture of shot-fired nails and masonry bolts at 200mm centres on each overlap. The termination detail on the culvert wall consisted of a galvanised steel strip securing the edge of the CC; the strips were secured at 300mm centres. Following installation, grout was added to the top of the strip to neaten edges and further prevent ingress. Water from the upstream side of the culvert was used with a sump pump to hydrate the material, with buckets used to hydrate CC on the culvert walls. The installation was carried out over 5 days by a team of five.

*Geosynthetic Cementitious Composite Mat



Culvert prior to works



CC batched rolls transported by trolley



Joining overlaps using shot-fired nails



Termination of CC edges using steel bars and grout



Hydration of CC on culvert walls



Termination details on wall outside culvert

Project Info



12 / 12 / 16



CC5™ Bulk Rolls



760m²



Vertical layers



Linha do Douro, Mosteirô,
Baião, Portugal



Maranhão, Sociedade
de Construções, SA



CC5™ used to protect
and stabilise a steep
slope overlooking a
single track railway



MARANHÃO
SOCIEDADE DE CONSTRUÇÕES, LDA.
ALVARÁ N.º 5147



Completed installation in Linha do Douro, Portugal

In December 2016, Concrete Canvas® GCCM* (CC) was used to protect a slope in Linha do Douro, Portugal. The slope is situated alongside a single track railway, which was in need of protection from potential rockfall caused by erosion. Shotcrete was considered for the project but CC was chosen as it didn't require line closure, eliminating associated disruption for users of the railway and the public management company, Infraestruturas de Portugal. The works were carried out by Maranhão, Sociedade de Construções, SA.

In preparation for the installation, vegetation, large rocks and other debris were removed from the slope, and bulk rolls of CC5™ delivered to site. The CC was mounted onto a spreader beam and suspended from an excavator for easy deployment. It was then unrolled down the slope and cut to length, with ground anchors and ground pegs used to fix the CC to the substrate at the crest and down the face of the slope, eliminating voids beneath the material. Layers were overlapped by 100mm and jointed using screws in a triangular pattern to help prevent ingress. Masonry screws were used where the CC met an existing stone wall. The CC was hydrated twice, with an hour rest period in between. Following installation, a poured concrete drainage channel was installed along the crest of the slope, running down the side and along the toe. This was created to direct rainwater away from the tracks.

760m² of CC5™ were installed in just 2 days by a team of 5 in cold weather conditions. The use of CC allowed the line to stay open, and provided a more ecological solution, while the speed and ease of installation, along with the lack of plant required, reduced disruption for residents and rail users, while ultimately reducing costs for the client.

*Geosynthetic Cementitious Composite Mat





Large rocks, debris and vegetation were removed prior to installation



The crew had to use climbing equipment due to the steepness of the slope



The CC was cut to fit around the pre-fitted weep holes



Screws were inserted in a triangular shape for greater ingress prevention



Hydration was given in two stages



Edges at the crest buried under a poured concrete drainage channel

Project Info

 27 / 09 / 16

 CC8™ Bulk Rolls

 750m²

 Transverse layers

 Corbridge, Northumberland, UK

 Construction Marine Limited

 CC8™ was used to line a channel as part of a scheme to repair the landslide which closed the Corbridge rail line in January 2016.



Channel two years after installation

In September 2016, Concrete Canvas® GCCM* (CC) was used for channel lining in Corbridge, Northumberland, UK. The channel was part of a crest drain situated at the top of a 25m deep cutting on a site near a railway line.

On 7th January 2016, the steep slope overlooking the southbound Newcastle to Carlisle rail line between Corbridge and Riding Mill suffered significant failure, resulting in a landslide which covered the tracks in soil, debris and fallen trees, closing the line. The event occurred following a prolonged period of heavy rainfall, resulting in flows breaching the existing drainage network at the crest. Over 50,000 tonnes of soil and rock were removed and 10,000 tonnes of rock fill imported to reinforce the cutting slope. The line was reopened on 8th February 2016. Works were carried out by Construction Marine Limited for Network Rail.

CC was specified to direct and control drainage and reduce the risk of future water ingress and failure. The channel was re-excavated to ensure it was able to manage the volume of water flowing through it. The CC was deployed from a spreader beam and plant and laid transversely across the channel. The material was cut using hand tools to reduce waste, and layers overlapped by 100mm. The CC was hydrated below the overlaps, jointed using stainless steel screws and fixed to the substrate using ground pegs within pre-dug anchor trenches, which were backfilled following hydration.

750m² of CC8™ were installed by a team of six. The client was pleased with the installation, as it was not only easy and quick to install, but will also help maintain stability of the cutting and mitigate potential slip and subsequent line closures.



A V bucket was used to dig the channel



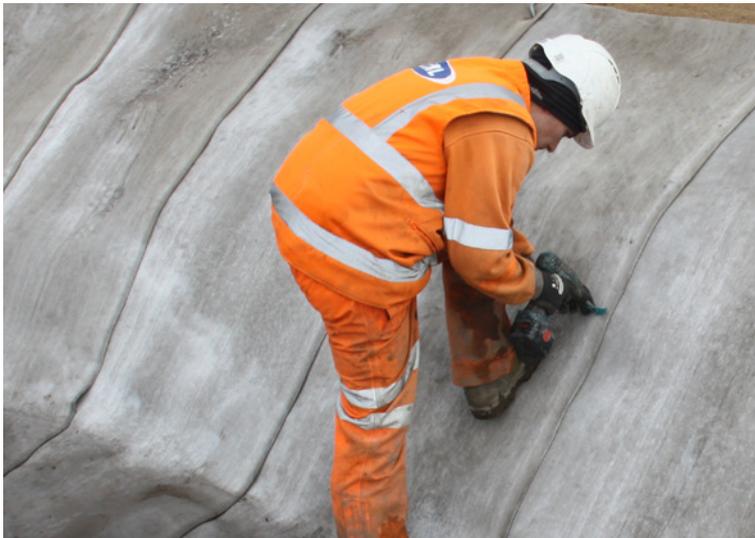
Site after ground preparation



Laying the CC8™



Ground pegs were used to secure the CC in the anchor trenches



CC under the overlaps were hydrated before fixing



Layers of CC were fixed using stainless steel screws