




# CONCRETE CANVAS®

Concrete on a Roll

## CULVERT LINING CASE STUDIES



RAIL



ROAD



MINING



PETROCHEM



AGRO



UTILITIES



PUBLIC WORKS



DEFENCE



DESIGN



SHELTER



Winner  
Technical Innovation Award



Innovation Award  
ICE Wales Cymru Awards 2017



2014 Fast Track 100  
16th fastest growing  
company in the UK.



2014 Queen's Award  
for Enterprise in  
Innovation



2013  
MacRobert Award  
Finalist



2013 Innovation Award Winner  
Ralltex Exhibition



2012 R&D 100  
Award winner  
R&D Magazine



2009 Winner  
Material ConneXion Medium Award  
Material of the Year



D&AD Yellow Pencil Award  
Winner  
Product Design

## Project Info

 02 / 08 / 17


 CC8™ Batched Rolls

 170m<sup>2</sup>

 Transverse layers

 Kirk Burn culvert,  
Laurencekirk, Scotland

 Briggs Building Ltd.  
with BEAR Scotland

 CC8™ was used to  
remediate a dilapidated  
culvert and prevent  
erosion caused by high  
water flow rates.



**briggs**  
building ltd



*The completed culvert lining installation in Laurencekirk, Scotland.*

In August 2017, Concrete Canvas® GCCM\* (CC) was used to remediate a dilapidated culvert in Laurencekirk, Scotland.

The original corrugated steel culvert, known as the Kirk Burn culvert, was 1.8m in diameter and had sustained significant degradation and erosion due to heavy water flows and abrasion. As a result, the existing 25mm bitumen coating inside the pipe had broken down through constant flow erosion and weathering.

For this project, installing a new culvert was cost prohibitive and would involve temporary road closures of the nearby A90, which is a major north-to-south road in eastern Scotland, running from Edinburgh to Fraserburgh. Other traditional alternatives, such as re-spraying the culvert with bitumen, are generally prohibited by the Scottish Environment Protection Agency (SEPA) due to environmental concerns. The use of Concrete Canvas was proposed by BEAR Scotland, and SEPA were satisfied that there would be no adverse environmental impact as the CC has a low alkalinity and low wash out.

Briggs Building Ltd, who had successfully installed the CC material for a similar application with BEAR Scotland the previous year in Newtonhill, was appointed to carry out the remediation works at the Kirk Burn culvert for Transport Scotland, with Consultation Services provided by BEAR Scotland.

\*Geosynthetic Cementitious Composite Mat



Flow erosion had caused the existing bitumen lining to break down



Water diverted into a 450mm HDPE Ridgidrain pipe



An Everbuild PVA adhesive & bonding agent was applied to crenulations



Semi-dry grout was applied to fill the corrugations



Batched rolls of CC8 were laid transversely across the width of the culvert



CC was fixed with tech screws & grout applied to prevent water ingress



Completed relined culvert on upstream side

Prior to installation, the river was dammed using sandbags 10 meters upstream from the culvert and water was diverted into a 450mm HDPE Ridgidrain pipe which allowed fish to safely pass through the culvert for the project duration.

The contractor pressure washed the culvert to remove any sediment and debris, and removed any loose bitumen sections inside the culvert. An Everbuild Feb General Purpose PVA adhesive and bonding agent was then applied to the crenulations prior to filling them with a grout mix to provide a suitable fixing surface and to minimise void spaces underneath the CC.

Due to restricted site access, batched rolls of CC8™ were delivered to site and unrolled by hand transversely across the width of the culvert. The adjacent CC layers were overlapped by 100mm and shingled in the direction of water flow. The CC overlaps were then screwed together and into the filled crenulations with 30mm stainless steel tech screws at 200mm centres and left unsealed, creating weep paths to prevent the build-up of any hydrostatic pressure behind the CC. The top edges of the CC were sealed with a line of grout to prevent water ingress behind the material. An anchor trench was dug on the upstream side to capture the CC edges and fixed with 300-500mm gabion stones before backfilling with material to prevent water ingress. The contractor used the water running in the HDPE pipe to hydrate the CC material with a hose pipe at the end of each day.

In total, 170m<sup>2</sup> of CC8™ were installed in 5 days by a crew of 4 people. The client was impressed with the ease and speed with which CC was installed, along with its minimal environmental impact and increased lifespan compared to bitumen.

## Project Info



11 / 09 / 17



CC13™ Bulk Rolls



160m<sup>2</sup>



Transverse layers



Cooks Bridge, Midhurst,  
West Sussex



Suttle Projects



CC13™ was used to provide scour protection and increase the working life of a culvert in West Sussex.



Completed culvert in use

In September 2017, Concrete Canvas® GCCM\* (CC) was used to line a culvert in Cooks Bridge, Midhurst, West Sussex. The culvert was situated under a highway, and provides the only passage under the road for the stream; however, the existing corrugated steel culvert had corroded over time, in part due to the abrasion from sediment and gravel transported along the channel in high flow conditions. The flow of water started to erode the soil beneath the structure, affecting the long-term performance of the culvert. CC was specified to provide scour protection to the culvert and increase the working life of the structure. The works were carried out by Suttle Projects for Igroup/Balfour Beatty Living Places/West Sussex County Council.

Bulk rolls of CC13™ were delivered free to site ahead of installation and mounted on a spreader beam to lift the material for batching on the side of the highway above, before the batched lengths were lowered and transported by hand into the culvert. Water was diverted away from the culvert during works using sandbags and overpumping to avoid high water levels in the culvert and the CC being hydrated too quickly, allowing plenty of time to work with the material, as it has a 2-hour workable period following initial hydration before it begins to harden.

To prepare the culvert, debris was removed from the corrugations and the culvert surface was cleaned to remove any sediment, some of which had solidified. The corrugation inverters were then filled with a rapid-set grout to ensure an even surface for the CC to be fixed to, as well as ensuring the material was flush to the culvert and to avoid any voids between the culvert and material. Grout was packed locally around protruding bolts and nuts to avoid potential puncture points.

\*Geosynthetic Cementitious Composite Mat



Site access was very restricted



The waterflow was restricted for the works using sandbags



Water redirected using overpumping



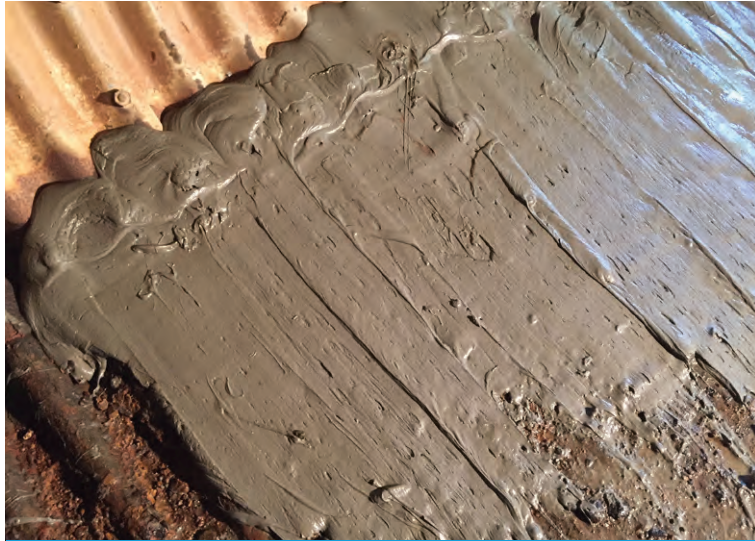
The culvert prior to prep and installation



The culvert floor was corroded and heavily sedimented



Quick-set grout was used to fill the voids in the corrugates



The grout provided a flat surface to lay the CC on top of



The CC was laid transversely across the culvert floor



CC was fixed to the culvert using tech screws



Voids behind the fixed CC were filled using more grout



CC extending onto concrete apron, fixed using tech screws and grout



CC aprons at the start of the culvert

*Completed culvert*

The CC material was then laid by hand, transversely across the base of the 23m x 6m culvert. The material was fixed to the culvert by drilling holes through the steel and fixing in place using tech screws. The CC was fixed along its edge at roughly 150mm intervals. Additional fixings were then applied at 300-500mm intervals, to help the material fit to the curve of the culvert successfully. Each additional layer was laid in the direction of waterflow, with an overlap over 100mm, and jointed using Clearfix adhesive sealant for added impermeability. Sandbags were then placed on top of the joints to weigh them down while they dried. Once installation was completed, and the grout set, the CC was hydrated using water from the stream.

Once set, the voids at the sides of the culvert and CC material were sealed by filling with poured grout to prevent ingress. At the start of the culvert, where there was a concrete apron, the CC was extended onto this and screwed in place, before a grout fillet was applied along the entire length to prevent water undermining. At the end, the CC was cut level with the headwall and another grout fillet applied and the edge buried with a larger stone.

The project as a whole took 11 days to complete, including mobilisation and preparation work. A total of 160m<sup>2</sup> of CC13™ were installed, fixed and hydrated in 3 days by a team of 4 people (with the majority of the installation time spent fixing the CC to the culvert with tech screws), on a site with limited access and material transported into position by hand.

***“We found Concrete Canvas very easy to deal with. They were extremely helpful and informative about the services they provide and the product itself. They arranged to visit the site to give an informative tool box talk to operatives. The material itself was simple to install, and the speed of install was surprising. We are very pleased with the finished product and will continue to work with Concrete Canvas.”***

Liam Tucker  
Director, Suttle Projects



## Project Info

 01 / 08 / 13


 CC5™ Bulk Rolls

 190m<sup>2</sup>

 Transverse layers

 Scottish Borders,  
Scotland, UK

 Castle Group Scotland

 CC5™ was used to  
remediate a dilapidated  
ARMCO culvert



*Completed relined culvert*

In August 2013, Concrete Canvas® GCCM (CC)\* was used to reline an ARMCO steel corrugated pipe which formed part of a culvert in the Scottish borders. The existing 1-2mm bitumen coating inside the pipe had broken down through flow erosion and weathering, resulting in silt, debris and vegetation growth and build up which begun to compromise and degrade the culvert. Replacing the culvert would be cost prohibitive and involve temporary lane closures of the nearby A7 trunk road. Bitumen coating is now generally prohibited by the Scottish Environment Protection Agency (SEPA) due to potential environmental damage, and any remediation solution would need SEPA approval. Glass Reinforced Plastic (GRP) was also considered, but would have to be specially made to fit the culvert, leading to increased cost and lead time. CC was chosen due to its speed of installation, flexibility, and minimal environmental impact, having been authorised for use in live water courses by the UK Environment Agency on previous projects.

Prior to installation, the ARMCO pipe was cleared of silt and debris and the damaged bitumen lining removed with a pressure washer. The corrugations were then filled in using a semi-dry grout mix before bulk rolls of CC5™ were delivered and cut to length on site, ensuring minimal material wastage. The CC was then laid transversely, overlapped by 100mm in the direction of water flow and fixed to the pipe at 200mm centres using stainless steel tech screws before being hydrated.

190m<sup>2</sup> of CC5™ was installed in a week and a half, including diverting water flow and preparation work. Castle Group Scotland were impressed with the ease and speed of installation CC, as well as its minimal environmental impact.

\*Geosynthetic Cementitious Composite Mat



Flow erosion had caused the existing bitumen lining to break down



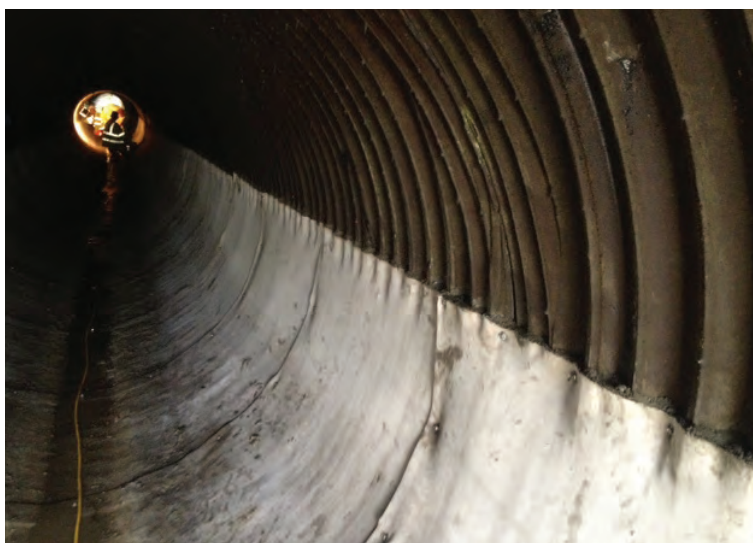
The culvert was pressure washed to remove the degraded bitumen



Semi-dry grout was applied to fill in the corrugations



CC5 was applied in transverse layers inside the culvert



Stainless tech screws were used to fix the CC8 to the pipe



Relined culvert section

## Project Info



24 / 09 / 14



CC5™ Batched Rolls



450m<sup>2</sup>



Transverse layers



Earlston, Scotland



Castle Group Scotland



CC8™ used to reline a failing culvert and prevent localised flooding.



Completed installation in Earlston, Scotland

In September 2014, Concrete Canvas® GCCM\* (CC) was used to line a culvert in Earlston, Scotland. The culvert was failing and previous lining/remediation attempts had been unsuccessful. Shotcrete was considered as an alternative, however this would have resulted in a much lengthier installation, as well as requiring much more complex logistics as access to the full length of the culvert was limited. Additionally there was concern over the environmental implications of installing shotcrete in this location.

Installation was carried out by Castle Group Scotland for Bear Scotland. To prepare the culvert the existing failed coatings were removed from the corrugated section and replaced with a semi dry mortar mix to provide a flat profile. Further down the culvert is of masonry construction, and the entirety of the culvert floor is poured concrete. Batched rolls of 5mm thick CC (CC5™) were delivered to site and unrolled by hand across the width of the culvert, with an overlap of 100mm created between adjacent layers. The overlaps were screwed with 30mm stainless steel screws at 200mm centres but were left unsealed, creating weep paths to prevent the build up of hydrostatic pressure behind the CC. The top edges of the CC were sealed with a line of grout to prevent water ingress behind the material. Water was pumped from the nearby water course for hydration.

450sqm of CC5™ were installed by 4 people in 4 days in a live water course. The client was very impressed with the installation and CC is likely to be used on further culvert projects.

\*Geosynthetic Cementitious Composite Mat



Masonry section before works began



Corrugated section before works began



Grout applied to corrugated section



Overlaps screwed, and grout applied to prevent ingress












The finished install within the culvert




A view of the finished install from outside the culvert

**Project Info**

-  19 / 09 / 16
-  CC5™ Batched Rolls
-  50m<sup>2</sup>
-  Longitudinal layers
-  N4 Watervalboven, Mpumalanga
-  WBHO
-  CC5™ was used to line a 48m long culvert located along the N4 toll road in Watervalboven, SA.



*The culvert prior to installation*

In September 2016, Concrete Canvas® GCCM\* (CC) was used to remediate a culvert along the N4 toll route in Watervalboven, Mpumalanga, South Africa.

The culvert had previously been lined with corrugated steel, however abrasion had damaged the galvanised layer of the material, which had led to the rapid deterioration of the steel itself, particularly where water was trapped in the corrugations.

The culvert is 48 metres long, and 900mm in diameter, and was posing serious occupational and health risks to the people working in it. The culvert also posed the challenge of difficult access, which presented the team with a problem during the project.

Conventional remediation methods on a culvert of this size are very costly and complex, and removing and replacing the culvert in its entirety would also be very expensive and challenging. CC proved to be a much more feasible solution as it was less expensive, easier to install and could be cut and transported in smaller, manageable lengths to take the restrictions of the culvert into consideration.

The works were carried out by WBHO for TRAC, with input from consultants SMEC.

\*Geosynthetic Cementitious Composite Mat



Existing corrugated steel culvert



Bulk rolls were used, then cut to specific lengths on site



CC5™ was cut to 8m lengths for easy transportation on site



Laying CC5™ lengths in culvert











Fixing with pop rivets





Completed installation

**Project Info**

-  13 / 03 / 14
-  CC8™ Bulk Rolls
-  80m<sup>2</sup>
-  Longitudinal layers
-  Porirua, Wellington, New Zealand
-  Rasmac
-  CC8™ was used to remediate a culvert to eliminate washout







*The completed project*

In March 2014, Concrete Canvas® GCCM\* (CC) was specified to remediate a culvert in Porirua, Wellington, New Zealand.

Sprayed concrete was considered, but the damp and cold conditions combined with the bed being lined with sediment would have made it exceptionally difficult to use this method. CC was selected due to limited access on the site, which can be negotiated by cutting the material into batched lengths and transporting it by hand on site. CC's rapid installation rates and cost effectiveness were also key advantages which led to its specification for this project. The works were carried out by Rasmac for Porirua City Council.

To prepare the site, the drain was cleared, the area dammed and the water flow diverted. A bespoke length was cut from a bulk roll of CC8™ and delivered to site. This was then unrolled on the flat and cut to length, before being carried into the culvert. The CC8 was fixed to the existing corrugated metal using 32mm hex self-drilling screws at 200mm intervals. Where joints were needed, overlaps of 100mm were created and mechanically jointed with more hex screws. To hydrate the material, the water flow was redirected through the culvert, allowing the CC to be submerged in water.

A total of 80m<sup>2</sup> of CC8™ were installed by 3 people in just 6 hours, following 8 hours of site preparation, when the client had allowed for 2 days. Furthermore, CC's low alkalinity and low washout rate meant the works did not negatively impact the local ecology.

\*Geosynthetic Cementitious Composite Mat



*The culvert before work began*



*Unrolling the CC8 in order to cut it to length*



*Fixing the CC to the culvert*



*32mm hex screws*



*The finished project*