

Concrete Canvas: A Multifaceted Construction Material



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Abstract: Cement concrete is a most used construction material, due to its enormous demand worldwide in the construction sector. Concrete serves many purposes in different adverse conditions, there are many advantages but there is one limitation that is concrete is not flexible. Concrete Canvas brought a revolutionary change in the construction materials called Geosynthetic Cementitious Composite Mats (GCCMs) which as many applications and used as an alternative to conventional concrete. It is a flexible, concrete canvas that gets hardens on hydration to form a thin, durable, waterproof and low-carbon concrete layer. Concrete Canvas may find its tremendous scope in the Construction sector as fire resistance and water proofing material. The concrete canvas has a self healing property thereby adds good benefit to the life of material and economically because of its zero percent repairs maintenance. Even though if the concrete canvas gets damaged after a period of time, it gets self healed with the contact of water which helps in the hydration process. This paper mainly focuses on the case study done on the applicability of concrete canvas for fire resistant, Water proof and bulletproofing with the help of AP State Police and to explore different applications in Construction sector as well as Defense sector.

Keywords: Concrete Canvas, Fire Resistant, Impregnated fabric, Self healing, Waterproofing.

I. INTRODUCTION

Concrete Canvas is a multifaceted material because of its flexible characteristic and ease of workability and being a material of Fireproof, Waterproof and Bullet proof. Lakhs of rupees are granted for repair, maintenance and restoration of building and canal lining annually. This all happens because of concrete cracks sooner or later and need to be repaired. Concrete Canvas is good product for treatment of expansion joints which adds life and durability to building and canal lining, thereby recovers financially and time. The technology or science behind the product is concrete canvas hardens after hydration and gains 80 percent of its strength and eventually gains more strength as time prolongs.

Concrete canvas being a Water Proofing material it can be used for repairing and preventing roof leakages and also for lining of side walls in water tanks to prevent water leakages. It is a worldwide recognized construction material having a versatility of mechanical properties such as good load taking, compressive strength, good impermeability and better durability. Because of its flexible nature concrete canvas can be moulded to desired shape which revolutionized the construction.

The Concrete canvas as vast scopes in various applications such as in slope protection, mining, overlaying on underground pipelines, agriculture, Military application and many more.

II. WHAT IS CONCRETE CANVAS?

It is made of three dimensional impregnated fabric matrix fiber which contains mixture of Dry Concrete, matrix fiber at its top and a Waterproof layer made of PVC which arrests water completely without seeping the water to the other side of the material. It is a flexible roll before hydration, after the hydration process it completely gets hardened and gains 80% strength and eventually gains more strength as time prolongs. It can be hydrated with any water even the salt water. The product was specifically developed for applications within the Petrochemical and Oil & Gas industries.

It is available in three different thicknesses in market: CC5, CC8 and CC13, which are respectively 5mm, 8mm and 13mm thick.

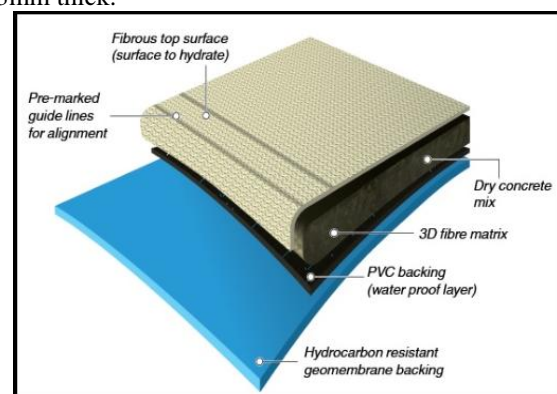


Figure.1 Materials used in Concrete Canvas

Concrete canvas consists of mixture of Dry concrete, Top surface with fabric matrix, Waterproof PVC at bottom coating. Concrete Canvas is a Geo Composite. It is required at places where a hard protective surface is required and where there is no chance of installing of conventional concrete. Figure 1 shows various material used in concrete canvas. Figure 2 shows the crosssection of Concrete Canvas.

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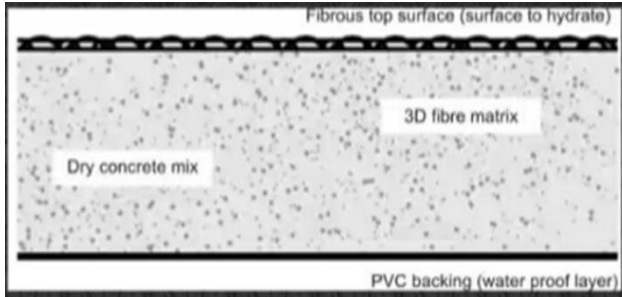


Figure 2 Crosssectional view of Concrete Canvas.

III. PHYSICAL PROPERTIES

Setting time: The time between the end of mixing initial set of a material made with hydraulic Binder or the hydraulic binder itself. The initial setting time should be greater than or equal to 120 minutes and the final setting time is greater than or equal to 240 minutes. concrete Canvas will achieve 70 to 80% strength in 24 hours after hydration.

Density: The dry density of Concrete canvas before hydration is 1500 kg/cc upon complete hydration the density increases 30-35 % to a range of about 1950-2025 kg/cc.

Thickness: Concrete Canvas is available in three thicknesses; CC5, CC8 and CC13, which are 5mm, 8mm and 13mm respectively. Thickness has no limit it varies between 2mm to 15mm.

IV. COST OF CONCRETE CANVAS

The cost of concrete canvas depends on the different thicknesses with are made available by the manufacturers. The below table 1 shows of the cost of concrete canvas available in the market. The material cannot be compared with other material because there is no substitute to the material.

Table 1 Cost of Concrete Canvas

CC	Thickness (mm)	Rate per Sqm (In Rupees)
CC5	5	3245/-
CC8	8	4902/-
CC13	13	6255/-

V. MARKET AVAILABILITY

Concrete Canvas is available in market in three different thicknesses 5mm, 8mm and 13mm. The Physical properties and availability of Concrete Canvas is tabulated in the Tables 2 and 3 below.

Table 2 Market availability of Concrete Canvas

CC	Thicknes s (mm)	Batch Roll (Sqm)	Bulk Roll (Sqm)	Roll width (m)
CC5	5	10	200	1.0
CC8	8	5	125	1.1
CC13	13	N/A	80	1.1

Table 3 Physical Properties of Concrete Canvas

CC	Mass (unset) kg/m ²	Density (unset) kg/m ³	Density (set) kg/m ³
CC5	5	10	200
CC8	8	5	125
CC13	13	N/A	80

Concrete Canvas is available in the market in three different formats i.e Bulk Roll up to 200sqm of Concrete on a Single pallet, Batched Rolls of 5 or 10sqm and Wide Rolls available in 2,3 and 4m width respectively. Figure 3 shows three types of formats of Concrete Canvas available in the market which is used for various applications.

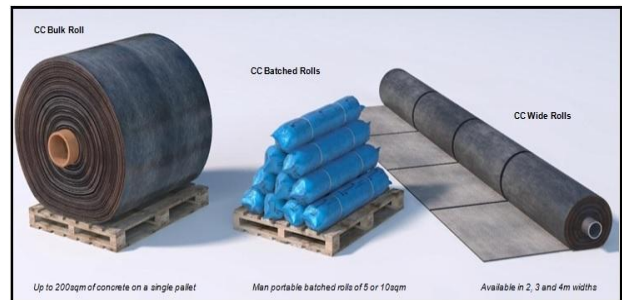


Figure3. Availability of Concrete Canvas in the market

VI. HYDRATION METHODS

Concrete Canvas can be hydrated using saline or non-saline water.

- The minimum ratio of water to Concrete Canvas is 1:2 by weight.
- It cannot be over hydrated so an excess is recommended.

The recommended methods of hydration are:

- Spraying
- Immersion

Spraying : The dry concrete mix of the concrete canvas is hydrates with water by spraying until it is completely saturated. Using of high pressure water jet may wash away the channel at weekend areas.

Immersion: Concrete Canvas immersed in water for a minimum of 90 second.

VII. ADVANTAGES OF CONCRETE CANVAS

Rapid: Hydration of material can be done by either spraying or Immersing fully in the water.

Easy to use: Dry concrete Canvas can be cut using simple hand tools such as utility knives.

Flexible: Concrete Canvas can be easily nailed through before setting.

Strong: To prevent cracking, fiber acts a reinforcement which absorbs energy against impact thereby provides stability at failure.

Fireproof: It as excellent retardant to fire because of the ceramic based material which can withstand high temperatures.

Durable: Concrete Canvas is chemically resistant and will not degrade in ultraviolet light.

Environmental friendly

VIII. METHODOLOGY

Our objective is to test the concrete canvas with Fire, water and Bullets so as to adopt the technology for AP state Police Force in agency extremist areas, where the construction activity is very difficult to take place. Concrete canvas can be used for deploying shelters in less time of 24 hours with minimum manpower. This can be used for guarding the sentry post with sand bags to prevent bursting of sand bags from firing of bullets. It acts as fire retardant in chances of fire accident. Since it is water proof material it has resistance to withstand heavy rains.

Materials Used: Petrol, Water (For Curing and Testing), Sand Bags stacked (40Nos), Bamboo Sticks (4 Nos), GI Wire, Concrete Canvas 13mm (CC). Figure 4 shows the materials used for installation and conducting the test.



Figure 4. Materials Used

Weapons Used: SLR (Self loading Rifle), AK 47 (Avtomat Kalashnikova), LMG (Light Machine Gun), Bullets 7.62 mm (45 rounds).

Installation Procedure:

- 1)The Sentry Post is first prepared by stacking sand bags one on each other in two rows with height 1.8m X Width 1.1m.
- 2)The concrete canvas is rolled out and laid on the sentry post covering the sentry post back and front.
- 3)Concrete Canvas is fixed to the sentry post by using 4 Nos bamboo sticks 2nos at front and 2 nos at back by using GI wire.
- 4)The concrete canvas is cured with water.

Figure 5 shows the installation procedure of sentry post with sand bags and concrete Canvas.



Figure 5 Installation of Sentry post with Sand Bag

Test Procedure:

- 1)**Fire Retardant:** 250 ml of Petrol is poured on the concrete canvas and burnt.
- 2)**Water Proof:** Water is poured on the Concrete Canvas.

- 3)**Bullet Proof:** 45 Rounds of Bullets are fired on the Concrete Canvas with three guns SLR, LMG, AK47 out of which 20 rounds of burst firing done by LMG. 10 rounds burst firing with AK47.

IX. TEST RESULTS AND OBSERVATIONS

- 1)**Water Proof:** Concrete Canvas is excellent waterproof material which does not allow seepage of water through the on the other side of the material which has chemically tested PVC Sheet.
- 2) **Fire Retardant:** Concrete Canvas is 100% fire retardant material because when petrol is poured and burnt on the concrete Canvas it burns only until the petrol is present on the concrete canvas and it is observed that it doesn't even leave any burnt stains on the material.
- 3)**Bullet Proof :** Concrete Canvas is tested with three guns LMG, AK47, SLR firing 45 rounds of 7.62mm bullets out of which 20 rounds of burst firing done by LMG. Ten rounds burst firing with AK47.

It is observed that 45 rounds of bullets pierced into the Concrete Canvas and than into first Sand Bag, out of which one bullet came out from other side of Concrete Canvas where there is loose sand and gap between the first and second Sand bag.

It is also observed that the structure of Sentry Post is same and remains undisturbed even after 45 rounds of Firing.

Test results and observations are shown in the figure 6 below.



Figure 6 Test results and observations

X. APPLICATIONS OF CONCRETE CANVAS

Ditch Lining: It is mostly used for ditch lining because it is quick, easy and less expensive when compared to conventional method of concrete for the application of ditch lining.

Slope Protection: Concrete Canvas can be used as slope stabilization. It can also be used as erosion control application.

Protection for Pipeline: The Concrete Canvas acts as protection for pipeline which prevent leakage of pipelines. It acts has a hard shield for the pipeline which prevents damages of pipelines any thereby improves its durability and life.

Force Protection: It is already proved in Afghanistan in January 2008 a notable amount of concrete canvas are laid in the frontline to analyse the field usage and the performance

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which is satisfactory for U.K army, as a reward the manufacturer got huge order of concrete canvas of 5500 sqm to the frontline of Afghanistan by U.K ministry of defense.

Helipad: Dust suppression system in helipad.

XI. MERITS OF CONCRETE CANVAS

Water Proof: The chemically treated PVC sheet is laid on one side of the concrete canvas which provides good impermeability to the material.

Strong: The cracking of the material is averted because of reinforcing fiber which takes energy from impacts and provides stability at time of failure.

Durable: It is chemical resistant, which can withstand any adverse weather conditions and has good protection for even Ultraviolet rays.

Flexibility: It has good twisting and wrapping characteristics and will closely follow any embankment. The material can negotiate rigid bends and can be installed to the existing infra structure. Flexible concrete canvas can be cut to required dimensions based on applicability and tailored using simple hand tools.

Eco-Friendly: When compared to conventional method of concrete it uses upto 95% less material. It has low mass and carbon free and used for many applications than conventional concrete.

Fire: It acts fire protection layer because can withstand high temperature, without even leaving any burnt stains on it.

Chemical: It has resistance to chemical attack and much resistance to the compounds which generally effects conventional OPC concrete.

Rapid Install: It is laid at rapid speed at rate of 200sqm/hour, up to 10 times quicker than conventional method of concrete solutions.

Self Healing: The self healing property of concrete canvas helps in repairing of materials which helps in no maintenance of the material thereby adds economical benefit also.

XII. APPLICATIONS IN APSPHCL WORKS

There are various applications where the concrete canvas can be used in AP State Police Housing Corporation Limited works.

1. It can be used in toilets flooring below tiles to make waterproof and prevent roof leakages.
2. It can be used for maintenance works like water leakage repairs on terrace slabs.
3. It can be used in terrace water tank to prevent leakages from tank.
4. It can be used for covering sanitary pipes to prevent leakages.

XIII. APPLICATIONS FOR POLICE FORCE

There are various applications where the concrete canvas can be used for AP State Police Force.

1. This technology can be used for erecting temporary shelters in agency areas.
2. The technology can be used for guarding Sentry Posts .
3. The temporary outposts can be erected by using concrete canvas.
4. It acts as fire proof, water proof material and bullet proof materials, so that it can withstand any adverse climatic conditions.

XIV. LIMITATIONS

The limitations of Concrete Canvas are as follows:

1. Concrete Canvas cannot be over hydrated.
2. Do not hydrate it directly by using high pressure jet directly onto the concrete Canvas as this may wash away the material .
3. It has 1-2 hours of workability after hydration, so do not move it once it has started to set.
4. In high temperature conditions reduces working time on concrete canvas.
5. If CC is fully saturated, the setting time may be delayed.

XV. CONCLUSION

- Concrete Canvas is an excellent material of Waterproof and Fire Retardant, but whereas material needs improvement for bulletproofing. The manufacturers need an improvement in the material so as to make it bulletproof.
- It can be used for various repairs and maintenance works in APSPHCL.
- Concrete Canvas is used for deploying temporary shelters in agency extremist areas with less time and manpower.
- It may be used for Sentry Post to make the structure undisturbed.

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