Experimental Study to Find The Strength of Concrete Block By Partial Replacement of Cement With Glass Powder and Coconut Fibre

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Abstract- *Glass is amorphous material with high silica content, thus making it potentially pozzolanic when particle size is less than 90μm. Studies have shown that finely ground glass does not contribute to alkali – silica reaction. In the recent, various attempts and research have been made to use ground glass as a replacement in conventional ingredients in concrete production as a part of greenhouse management. A major concern regarding the use of glass in concrete is the chemical reaction that takes place between the silica – rich glass particle and the alkali in pore solution of concrete, which is called Alkali – Silicate reaction can be very detrimental to the stability of concrete. Utilization of waste glass is very important for human development because huge amount of glass waste produce by human increases the need of precious land for dumping waste glass, decreasing possible area that can be used for landfills of other waste increasing the need to establish new expansive landfills, lactates and gas releases from the landfill site degrade communities living condition and harmful to human health, location of most recycling plants are built within low income neighborhoods because of cheap labor and strict regulation may affect respiratory system if breath in pollutants.*

Keywords- cement, fine aggregate, coarse aggregate, water, Pozzolans, Glass Powder.

I. INTRODUCTION

Concrete is comprised of cement, fine aggregate, coarse aggregate, water, Pozzolans and air. Cement is made by grinding a calcareous material such as limestone or shell with an argillaceous (clayish) material such as clay, shale. Light weight concrete, high density concrete, coconut fibre reinforced concrete, self compacting concrete, high performance concrete, bacterial concrete, geo-polymer concrete, vacuum concrete, aerated concrete are some of the main type of concretes used for construction activities.

Concrete is one of the most widely used construction material in the world.Cement is costly & not environment friendly which is used bulk in construction & non degradable glass powder heavy wastage is hazardous to environment. Coconut fibre waste having very high moisture content so storing in rainy season and transportation is costly.

II. IDENTIFY, RESEARCH ANDCOLLECT IDEA

i. Identify the physical properties of raw material used to prepare Cement Concrete block by using glass powder and coconut fibre as a partial replacement of cement.

ii. Manually calculate the mix proportion of the mixes to prepare Concrete block by partial replacing cement with glass powder and coconut fibre and compare the compressive strength of Concrete block with and without glass powder and coconut fibre.

iii. Compare the compressive strength of the Concrete block containing glass powder and coconut fibre with normal block.

iv. Cost comparison between the Concrete block containing glass powder and coconut fibre with Normal Concrete block.

III. WRITE DOWN YOUR STUDIESAND FINDINGS

Durability of concrete with partial replacement of cement by coconut fibre and glass powder can be studied.

1. Alkali aggregate reaction of concrete with partial replacement of cement by coconut fibre and glass powder can be studied.
2. Behaviour due to acid attack of concrete with partial replacement of cement by coconut fibre and glass powder can be studied.

IV. METHODOLOGY

MATERIALS USED:

1) Natural Aggregate: Gravels are obtained by crushing natural basalt stone obtain from quarries. They are hard, strong, tough, clear and free from veins, alkali, vegetable matter and other deleterious substances. Aggregates are free from such material, which will reduce strength or durability of concrete.
2) Sand: Natural sand free from silt, veins, alkali, vegetable matter and other deleterious substances, obtained from Bhima, Ghod River.
3) Cement: Ultratech 53 GRADE ordinary Portland cement is used for all mixes.
4) Glass powder: Fine glass powder obtained from grinding and cutting of glass.
5) Coconut fibre: Obtained from coconut husk.

1. Cement: The cement used in the tests was Ordinary Portland Cement (Grade 53) locally available.

Table 1 Properties of Cement

Sr. No.	Characteristic	Result	Requirement
01	Fineness	6.7%	Residue less than 10 %
02	Soundness	8.1 mm	Not be more than 10 mm
03	Setting Time Initial Final	 34 Min 493 Min	Should not be less than 30 min. Should not be more than 600min.
04	Compressive Strength 3 Day 7 Day 28 Day	 28.2MPa 9.4MPa 54.7MPa	 Not less than 27 MPa Not less than 37 MPa Not less than 53 MPa

2. Fine Aggregate (Sand): Locally available clean and good graded fine aggregate was used after passing through I.Ssieve2.36 mm.

Table 2 Properties of Fine Aggregate (Sand)

Sr. No.	Characteristics	Result
1	Specific gravity	2.74
2	Water absorption	1.2%
3	Bulk density	1650 kg/m^3
	Grain size	0-2.36 m

3. Coarse aggregate: The fractions from 80 mm to 4.75 mm are termed as coarse aggregate. The material which is retained on BIS test sieve no. 480 is termed as a coarse aggregate. The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having maximum size of 20 mm was used in the present work.

Material = 20 mm
Weight = 1000 grams

Table No 3- Sieve analysis of coarse aggregate (20mm)

Sieve size	Weight Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Weight Retained (gm)	Passing
25 mm	0	0	0.00	100.00
20 mm	140	140	14.00	86.00
10 mm	810	950	95.00	5.00
4.75 mm	50	1000	100.00	0.00
Pan	0	1000	100.00	0.00

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4. Properties of Glass Powder:

Waste glass when ground to a very fine powder shows pozzolanic properties. Therefore, glass powder can partially replace cement and contribute to strength development. Finely ground glass has the appropriate chemical composition including SiO2 to react with alkalis in cement (Pozzolonic Reaction) and form cementitious products that help contribute to the strength development. Chemical composition of glass powder is given in the table below.

Sp gravity: 2.45
Unit Weight: 2579 kg/m3

Table 4:-Chemical composition of glass powder

Chemical	Waste Glass Powder
SiO2	73.5%
Al2O3	0.4%
Cao	9.2%
Fe2O3	0.2%
Mgo	3.3%
Na2o	13.2%
K2O	0.1%
SO3	-
Loss of ignition	-
neness % Passing (Sieve Size)	90 um

5. Properties of Coconut Fibre:

Coconut fibres are extracted from the outer shell of a coco-nut. There are two types of coconut fibres, brown fibres ex-tracted from matured coconuts and white fibres extracted ten-der coconuts. Brown fibres are thick, strong and have high abrasion resistance, which is used commonly. There are many advantages of coconut fibreseg. they are moth-proof, fungi and rot resistant, provide excellent insulation against tempera-ture& sound, not easily combustible, unaffected by moisture and dampness, tough, durable, resilient, springs back to shape even after constant use, totally static free and easy to clean.

Coir fibres were added 0.5% by the weight of cement and in 5 cm length.

Table 5 Typical Properties of coir fibre

Colour	Brown
Fibre length, mm	10-200
Fibre diameter, mm	0.2-0.35
Bulk Density, kg/m3	140-150
Ultimate tensile strength, N/mm2	80-120
Modulus of elasticity, N/mm2	18-25
Water absorption, %	30-40

Photo 1: Raw coconut fibres

6. Total quantity of materials required for M25 grade of concrete:

Table 6 Quantity of materials

Specimen	Cement (Kg)	Sand (Kg)	Aggre-gate (Kg)	Glass Powder (Kg)	Coconut Fiber
(Normal Block) 4 Cubes	4.78	10.31	15.49	0	0
10%GP & O.25%CF 4 cubes	4.29	10.31	15.49	10%= 0.478	0.25%= 11.95gm
20%GP & O.5%CF 4 cubes	3.80	10.31	15.49	20%= 0.956	0.5%= 23.9 gm
30% GP & 0.75% CF 4 cubes	3.31	10.31	15.49	30%= 1.434	0.75%= 35.8 gm
40%GP & 1%CF 4 cubes	2.82	10.31	15.49	40%= 1.912	1%= 47.8 gm

V. ANALYSIS

1. Slump cone test-

This test is extensively used on site. The test is very useful in detecting variations in uniformity of a mix for a given nominal proportion. This test shows behaviour of compacted concrete under the action of gravitational field slump occurs due to self weight of concrete there is no external energy supplied for the subsidence of concrete.

Apparatus:

Slump cone (bottom diameter 200 mm, top diameter 100 mm and height 300 mm), standard tamping rod 16 mm in diameter and 600 mm in length along with bullet end.

The slump shall be recorded in mm of subsidence of the concrete during the test. Any slump in which one half of the cone slides down in an inclined plane is called a shear slump in such case the test shall be repeated if the shear slump persists as may be in the case of harsh mixes this is an indication of lack of cohesion of the mix. If the slump slides evenly on all sides, it is called a true slump In case of concrete mixes with high workability a collapse slump is possible. The values of slump test obtained are interpreted as follows:

Table 7 Slump criteria and its value

Degree of Workability	Slump value in mm	Suitability
Very Low	0-25	Concrete roads.
Low	25-50	Mass concrete foundations, lightly reinforced sections.
Medium	50-100	Manually compacted flat slabs,
High	100-175	For sections with congested sections.

1) Water cement ratio = 0.43
2) Slump measured in mm = 48 mm
3) Degree of workability = Low

Result:

The slump measured for the given sample is 48 mm. From the slump measured it can be concluded that the concrete has low workability such concrete is suitable for mass concrete foundations, lightly reinforced sections.

Photo 2.: Measurement of slump cone test

2. Casting of Concrete Cube (IS: 10086-1982)

1) The cube moulds are of 150mm size confirming to IS: 10086-1982.
2) In assembling the mould for use , the joints between the section of mould shall be thinly coated with oil and similar coating of mould oil shall be applied between the contact surface of the bottom of the mould and the base plate in order to ensure that no water escape during the filling.
3) The interior surface of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete.
4) Compaction of test specimen shall be made as soon as practicable after mixing and in such way as to produce full compaction of the concrete with neither segregation nor excessive laitance.
5) The concrete filled into the mould in layers approximately 5 cm deep.
6) In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of concrete within the mould.
7) Each layer shall be compacted is done by vibrator and by hand, the standard tamping bar shall be used and the strokes of the bar shall be distributed in a uniform manner over the cross section of the mould.
8) The 35 number of strokes are given per layer.
9) The strokes shall penetrate into the underlying layer and the bottom layer shall be ridded throughout its depth.
10) The voids left by the tamping bar, are close by tapping the sides of the mould.

VI. ANALYSIS

Compressive Strength of Concrete cube:

Table 4.1: Compressive strength of concrete cube specimen tested after 14 days of curing.

Glass Powder (%)	Coconut Fibre (%)	Load (KN)	Compressive Strength (N/mm2)	Average Compressive Strength (N/mm2)
0	0	549.9	24.44	24.32
		544.5	24.20	
10	0.25	463.5	20.6	20.95
		479.25	21.3	
20	0.50	594	26.4	26.15
		582.75	25.9	
30	0.75	513	22.8	22.5
		499.5	22.2	
40	1	470.25	20.9	20.25
		441	19.6	

Table 4.2: Compressive strength of concrete cube specimen tested after 28 days of curing.

Glass Powder (%)	Coconut Fibre (%)	Load (KN)	Compressive Strength (N/mm2)	Average Compressive Strength (N/mm2)
0	0	643.5	30.6	30.4
		634.5	30.2	
10	0.25	648	28.8	28.6
		639	28.4	
20	0.50	738	32.8	32.75
		735.75	32.7	

Discussion:

- The maximum compressive strength is 32.75 N/mm2 at 20% replacement of glass powder and 0.50% replacement of coconut fibre.
- The maximum compressive strength at 20% replacement of glass powder and 0.50% replacement of coconut fibre is 7.73% greater than the compressive strength of traditional concrete.
- Compressive strength from 20% replacement of glass powder and 0.50% replacement of coconut fibre is reduced as we increase percentage of glass powder and coconut fibre.

VII. CONCLUSION

The test conducted on materials like Aggregate, Sand, Cement, Glass Powder, Coconut Fibre having all test result within permissible limit as per IS codes.

1. The modified concrete mix using Glass Powder and Coconut Fibre performs satisfactorily on various tests, with acknowledgement to the proportional relationship between its rates of strength-loss and contain in the mix. Mixing, casting and compacting of concrete mix using Glass Powder, Coconut Fibre and coarse aggregates with local materials can be carried out in a similar fashion to that of traditional concrete mix.
2. The maximum compressive strength obtained is 32.75 N/mm2 at 20% replacement of glass powder and 0.50% replacement of coconut fibre.
3. By reinforcing the concrete with coconut fibres which are easily available, we can reduce the environmental waste.
4. Modified concrete casted using Glass Powder and Coconut Fibre helps in resisting cracks under the action of compressive forces.

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