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A Study on Utilization of Concrete cloth

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ABSTRACT

This paper reviews the Utilization of concrete cloth in Civil Engineering field. It comprises the important findings from the experimental works of many researchers. To overcome through the drawback of non flexible property of concrete. a new construction material was developed by British Engineering Company called Concrete Canvas. Concrete cloth is a flexible; cement impregnated fabric that hardens when hydrated to form a thin, durable, water & fire proof concrete layer. CC allows concrete construction without the need for plant or mixing equipment. Simply position the canvas & just add water. CC has a design life of above 10 years and is significantly quicker and less expensive to install compared to conventional concrete.

Keywords: Concrete Cloth (cc), Polyethylene, Compressive Strength, Abrasive Resistance.

1. INTRODUCTION

Concrete Cloth is a flexible, cement impregnated fabric that hardens on hydration to form a thin, durable, waterproof and fire resistant layer. CC consists of a 3- dimensional fiber matrix containing a specially formulated dry Concrete mix. A PVC backing on one surface of the cloth ensures the material is completely waterproof, while hydrophilic fibers (Polyethylene and Polypropylene yarns) on the opposite surface aid hydration by drawing water into the mixture.

The material can be hydrated either by spraying or by being fully immersed in water. It can be easily nailed, stapled through or coated with an adhesive for easy attachment to other surfaces.

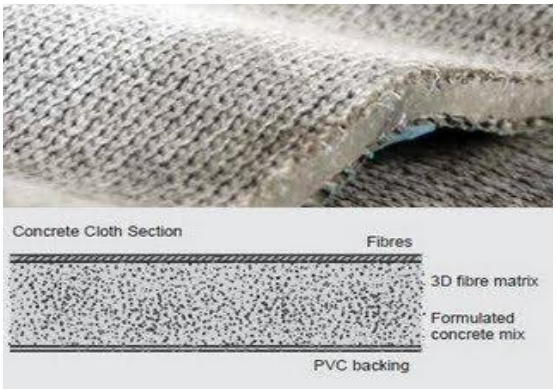

Figure 1: Concrete Cloth Section

Once set, the fibers reinforce the concrete, preventing crack propagation & providing a safe plastic failure mode. CC is available in 3-thicknesses; CC5, CC8 & CC13, which are 5, 8 & 13 mm thick respectively & it is as shown in Fig.1.

The market available concrete cloth specifications are:

CC Type	THICKNESS (mm)	ROLL WIDTH (mm)	DRY WEIGHT (kg/sqm)	BATCHED ROLL COVERAGE (sqm)	BATCHED ROLL LENGTH (sqm)	BATCHED ROLL COVERAGE (sqm)	BULK ROLL LENGTH (m)
CC5	5	1000	7.0	10	10	200	200.0
CC8	8	1100	12.0	5	4.5	125	113.6
CC13	13	1100	19	N/A	N/A	80	72.7

HISTORY OF CONCRETE CLOTH

The technology of concrete cloth was found for the use of emergency shelters. This technology wasn't commercialized for other works. Later researches were made on concrete cloth and incredible product was introduced to construction field.

The concept of concrete cloth was first proposed by Brewen and Crawford in 2005. Later the research was conducted and the British Engineering Company found the Revolutionary material called as Concrete Cloth or Concrete Canvas. It is a new era product in the field of construction

MATERIAL PROPERTIES OF CONCRETE CLOTH

The material property of concrete is its strength and physical properties:

Strength of Concrete Cloth

The typical strength is discussed below:

Compressive Strength

An early high strength is required for concrete cloth. Compressive strength test on concrete cloth is based on ASTM C473 part 07. Compressive strength of 38 MPa was obtained on 7th day. The 10^{th} day compressive strength was recorded at 40MPa and then 10 day compressive Young's modulus was 500 MPa.

Bending Test on Concrete Cloth

It is the ability of material to resist the bending forces. The 7-day minimum bending stress was 3.3 MPa and bending modulus was 180 MPa.

Abrasive Resistance Test

The resistance exerted by the body for abrasive action is abrasion resistance. As per ASTM C1353 part 8, the standard method used to calculate a materials abrasive resistance, concrete cloth lost 60% less weight than that of marble over 2000 repeated cycles.

Physical Properties of Concrete Cloth

Thickness

Concrete cloth is normally available in 3 thicknesses, 5mm, 8mm and 13 mm thick. Theoretically there is no limit in the thickness of concrete cloth. A typical thickness can be in between 2 to 15 mm.

The factors that limit the thickness of concrete cloth is its ability to penetrate liquid or water through it to the lower and interior base of the material for hydration.

Setting Time

The time required by the concrete cloth from end of mixing to initial set of concrete cloths is known as setting time.

For concrete cloth, the initial setting time should be greater or equal to 120 minutes and final setting time is greater than or equal to 240 minutes. Concrete cloth can achieve 70 to 80% of its strength in 24 hours of hydration.

Density

Before hydration of concrete cloth, the density is 1500 kg/m^3 and after hydration the dry density increases 30 to 35% the range of 1952-2050 kg/m^3.

PROCESS OF MAKING CONCRETE CLOTH

The process of placing, hydrating and achieving the strength of the concrete cloth is explained in the following steps

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Preparation of Subgrade

The subgrade on which the concrete cloth will be placed is to be prepared properly so as the concrete cloth takes the shape of its host.

So, any type of rocks, uneven shape regions or vegetation is to be properly taken care of. Compact and smooth surface is to be prepared prior to the placement of concrete cloth.

Placement of Concrete Clot

Now the concrete cloth is placed upon the prepared subgrade. One cloth is overlapped over the other to get a strong bond.

The PVC coated layer is placed at the bottom so that the water supplied for the hydration of concrete cloth doesn't seep through it and water is lost. The fibrous layer is placed on the top or upwards.

Cutting

After the placement of concrete cloth, the extra concrete cloth is cut down which is exceeding the required area of installation. This cutting must be done using the commonly used cutting tools.

Fastening or Anchoring

Now the concrete cloth is to be anchored or fixed to the host material so that it doesn't displace. For soil, host nails or anchors or screws are used. For hard Surface adhisives are also us

Hydration of Concrete Cloth

Hydration of concrete cloth can be done by following two methods:

Immersion

In this method, the concrete cloth is dipped into water for not less than 90 seconds and placed.

Spraying

The concrete cloth is placed and the water is sprayed on it. Care must be taken that the direct Jet of pressure water is not used as it washes wash away the cementitious material from the fiber.

Saline or non-saline water can be used for hydration of concrete cloth. The water to cement ratio is 1:2 by weight.

Re-Spraying or Curing

The required amount of water is supplied to concrete clothes at the first time only, but due to warm temperature or when placed on steep or vertical surfaces some amount of water is lost. To replenish, spraying is done after an hour or two.

LITERATURE REVIEW

Many authors have reported the use of used foundry sand in various civil engineering applications.

Ansari Umair Ahmad and Prof. Pallavi K. investigated flexural performance of Aluminum reinforced Concrete Canvas panels were examined through a three-point flexural (bending) test. The flexural strength of Concrete Canvas panels combined with Aluminum reinforcement is 23 Mpa which is about 10 times greater than that of Concrete Canvas panels considered alone (2.4 MPa). The results exhibit from the experiment that the flexural performance of Concrete Canvas is significantly improved by reinforcing the CC panels with aluminum mosquito sheet

Pallavi K. Pasnur investigated uses, application,limitation of concrete canvas. From point of effective cost Concrete Canvas sheet is a competitive alternate product of concrete

Fangyu Han,Huisu chen designed formulation of dry cement powder for concrete canvas, which was expected to have both high mechanical strengths and short setting times, was obtained by partially replacing calcium sulfoaluminate cement (CSA) with anhydrite at four levels (0%, 10%, 20% and 30% by mass of CSA cement). The influence of anhydrite fineness on the mechanical properties of concrete canvas and its mechanical anisotropy were both investigated. X-ray diffraction analysis and isothermal calorimetry were used to investigated the underlying mechanism. Results revealed that increasing anhydrite content or fineness improve the mechanical strengths of concrete canvas and shortened its setting times. However, a slight decrease of mechanical strength occurs at the later age when the replacement level was 30 wt%. A large amount of unhydrated particles was found in hardened specimens. The concrete canvas shows higher mechanical strengths in the warp direction than in the weft direction, and it exhibits the lowest compressive strength in the through-the-thickness direction.

Wulong Zhang investigated a theoretical model was presented for studying influences of 3D spacer fabric on drying shrinkage of concrete canvas. The model was based on assumption that drying shrinkage restraint provided by 3D spacer fabric was joint action of each component of 3D spacer fabric separately. To calibrate this model, the drying shrinkage of two concrete canvases reinforced by PET-based 3D spacer fabric with one solid outer textile substrate was experimented. Moreover, a simplified expression of maximum tensile stress generated in the matrix of both concrete canvases was obtained for evaluating their risk of drying shrinkage-induced cracking. The results showed that drying shrinkage strain of concrete canvas samples

became lower due to the restraint provided by 3D spacer fabric and a satisfactory correlation between model predictions and experimental results was found at later age. For both concrete canvases, a greater restraint was found in warp direction, thereby resulting in a larger tensile stress generated in the matrix. Furthermore, the restraint on the drying shrinkage of concrete canvas was provided mostly by spacer yarns and thereby it contributed to the most of maximum tensile stress generated in the matrix of concrete canvas.

HUli, HUISU chen etal. investigated the design methodology for the CC-faced reinforced soil retaining wall structure according to the mechanical properties of CC. The result demonstrates that carbon nanotube (CNT) modified ultra-high molecular weight polyethylene (UHMWPE) unidirectional fabric reinforced CC can be applied to the reinforced soil retaining wall with a height of between 3 m and 10 m, and reasonable spacing of reinforcements is 0.5 ~ 1 m. In addition, the connection between the reinforcement and CC wall can be safely against bearing capacity failure. The results of a FEM parametric study indicate that the horizontal displacement of CC was a little large (about 20 mm @ 6 m height retaining wall). Relative large maximum displacement of the CC wall indicated that the high stiffness reinforcement should be used to reduce the overall horizontal displacement of the wall.

Prof. K.Srinivas and Prof. Ravinder Engineers Incorporated Ltd (EIL) was commissioned by Concrete Canvas Ltd (CCL) to prepared a comparison of costs for lining an open, trapezoidal ditch 900 x 900 x 900mm, 500m in length. The comparison for construction costs requested, were:-In Situ concrete lining, average thickness 150mm. Precast Concrete Paving Slabs, laid on sand / cement screed. Sprayed Concrete (Gunite) average thickness 100mm with mesh. Concrete Canvas CC8.The rates assumed that the initial ditch excavation to form the trapezoidal shape was complete prior to commencement of lining and therefore had been excluded in the costs. The above rates assume that the site had tarmac access for pouring in-situ concrete, delivery of sprayed concrete and paving slabs. It significantly quicker and less expensive to install compared to conventional concrete. It was specially used, where the workmanship is very difficult. It was specially used in emergency works such as in military.

CONCLUSION

This investigation results the following conclusion

1. Rapid-the material can be hydrated by either spraying it or fully immersing it in water. Once hydrated, it remains workable for 2 hours and hardens to 80% of its final strength within 24 hours. These times can be reduced by adding accelerants into the dry mixture at the point of manufacture;
2. Easy to use-dry Concrete Cloth can be cut or tailored using simple hand tools such as utility knives. The PVC side can be supplied with an adhesive backing and the fibrous side bonds well to concrete or brick surfaces when set. It can be easily repaired or upgraded using existing cement products;
3. Flexible-Concrete Cloth can be easily nailed through before setting. It has good drape characteristics, allowing it to take the shape of complex surfaces including those with double curvature;
4. CC is a low mass, low carbon technology which uses up to 95% less material than conventional concrete for many applications. It has minimal impact on the local ecology due to its limited alkaline reserve and very low wash rate
5. Fireproof-Concrete Cloth is a ceramic-based material and will not burn;
6. Durable-Concrete Cloth is chemically resistant and will not degrade in ultraviolet light.

DISCUSSIONS

In this review paper we studied Concrete canvas can be used to reline earthen, brick and concrete culverts which have degraded due to scour and corrosion. Concrete Canvas combined with reinforcement increased the bearing capacity.CC was less expesive,easy to install.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.