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CULVERT LINING CASE STUDIES

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CULVERT LINING

Project Info

- 02 / 08 / 17
- CC8™ Batched Rolls
- 170m²
- 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.

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.

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CULVERT LINING

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

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CULVERT LINING

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, 170m² 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.

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CULVERT LINING

Project Info

- 11 / 09 / 17
- CC13™ Bulk Rolls
- 160m²
- 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 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 inverts 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.

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CULVERT LINING

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

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CULVERT LINING

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

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CULVERT LINING

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 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 160m² 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

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CULVERT LINING

Project Info

- 19 / 09 / 16
- CC5™ Batched Rolls
- 50m²
- 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 lead to the rapid deteroriation 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.

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CULVERT LINING

Existing corregated 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

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CULVERT LINING

Project Info

- 27 / 09 / 18
- CC8™ Bulk Rolls
- 205m²
- Transverse layers
- Bullockstone Road, Herne Bay, Kent, UK
- Steadline for Amey
- CC8™ used to provide protection to a culvert invert to prevent further degradation.

Completed installation

In September 2018, Concrete Canvas® (CC) GCCM* was specified to remediate a culvert on Bullockstone Road in Herne Bay, Kent. The invert had begun to corrode due to constant water immersion and sediment flow, requiring repair.

CC was specified due to its flexibility, which allows lining of the culvert floor without significantly reducing capacity or flow, maintaining its original shape, design and usability. CC has excellent abrasion resistance and provides a hard wearing protection layer to prevent sediment corrosion. The works were carried out by Steadline on behalf of Amey for Kent County Council.

Prior to the installation, the watercourse was dammed and over-pumped to divert water from the culvert. Approximately 600mm of stream bed material was removed, revealing its condition. The corrugations were then filled with a repair mortar before delivery and deployment of the specified CC8™ material. The installation started downstream, with the material laid transversely and layers overlapped in the direction of waterflow. The material was fixed to the culvert by drilling and fitting Hilti tech screws at 200mm intervals along joints, and 500mm intervals elsewhere. Once installation was completed, the dam was carefully lowered to allow water into the culvert before the water was brushed up the sides to ensure thorough hydration.

205m² of CC8™ were installed in approximately 3 days, following an additional 2.5 weeks for preparatory works. The client is pleased with the outcome of the project and is considering the use of CC to line further culverts.

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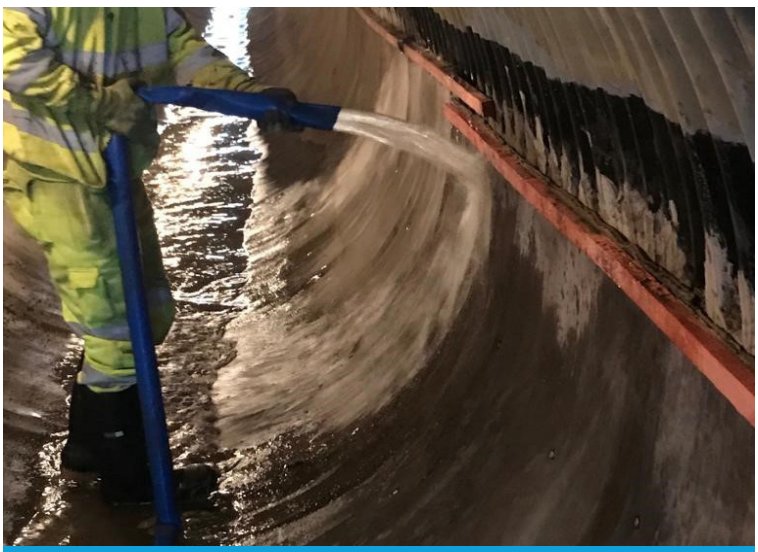
CULVERT LINING

Culvert prior to works

Silt build up and corrosion of culvert floor

Inverts filled with concrete mortar following cleaning

Fixing of first CC length to culvert and outside wall



Hydration of the material

Completed culvert back in use

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CULVERT LINING

Project Info

- 25 / 07 / 18
- CC13™ Bulk Rolls
- 560m²
- Transverse layers
- Halfway Bridge, West Sussex
- Suttle Projects
- CC13™ used to provide scour protection to a culvert under the A272

Completed CC culvert lining installation

In July 2018, three corrugated culverts were lined with Concrete Canvas (CC) GCCM* in West Sussex.

The culverts direct the river Rother under the A272 at Halfway Bridge, and were degrading due to sediment flow. One of the three was becoming increasingly affected, with a large amount of silt build up reducing its capacity.

CC was proven to provide the required protection following the success of the culvert lining works at Cooks Bridge, installed by Suttles for Balfour Beatty Living Places (BBLP) and West Sussex County Council (WSCC) in September 2017. The clients returned to Suttles to request they carry out the works as contractor for this project also.

Each culvert measured around 32m long, with a diameter of 3.23m. In order to carry out the installation, the first culvert was dammed and the river water directed through the other two culverts to allow works to take place.

As the works were carried out during the summer months, the river level was fairly low throughout, so the contractor didn't have to worry about the river flowing over the dams and disrupting works.

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CULVERT LINING

Thick silt build up in culvert 1

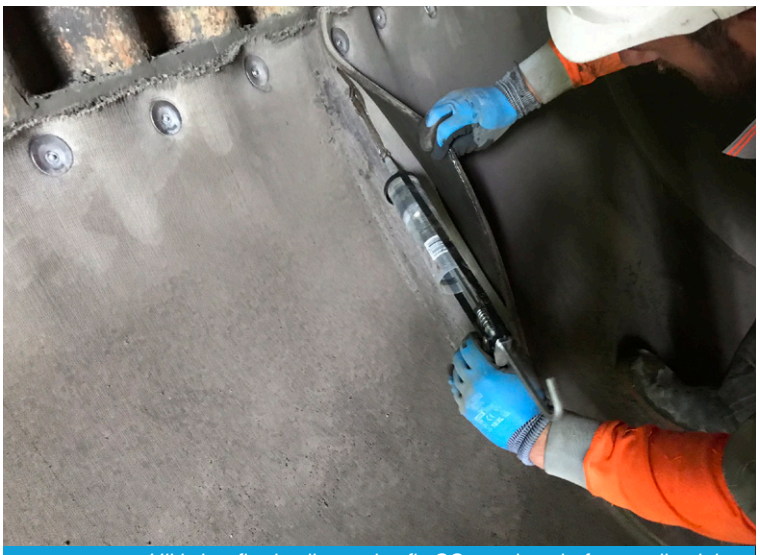
Culvert 2 prior to works

Culvert 3 prior to works

Devegetation of works area

Silt and substrate removed from beside culvert 3

Installing first layers of CC



Hilti shot-fired nails used to fix CC to culvert before sealing joints

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CULVERT LINING

Hydration

Edge of CC secured to archway and buried with poured concrete

Completed culvert installation

Following damming, silt build up was removed by hand, and the corrugations filled with grout. CC13™ bulk rolls were delivered and cut to required length on site. The CC was installed transversely and fixed to the culvert using Hilti shot-fired nails, while overlaps were jointed using adhesive sealant for increased impermeability. Once installation was completed, the dams were removed and water allowed to flow through it to hydrate the material. Water was then brushed up the sides of the culvert to hydrate the remaining material. In some cases, the water was hydrated using a hose and the river water.

Installation for each culvert took around 8 days, with 5 days required to grout the inverts, and 3 days for installation, including capturing the edge layers in an anchor trench, backfilling and hydration.

The project was a success, with a total of 560m^2 of CC13™ installed by a team of four, and completed one week ahead of schedule. The clients and contractor were once again very pleased with the outcome of the project, having used CC on the Cooks Bridge installation the previous year. The use of CC will once again prolong the life of the culvert, without requirement for asset replacement, saving the clients both time and money, due to the difficulties of accessing the site.

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CULVERT LINING

Project Info

- November 2014
- CC5™ Batched Rolls
- 31m²
- Transverse layers
- Lewis County, Washington, USA
- Lewis County maintenance crews
- CC was used to repair an eroded culvert located in an environmentally sensitive fish habitat

Completed culvert

In November 2014, Concrete Canvas® (CC) GCCM was specified to reline a steel corrugated culvert pipe in Lewis County, Washington, USA.

The existing pipe, which measured 5ft high, 7ft wide and 34ft long, had broken down as a result of flow erosion and weathering. Water was flowing through the bottom of the culvert and compromising the base soils below as well as the integrity of the rural country road above. A road closure, which would be required to replace the culvert, was not an option.

CC was a much more cost effective solution for this problem and was chosen due to its speed of installation, ability to easily accomodate changes in profile and minimal environmental impact. CC has a low alkaline reserve, allowing it to be used in live watercourses without any adverse effect to the local ecology. This was important for this particular project as the material would be installed into an environmentally sensitive fish habitat.

To facilitate installation, a stream bypass was installed to divert water around the work zone, which was then isolated with cofferdams while a fish rescue was performed and the site de-watered. Sediment laden water was pumped downstram to a grassy area where water was filtered prior to rejoining the stream channel.

The installation was completed over two days; the first day, the crew of five workers installed the CC, before hydrating it and leaving it overnight to set. On the second day, the CC edges were sealed using caulk.

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CULVERT LINING

Isolating with cofferdams and de-watering the site

CC post-installation, prior to trimming and sealing of edges

Tar used to seal material edges

Water catchment for pH testing

The CC lining covered an area of approximately 10ft wide and 34ft long. A minimum overlap of 4 inches (approximately 100mm) was given between layers. Self-tapping stainless steel screws were used to fix the CC to the culvert, placed approximately every 4 inches (100mm) along the sides of the culvert, and every 18 inches (approximately 450mm) along the culvert floor. The use of the caulk to seal the CC edges prevented any ingress and protected the edges of the material, while offering an additional fixing method to secure the material in place. Tar was also applied over the edges to ensure a water tight seal. At the inlet and outlet of the culvert, CC was wrapped and fixed beneath the culvert pipe and substrate placed to fill existing voids.

Once installation was completed, pH monitoring was carried out as water was introduced to the material for hydration. Any excess water in the work zone was pumped to an upland where it would infiltrate. Once the CC had hardened, the water was pumped through the culvert, tested, and pumped to an upland until pH readings were within 0.5 units of the background readings between 6.5 and 8.5 units. Once was complete and pH readings met the required levels, the cofferdams were removed and the stream allowed to flow freely.

The client was pleased with the installation, noting that the CC was delivered on time and well-packaged. Workers were trained on-site and the project ran smoothly. After numerous high-flow events during the months following the completion of the project, the CC was still performing as designed. Overall, Lewis County rates the project a success.

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CULVERT LINING

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

Completed installation

In November 2018, Concrete Canvas® (CC) GCCM* was specified for use as a culvert lining solution. The culvert is situated below the west coast mainline, owned by Network Rail, near Southwaite in Cumbria. While the culvert was in a fair condition prior to the works, it was a masonry structure which had become overgrown with weeds and was in need of a lining solution to prevent erosion of the masonry floor and walls, and prolong its working life.

CC was chosen for the project by Network Rail due to its ease of install, use and transportation on site. The limited access to site meant any materials had to be transported down a muddy slope via wheelbarrows or trolleys. As a result, CC's man-portable batched rolls were specified. The client, Network Rail, carried out works for this project themselves, with support provided by internal design engineers.

Prior to installation, any missing sections of masonry or large voids were filled to prevent water ingress below the CC material. Vegetation was removed, and sections of a wall were repaired and repointed where required.

Working with the design engineer and Site Agent, the batched rolls of CC were cut to 3.5 linear metre lengths which covered the invert of the culvert and the return up the walls on each side to a height that would be above a high-water line. Batching the material to the exact required lengths allowed for minimal wastage and made the material easier to handle in the culvert.

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CULVERT LINING

Proximity of culvert to rail line

Culvert prior to works - water overpumped to allow installation

Water overpumped

Fixing CC to masonry wall

Shot-fired nails, steel bars and grout used for fixing and termination

Hydration of CC on walls

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CULVERT LINING

Grout & stones applied to CC floor to provide rocky surface for fish

Completed installation, with additional stone floor

The material was fixed to the masonry culvert with a mixture of shot fired nails and masonry bolts at 200mm centres on each overlap. The termination detail on the wall of the culvert was a galvanised steel strip securing the edge of the canvas to the wall and the galvanised strips were secured at 300mm centres. At the end of the installation a small bead of grout was then added to the top of the strip to neaten the edges and further prevent ingress of water.

The material was hydrated in accordance with CC's hydration guidelines. 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 a five days, including culvert preparation, by a team of 5. The Site Agent was impressed with the ease of installation of the material and how easily it moulded into shape.

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