

Project Info



29 / 09 / 2020



CCX-BTM



400m²



Transverse layers



Atfih, Egypt



Geotech & Samco



CCX-BTM installed on a trial basis to provide a non-erodible and impermeable liner to an unlined irrigation canal



Completed CCX-BTM trial installation in Egypt

Project Introduction

In September 2020, Concrete Canvas CCX-BTM (CCX-BTM) was installed on a trial basis at a site in Atfih, Egypt. The objective was to provide a rapidly installable, non-erodible and impermeable lining solution for an existing unlined irrigation canal.

The section of canal being lined measured 50m in length, with an invert width of 1m and an average side slope measurement of 3m at a 1:1 slope.

CCX-BTM was installed by Geotech (the official Egyptian partner for Concrete Canvas Ltd) & Samco (Geotech's parent company) for the Egyptian Ministry of Irrigation, with guidance and support provided by a representative from Concrete Canvas Ltd on site.



Background

The Egyptian Ministry of Irrigation are currently carrying out a scheme to extensively upgrade their network of irrigation canals from earth lined to concrete lined.

At present, the majority of canals in Egypt are unlined, resulting in more than two-thirds of the water conveyed being lost to seepage.

The existing specification for lining the canals is the creation of a formation layer with 300mm thick un-grouted rock. On top of this, a layer of geotextile is placed, followed by a 100mm thick skin of 20Mpa concrete. This three-stage process is very time consuming to install and does not incorporate the use of a geomembrane. It is also prone to differential settlement panel movement and cracking with a resultant significant increase in permeability and water loss again to seepage.

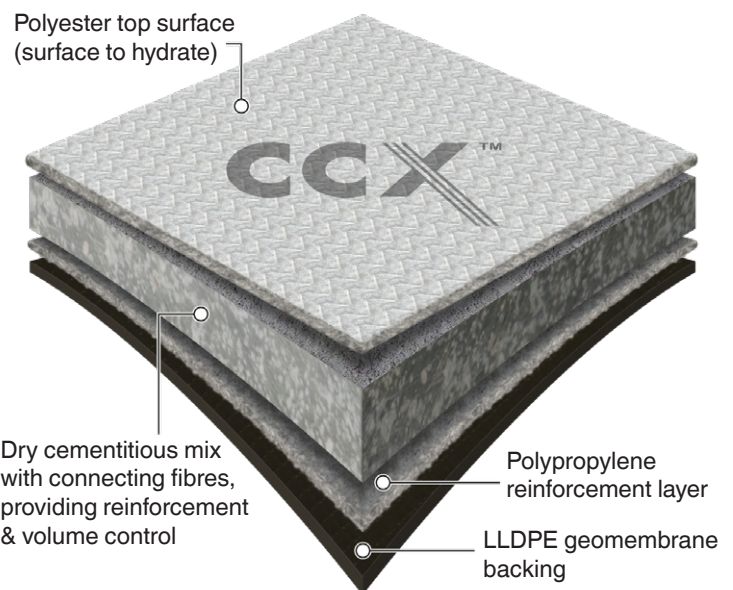
CCX-B™ was awarded a trial at Atfih to demonstrate its speed of installation and impermeability that ensures water tightness and maximises the capacity of the canal. CCX-B™ also has a much greater differential capacity making it more suitable to expansive soils. The composite nature of CCX-B™ is therefore capable of replacing all three elements of the existing specification in one application.

Introduction to CCX-B

CCX™ is part of a revolutionary class of construction materials called Geosynthetic Cementitious Composite Mats and Barriers (GCCM/Bs).

It is a flexible, concrete filled geosynthetic, that hardens on hydration to form a thin, durable, water proof concrete layer. Essentially, it's *Concrete on a Roll*™. CCX™ allows concrete installation without the need for plant or mixing equipment while also reducing vehicle movements and contractor burden. Simply unroll and just add water.

CCX-B™ consists of two interconnected layers of geotextile that encapsulate a specially formulated dry concrete mix. A 1mm thick LLDPE geomembrane backing ensures the material has very high impermeability whilst the composite geotextile reinforced concrete top cover provides a high degree of long-term durability.



CCX™ can be rapidly unrolled to line existing or new earth canals as well as remediating existing concrete canals. It is significantly faster, easier and more cost effective to install than conventional lining methods. As a result, CCX™ is the ideal solution for lining and remediation of irrigation canals, increasing their operational life and significantly reducing water seepage losses.

Site Conditions

The condition of the existing canal was very poor on initial inspection. When the canal was drained to carry out a detailed inspection, it was revealed that significant erosion of the sides, as well as deposition of sediment and waste on the floor had occurred, drastically reducing its capacity and functionality.

The design profile of the canal required reinstatement prior to lining. This was accomplished by first cleaning out the deposited sediment and then tipping in an imported gravel. The gravel was compacted in layers to the top of the slopes and then the canal profile excavated from this. Once the profile excavation was completed, the invert was re-compacted to create a sound working surface.

Anchor trenches were excavated by hand 300mm from each canal shoulder, measuring 200mm deep by 300mm wide, allowing for a CCX-B™ run-out of 100mm.

In terms of climatic conditions, the site location is very hot year-round with average daily temperatures of between 35 and 40 degrees Celsius at the time of the trial. During September it is also common to have significant drying conditions due to wind which prevailed during the course of the trial.



Site prior to works



Above and Below: The existing solutions used showing degradation





Following excavation, a sand-based gravel substrate was imported



Canal profile following compaction of substrate



Rolls of CCX-B™ were delivered to site by truck



Anchor trenches created on canal shoulders and 50m termination point



CCX-B™ rolls positioned along the canal shoulders for easier deployment

Installation of CCX-B™

Installation began downstream, with the CCX-B™ rolls laid transversely across the channel profile, working in an upstream direction. The rolls, which measured 10m or 20m long and 2m wide, were lifted on a spreader beam by a 10-tonne excavator and the material drawn off by hand. Once laid in place, the CCX-B™ was cut to length with a disc cutter and temporarily pegged within pre-prepared anchor trenches to prevent movement. Subsequent lengths of CCX-B™ were laid so as to overlap the preceding panel by 100mm, with overlaps oriented in the direction of water flow.

In order to joint layers of CCX-B™, the top cement filled geotextile laps were folded back to reveal the underlying LLDPE geomembrane backing. The geomembrane is overlapped to create a 100mm wide lap. The geomembrane backing can then be bonded using either a Leister Twinny double track welder or a Leister Triac hand held hot air gun and roller.

The benefit of the track welder is that it allows for both peel and rupture resistance testing of the weld integrity to provide a certifiable solution. However, the integrity of the track weld can be difficult to achieve given the changes in profile of a trapezoidal channel. It was therefore deemed beneficial to carry out the geomembrane bonding with a hand-held hot air gun and roller to enable the more difficult transitions from edge to slope and slope to floor to be achieved without damaging it.

Once the geomembrane had been welded, the cement filled geotextile overlaps were folded back, one over the other, to create a 100mm wide protective lap. These overlaps are fixed either by thermally bonding the layers with a Leister Triac or by adhesion. Both methods were trialled on this installation, with adhesion provided by applying two 10mm diameter beads of adhesive sealant parallel to the geotextile laps at a distance of 30mm and 70mm from the overlapping edge. Thermal bonding was achieved with a 60mm perforated nozzle.

Once jointing was completed, the edges were secured within the anchor trenches using an anchor peg and hydration commenced.

Due to the high ambient temperatures on site, in combination with a moderately dry wind and CCX's initial setting time, it was critical that hydration was carried out sufficiently and systematically. It was determined that a staged approach of three rounds of hydration be conducted, initially at 15-20-minute intervals and then a final hydration given to saturation approximately 1 hour later. Following hydration, anchor trenches were gravel backfilled and hand-compacted.

The installation progressed at a rate of approximately 75sqm per hour and was completed within half a day.



Layers of CCX-B™ overlapped by 100mm



Lengths of CCX-B™ were manually pulled across the canal and positioned



Test welds were carried out and pressure tested prior to installation



Thermally welding geomembrane backing layers



Adhesive sealant applied to overlaps



Hydration of CCX-B™ at dusk to avoid excessive evaporation



Tucking downstream edge into anchor trench



Downstream anchor trench backfilled with poured concrete

Performance Testing

In order to determine the performance and long-term efficacy of CCX for this trial, post-installation tests were carried out to:

1. De-silt the CCX lined canal with a mechanically operated bucket;
2. Carry out a patch repair of a small section in case of future damage caused by operator negligence;
3. Conduct a laboratory test and analysis of the water cement ratio and flexural strength of CCX-B to ASTM D8030 and ASTM D8058 respectively.

De-siltation by mechanically operated bucket was carried out successfully without any damage caused to the lining. A patch repair was also carried out successfully to a purposefully created small puncture of the CCX-B lining. A detailed repair methodology was then drafted accordingly for future use. Laboratory testing of CCX-B provided for the trial has yet to be concluded at the time of publishing of this case study.

Project Outcome

The trial was successful and is currently under consideration by the Ministry of Irrigation for incorporation as an approved alternative to their current lining specification. It fulfilled all the pre-requisites of the Ministry of Irrigation in terms of speed of installation, impermeability and maintenance.

The 50m length of canal lined with CCX-B™ is noticeably more efficient than the unlined section positioned upstream and downstream. CCX-B™ provides a more durable, erosion resistant and impermeable solution than that currently incorporated on the canal network and is fit for purpose for all future canal linings of similar terrestrial conditions.



Completed installation of CCX-B following final hydration™