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EXPERIMENTAL STUDY ON LIGHT WEIGHT HIGH STRENGTH CONCRETE

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Abstract - The increasing demand of concrete which produce the cost and materials for this purpose the wastes of glass and plastic are used as replacement of concrete. To use of glass powder and plastic as partial replacement of fine aggregate and coarse aggregate in concrete this generally reduces the density of the concrete. The application of innovative materials in the concrete will improve the strength of concrete in a better manner; one of such innovation is high strength concrete. High strength concrete can be achieved by many modes.so in this work we are going to replace fine aggregate and coarse aggregate by 2% and 4% using equal amount of plastic and glass powder. Finally we are going to evaluate the effectiveness of glass powder and plastic in strength enhancement and cost reduction. Strength and result was compared with normal concrete. The effect waste glass powder in the production high strength. It can be concluded that granulated waste materials such as glass and plastic can be used in cementitious concrete composites without seriously hindering its mechanical properties up to the composition range used in the study (2% and 4%) respectively.it can be used to supports the idea that all the waste materials, as used within the ranges specified acted as crack arresters in the entire composite prepared. The glass and plastic arrested the cracks completely or deflected them when encountered. In this lightweight high strength concrete may considerably reduce the dead loads in building which may simultaneously increase the stability of the building and the strength of concrete is also high in order to withstand high loads, these type of concrete can be produced in more cheaper way by using waste and recycled materials in concrete. These types of concrete can be adopted in any type of building work which has to withstand more loads. Due to its Workability and self-compacting nature, it can be used more in precast structures.

Keywords- Glass powder, Stability, Light weight concrete, Workability, Compressive Strength,

I. Introduction

Concrete is the most widely used building material. It is versatile as desirable engineering properties, can be moulded in to any shape and more importantly, is produced with cost effective materials. Although recent developments in plastic and other lighter materials have resulted in the replacement of concrete in some application, Concrete is a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate. In hydraulic cement concrete, the binder is formed from a mixture of hydraulic cement and water.

A Glass is a hard, brittle, translucent and commonly transparent substance, white or colored, having a conchoidal fracture, and made by fusing together sand or silica with lime, potash, soda, or lead oxide. Certain, substitute aggregates, such as glass, can help reduce the cost of concrete, especially if aggregate is in short supply. In all the aggregates, there were some relatively large voids and fissures that made the aggregate weak and friable. Some of the aggregates had a distinct dense outer shell. The particle density varied from 1.07 to 1.54 g/cm^3. This variation was related to characteristic differences in macroscopic and microscopic pore structure [4]. The tensile-compressive strength ratio appears to be lower for high-strength lightweight concrete than for high-strength normal weight concrete [5]. The properties of concretes containing waste glass as fine aggregate were investigated in this study. The strength properties and ASR expansion were analyzed in terms of waste glass content. An overall quantity of 80 kg of crushed waste glass was used as a partial replacement for sand at 10%, 15%, and 20% with 900 kg of concrete mixes. The results proved 80% pozzolanic strength activity given by waste glass after 28 days.

II. Physical Properties of the Material Used

A. Physical Properties of Glass and Natural Sand

In this project the materials used in the Concrete are Glass and Natural Sand. The Physical Properties of the Glass and Natural Sand shown in the table 1.

TABLE I. Physical Properties of the material

Property	Glass powder	Natural sand
Specific gravity	2.4-2.8	2.60
Bulk density	2.53	1.46
Moisture content (%)	Nil	1.50
Fine particles less than 0.075mm (%)	12-15	06
Sieve analysis	Zone II	Zone II

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B. Specimens with Plastic and Glass Powder Replacement:

Casting each 12 numbers of the cubes, cylinders and prisms with quarry dust and glass powder replacement. The specimens are prepared in Different Percentage such as 2%, 4%. Specimens are made with different percentage of glass powder with plastic. Totally 54 specimens are prepared and after curing for7 days and 28 days specimens are tested and result have been obtained.

1) Mix Design

Specific Gravity (coarse aggregate) = 2.7

Specific Gravity (fine aggregate) = 2.7

Specific Gravity (cement)= 3.15

Compaction factor = 0.9

Degree of exposure = mild

fck = fck + t_s (using IS 10262, 1992)

= fck+1.65×5= 80+1.65×5

= 88.53 N/mm^2 (compressive strength)

Water Cement Ratio is 0.283

Using "Fig 1- Generalized Relation between Free Water-Cement Ratio and Compressive Strength of Concrete" of IS 10262-1992

Density of Mix 1 (Without Silica Fume):

10*2.65*(100-1.5)+(495*(1- 2.65/3.15)) – 140*(2.65-1) = 2457 kg/m^3

Aggregates = 2457 – 140 – 495 = 1822 kg/m^3

Sand = 1822 x 0.45 = 820 kg/m^3 (say)

12.5 mm Aggregate = 1822 x 0.55 =1002 kg/m^3 (say)

Density of Mix 2 (With Silica Fume):

10*2.65*(100-1.5) + (450*(1-(2.65/3.15)) + 45*(1-(2.65/2.20))) – 140*(2.65-1) = 2440 kg/m^3

Aggregates = 2440 – 140 – 450 – 45 = 1805 kg/m^3

Sand = 1805 x 0.45 = 810 kg/m^3 (say)

12.5mm Aggregate = 1805 x 0.55 = 995 kg/m^3 (say)

TABLE III. Mix Proportions

Mix proportion	Cement	Fine Aggregate	Course Aggregate
Without Silica fume	1	1.65	2.02
With Silica fume	1	1.80	2.21

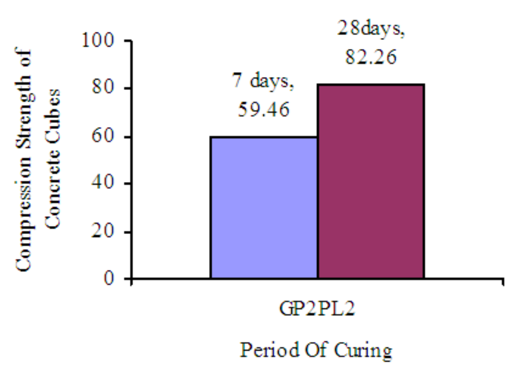
III. Mechanical Properties of the Concrete

A. Compressive strength on concrete Cubes

The mould after filling with coarse was placed on the vibrating table. After 14 days was over the cube was taken out. Then the cube was taken out. Then the cube specimen was placed the compression testing machine. The load was gradually applied and the value at which the maximum failure occurs was noted. Similarly the remaining cubes were tested. At the end of 28 days of the remaining cube specimens was taken and compressive strength was found out and the Cubes and Cylinders shown in the table III, IV and shown the figure 1, 2 are done in the Varies Mix Proportions [1, 3]

TABLE IV. Glass Powder And Plastic Mixed Cement Concrete Cubes With 2 %

Designation	% of Glass Powder	% of Plastic	Compressive Strength of Cubes (N/mm²)	
			7 Days	28 Days
GP2PL2	2%	2%	60.32 59.39 58.67	84.34 82.12 80.33
	Average		59.46	82.26

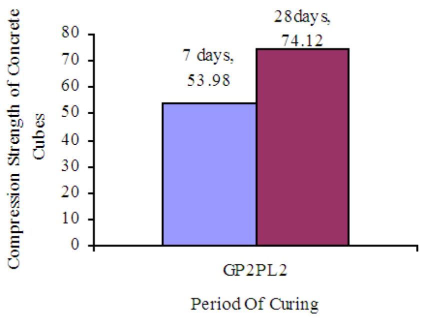


Fig, 1 : Compressive Strength of Cube for 2% of replacement

TABLE V. Glass Powder and Plastic Mixed Cement Concrete Cubes With 4%

Desig-nation	% of Glass Powder	% of Plastic	Compressive Strength of Cubes (N/mm²)	
			7 Days	28 Days
GP2PL2	4%	4%	54.22 53.22	76.45 73.56

			52.15	72.36
	Average		53.98	74.12



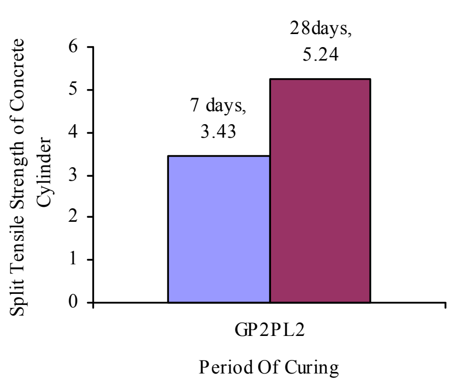
Fig, 2 : Comperssive Strength of Cube for 4% of replacement

B. Split Tensile Strength on the Concrete Cylinder

The cylindrical specimen is placed horizontally between the loading surfaces of a compression testing machine. Narrow packing strips of suitable material such as plywood is used to reduce the high compression stresses. The load is applied without shock and increasing continuously at a rate of the specimen. The load is increased till the specimen fails and the continuous load applied to the specimen during the test is recorded, the figure 4, 5 shows the split tensile testing machine for the concrete [1, 3]

TABLE VI. Glass Powder and Plastic Mixed Cement Concrete Cylinder With 2%

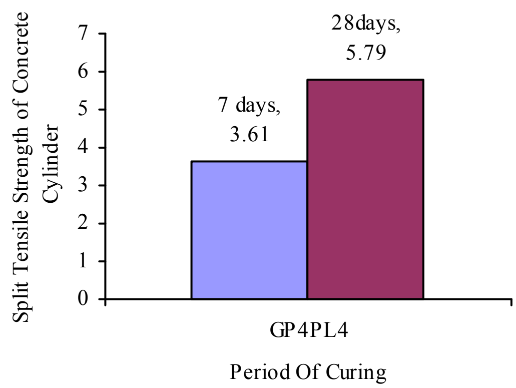
Designation	% of Glass Powder	% of Plastic	Split Tensile Strength of Cylinder (N/mm^2)	
			7 Days	28 Days
GP2PL2	2%	2%	3.28 3.45 3.56	4.92 5.21 5.60
	Average		3.43	5.24



Fig, 3 : Split Tensile Strength of Cylinder for 2% of replacement

TABLE VII : Glass Powder and Plastic Mixed Cement Concrete Cylinder With 4%

Designation	% of Glass Powder	% of Plastic	Split Tensile Strength of Cylinder (N/mm^2)	
			7 Days	28 Days
GP4PL4	4%	4%	3.65 3.46 3.72	5.62 5.84 5.90
	Average	3.61	5.79	



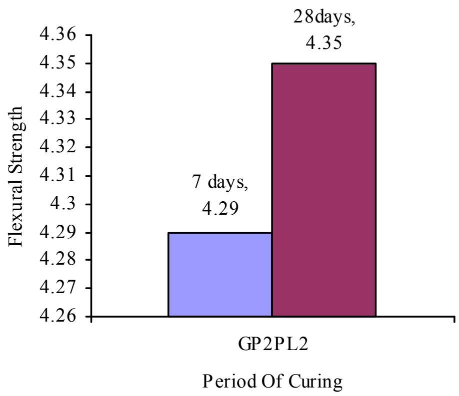
Fig, 4 : Split Tensile Strength of Cylinder for 4% of replacement

C. Flexural strength on concrete

The cylindrical specimen is placed horizontally between the loading surfaces of a compression testing machine. Narrow packing strips of suitable material such as plywood is used to reduce the high compression stresses. The load is applied without shock and increasing continuously at a rate of the specimen. The load is increased till the specimen fails and the continuous load applied to the specimen during the test is recorded, the figure 5, 6 shows the split tensile testing machine for the concrete cylinder. [2]

TABLE VIII. Tensile strength test on Beam in2% of replacement

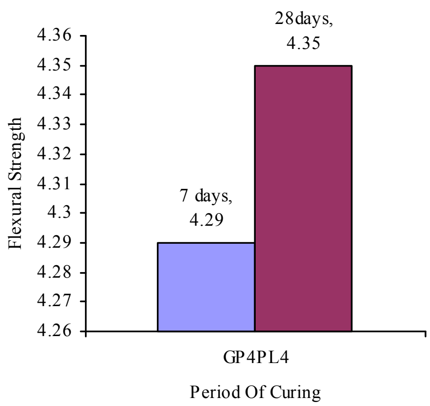
Designation	% of Glass Powder	% of Plastic	Flexural Strength of Beam (N/mm^2)	
			7 Days	28 Days
GP2PL2	2%	2%	4.32 4.11 4.45	4.56 4.34 4.17
	Average		4.29	4.35



Fig, 5 : Tensile Strength of Beam in 2% of replacement

Table – VIII :Tensile strength test on Beam in 4% of replacement

Designation	% of Glass Powder	% of Plastic	Flexural Strength of Beam (N/mm²)	
			7 Days	28 Days
GP4PL 4	4%	4%	4.32 4.11 4.45	4.56 4.34 4.17
	Average		4.29	4.35



Fig, 6 : Tensile strength test on Beam in 4% of replacement

IV. Conclusion

Based on the results of investigation reported in this project, the following conclusions are drawn

In general, the use of 2% of glass and 2% of plastic waste materials is, indeed, a viable solution to recycling such materials in concrete composites

It can be concluded that granulated waste materials such as glass and plastic can be used in cementitious concrete composites without seriously hindering its mechanical properties up to the composition range used in the study (2% and 4%) respectively.

This project of lightweight high strength concrete may considerably reduces the dead loads in building which may simultaneously increase the stability of the building and the strength of concrete is also high in order to withstand high loads, these type of concrete can be produced in more cheaper way by using waste and recycled materials in concrete.

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