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Study on Applicability and Uses of Concert Cloth in Civil Engineering

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Abstract - Concrete cloth (CC) is a unique proprietary material. It has a very wide range of applications throughout the building & civil engineering industry. 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. This paper focuses the uses and applications of using Concrete canvas or Concrete cloth in civil engineering. For Rapid and fast construction of structures like canals and many other which are made for temporary purpose. In the paper the engineering properties of the material is also discussed.

Keywords: Concrete canvas; Concrete Cloth; Flexibility; Water proof; Fire proof.

1.INTRODUTION

Concrete Cloth was first invented and patented in 2005 by Peter Brewin and Crawford. Later the research was conducted and the British Engineering Company found the Revolutionary material called Concrete Cloth or Concrete Canvas. It is the new era product in the field of construction. The invention of Concrete Cloth has provided the construction industry with a spectrum of highly valued applications and solutions, due to its durable qualities and components. These properties include water resistance, fire proof, high abrasion, chemical resistance and an extremely fast setting time. They have proven beneficial in a wide variety of functions such as ditch lining, slope stability and the establishment of Concrete Canvas shelters which are quick and easy to develop and are invaluable in situations such as natural disaster scenarios.

Figure 1.1: Concrete Cloth

Concrete Cloth is a GeoSynthetic Cementitious Composite Material (GCCM), which is composed of three main parts. 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 air 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. 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. This evolution may lead to a new way of construction without the use of the mixing equipment. Thus it makes construction must more easily in just two steps placing them in passion by adding water. They have faster development around the world due to the significantly quicker and economical comparatively.

2.MATERIAL AND METHODOLOGY

2.1 General

Concrete Canvas (CC) is a flexible; cement impregnated fabric that hardens when hydrated to form a thin, durable, water and fire proof concrete layer. The following data provides useful information for installers, customers and specifies of CC. It provides an overview of useful data and techniques that can be used across a wide range of applications.

2.1.1 CC Specification

CC Types

There are 3 CC types available with the following indicative specifications:

2.1.2 Bulk Rolls / Batched Rolls

CC is available in two standard roll sizes; bulk rolls or smaller batched rolls. The quantity per roll differs between the CC types. Bulk rolls weigh 1.6T and are supplied on 6 inch cardboard tubes which can be hung from a spreader beam and unrolled using suitable plant equipment (see below). Bulk rolls provide the fastest method of laying CC and have the additional advantage of reducing the number of joints required. Batched rolls are supplied on 3 inch cardboard cores with carry handles designed as a 2 to 4-man lift. All CC thicknesses can be supplied batched to custom lengths for a small additional charge.

2.1.3 Examples of CC Applications Some examples of applications for the different CC types are given in Table2.

Table 2:

Application	CC5	CC8	CC13	Comment
Dust Suppression	●	○		Use CC8 if the area is to be regularly trafficked.
Foundation Blinding	●	○		Use CC8 for heavy duty application.
Weather Proofing / Slope Stabilisation	●	●		Use CC5 for CC8 depending on ground conditions.
Ditch Lining	○	●	○	Use CC5 for light duty applications. Use CC8 for medium duty applications. Use CC13 for heavy duty applications.
Bund Lining	●	●	●	All thicknesses may be used depending on level of traffic.
Sandbag / Gabion Reinforcement	○	●	●	CC8 has been tested by the British Army of sandbag reinforcement
Trackway / Flooring		●	●	Use CC8 to CC13 depending on loading or substrate.
Pipe Protection	●	●	●	All thickness may be used depending on protection requirements.
Cable Covering	○	○	●	All thickness may be used depending on protection requirements.

2.1.4 CC Material Properties

Table 4: Physical Properties of CC				
CC	Thickness (mm)	Batch Roll Size (sqm)	Bulk Roll Size (sqm)	Roll Width (m)
CC5	5	10	200	1.0
CC8	8	5	128	1.1
CC13	13	N/A	80	1.1
CC	Mass (unset) (kg/m2)	Density (unset) (kg/m3)	Density (set) (kg/m3)	
CC5	7.0	1500	+30-35%	
CC8	12.0	1500	+30-35%	
CC13	19.0	1500	+30-35%	

2.1.5 Strength

Very high early strength is a fundamental characteristic of CC. Typical strengths and physical characteristics are as follows:

Compressive testing based on ASTM C473 – 07

- 10 days compressive failure stress (MPa) 40
- 10 days compressive Young's modulus (MPa) 1500

2.1.6 Bending tests based on BS EN 12467:2004

- 10 days bending failure stress (MPa) 3.4
- 10 days bending Young's modulus (MPa) 180

2.1.7 Abrasion Resistance (ASTM C1353-8)

- CC lost 60% less weight than marble over 1000 cycles.

2.2 Tensile Test

Table 3: Tensile Test Data		
	Tensile Strength (kN/m)	
	Length direction	Width direction
CC5	6.7	3.8
CC8	8.6	6.6
CC13	19.5	12.8

2.2.1 Abrasion Resistance (DIN 52108)

- Similar to twice that of OPC Max 0.10 gm/cm2

2.2.2 CBR Puncture Resistance EN ISO 12236: 2007 (CC8 & CC13 only)

- Min. Push-through force 2.69kN
- Max. Deflection at Peak 38mm

2.2.3 Resistance to Imposed Loads on Vehicle Traffic Areas

EN 1991-1-1:2002 (CC8 & CC13 only)

- Category G compliant
- Gross weight of 2 axle vehicle 30 to 160kN
- Uniformly distributed load not exceeding 5kN/sq m

2.2.4 Physical Properties

Initial Set≥ 120 min

Final Set.≤ 240 min.

2.2.5 Method of Hydration CC can be hydrated using saline or non-saline water. The minimum ratio of water to CC is 1:2 by weight. CC cannot be over hydrated so an excess is recommended. The recommended methods are: In a hot/arid environment, re-wet the material 2 - 4 hours after the initial hydration.

Figure 2.2.5: Spray The Fiber Surface with Water Until It Feels Wet to Touch for Several Minutes After Spraying.

2.2.6 Immersion: Immerse CC in water for a minimum of 90 seconds.

2.2.7 Spraying: Spray the dry CC with water until it is saturated. Do not use a direct jet of pressurized water as this may wash a channel in the material and create a weakened area.

2.2.8 Re-spray the CC again after 1 hour if:

- Installing CC5
- Installing CC on a steep or vertical surface
- Installing in warm climates

2.3 Cutting and fixing:

- A snap off type disposable blade is the most suitable tool for cutting CC before it is hydrated or set.
- When cutting dry CC, a 20mm allowance should be left from the cut edge due to lost fill.
- This could be avoided by wetting the CC prior to cutting.
- CC can also be cut using handheld self-sharpening powered disc cutters.
- Cutting set CC: Set CC can be cut as with conventional concrete, with angle grinders, construction disc cutters or quality tile cutters.

2.3.1 CC Mechanical fixing: There are large number of mechanical fixings that are suitable for concrete canvas. To improve the mechanical strength or water proofing properties of joints.

2.3.2 Staples: Wide range of manual, electrical or gas powered staplers are suitable for attaching CC to soft substrates such as wooden boarding for building cladding. Commercially available hand staplers are suitable for fixing 2 layers of CC together where a small amount of compression force is required.

2.3.3 Nails: Standard nails can be used to attach CC.

Alternatively, a power tool such as the Hill nail gun, provide a quick and effective method of securing CC to hard surfaces such as concrete or rock. It is important to ensure that the nail is used with at least a 15mm washer to ensure the head does not penetrate through the surface of the canvas.

2.3.4 Screws: Self tapping screws provide a quick and readily available means of attaching CC to substrate or to itself. Typically, applications include sandbag reinforcement or covering existing wooden or steel structure.

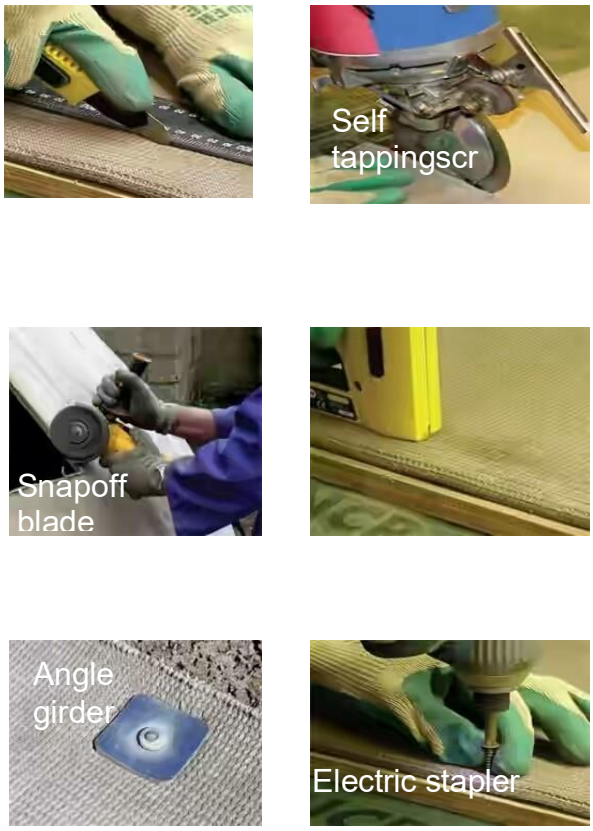

Fig 2.2: Concrete cloth Tools

2.3.5. Pegging: Pegging is recommended for ground surfacing applications such as ditch lining, slope stabilization or erosion control. Typically pegs are specified every 2m for most applications, but this will vary depending on ground conditions.

Fig 2.3.5 Pegging

2.6 Finishing:

The fiber surface of CC can be easily painted once set, using standard exterior masonry paint. Alternatively, Concrete Canvas Ltd. recommend a range of copolymer concrete surface treatments which can provide a colored uniform finish and hydrophobic protection against staining and organic growth. Fire resistant paints have also been shown to be effective when thermal performance is critical.

2.4 Key benefits of the concrete cloth:

- Quick: Unroll, place and wet
- Simple: Cannot be over-hydrated
- Versatile: One material, many uses
- Durable: Wear-resistant concrete
- Portable: Easily transported and deployed without specialized equipment.

2.5 CONCRETE CLOTH CIVIL APPLICATIONS

- Ditch lining
- Erosion and scour protection
- Slope protection, weathered rock protection
- External pipe protection
- Internal culvert repair
- Secondary containment
- Weed control

Fig 2.5: Ditch lining

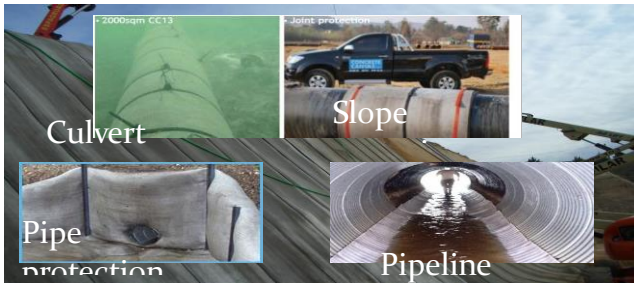

Fig 2.5: Pipe protection

2.6 Military applications:

- Force protection
- Structure upgrades
- Helipad construction
- Expedient resurfacing
- Ditch lining/Tank lining
- Slope protection

2.7 LITERATURE REVIEW

1. Lin Liu: she described about the concrete cloth Its final shape is exactly same as the outer profile of the structure or element covered by the CC.

2. Zhang Jun, Xu Wei, Weng Xingzhong, Gao Peiwei, Yao Zhihua, Su Lihai and Wang Jiang: They have researched that CC has a series of advantages, including rapid strength formation, simple and convenient construction, flexible and diverse specifications, good structural performance, water-proof, fire resistance, corrosion resistance, environment friendliness, durability, and economical efficiency.

3. K. Srinivas and Prof. Ravinder: he described about using fabrics for concrete casting, Volume 12, Issue 3, CC provides a quick means to directly apply a thin, uniform, protective concrete covering to the slope surface and can be applied in all weather conditions. CC is fixed by short nails and provides a strong, waterproof, surface stabilizing covering enhanced by internal reinforcing Fibers.

4. Maqbool Akhtar and Rajendra Singh Dang: they described Construction of temporary structures at relief camps or in making temporary dispensaries in rural areas. Lining of canals where water is to be flowed for the fields for uses of construction works. In making the fencings of the house it's used over the barbed wire to provide the additional strength and security. It's used at slopes to prevent them from erosion in hilly areas. It's also used as water proofing agent over the warehouse's roof as well as over the houses in emergency conditions. In Military works it's used in many operations additional strength. In construction of runways and helipads for the fighter planes as well as helicopters.

5. Hui Li, Huisu Chen, Lin Liu, Fangyuan Zhang, Fangyu Han, Tao Lv, Wulong Zhang, Yujie Yang: they described that the characteristics of rapid hardening and high early strength of the CC product make it very suitable for the application in retaining wall structure. Based on the experiment study of CC's mechanical properties, a standard design procedure for CC-faced retaining wall is presented in this paper, which includes the methodology of calculating the spacing of reinforcement, the local

bearing capacity and the lateral horizontal displacement. The results indicate the CC-faced retaining wall may meet the capacity requirements if the wall height is lower than 10 m.

6. Anurag Goyal, Shweta Petkar, Yash Goyal, Prof. Sanjay Karodpati: They researcher that the Study shows that it can be helpful in both temporary and well as permanent purpose. In India concrete canvas is imported from foreign countries, so by introducing its benefits and cost analysis to Indian construction industry we can initiate its manufacturing in India. It is the latest invention in the construction sector. It owing to its easy manufacturing process, better flexibility properties, a higher degree of waterproofing and easy to customized use can prove a boon for the construction industry.

3. LIMITATIONS

- CC cannot be over hydrated
- Do not jet high pressure directly onto the cc as this may wash a channel in the material.
- CC has a working of 1-2 hours after hydration. So do not move it once it has begun to set.
- Working time will be reduced in hot climates.
- If cc is fully saturated, the set may be delayed and strength reduced.

CONCLUSION

1. Concrete Cloth is a promising innovative material that has potential which is yet to be explored in the construction industry. It is specially used, where the workmanship is very difficult and in emergency works such as in military.
2. The concrete canvas is the latest invention in the construction sector. It is owing to its easy manufacturing process, better flexibility properties, a higher degree of waterproofing and easy to customized use can prove a boon for the construction industry.
3. Study shows that it can be helpful in both temporary and well as permanent purpose. In India concrete canvas is imported from foreign countries, so by introducing its benefits and cost analysis to Indian construction industry we can initiate its manufacturing in India.
4. The study shows that it is a good material for use at temporary as well as permanent purposes Specially in Tunnel Lining, Defense uses, Water proofing, Fencings, and Construction of military runways, and from cost effective point of view Concrete Canvas/cloth is a competitive alternate product of concrete.
5. CC has a series of advantages, including rapid strength formation, simple and convenient construction, flexible and diverse specifications, good structural performance, corrosion resistance, environment friendliness, durability, and economical efficiency.

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