



CONCRETE CANVAS® *Concrete on a Roll*

ENVIRONMENTAL CASE STUDIES



The Queen's Awards
for Enterprise
International Trade
2019



Board of Trade
Winner
2018



Winner
Technical Innovation Award



Innovation Award
ICE Wales Cymru Awards 2017



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Corporate
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RAIL



ROAD



MINING



PETROCHEM



AGRO



PUBLIC WORKS



UTILITIES



DEFENCE



DESIGN



SHELTER

Concrete Canvas® (CC) is part of a revolutionary new class of construction materials called Geosynthetic Cementitious Composite Mats (GCCMs). It is a flexible, concrete filled geotextile that hardens on hydration to form a thin, durable, water proof and fire resistant concrete layer. Essentially, it's concrete on a roll.

Low Carbon

CC is a carbon efficient, sustainable material that offers significant embodied carbon reduction compared to traditional concrete methods. The material has undergone a full Life Cycle Assessment as per ISO 14040 resulting in an Environmental Product Declaration as per EN 15804. View the [CC Carbon Report](#) for further information.

CC enables up to 150mm of poured concrete to be replaced with just 8mm for many surfacing applications. As a result, material savings of 95% can be achieved for a typical construction project. In addition CC reduces the transportation requirement of construction work.

A single pallet of 8mm thick CC (CC8™) contains 125m² of concrete surfacing; the same coverage using poured concrete would require 2 17t ready-mix trucks. In other words, a single truck load of CC Bulk rolls replaces a further 33 vehicle movements. **When considering raw materials alone, a CC-lined channel will contain only 45% of the Embodied Carbon of a conventional concrete channel. A saving of 55%.**

Low Washout

CC traps dry concrete powder in a 3-dimensional fibre matrix. Testing based on BS8443 to indicate the effect of underwater setting, shows that CC loses only 3% by mass. By comparison, specialist underwater concretes typically lose between 10-15% whilst also requiring much larger initial volumes.

CC has been independently tested by the CTL Group laboratories in the US which measured leachates from CC both during hydration and post-set. All leachate levels were found to be below the levels set by the US Environmental Protection Agency (EPA).

Limited Alkaline Reserve

CC uses a specialist high early strength concrete with a limited alkaline reserve. Unlike most concretes, it is not classified as an irritant and is less damaging to the environment.

Environment Agency Use

CC was first specified for use by the Environment Agency (EA) Biodiversity team in 2010 on the Church Village Bypass Project. Benefits cited included 'surface roughness to provide diversity in the channel's morphology' and its ability to introduce 'sinuosity in the channel line'.

Since 2010 CC has been used in multiple installations on a case-by-case basis including projects for the Environment Agency (EA), Natural Resources Wales (NRW) and Scottish Environmental Protection Agency (SEPA).

Greening

Untreated CC will naturally 'green' over time as the textured top surface allows moss growth, whilst the fibre-reinforced concrete layer will prevent root-growing vegetation, which would otherwise restrict water flow and increase maintenance costs.

Manufacture

Concrete Canvas Ltd is ISO9001 certified; we pride ourselves on the responsible sourcing and production of our products. CC is [BBA certified](#) with a durability in excess of 120 years when used in erosion control applications. All materials are sourced to minimise environmental impact. For example, the PVC we use is a high grade phthalate free (no DOP) compound. This is designed to maximise the products life expectancy and minimise its impact on the environment.



Project Info



02 / 11 / 16



CC13™ Bulk Rolls



1040m²



Vertical layers



Pontypridd, South Wales, UK



Natural Resources Wales



CC used to provide slope protection to sections of embankment along the River Taff



**Cyfoeth
Naturiol
Cymru**
**Natural
Resources
Wales**



Completed CC lined section of River Taff embankment

In November 2016, Concrete Canvas® (CC) GCCM was used as a remedial slope protection solution to line sections of embankment on the River Taff in South Wales. From its confluence at Cefn-coed-y-cymmer the River Taff flows south, passing through Pontypridd and the centre of Cardiff, before emptying into Cardiff Bay.

Sections of the river bank are formed from grouted rip rap embankments which are believed to have been installed in the early '50s. A particular section within Treforest Industrial Estate, was heavily cracked, showing signs of severe spalling and established vegetation growth. Remediation was required to provide an effective erosion protection layer that would prevent further scour and undermining of a walkway at the crest.

Following similar successful works at Crindau in Newport, Concrete Canvas Ltd were approached by Natural Resources Wales. The area considered for remediation was approximately 220 linear metres in length and approximately 4m in height, terminating halfway up the slope. The riprap butted into a concrete kerb at the toe, capping sheet piling beneath. The bank showed signs of erosion which could potentially cause stability issues in the future. Re-pointing sections of the riprap was considered, but would be a costly, temporary solution and wouldn't address underlying drainage issues. Replacing the riprap entirely would involve excavation and import of fill; this in itself would be costly without consideration of the limited site access. Sprayed concrete, in-situ poured concrete and vegetation were amongst other options considered but required specialist contractors and equipment, could contaminate the river and would be time consuming, short-term solutions.





Evidence of weed growth, cracking and spalling



Installation of the CC following ground preparation



Preparation of the slope; regrading and placing of the geotextile



Fixing of the overlapped CC layers using screws at 150mm centres



Hydration of CC using river water



Grouted termination to riprap and backfilled crest anchor trench



Installation 48 hours after Storm Dennis

CC13™ was specified in order to maximise the durability and effectiveness of CC as an erosion protection solution in order to withstand the potential fast flow velocities of the River Taff, shear force loads and the likelihood of impact from debris.

A temporary aggregate access road was constructed using site won river material for plant access, allowing the CC13™ to be deployed via bulk rolls dispensed from a spreader beam. The poor condition of the rip rap would have compromised the stability of the CC lining and create an uneven surface, with the potential for void development below. As a result, the riprap was removed using plant, and the surface graded for a uniform surface prior to installation. A layer of separation geotextile was laid first, mitigating wash out of the substrate fines through tidal action between the CC joints.

The CC was deployed vertically from crest to toe in order for each layer to be individually anchor trenched at the crest and mechanically fixed to the concrete kerb at the toe. Vertical layers also allowed for easier and staged installation.

CC layers were overlapped by 100mm, shingled in the direction of water flow and subsequently screwed together through the overlap at 150mm centres using 30mm SS screws, creating a natural weep path between the layers, allowing the release of any build-up of hydrostatic pressure. The top edges of CC were secured using steel pegs within an anchor trench, which was later backfilled following CC hydration. At the toe, CC was mechanically fixed to the concrete kerb to prevent displacement. Each layer was secured to the embankment face using concrete masonry anchors with washers and side edges anchor trenched within poured concrete to prevent water ingress. A series of drainage chambers were installed along the length of the embankment. The installation was painted green on completion to match in with the natural surroundings.

Project Info



29 / 08 / 16



CC8™ and CC13™ Bulk
& Batched Rolls



837m² of CC8™
128m² of CC13™



Transverse layers



Glenridding, Ullswater,
Cumbria



7 5 Engineer Regiment



Re-lining of existing
ditch on top of a tailings
dam to prevent damage
from severe rain storms.

Lake District
National Park



[CLICK TO VIEW
NEWS FOOTAGE](#)

Batch & Bulk Rolls of CC being delivered via a commercial helicopter

In August 2016, Concrete Canvas® GCCM* (CC) was used to line a drainage channel at Glenridding Mine, Ullswater, Cumbria. The aim was to re-line an existing 200m long channel on top of a tailings dam to prevent damage from runoff during severe rain storms.

The project was managed by the Lake District National Park Authority with significant support from the 7 5 Engineer Regiment under 4 2 Brigade, design input from the Coal Authority and the Environment Agency. The installation was completed over a ten day period, in mostly clear weather.

Various methods have previously been used to line the channel including dry stone walling and poured concrete. The Coal Authority, who provide geotechnical advice to the Lake District National Park Authority recommended the use of Concrete Canvas®.

Removal of some of the dry stone walls and overburden on one side of the channel took place prior to installation. The CC was trimmed using knives, and anchored to the ground using steel pegs and heavy rocks. The overlaps were jointed using stainless steel screws at 200mm centres. An army issue portable temporary 10,000 litre reservoir was used for hydration.





The channel prior to remediation



Large stones and debris were cleared to be re-used after CC installation



The 7 5 Engineer Regiment under 4 2 Brigade at work



A combination of CC8™ & CC13™ was used



The site was extremely difficult to access, all work was carried out by hand



Hydration taking place via an army issue portable 10,000 ltr reservoir



An aged image (May '17) of the completed lined channel at Glenridding, Ullswater

Greenside Mine was, at one time, the UK's largest producer of lead ore and is now designated a Scheduled Monument as a result of over 150 years of continuous operation and evidence still being visible on the ground of the different mining techniques deployed over that time. Above the tailings dam, the natural scree habitat is designated as SSSI for species such as Juniper, rare mosses and ferns including the Parsley Fern.

Being such a sensitive location, arranging permitting was essential for planning permission, Environment Agency Licensing, LFRM, Scheduled Monument and SSSI Consent. This very complex permitting procedure, carried out by the Lake District National Park Authority was made much easier through the use of CC rather than poured concrete, and the fact that it could be installed by hand meant that (a) it was feasible, and (b) there was a very small on-the-ground footprint during deployment. Without the issue of re-bond that is present in more conventional construction methods such as shot-crete, CC proved to be a far more environmentally friendly option.

The mine site is on a steep hillside 2 miles up a remote track, presenting a number of logistical issues in regards to delivery. With no possibility of off-loading on site, the project manager organised delivery of palletised material by HIAB wagon to a point 500m away, with pallets then being flown into position by commercial helicopter. The rolls of CC8™ were batched to specific lengths to accommodate the different profile the channel takes along its 200 metre length. Concrete Canvas ensured that the man-portable batch rolls, were all labelled correctly and palletised to the customers' requirements into loads that each weighed less than 950kg, allowing them to be subsequently lifted and accurately positioned by helicopter. Getting the logistics correct was key to enabling a rapid delivery and the success of the project. With no wheeled or tracked machinery able to access the site, correctly positioning the pallets by helicopter meant the volunteer Army workforce was then able to focus on the installation of CC in the channel rather than waste time moving materials by hand.

Project Info



29 / 01 / 14



CC5™ Batched Rolls



270m²



Transverse layers



Brecon, Wales, UK



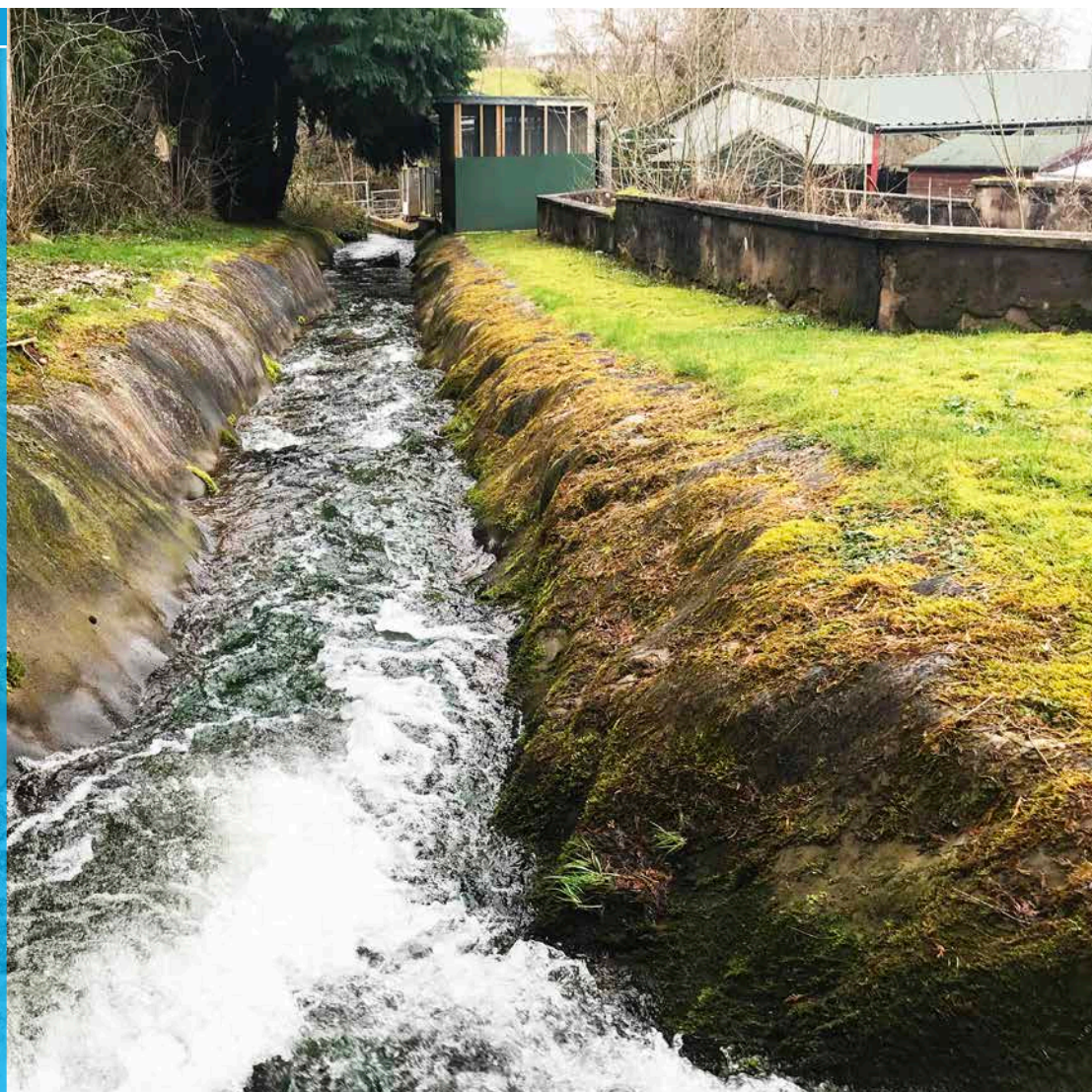
Natural Resources
Wales



CC5™ was used to
line a damaged leat in
Brecon, Wales



**Cyfoeth
Naturiol
Cymru**
**Natural
Resources
Wales**



Completed installation at Cynrig Hatchery

In January 2014, Concrete Canvas® GCCM* (CC) was specified as an erosion protection liner for a leat at Cynrig Hatchery near Brecon in Wales. The leat was used to direct overflow from the river Cynrig, a tributary of the River Usk. The overflow posed a risk to the hatchery's stocks of juvenile salmon. The leat had sustained damage and erosion over time; it's original wood-lined face and an adjoining rock bed was leaking into a nearby reed run and threatened the hatchery's infrastructure. The site is owned and operated by Natural Resources Wales (NRW), who also carried out the works.

Upon close inspection of the leat's condition, the decision was taken to excavate it out to profile first, and then line it with CC5™. Man-portable batched rolls were specified due to the difficulty of getting heavy plant near the installation site. CC5™ was used to line 40 linear meters of channel with a varying profile at an average width of approximately 5.5m and a 1.5m depth.

The CC was laid transversely, with adjacent layers overlapped by 100mm before being screwed in place. The overlaps were not sealed, allowing natural weep paths to form and preventing the build-up of hydrostatic pressure behind the material. The leading edge at the mouth of the channel, beneath a footbridge, was anchor trenched into a poured concrete base. The material at the crest was also buried to provide a neat termination and prevent water ingress. Rocks of ecological concern were recovered and placed on top of the CC after installation, creating natural baffling. CC5™ had the flexibility to negotiate existing pipework and a concrete base that was unearthed at the foot of the channel.

A total of 270m² of CC5™ were installed by three NRW operatives in less than five hours.





Damage to a leat had caused leaks which threatened the hatchery



The site was excavated and graded, and batched rolls delivered



CC5™ was applied in transverse layers with a 100mm overlaps



CC was fixed using steel ground pegs and concrete masonry fixings



CC5™ was captured within anchor trenches and hydrated



Completed channel installation

Project Info



03 / 11 / 14



CC8™ Bulk Rolls



200m²



Transverse layers



York, UK



Balvac Limited on behalf of the EA



CC used to line an eel and lamprey pass on the River Ouse at Naburn Weir.

Balvac
Balfour Beatty



Section of completed installation at Naburn Weir eel and lamprey pass

In November 2014, Concrete Canvas® GCCM* (CC) was used to line a channel, which would serve as an eel and lamprey migration pass, on the River Ouse at Naburn Weir in York, UK.

The Environment Agency (EA) carried out this project as part of their species management programme, aiming to create a naturalised channel flowing across the EA-owned land adjacent to the weir and existing fish pass. This channel would allow eels and lamprey to migrate upstream. The pass has created a series of pools and small step-weirs which these species can access on a rising tide.

The project required an innovative design approach to provide a channel capable of providing a constant trickle flow of water through complex and difficult ground conditions, on a site covered by invasive plant species and subject to tidal inundation and fluvial flood flows. The ground conditions presented a challenge in terms of designing an impermeable channel which could carry low-flows without leakage and also to resist out-of-channel flows from the River Ouse, which is a regular occurrence at this site. The ground consisted of tidal and fluvial silt deposits, overlaying the demolished remnants of an old mill building. The channel had to be constructed to a gradient such that the drops between each successive pool were no greater than 100mm and to connect to the river Ouse, both upstream and downstream of Naburn Weir.

It was not possible to form a natural channel due to unstable silt deposits overlying the site and because low flows would seep through due to the porous soil and rubble content.

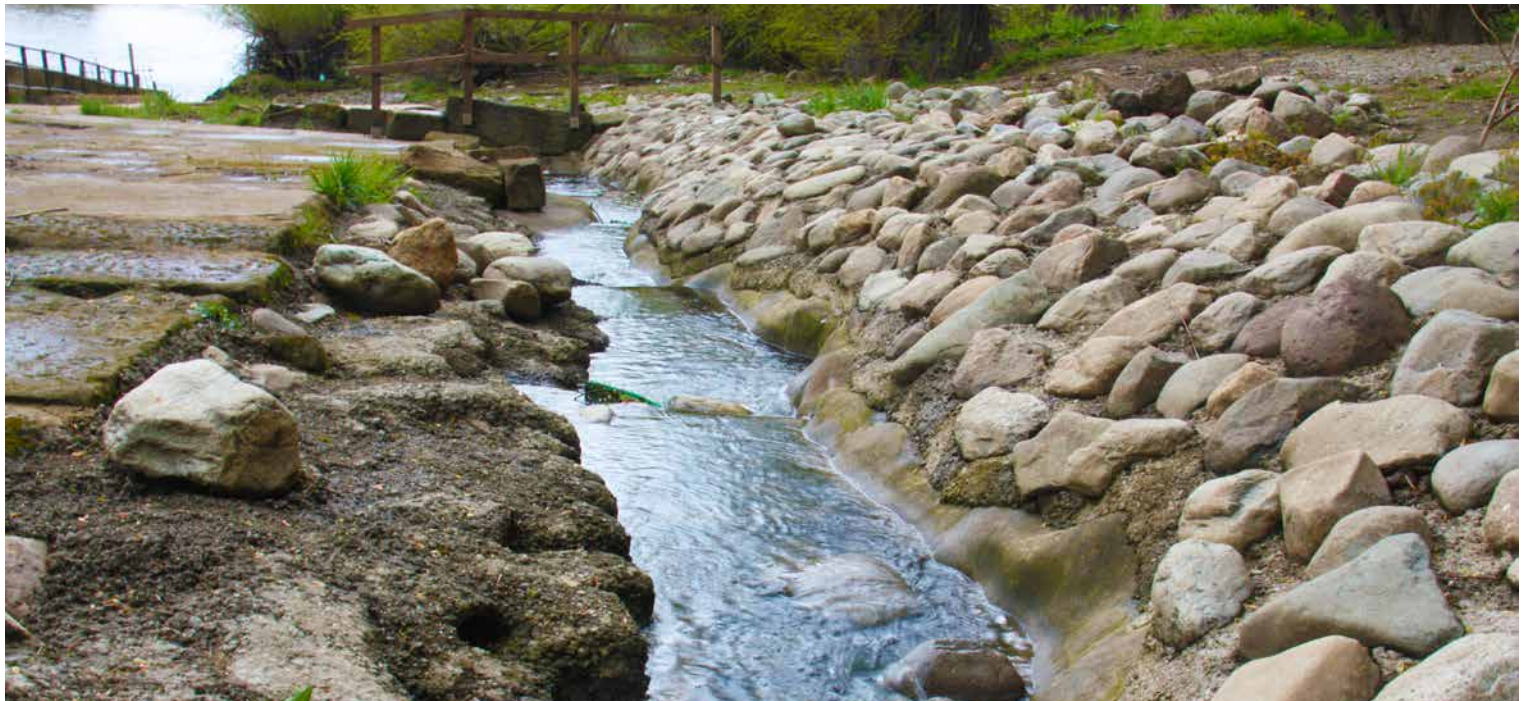




Ground preparation



CC laid transversely to accommodate channel variations



Channel showing moss growth and 'greening'

Mass or reinforced concrete forms were discounted due to expense, high carbon impact and differential settlement issues. Concrete Canvas® was specified as it would reduce permeability, require little preparation, and accommodate existing stone slabs. CC's low cement content in comparison to alternatives provided a sustainable solution and much lower carbon footprint. It's draping characteristics created a natural looking profile and the fibrous top surface allowed it to quickly develop algae and weed growth whilst preventing root growing vegetation that would otherwise block the channel. It also provided a surface onto which river lamprey have been seen to attach themselves whilst resting in the flow.

Balvac Ltd. carried out the works, with designs produced by the EA's Asset Performance Project Team and on-site support from Concrete Canvas Ltd. Overall, a high-quality design was achieved and delivered which overcame the ground conditions and site constraints and provided an attractive, functional, innovative solution. The design has already proven to be effective with over one hundred river lamprey captured in one survey and elvers seen in all of the pools.

The EA have upheld their responsibilities under the Eel Regulations now that both species are able to migrate upstream beyond the weir at the tidal limit of the River Ouse. The project was awarded the ICE (Institution of Civil Engineers) Sir John Fowler Award at the 2015 Yorkshire and Humber annual awards.

Project Info



18 / 08 / 14



CC8™ Bulk Rolls



550m²



Vertical layers



Crindau, Newport,
Wales, UK



Cyfoeth Naturiol Cymru
(Natural Resources
Wales)



CC8™ used to prevent
deep slip and tidal/
weathering erosion of a
clay core, grassed flood
berm on the banks of a
tidal estuary on the River
Neath in Newport, Wales.



**Cyfoeth
Naturiol
Cymru
Natural
Resources
Wales**



Completed first section of lined berm

In August 2014, Concrete Canvas® GCCM (CC) was specified by Natural Resources Wales (NRW) as a protective liner to a clay and top soil flood defence berm on an estuary bank in Crindau, Newport, in South Wales.

Two sections of embankment were deemed to be at risk of slip and tidal erosion; a 10 linear metre section on the south facing bank and a 20 linear metre section on the western bank of the estuary bend. Any undermining of the flood bank could potentially compromise a nearby industrial estate.

In previous years, vegetation mats had been installed as a means of reinforcing the berm, but had quickly degraded. Prior to CC installation, ground preparation consisted of light grading of the profile and removal of vegetation growth. CC8™ was specified to provide erosion protection, protection against tidal scouring and undermining at high tides.

CC was delivered in bulk rolls, dispensed via a spreader beam and batched on site to required lengths to avoid wastage. Layers of CC were laid vertically, with adjacent layers overlapped by 100mm and screwed together at 150mm centres. The CC was secured to the slope using 380mm steel pegs through the overlaps at approximately 3m centres. The ends of the CC layers were anchor trenched at the toe and crest, using backfill from the profile grading. Cuts were made into the unset CC to accommodate a number of service pipes and drain covers. Once installed, the CC was hydrated.





Berm prior to vegetation removal and grading



Batching lengths of CC from spreader beam suspended bulk roll



Fixing of the CC overlaps with stainless screws at 150mm centres



Backfilling anchor trench at toe of second section berm



Backfilled anchor trench post hydration



Drain pipe cover access through CC

Project Info



15 / 01 / 13



CC5™ Batched Rolls



30m²



Transverse and Vertical
layers



Coatham Marsh
Nature Reserve, UK



Tees Valley Wildlife
Trust



CC5™ was used by
Tees Valley Wildlife
Trust to construct a
5m long artificial sand
martin bank at Coatham
Marsh nature reserve.



Environment
Agency



Completed Sand Martin Bank

In January 2013, Concrete Canvas® GCCM* (CC) was used to create a 5m long artificial sand martin bank at Coatham Marsh Nature Reserve to enhance wildlife habitat on the site. The work formed part of a project funded by the Environment Agency (EA) who are currently involved in improving coastal defences along Redcar seafront, and saw a need to balance this construction with some improvements for local wildlife.

Most artificial sand martin banks are constructed from concrete blocks, with sand and/or earth banked up behind. However, TVWT wanted to limit the amount of concrete used in the project, due to the difficulties and logistics involved with repairing or removing it in the future. CC was chosen as it can be supplied in man-portable rolls, can be installed in the rain, is more environmentally friendly than traditional methods due to its low alkali reserve and wash out rates, and offers significant cost savings over traditional methods. The works were carried out by Tees Valley Wildlife Trust.

The shape of the sand martin bank was defined a 5m long timber sub-structure consisting of timber posts driven into the ground, and braced and reinforced by a frame and shuttering. The CC was laid vertically over the shuttering, pulled taught to ensure it followed the contours of the frame and fixed using wide-head screws and galvanised nails. Crosses were then cut into the material to allow insertion of plastic nesting tubes, and the CC hydrated. Hydration was given again the following morning to ensure the material would set completely. Sandbags were then stacked inside the timber structure to reduce any sinkage, before the back of the structure was covered with mounded up soil, which will eventually green over and allow the structure to blend in to the landscape.

*Geosynthetic Cementitious Composite Mat





Timber frame prior to installation of CC8



Hydration after insertion of nesting tubes



Structure prior to installation of sandbags and mounded soil

"Use of the CC8™ on our nature reserve couldn't have been easier and saved us a great deal of time and effort. We didn't have to worry about the footings being in 18 inches of water as the material sets hard even in these conditions and was very easy to attach to the sub-frame. It is a great product with many applications. We will definitely be using Concrete Canvas again."

Dan van den Toorn
Reserves Officer, Tees Valley Wildlife Trust

Project Info



December 2010



CC5™ Batched Rolls



10m²



Vertical layers



Maldon, Essex, UK



Environment Agency



CC5™ was used to provide weed suppression below a set of steel seawall steps to eliminate maintenance requirements



Completed installation



Steps removed prior to installation



Deploying CC batched roll



Installing CC

In December 2010, Concrete Canvas® (CC) was trialled as a weed suppression solution beneath a set of steel seawall steps. The steps provide Environment Agency (EA) operatives safe access up and down their seawall embankments to structures such as sluices and pumping stations. The steps have an open tread mesh which allowed grass to grow up from beneath, meaning that additional maintenance was required to keep them clear from obstructions.

The grass and vegetation below the steps could not be removed using strimming equipment and herbicides were discounted as many of the seawalls that the stairs gave access to were environmentally designated sites (SSSI, RAMSAR, SPA, SAC etc.) and near water. The decision was reached that the best way to prevent grass growth was to suppress the area beneath the stair access. A layer of geotextile or filter canvas was considered but it was thought that this would degrade due to UV exposure and wouldn't provide a long term solution.

CC was chosen instead due to its durability and protection from weathering and UV degradation. CC was installed quickly, by removing several of the step treads and unrolling a 10m² batched roll down the embankment. This was advantageous as the steps did not have to be fully removed, which saved time and mitigated requirement for plant equipment on site. The EA were also able to take advantage of the borrow dyke ditch behind the seawall to collect water for hydrating the CC.

The project was considered a success and plans are being considered to apply Concrete Canvas® to a number of other seawall step sites.



Project Info



03 / 02 / 10



CC8™ Bulk Rolls



240m²



Longitudinal layers



Church Village Bypass,
South Wales, UK



Costain



CC8™ used to line a
drainage channel at
the crest of a slope
adjacent to a newly
constructed bypass.




Completed installation in Church Village

In February 2010, Concrete Canvas® GCCM* (CC) was used to line a drainage channel in Church Village, South Wales. The channel was situated along the crest of a slope, and adjacent to a main road. In the previous year, Costain were appointed as the main contractor for the £90m Church Village Bypass scheme.

The scheme involved the construction and introduction of two road bridges, four roundabouts, three community foot-bridges, two cattle grids and one subway, along with the installation of holding ponds and an extensive surface drainage network. The contractor aimed to use alternative materials, such as recycled aggregates, to minimise the impact on the local ecology and environment. Following approval from the Environment Agency, the Costain specified CC for use within the drainage network.

The original channel was graded and vegetation removed prior to installation. The bulk rolls were then delivered to site and lifted on a spreader beam using plant equipment before being unrolled and laid within the channel. The installation was carried out in three parts, with the first length of material laid along the channel's base and fixed to the substrate using ground pegs. The material was then laid either side of the first length, overlapping this first layer by 100mm. The overlaps were then jointed using screws at approximately 200mm intervals, however the overlaps were not sealed in order to allow for natural weep paths. The edges of these layers were then fixed to the substrate within anchor trenches on each shoulder of the channel, which were later backfilled following hydration. A total of 240m² of CC8™ was installed in the installation.

*Geosynthetic Cementitious Composite Mat





Site prior to works - channel is at close proximity to a main road



Deploying CC



CC was laid in three longitudinal sections



Anchor trenches were backfilled to prevent ingress



Termination of channel into stream



Completed installation



The installation site was re-visited in winter to find out how well the material was performing in cold, frosty conditions

9 Years After Installation



Despite significant weed and vegetation growth around the channel, the CC is performing as expected and providing weed suppression within the channel itself

“The Church Village Bypass scheme presented our team with a unique challenge. The location and nature of the works required the sensitive use of appropriate construction materials in order to minimise the impact on the local environment. Concrete Canvas provided a means of rapidly installing a low carbon concrete ditch whilst maintaining the natural aesthetic of the overall scheme.”

**Daniel Powrie CEng MICE,
Project Manager,
Costain Group**