CONCRETE CANVAS®

Concrete Impregnated Fabric

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BUND 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
Railtex 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

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BUND LINING

Project Info

- 10 / 07 / 17
- CC5™ Bulk Rolls
- 6,400m²
- Transverse & Vertical layers
- Athens, Greece
- Perendes Technologies-Anelixis Constructions
- CC5™ was used to line a bund and tank farm which required protection from further weathering erosion, and weed suppression.

The completed installation in Athens, Greece

In September 2017, Concrete Canvas® GCCM* (CC) was used for bund lining at a petroleum tank farm in Athens, Greece.

The existing bunds of the petroleum tank farm were subject to weathering and erosion affecting the ground's integrity and stability. The client required a long-term, durable and cost-effective solution to combat the issues. In addition, Athens is subject to extremely hot weather in summer months, with temperatures often hitting highs of 48°C, which meant the heavily vegetated bunds posed a fire hazard. As a result, a weed suppression solution was also required to prevent fires. The chosen solution also had to be easily installed without interfering with the existing complex pipe infrastructure.

Originally, a concrete and shotcrete combination was considered for the installation, however, the associated risk of rebound could affect the site's infrastructure. In comparison, CC would provide a much cleaner install. There were also site access issues which had to be taken into consideration and traditional concrete methods typically require use of heavy plant on-site, which would not have been possible, as a result, CC was specified.

The works were carried out by Perendes Technologies-Anelixis Constructions for Elin Oil Hellenic Petroleum Company SA, with consultation services provided by PowerServe Ltd Greece.

*Geosynthetic Cementitious Composite Mat

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BUND LINING

The existing bunds had been affected by weathering erosion

Heavy vegetation growth was at risk of causing fires in the summer heat

All vegetation was removed prior to installation

And the ground levelled

The CC was mounted onto a spreader beam and crane for easy deployment

CC was unrolled down the slope and along the tank farm floor

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BUND LINING

CC was fixed to a concrete slab at the crest of the slope with masonry nails

Overlaps were sealed using Everbuild Clearfix adhesive sealant

The CC was fixed and jointed using screws and anchor bolts

CC was cut using hand tools to negotiate storage tanks

The team also had to negotiate corners

CC easily accomodated the complex pipework

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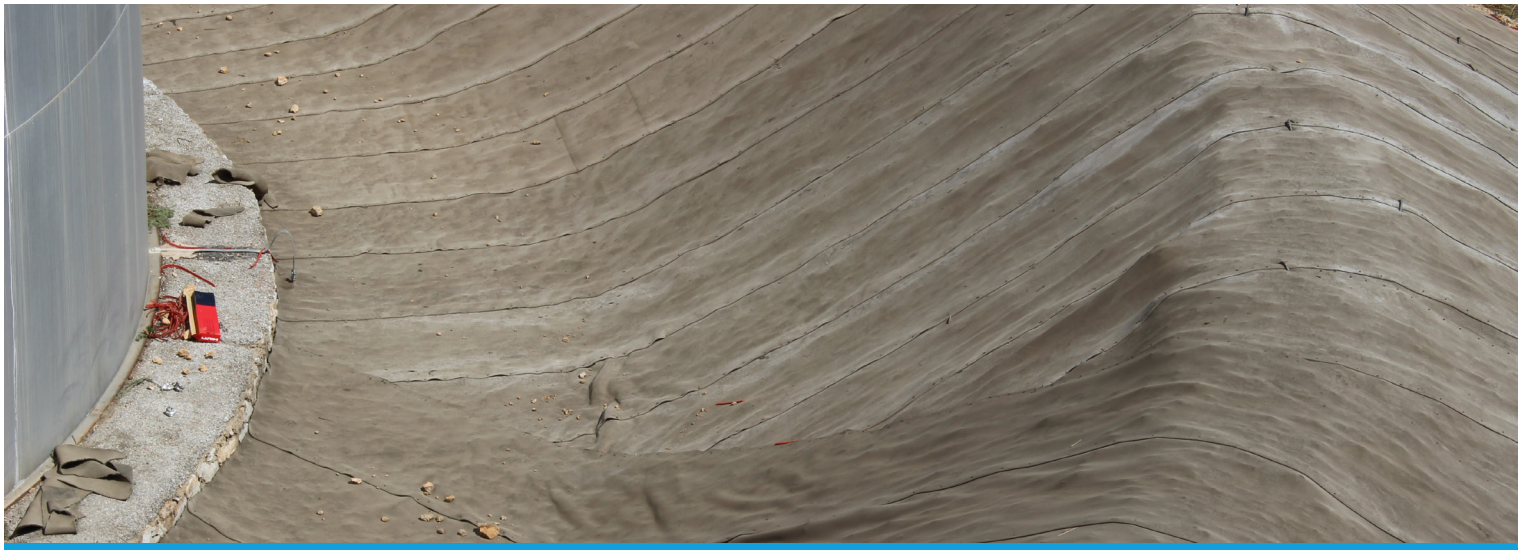
BUND LINING

The CC was hydrated using a hose attached to fire pipes



Completed installation around a storage tank

Birdseye view of the completed installation

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BUND LINING

The installation was completed in 9 days

Infrastructure such as the petroleum storage tanks and pipework were easily accommodated due to the drape characteristics and flexibility of CC. The CC around the walls of the storage tanks, corners and other complex shapes from protruding infrastructure, was cut using hand tools, and where needed, an extra layer of CC was fitted around the item, then sealed. Once the installation was complete, the CC was hydrated using hoses attached to fire pipes. This was repeated three times due to the high temperatures to ensure adequate hydration.

6,400m² of CC5™ were installed in 9 days by a team of 10 people, including 8 workers and 2 supervisors, in consistently high temperatures of around 45°C, on a site with restricted access. Elin Oil Hellenic Petroleum Company SA were impressed with the simple and rapid installation of CC as well as its immediate effectiveness after laying. The client and contractor also commented on the cost efficiency of CC, the ability to install the material with minimum and basic equipment, as well as the cleanliness of install compared to shotcrete. The use of CC will also mean the client's need to carry out regular maintenance on the site will be significantly reduced in future. They have now begun looking into the suitability of CC for further installations on their other tank farms around Greece.

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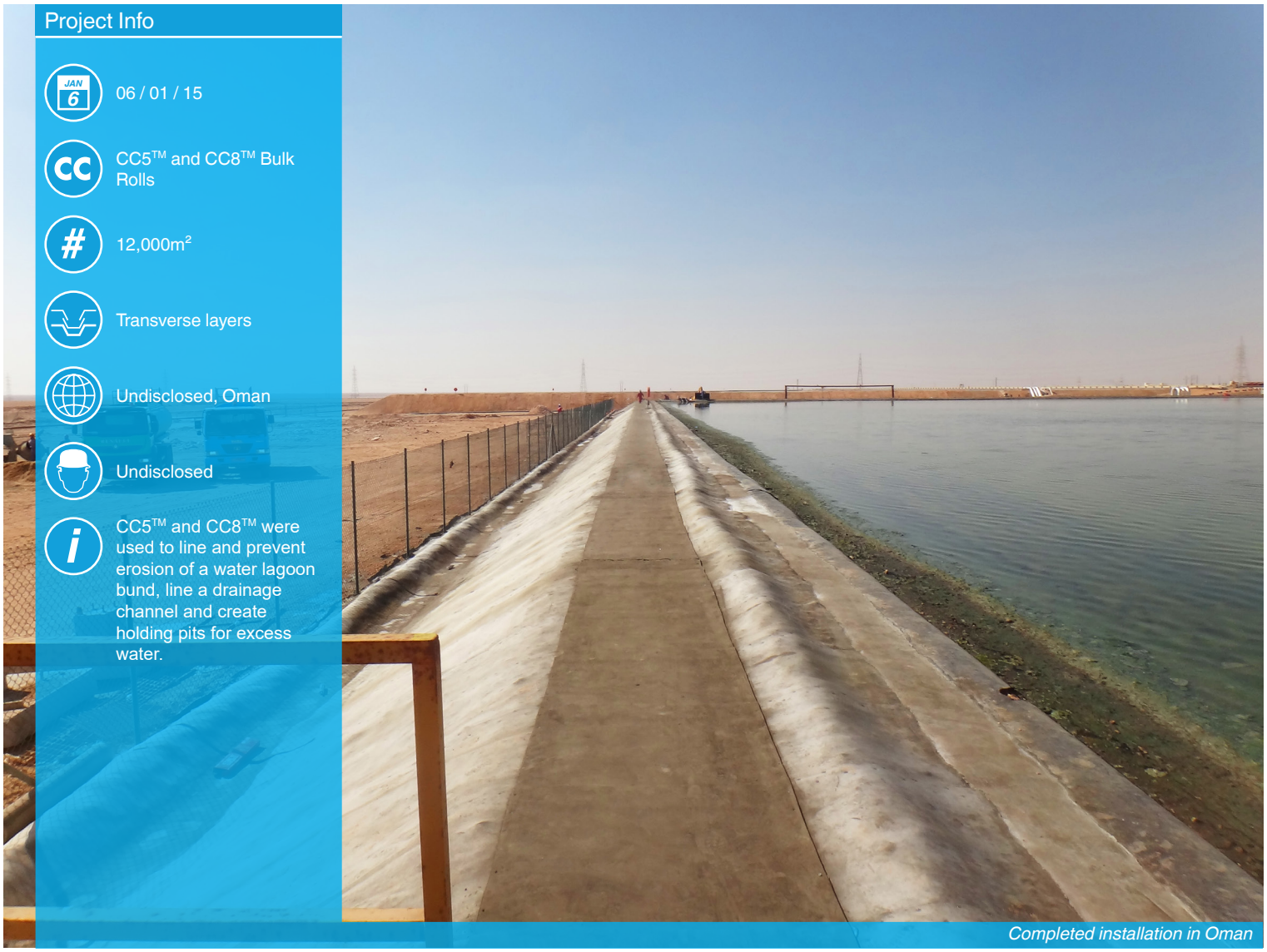
BUND LINING

Project Info

- 06 / 01 / 15
- CC5™ and CC8™ Bulk Rolls
- 12,000m²
- Transverse layers
- Undisclosed, Oman
- Undisclosed
- CC5™ and CC8™ were used to line and prevent erosion of a water lagoon bund, line a drainage channel and create holding pits for excess water.



Completed installation in Oman

In January 2015, Concrete Canvas® GCCM* (CC) was used to line a water lagoon bund at an oil field site in Oman.

The bund was subject to periodic severe erosion, when the water lagoon would flood and send water cascading down the sides of the bund. The water then posed a flooding risk to the production area. As a result there was also a requirement to create drainage channels on the outside toe of the bund to direct any water overflow to holding pits, also lined with CC. Shotcrete was considered, but it would have taken considerably longer to install with much more complex logistics. There were also numerous pieces of existing infrastructure such as pipework which would have made a shotcrete installation challenging.

The site is located 600km from the nearest town so getting raw material to site can be very costly. The bund ranged from 6m to 9m in height and created a rectangular perimeter for the lagoon, measuring 276m x 115m. The location is such that there were large climate and weather variations throughout the install; temperatures ranged from 6°C to 27°C and there was rain, fog, mist and sand storms on various days, with visibility dropping to <5m several times. Some of the existing pipework could be lifted to allow installation underneath, however it was not possible to lift all the pipework or move the stairways and electrical trays, creating access issues. On the 276m long north side of the lagoon the presence of pipe lines nearby prevented any plant access, and on the east and west sides more pipe lines limited the access options.

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BUND LINING

The bund was severely eroded in some areas prior to works

Pipework on the northside of the lagoon prevented plant access

The bund was graded prior to installation

An anchor trench was created prior to installation

Bulk rolls were mounted on a spreader beam for easy dispensing

A pre-cut piece of CC being laid under existing pipework

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BUND LINING

Fixing overlaps with screws

CC installed uinder a stairway

The CC was jointed with screws

The CC was cut to shape accomodate existing infrastructure

The CC edges were buried in pre-dug anchor trenches

Five water collection pits were created

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BUND LINING

Completed installation

The bund wall was graded and erosion damage repaired to avoid voids forming under the CC. On the north side of the lagoon, the bund was raised by 500mm to repair extreme erosion and increase the lagoon capacity. A drainage channel was constructed at the base of the bund by creating a small berm, and an anchor trench was cut into the top of the berm.

29 bulk rolls of CC8™ and 42 bulk rolls of CC5™ were delivered to site. Where weather and access allowed, the bulk rolls were mounted onto a spreader beam hung from a telescopic handler and unrolled down the berm and cut to length with a utility knife. On days where the wind was too strong, or where access was limited, the CC was unrolled on the flat and cut to profile lengths then transported to the berm by hand. The leading edge of the CC was placed into an anchor trench, unrolled down the berm and across the drainage channel at the toe. Each layer of CC was overlapped by 100m, sealed and jointed with an offset double row of screws applied at 200mm centres with an auto-fed screw driver. Following installation, hydration was given using a 45,000L water truck and hose. At 5 locations around the berm, water collection pits were created to collect the water carried by the drainage channel; these were lined with transverse layers of CC. Where pipes couldn't be lifted, smaller sections of CC were cut to size and fitted around the pipes, with sealant used to create an impermeable joint.

A total of 12,000m^2 of CC were installed at rates of up to 1500m^2/day. The installation was carried out over 14 days by a team of 14 people, in high temperatures and difficult environmental conditions. The installation has directly led to CC being specified on two further projects.

CC was 3 times faster to install, and the client has estimated CC provided a cost saving of $250,000 - $500,000 over shotcrete. During this installation another water lagoon overflowed and caused extensive erosion to its bund. The client had been so impressed with the CC installation they immediately specified CC to re-line this bund as an emergency response installation, during which the bund had to be raised by a further 500mm.

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CC HYDRO™
Concrete Impregnated Containment

BUND LINING

Project Info

- 05 / 10 / 2015
- CCH5™ Bulk Rolls
- 1280m²
- Transverse layers
- Undisclosed, UK
- Celtic Lining
- CC Hydro™ used to line a secondary containment bund at an anaerobic digestion site

Celtic Lining Ltd

Completed section of bund

In October 2015, CC Hydro™ GCCB* was used to line a secondary containment bund at an anaerobic digestion facility in the UK.

The green energy scheme produces 1.2 megawatts of energy an hour from hops and other farm waste. The project brief was to provide a secondary containment method that would prevent any of the tank contents infiltrating the groundwater should there be a tank failure. Conventional berm lining methods were considered, however CC Hydro™ (CCH) offered an environmentally friendly, fast and cost effective install.

CCH is a concrete impregnated geotextile that hardens on hydration to form a durable, fibre reinforced concrete layer for the containment of liquids including fuels, oils and other chemicals. The system provides a high performance, armoured, impermeable barrier for lining applications including berms, bund floors and drainage channels. CCH consists of a 3-dimensional fibre matrix containing a specially formulated dry concrete mix. The fibre matrix acts to contain the dry concrete, aids hydration during wetting and provides fibre reinforcement once set. This concrete layer protects a hydrocarbon resistant geomembrane bonded to the rear surface which provides a minimum impermeability of k = 1 x 10^{-12} m/s. A 100mm welding strip allows for efficient thermal welding and rapid on-site quality control and testing.

*Geosynthetic Cementitious Composite Barrier

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CC HYDRO™
Concrete Impregnated Containment

BUND LINING

CC Hydro™ User Benefits

All-in-one Solution
CC Hydro™ combines the impermeability of a containment liner with the hard armour protection and durability of concrete, reducing installation times and simplifying logistics.

No Top Cover
CC Hydro™ does not require a protective top cover. This removes the need for additional excavation, the treatment of contaminated arisings and the import of costly fill material.

Maintains Volume Capacity
CC Hydro™ can be laid directly onto existing profiles without loss of volume capacity for refurbishment projects, providing significant overall time and cost savings.

Reduced Life-Cycle Costs
CC Hydro™ provides effective weed suppression eliminating the ongoing maintenance cost of soil covered systems. CC Hydro™ also reduces the end-of-life costs associated with treatment of any contaminated top cover.

CC Hydro™ Key Properties

High Impermeability
CC Hydro™ has excellent impermeability and has been independently tested to BS-EN-1377 to have a hydraulic conductivity better than $1x10^{-12}$ m/s.

Durable
The concrete surface of CC Hydro™ provides a hard armour surface, protecting the geomembrane liner from puncture, abrasion, weathering, burrowing animals and UV degradation.

Chemical Resistance
CC Hydro™ has been shown to have excellent resistance to a wide range of chemical reagents, including hydrocarbons, digestates and acidic leachates.

Testible Joints
CC Hydro™ incorporates a high-visibility welding strip, allowing the joint to be thermally bonded with a twin-track or triple-track air channel for fast and simple on-site pressure testing.

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CC Hydro™ Thermal Welding

CC Hydro™ can be thermally bonded using similar welding and solvent methods to standard plastic liners and geomembranes to provide testable joints with the same level of impermeability as the material itself. For this installation, thermal welding with a twin track air channel was specified to allow the onsite testing of joints for quality control purposes. Welding rates of CC Hydro™ can vary from 3-6m/minute subject to site conditions and CQA requirements.

1: Alignment

CC Hydro™ is marked with two guidelines, 15mm and 30mm from the edge of the material. When overlapping layers for thermal welding, the upper most layer should line up with the 30mm guideline. This provides the necessary clearance between the thermal weld strip and CC Hydro™ to allow pressure testing.

2: Cleaning

The two geomembrane faces should be wiped down prior to welding to remove any dirt or moisture, to ensure an optimum weld.

3: Welding

Welding on this project was performed by TWI (UK Thermal Welding Institute) certified operators using Leister Twinny T and S models. The welding machines were individually calibrated at the beginning of each days phase of work to adjust to ambient temperature. Cut sample sections were also regularly welded and pull tested to destruction to check the integrity of the weld channels.

4: Testing

As per industry standards, regular pressure testing of welded seams was performed over the course of installation. In this instance, channel welds were clamped at the crest and toe of the CC Hydro™ layers, before pressurising to 2bar. A successful weld was determined if the pressure didn't decrease by greater than 10% over a five minute interval.

For more information please the *CC Hydro™ Thermal Welding Guide*.

Alignment

Cleaning the geomembrane faces to be welded

Welding

Testing

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CCHYDRO™
Concrete Impregnated Containment

The anaerobic digestion site

Services that needed to be accommodated

Overhead pipe and plant limiting access

The site had several access issues, including berm penetrating services and overhead pipework. The flexibility of CCH made it quicker and easier to accommodate existing infrastructure compared to conventional alternatives. CCH also requires lower material volume, resulting in significant reductions in plant movement, thereby increasing site safety.

Prior to works, the berm was graded, loose rock removed and a sand blinding layer applied to fill voids, ensuring intimate contact between the material and substrate. Bulk rolls of CCH5™ were delivered to site in staggered deliveries to minimise on-site storage and match the rate of installation.

The CCH was mounted onto a spreader beam, mounted on a telehandler, and the material unrolled either up or down the berm face depending on access. The material was cut to length to reduce wasteage, and the leading edge tucked into an anchor trench at the crest and fixed using ground pegs. The toe edges were lapped onto a cut step in the poured concrete base and formed an interior drainage channel. The overlapping layers of the CCH were thermally welded, and joints then inspected and pressure tested. At the end of each day, the crest anchor trench was backfilled and the CCH hydrated, before the last, exposed length of CCH was covered in tarpaulin to protect it ahead of installation and welding the next day.

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CC HYDRO™

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Ground preparation

Unrolling the CC Hydro™

Cutting the CCH to length

Fixing into the anchor trench

Setting up a thermal welder

Welding

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CC HYDRO™
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BUND LINING


Backfilled anchor trench


Hydration


CCH installed around existing infrastructure


Toe drain details

In challenging weather conditions and areas of limited access, the entirety of the 1250m^2 of CC Hydro™ was installed onto the berm face over a six day period by a crew of 4 operators. The lining of the berms with CC Hydro™ satisfies local regulatory requirements for the safe containment of potentially hazardous pollutants in the event of tank rupture and will now provide greater flexibility on the media used to power the facility. Following the success of this installation, CC Hydro™ is now being considered for several other AD plants in the region with similar regulatory requirements.

"Despite challenging weather conditions, and that this was our first experience of installing CC Hydro, we were delighted with the successful outcome of this project. With our vast and varied experience of welding conventional plastic liners for landfill projects, we were comfortable with the processes involved, following similar methodologies and using similar equipment. Having experience of CC Hydro now give us another option to present to clients and we very much look forward to the next project."

Dyfed Jones
Project Manager, Celtic Lining

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