An Experimental Study on Concrete Cloth

M. Satyanarayana, P. Padma Rao, A. Suri Babu , R. Venkata Ramana , G.Sambasiva Rao.

Abstract ***Present generation is having a huge demand for construction materials to follow different conventional methods due to a rapid increase in the materials widely used in construction & it also needs an enormous amount of economical investments on materials. There is no provision for very rapid and emergency workable concrete installation methods. Concrete as construction material is recognized globally but the inquest to improve its flexibility has always attracted the attention of researchers. As there are many advantages of concrete but one thing makes it inefficient i.e., it isn't flexible when hardened. The increasing cost of repair work due to weathering actions, ground surface damage, seepage in water canals always remained a concern. A new technique has developed called concrete cloth which makes the defects free from concrete & which is flexible and easy to use. CC has a ceramic nature that makes it fire resistant and water proof.***

Key words: Concrete cloth, GGBS (Ground Granulated Blast Furnace Slag), Hydrophilic Sheet, Air Mesh, Seepage, Flexible and Fire Resistant.

I. INTRODUCTION

Concrete cloth is an upcoming cloth protecting for the concrete and for construction in civil Engineering, & it has huge range of applications due to its flexibility. It was first proposed in 2005 by Brewin & Crawford. It is an impregnated fabric that hardens on hydration to form a thin, durable, has able to resist water and fire proof layer e.g.: Like a thick mat, Concrete Cloth can closely cover the surface of arbitrary structure or element before using it & shape is completely the same as the outer profile of the structure where Concrete Cloth has applied. Concrete cloth is also called a rolling liquid which applied on the wall for protecting the ingress of the ion passing through it (corrosion). It doesn't require any mixing plant for mixing it. simple way is to just add the water to it and then applied directly as and when required & using water doesn't need to be potable, and bore-hole water it can be either river water or seawater can be used. No major ground excavation or foundation work is required.

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Figure 1: cross sectional view of Concrete Canvas

OBJECTIVES

As this idea is under patent rights & the details of this were unaware. So, the following are some of the goals that we need to achieve.

- To use it as a replacement for components of a construction activity other than framed elements.
- To determine the Tensile strength of CC using UTM along with Flexural strength & Compressive strength.
- The main criterion is to determine the Mix Proportion and Materials required to lie CC.
- To make it available at an economical rate with more design life.
- To produce a composite material of concrete which is flexible and easy to use

SCOPE:

- An innovative technique in concrete world Especially for construction technology for emerging technologies.
- Compared to traditional concrete solutions it is quicker, economical & very easy to install.
- It has additional benefits i.e., Use of less material than conventional concrete and reducing its effects on ecological balance makes us sustainable environment.
- By replacing GGBS material with cement that helps to decrease the usage of cement contents and also gives the effective strength.
- Replacement of all the elements of CC with newer ones (assigning individual component behavior closer to actual elements).

Tests conducted:

- Compressive strength(ASTM C109 – 02),
- Flexural strength(EN 12467:2004),
- Tensile strength,
- Manning's value,
- Freeze - thaw testing (ASTM C: 1185)
- Freeze - thaw testing (BS EN 12467 : 2004 part 5.5.2)
- Soak - Dry testing (BS EN 12467: 2004 part 5.5.5)
- Water im permeability (BS EN 12467: 2004 part 5.4.4)
- Abrasion Resistance (DIN 52108)

II. MATERIALS AND PROPERTIES:

In this investigation, materials used are as given below:

- The OPC of 53 grade conforming to IS: 12269-2013.
- GGBS (Ground Granulated Blast Furnace Slag) conforming to IS: 12089-1987.
- Sand confirming zone II as per IS: 383 - 1970.
- Crushed coarse aggregates below 4.75mm.
- Accelerator ($CaCl_2$)
- Hydrophilic material (Nylon Cloth)
- Air Mesh
- PVC backing
- Adhesive (SR 998)

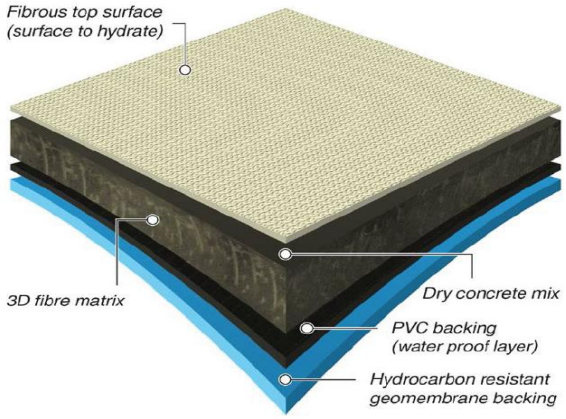

Figure 2: Types of materials used in Concrete Cloth.

Cement:

OPC Cement have been used of locally available.

The physical properties of the cement are listed in Table – 1

Table 1: Physical properties of OPC based cement.

S.No	Physical properties of OPC 53 Grade cement	Result	Requirements as per IS:12269-2013
1	Specific Gravity	3.15	-
2	Standard Consistency (%)	30%	-
3	Initial Setting Time	45 min	Not less than 30 mm
4	Final Setting Time	530 min	Not greater than 600 mm
5	Fineness	7%	Should be < 10%
6	Soundness	4 mm	Should be < 10 mm

Ground Granulated Blast Furnace Slag (GGBS):

GGBS (Ground Granulated Blast-Furnace slag) is a fine powder obtained iron industries it mainly consists a mixture of limestone in the form of flux & quenching molten iron slag (a by product of iron and steel-making) from a blast furnace into water or stream, to produce a glassy, granular product that is then dried and ground into a fine powder.

The chemical composition & its components of blast furnace slag are CaO (30 - 50%), SiO_2 (28 - 38%), Al_2O_3 (8 - 24%), and MgO (1 - 18%). In general, increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength. The MgO and Al_2O_3 content show the same trend up to respectively 10-12% and 14%, beyond which no further improvement can be obtained.

Table 2: GGBS - PP & CC.

CC (Chemical Composition)		PP (Physical Properties)	
CaO	40%	Colour	Off - white
SiO_2	35%	G	2.85
Al_2O_3	13%	Bulk Density	1200 kg/m^3
MgO	8%	SSA (Specific surface area)	>350 m^2/kg

Fine Aggregates:

Due to the weathering of rocks the fine aggregates are finely divided by the passage of 4.75mm sieve & is mostly a natural granular material. It's mainly consists of constituent of sand i.e., silica (Silicon dioxide, or SiO2) in the form of quartz, because of its chemical inertness and considerable hardness, is the most common weathering resistant mineral. River sand locally available in the market was used in the investigation. In order to maintain bonding, angular fine aggregates were preferred. In CC the purpose of the fine aggregate is to fill the spaces along with cement dry fill. The sand which we are using is confirming zone II as per IS: 383 - 1970.

Specific gravity= 2.54

Bulking of sand=8%

Crushed Coarse Aggregates:

In case of 3d spacer fabric, the spaces range from (2 to 3 mm) So that there is no need of other external material to fill the spaces but coming to Air Mesh the spaces range from (3.5 to 4.5 mm). It could be problematic for the bonding of linking fibres and cement. So to promote bonding external material (crushed aggregate passing 2.36 mm IS sieve) similar to the conventional concrete is chosen. It helps to fill gap in the individual holes and increase the bonding also resist to shrinkage.

Specific Gravity=2.67

Accelerator ($CaCl_2$):

Here acaccelerator used is $CaCl_2$ which accelerates even when set at low ambient temperatures & helps us increasing its initial & final strength of the concrete.

Air Mesh:

Fibres are the finest & smallest particles of the fabric. Their fine hair like particles(substances) are available in natural or manmade ways. Terelene is the name given to polyester which is a manmade & it is easily handled, washed due to its thermoplastic in nature & it can be ironed at 145^0 Celsius. Air Mesh is knitted using polyester fibres on Racheal Machine (a specially

designed machine to fabricate 3d nets for different purposes).

Figure 3: Showing the 3-dimensional Air mesh fabric

Hydrophilic Sheet:

It is economical & can be used in the construction. The advantage of using (Nylon) is that it can be remoulded in any shape because it is thermoplastic in nature.it is introduced in the year 1938 to make use of the stocking for various other products such as parachutes, Ropes, tyre chords, mosquito nets and tent. Hydrophilic sheet affords greater design flexibility & can be permanently set into the fabric.

Figure 4: Hydrophilic Layer

PVC Backing:

PVC (poly vinyl chloride) is a water resistant material which is widely used all over the world. It is an excellent chemical resistant has electrical insulating properties. Being thermo-formable shows good stability to temperatures.

Figure 5: PVC backing layer.

Adhesive (SR 998):

Adhesive SR 998 is used for getting good bond strength & it dries in a hard-flexible film resistance to water and corrosion also. simple way to protect its strength & durability is applying to the walls by brush or roller as the paint is applied.

Water:

It is a very important in any construction works carried out through its whole process because it defines it's all strength characteristics. If more amount of water used in the construction it may cause bleeding of the materials and segregation of the materials takes place. Generally, 3/10 th of weight of water is added to the concrete for complete hydration of the materials and it achieve good strength. w/c ratio =0.35 is used for the conventional concrete. If fibres are introduced in the construction, the excess water present in the concrete absorbs the water by the fibres and makes its free from segregation & bleeding & water should be added with in its permissible limits & less water is used then top layer gets hardened but the bottom layers don't set leaving CC a useless one. Portable water, Saline water could be used as CC do not have any corrosive material.

III. METHODOLOGY

By controlling the following variables in manufacturing, it is possible to produce a filled cloth where the void ratio and swelling is controlled so as to limit the space available to be occupied by the liquid component.

- The arrangement, shape and physical properties of the linking fibres,
  the selection of the filler materials with suitable physical characteristics
  including density and Grain size analysis,
- Selection of the reagents with suitable physical characteristics including
  Density and Grain size analysis,
- Careful control of manufacturing process especially loading the fill to the
  Correct bulk density within the material and Control of the ratio of reagents and fillers within the dry fill.

$$MV - OV = X * LV$$

Where:

- **MV**= the maximum volume of the space within the cloth (per unit area of the cloth); thus MV includes both the volume of empty space in the cloth before addition of the powder material, and an additional volume resulting from any expansion of the space due to the pressure exerted by the swelling of the powder material during the addition of the liquid or during the setting of material.

- The additional volume may be modified by adjusting the quantity and stiffness of the linking fibres but will generally be of the order of up to 15%, e.g. about 12%, of the volume of empty space in the cloth before addition of the powder material;
- **OV**= the volume of the space within the cloth that is occupied by the particles of the powder material, which volume does not include the volume occupied by voids within the powder material (per unit area of the cloth);
- **LV**= the volume of liquid (per unit area of the cloth) that results in the maximum long term (28 day) compressive strength, of the fill blend when set; this can be derived empirically or from the reagent manufacturer/blenders recommended liquid to reagent/blend ratio; and
- **X** = a factor between 0.65 and 1.

For example using a particular OPC based Cement formulation, where the liquid is water, the value of X used is 0.75.

IV. MIX DESIGN:

In India, while casting concrete blocks to tests its mettle we just follow some guidelines shown through Indian Standard Codes. These show a path to precede the work as a reference / practical work. But these were written in accordance with rigid nature of concrete. No one else in the whole world knows how to make a concrete a flexible material. As we know that many of the conclusions were made based on a popularly used technique i.e., Trail and Error Method. Assumption is the first word that defines this method. As we were unaware of the Code books related to CC, So that the only way to gain the best proportion is through Multiple Proportioning. It is a complicated one, to make it simple assuming a component of proportion as constant and varying the components. As we are using finer elements, mainly cement and fine aggregate.

Considering X: Y i.e.,

X = cement as one part,

Y = fine aggregate as other part.

Also considering the addition of $CaCl_2$ as 2% the amount cement content is taken to attain higher early strength and faster setting. Assuming Cement as unity, following are the Proportions that were kept for testing and are listed below.

Table 3: Mix proportions of Cement: Sand mixture

S.NO	Cement : Sand (Ratio)	Wt of Cement in gm	Wt of F.A(Sand) in gm	Wt of CC in gm
1	1:3	200	600	1225
2	1:2	750	1500	1240
3	1:1	1000	1000	1260

Table 4: Mix proportions of (OPC+GGBS): Sand mixture

S.NO	(OPC+GGBS):Sand	GGBS Wt in gm	Cement Wt in gm	F.A in gm	Wt of CC in gm
1	(0.8+0.2):3	40	160	600	1204
2	(0.8+0.2):2	150	600	1500	1233
3	(0.8+0.2):1	200	800	1000	1248

Table 5: Mix proportions of (OPC+GGBS) :(SAND+C.A) mixture

S.NO	(OPC+GGBS):(SAND+C.A)	GGBS gm	Cement gm	Sand gm	C.A gm	Wt of CC gm
1	(0.8+0.2):(0.4+0.6)	200	800	400	600	1350
2	(0.8+0.2):(0.5+0.5)	200	800	500	500	1380
3	(0.8+0.2):(0.6+0.4)	200	800	600	400	1249

V. WORK PROCEDURE:

The following are the steps that are involved in laying Concrete Cloth,

1. Before the start of the experiment, it is important to know / how could be the surface that is used for laying CC.
2. The surface that is recommended is to be flat so that no undulations can be seen beneath and proper alignment of the layers is done without any error.

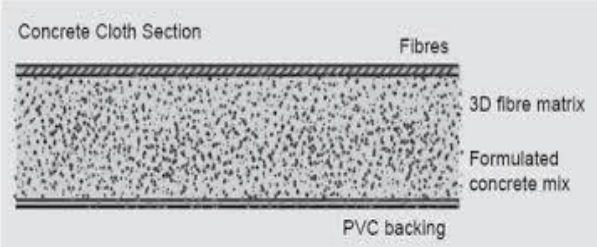

Figure 6: Concrete cloth diagrammatic Cross section view.

3. At first, Place a PVC sheet of required size (1ft*1ft) for testing on the flat surface and place the Air Mesh on the PVC sheet of same size using the strong Adhesive (we used SR 998) with high Pressure. Meanwhile take a plastic / steel pan for making design mix, follow above mix proportion (3.2 tables (1, 2& 3)) and take weights using weigh balance.

4. Mix the materials thoroughly to get a uniform mixture.
5. Add an accelerator to the cement mix to accelerate the setting process in order to gain high early strength. Use $CaCl_2$ of about 2% the quantity of cement sample alone.
6. Now pour the dry cement filler into the spaces of the Air mesh and compact the material using vibrating machines.
7. After then, the top face is covered with a hydrophilic layer which is attached by using an adhesive in a pattern manner. So that no fall out of material takes place. The importance of this layer is to prevent the dry mix to coming out and at the time of curing it acts as a media to distribute and drain out the water uniformly throughout the cloth.
8. Finally, the cloth is ready to use at site. It is flexible and rolled in bulks.
9. Coming to Curing,
   The volume of water that is required to cure the laid sample of CC is given by the formula. (explained in 3.1.2)
   X = (Normal consistency of cement sample / Optimum water-cement ratio)

$$X = 0.3/0.4$$
$$= 0.75$$

10. Gently sprinkle the water over the top layer with hand or with the help of spraying equipment. (Don't disturb the CC until it sets.)
11. Test the panel laid for 3 days and 7 days (as we are using it for immediate works).
12. Go through the tests that are explained in 3.5
13. Record the results obtained and tabulate the observations.

Figure 7: Side view of CC specimen showing bonding of fibres with the concrete.

VI. RESULTS OBTAINED

Compressive Strength Test:

A total of 9 proportions of CC of size 30cm*30cm were casted and tested for 7 days testing each of 3 specimens are laid to get an average value. The results are tabulated as below:

Figure 8: Universal testing Machine for Compressive strength of a material.

Table 6: Compressive test results for Cement: Sand mix

S. No	Cement:Sand	Cement wt gm	Sand wt Gm	CC wt gm	Water content ml	Load KN	Area m2	Compressive stress (N/mm2)
1(a)	1:03	200	600	1216	486	605.9	0.0616	9.84
1(b)	1:03	200	600	1225	490	624.5	0.0616	10.14
1(c)	1:03	200	600	1234	493	666.6	0.0616	10.82
2(a)	1:02	750	150	1240	496	697.8	0.0616	11.33
2(b)	1:02	750	1500	1232	492	686.7	0.0616	11.15
2(c)	1:02	750	1500	1245	498	701	0.0616	11.38
3(a)	1:01	1000	1000	1260	504	761.2	0.0616	12.36
3(b)	1:01	1000	1000	1253	501	724.4	0.0616	11.76
3(c)	1:01	1000	1000	1240	496	741.9	0.0616	12.049

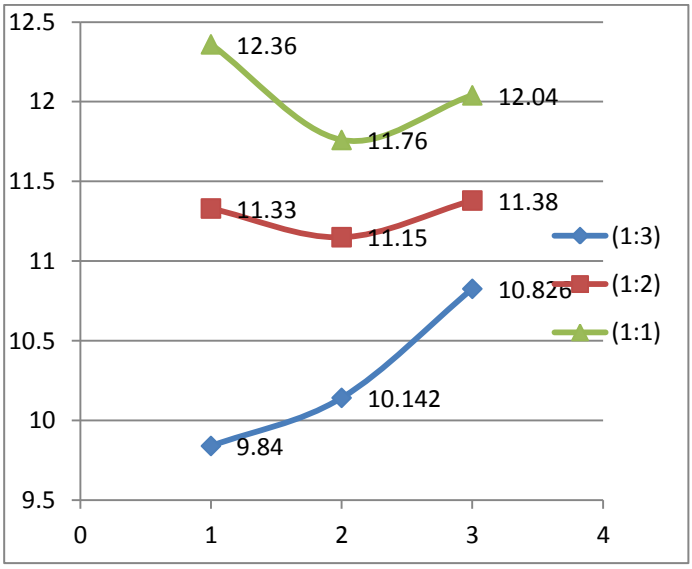

Figure 9: Graphical representation of Compressive strength of Concrete cloth for Cement : Sand mix

Table 7: Compressive test results for Cement & GGBS : Sand mix

S. No	(Cement+GGBS):Sand	Cement wt gm	GGBS wt gm	Sand wt gm	CC wt gm	Water Content ml	Load KN	Area m2	Compressive Stress N/mm2
1(a)	(0.2+0.8):3	160	40	600	1204	482	748.63	0.0616	12.15
1(b)	(0.2+0.8):3	160	40	600	1198	480	766.23	0.0616	12.44
1(c)	(0.2+0.8):3	160	40	600	1214	485	818.99	0.0616	13.30
2(a)	(0.2+0.8):2	600	150	150	1233	493	830.7	0.0616	13.49
2(b)	(0.2+0.8):2	600	150	1500	1249	500	819.5	0.0616	13.31
2(c)	(0.2+0.8):2	600	150	1500	1222	492	854.9	0.0616	13.88
3(a)	(0.2+0.8):1	800	200	1000	1248	500	914.9	0.0616	14.85
3(b)	(0.2+0.8):1	800	200	1000	1256	502	867.6	0.0616	14.09
3(c)	(0.2+0.8):1	800	200	1000	1236	494	883.3	0.0616	14.34

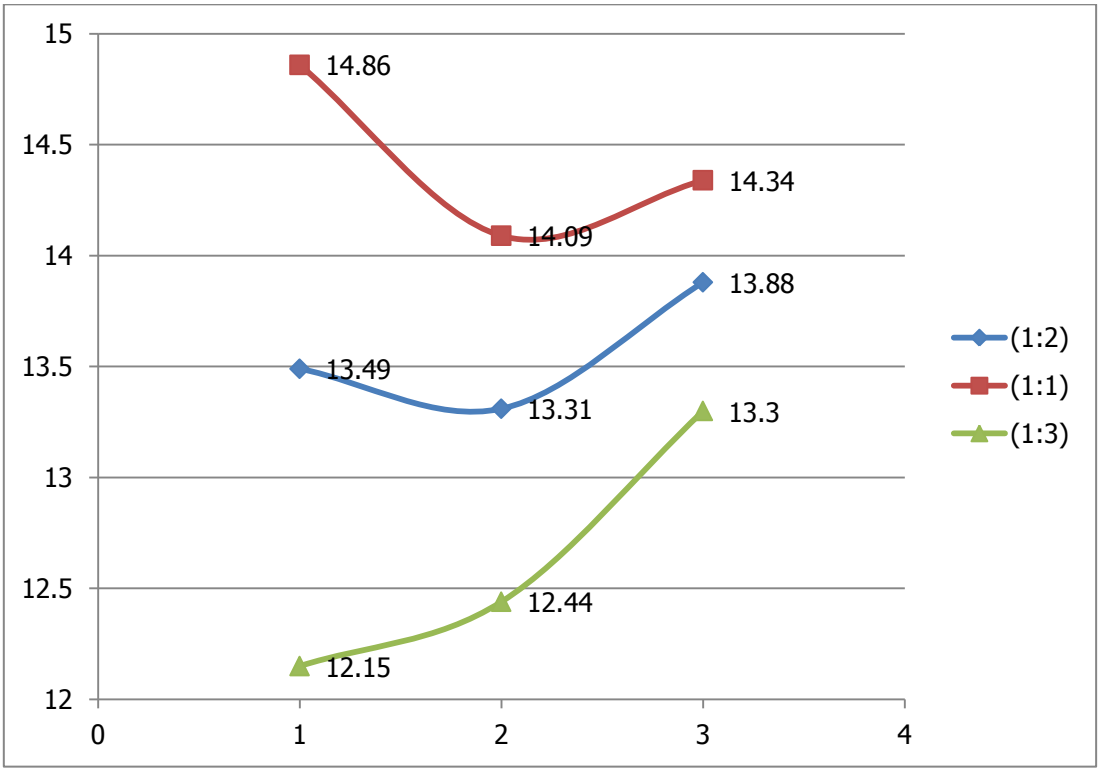

Figure 10: Graphical representation of Compressive strength of Concrete cloth for Cement & GGBS : Sand mix

Table 8: Compressive test results for Cement & GGBS : Sand & Crushed Aggregates mix

S. No	(Cement+GGBS) : (Sand+Crushed.Agg)	Cement wt	GGBS wt	sand wt	Crushed Aggregate wt	CCwt	Water Content	Load	Area	Compressive Stress
		gm	gm	gm	gm	gm	ml	KN	m2	N/mm2
1(a)	(0.2+0.8):(0.6+0.4)	160	40	400	600	1350	540	876.6	0.0616	14.23
1(b)	(0.2+0.8):(0.6+0.4)	160	40	400	600	1343	537	835.3	0.0616	13.56
1(c)	(0.2+0.8):(0.6+0.4)	160	40	400	600	1365	546	847.7	0.0616	13.76
2(a)	(0.2+0.8):(0.5+0.5)	600	150	500	500	1380	552	853.1	0.0616	13.85
2(b)	(0.2+0.8):(0.5+0.5)	600	150	500	500	1369	547	812.8	0.0616	13.20
2(c)	(0.2+0.8):(0.5+0.5)	600	150	500	500	1393	557	806.2	0.0616	13.09
3(a)	(0.2+0.8):(0.4+0.6)	800	200	600	400	1295	500	813.2	0.0616	13.20
3(b)	(0.2+0.8):(0.4+0.6)	800	200	600	400	1283	513	798.6	0.0616	12.97
3(c)	(0.2+0.8):(0.4+0.6)	800	200	600	400	1309	523	820.8	0.0616	13.33

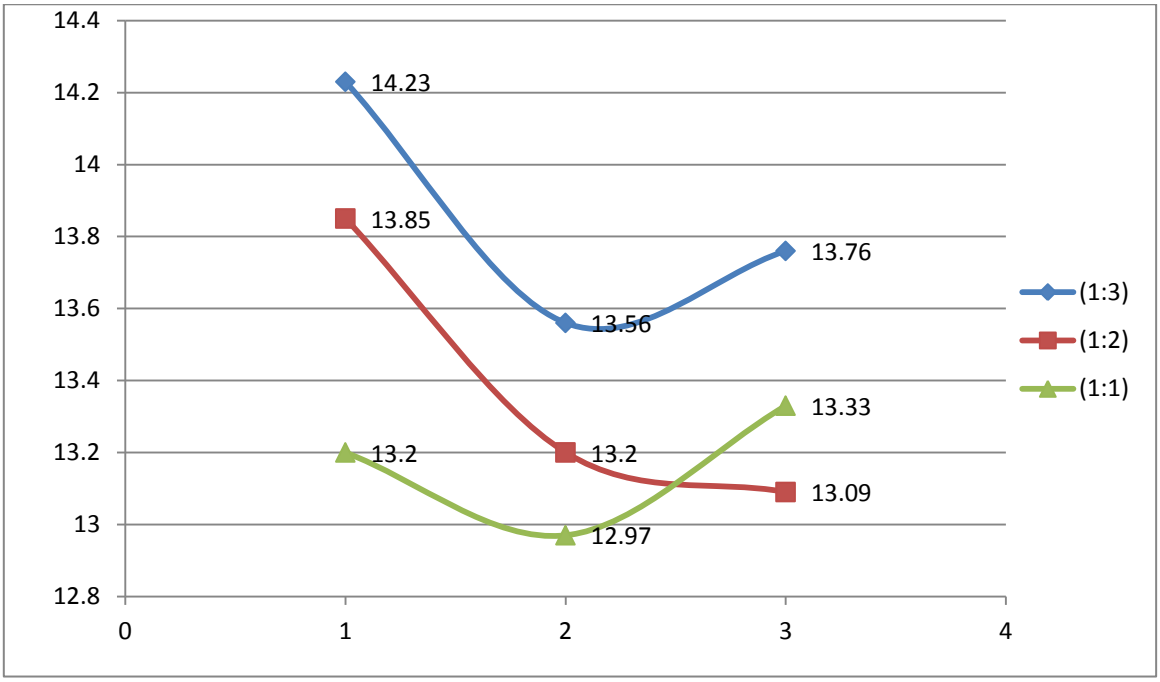

Figure 11: Graphical representation of Compressive strength of Concrete cloth for Cement & GGBS : Sand & Crushed aggregates

Table 9: Average Compressive test results for all proportions

S. No	Proportion	Water	Load	Area	compressive stress
units	ratio	ml	KN	Sq . m	N/mm2
1	1:3	490	632.26	0.06157	10.269
2	1:2	495	694.87	0.06157	11.286
3	1:1	500	742.10	0.06157	12.053

4	(0.8+0.2):3	541	777.62	0.06157	12.63
5	(0.8+0.2):2	552	834.88	0.06157	13.56
6	(0.8+0.2):1	512	889	0.06157	14.439
7	(0.8+0.2):(0.4+0.6)	482	852.74	0.06157	13.85
8	(0.8+0.2):(0.5+0.5)	498	823.8	0.06157	13.38
9	(0.8+0.2):(0.6+0.4)	495	810.63	0.06157	13.166

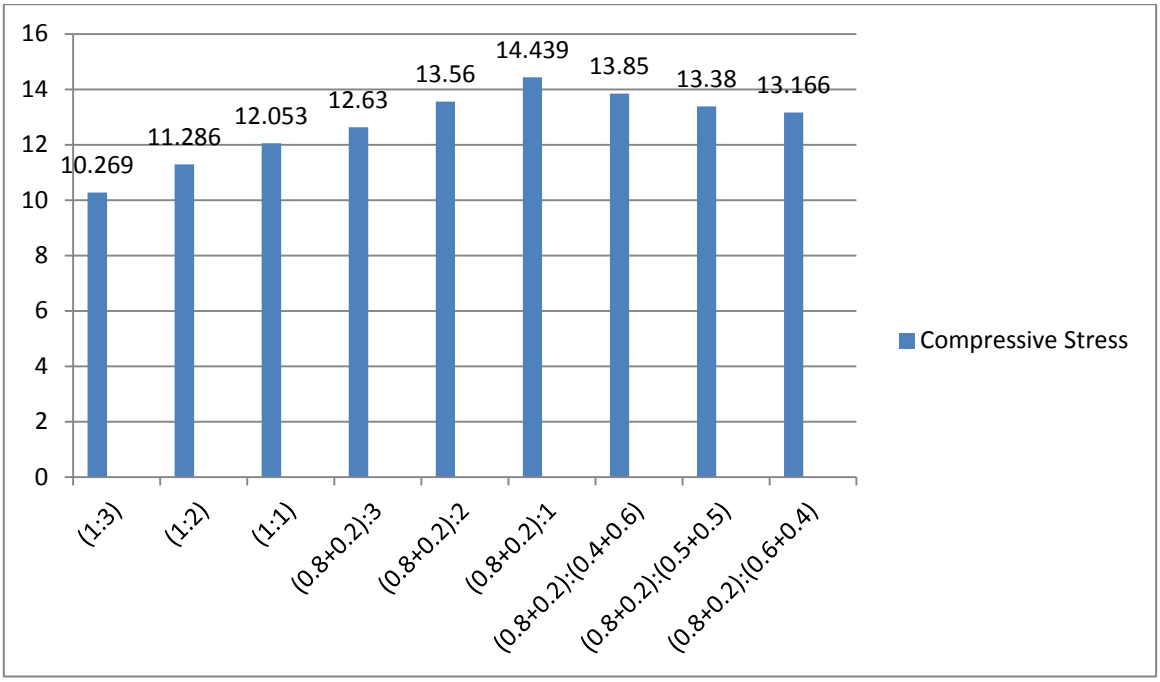

Figure 12: Average compressive test results for all proportions in Bar chart.

4.1.2 Tensile strength test:

It the maximum stress obtained before it undergoes failure. Tensile strength of concrete is very low with respect to its compressive strength. It Is taken as 1/10 of its compressive strength.

Figure 13: UTM for tensile strength of a specimen (CC)

Table 10: Tensile test results for all proportions

S. No	Proportion	Tensile load	Extension	Time taken
		N	%	sec
1	(1:3)	1	5.1	18
2	(1:2)	108	5.3	24
3	(1:1)	111	5.9	27
4	(0.8+0.2):3	134	6.2	28
5	(0.8+0.2):2	139	6.3	29
6	(0.8+0.2):1	143	6.6	31
7	(0.8+0.2):(0.4+0.6)	121	5.2	19
8	(0.8+0.2):(0.5+0.5)	124	5.5	22
9	(0.8+0.2):(0.6+0.4)	120	5.1	18

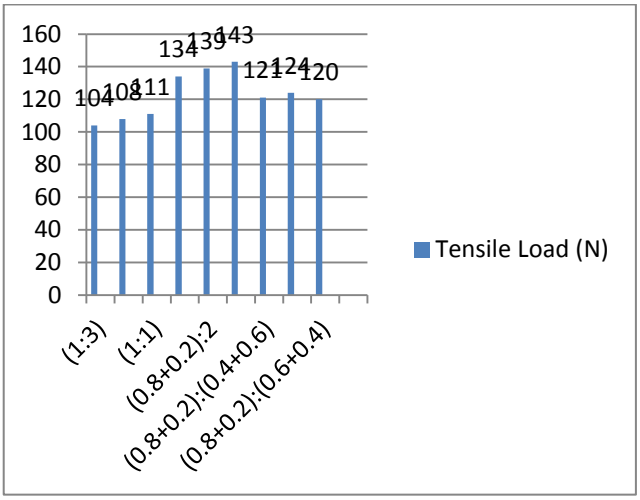

Figure 14: Tensile load test results for all proportions in bar chart

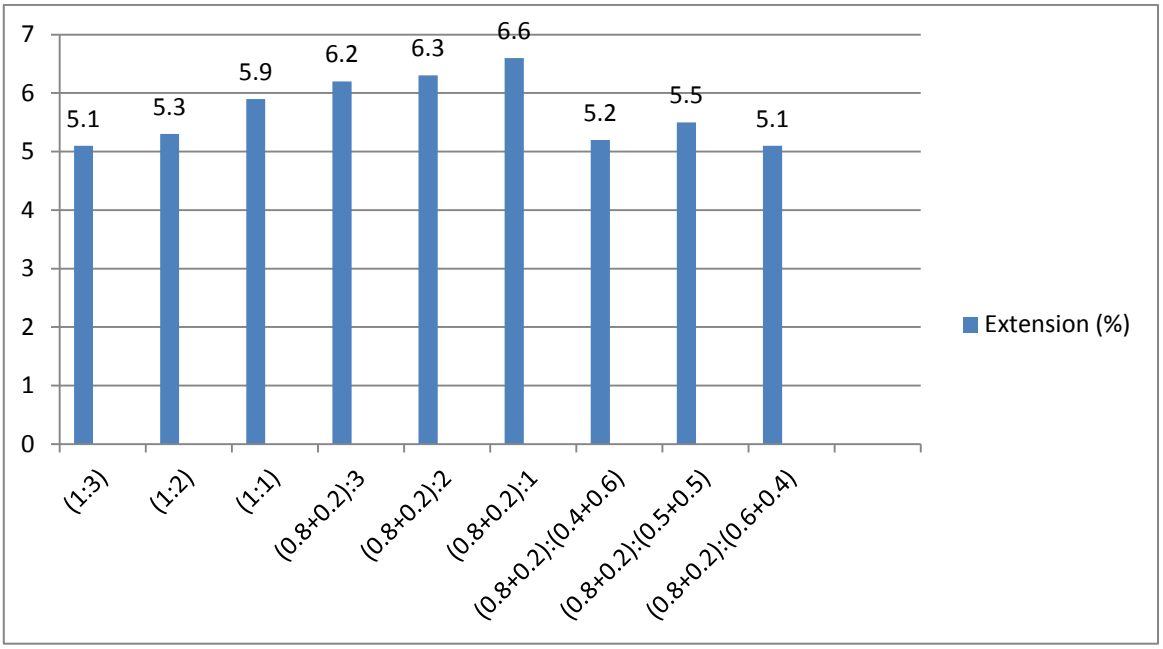

Figure 15: Extension (%) of CC results for all proportions in Bar chart

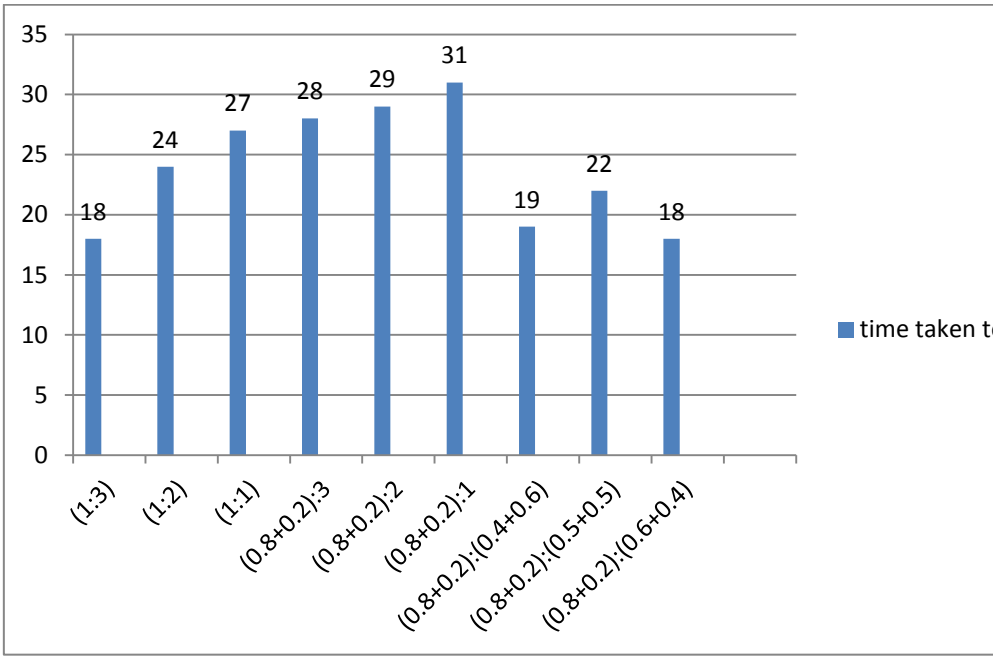

Figure 16: Time taken for CC to fail under tension for all proportions in bar chart.

VII. DISCUSSIONS

Let us assume the mix proportions as following in order to make a comfortable view of the observations that are discussed below,

Cement: Sand 1:3 **M_1**

Cement: Sand 1:2 **M_2**

Cement: Sand 1:1 **M_3**

(Cement+GGBS): Sand (0.8+0.2):3 **M_4**

(Cement+GGBS): Sand (0.8+0.2):2 **M_5**

(Cement+GGBS): Sand (0.8+0.2):1 **M_6**

(Cement+GGBS): (Sand+Crushed.Agg) (0.8+0.2) :(0.4+0.6) **M_7**

(Cement+GGBS): (Sand+Crushed.Agg) (0.8+0.2) :(0.5+0.5) **M_8**

(Cement+GGBS): (Sand+Crushed.Agg) (0.8+0.2) :(0.6+0.4) **M_9**

1. From the results, the Average Compressive strength of CC (concrete cloth) varies as (0%, 9.9%, 17.37%), (0%, 7.36%, 14.32) and (0%, -4%, -5%) for M_1, M_2, M_3, M_4, M_5, M_6, M_7, M_8, M_9 respectively considering the percentage increase with successive three mixes of all three major types of mixing.
2. From the tensile strength of Concrete cloth, it depicts clearly that the tensile load carrying capacity of the individual mixes increases gradually from M_1 to M_3, M_4 to M_6 but in the last 3 mixes which are having same parts but difference is identified when comes to the other part of mix is that there is a variation in fine aggregate and crushed coarse aggregates. (0.5+0.5) = (F.A+CCA) holds greater tensile load.
3. The behaviour of the percentage extension and time taken for the specimen to break when tensioned to failure follows the same path of the tensile load carrying capacity.

4.2.1 Flexural strength test:

It is the highest stress developed in a material before it reaching its yield strength (Moment of yield) of the material in a Flexure strength. It is also known as Modulus of Rupture & some also called as Bend Strength or Transverse Rupture Strength. 3-Point method is used to test flexural strength of a specimen. But, as per experimental point of view it is observed that the specimens that are casted to test for flexure haven't gained enough rigidity i.e., the CC specimen has attained Semi-Rigid State. So, the specimens with all mixes are failed under Flexure. The CC is flexible even after the concrete inside the CC is hardened.

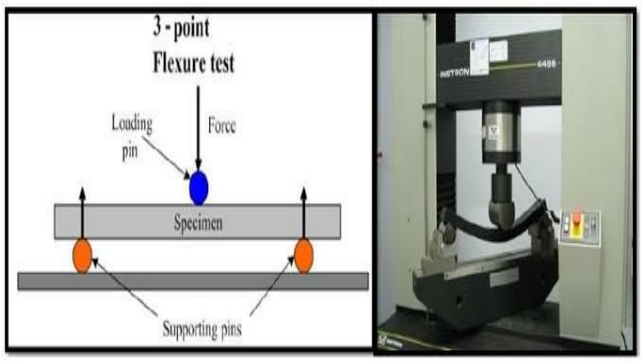

Figure 17: 3-point flexural testing machine

4.2.2 Permeability test:

Water Permeability test determines the resistance of specimen or a material against flow of water under hydrostatic pressure. It is a prominent one to evaluate the water passage through material when it is subjected to hydrostatic pressure. Durability testing is important to determine the lifespan of your structure. In this project the Permeability test is done on the PVC backing layer to know whether the CC specimen is impervious to water or not. In this test we haven't used any equipment to measure the property. The test is conducted by simple observation by pouring a litre of water into the previously mould PVC layer with a measuring jar underneath the mould for about an hour. It is observed that no leakage of water takes place through the PVC backing layer. So by this it could be used as a water resisting sheet where losses are more.

4.2.3 Fire Resisting Test:

A fire-resistance rating typically means the duration for which a passive fire protection system or a material can withstand a standard fire resistance test.

It is a simple test, to show how much time does a substance or a material or any specimen can withstand fire i.e., basically melting point of the material due to the transfer of heat produced by the burn out of external activity. The test is conducted on both the sides of the CC.

On top side,

- It is noticed that the hydrophilic layer is resisting the fire which is applied externally, shows no tear or burn out of layer takes place and distribution of heat is limited to less area when applied at 1sq.cm area. The test conducted for about an hour.

On bottom side,

- It is observed that the PVC backing failed by melting off.

As the air mesh is used as a core element in CC but when tested separately catches fire as they are made of polymers i.e., plastics. But when CC is tested the flame does not have impact on the fabric. The concrete inside it absorbs the heat showing a composite material property.

CONCLUSION:

The conclusion is made on our results shown are as follows:

- The compressive strength of CC(concrete cloth) increased due to its increase in cement content in the mix forming a suitable strong bond between the filler materials.
- The maximum compressive strength of concrete cloth is obtained from the ((cement + GGBS) and sand) mix of about 14.85 N/mm2 which has a greatest tensile load carrying capacity of about 143 N.
- The minimum compressive strength of concrete cloth is obtained from the ((cement) and sand) mix of about 9.84 N/mm2 which has a least t tensile load carrying capacity of about 104 N.
- Addition of GGBS to cement sand mix increases the compressive strength of cement by an average of 21%.
- Replacement of sand with crushed stone aggregates decreases the strength properties of CC by 11%.
- The specimen (CC) has attained semi-rigid state, fails to perform flexural strength.
- The PVC backing shows great stability against the water penetration, so it serves CC as a layer that's gives an extra advantage when used at sites.
- The hydrophilic layer that is attached on the top acts a fire resistant. So that it helps the CC's internal arrangement is disturbed but there is a uniform distribution and transfer of heat through the cross section is greatly achieved.
- Mix proportions casting, testing and result gain helped to achieve a design mix process when cured for 7days.
- Manufacturing of a composite material of concrete which is flexible before adding water and rigid after adding water.

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