

Experimental Investigation on Stamped Concrete with Alkaline Resistance Glass Fibre and Colour Powder

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ABSTRACT: Construction of high rise buildings and sky scrapers leads to the obstruction of natural light in buildings. Due to this problem, use of artificial light has increased in large amount. Thus, it becomes necessary to reduce artificial light consumption in structure. This leads to the introduction of innovative concrete, stamped colour concrete. Transparent concrete is fibre reinforced concrete which is used for aesthetical application by inserting the alkaline resistant glass fibres in concrete. Both natural as well as artificial light passes through the transparent concrete due to optical fibres. This study is not only constrained with the decorative purpose but the effect of fibre application in strength aspect is also discussed. Load carrying capacity of stamped concrete increases when fibres are arranged in different layers and also various pattern can be created to make the concrete decorative. This concrete can be used in interiors of hall, lobby and ceiling to glow in dark by external lighting source and in day time it glows by the light transmission from natural resources. This paper presents the study on addition of alkaline resistant glass fibre in stamped concrete. We also reduce the cost of tiles. So this is the one of the advantages of stamped concrete.

KEYWORDS: stamped, alkaline resistant glass fibre, strength.

I.INTRODUCTION

Concrete is the premier civil engineering construction material. Concrete is considered a brittle material, primarily because of its low tensile capacity and poor fracture toughness. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water and admixture(s). Among all the ingredients, aggregates form the major part. Inert granular materials such as sand, crushed stone or gravel form the major part of the aggregates. Traditionally aggregates have been readily available at economic prices and of qualities to suit all purposes. But, the continued extraction of aggregates from nature has caused its depletion at an alarming rate. Many of the non-decaying waste materials will remain in the environment for hundreds, perhaps thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby contributing to the environmental problems. Use of these materials in such a rate leads to preservation of natural aggregates sources. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material. Concrete is the most widely used construction material has several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. At the same time concrete is brittle and weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. These shortcomings are generally overcome by reinforcing concrete. Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the incapacity of concrete in tension but the ductility magnitude of compressive strength. Glass fibre Reinforced Concrete (GFRC) AKGF(Alkaline resistant glass fibre) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibres.

II.MATERIAL PROPERTIES

2.1 Materials

In the design of high performance concrete the selection of proper ingredients evaluating their properties and understanding the interaction between different materials plays a major role in performance of the concrete. The ingredients used are cement, natural sand, manufacture sand, coarse aggregate, hyper plasticizer, alkaline resistant glass fibre, stamping mould, colour powder. The performance requirements of concrete enhancements of the following.

2.2 Alkaline resistant glass fibre

The materials have a good resistance for tension. That is the reason why Glass fibre is chosen as reinforcement for concrete. Right now, is used mostly for cladding buildings, lining, sewer pipe, shoulder of roads and etc... Compatibility of glass fibre with concrete or mortar helps us to use it easily in our daily project especially for facade of buildings, as we said ARglass fibre that have good resistance to alkalinity that contains in cement (pH > 12.3) with high level. AR-glass fibre can control shrinkage cracks easily; it shows this property particularly in cladding purpose or rendering. Because of most important thing in GRC it is water: cement ratio maximum 0.35, which helps to control the shrinkage and bonding each other by glass fibre. GRC can be used as alternative material of natural stone, especially in those countries where stone is less or unavailable. Also for those countries that favour stone only, the cost is higher, but because of less maintenance one can return back this money. Changing GRC panel is very easy as compared to other cladding because of making GRC by panel and just installing on the site. Also if broken one panel can be repaired or removed and a new one can be put, but if stone or tile is broken, it is not easy to change. The properties of alkaline resistant glass fibre as shown in table 2.1

Table 2.1: Properties of alkaline resistant glass fibre

S.No	Physical properties	Result
1.	Specific gravity	2.68
2.	Physical form	filament
3.	Size (Micron)	14
4.	Color	white



Figure 2.1 alkaline resistant glass fibre

2.2 Colour powder

In the case of permanent through-coloured, with or without decorative coloured coarse aggregates, certain after finish techniques may be used. These are usually tooled finishes which are achieved after setting and early hardening and subsequent stripping of precast concrete from form-work (moulds or shuttering). Tooled finishes for many types of concrete units, including columns, can include 'Bush' Hammering, 'Hammered Knib', as well as

sand/grit blasting and high pressure water blasted finishes. All of these processes remove the hardened surface cement paste 'glue' or 'matrix' at the surface to reveal the aggregates and, of course, their colour.



Fig. 2.2 colour powder

2.3 Hyper plasticizers

Hyper plasticizer named HS-100 is used. It helps in improves workability and flow-ability of concrete without increase in water, high early strength of concrete with improved hardness, reduces line friction. Protects reinforcement against corrosion and increase compact strength against heavy loads. Reduction in water-cement ratio and improved resistant against bleeding, segregation and water absorption.

III. MIX DESIGN

3.1 GENERAL

The process of selection suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required strength and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in two states, namely the plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted. The property of workability therefore becomes of vital importance.

3.2 MIX PROPORTIONS

Cement = 400 kg/m³
Water = 160 kg/m³
Fine aggregate = 836 kg/m³

Mix proportions	Cement kg/m ³	Fine Aggregate kg/m ³	Coarse Aggregate kg/m ³	Water kg/m ³	Chemical Admixture kg/m ³	Alkaline resistant glass fibre kg/m ³
Mix 1(0.3%)	400	836	1075	160	0.054	0.033
Mix 2(0.5%)	400	836	1075	160	0.054	0.050

Coarse aggregate = 1075 kg/m³
Chemical admixture = 5.4 kg/m³
Alkaline resistant glass fibre = 500 gm

The table 3.1 shows the mix proportion of concrete.

Table 3.1 Mix proportion.

IV. EXPERIMENTAL PROGRAM

4.1 MECHANICAL PROPERTIES

4.1.1 Compression Test (Ref: IS: 516-1959)

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristics properties of concrete are qualitatively related to its compressive strength. Compressive strengths were attained as a result of the compressive tests conducted on the cube specimens of size 100mm x 100mm x 100mm . Cube was placed on the platform of the compression testing machine. The load was applied gradually till the concrete cubes get failed. The specimens are subjected to compressive loads in compression testing machine as per IS: 516-1969 and the crushing load is noted which gives the compressive strength of that cube. The compressive strength is the ratio of crushing load to the surface area of the specimens expressed in N/mm^2 . Similarly the compression strength values of all the cubes are found.



Fig 4.1 Test Set up for Compressive Strength Test

4.1.2 Flexure Test (Ref: IS: 516-1959)

The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress, here given the symbol f_{cr} . The flexural strengths of the respective specimens have been obtained from the flexural tests performed on the prism specimens of size 100mm x 100mm x 500mm. The flexural strength are tested using a two point loading frame machine as per standard as shown in figure 5.2.



Fig 4.2 Test Set Up for Flexural Strength

The modulus of rupture can be determined by using the formula given below

$$f_{cr} = (P_{max} \times l) / bh^2$$

where,

- f_{cr} = Flexural strength
- P_{max} = maximum load in (N) kg.
- b = width of the prism in mm
- h = depth of the prism in mm
- l = span of the prism in mm

The loading must be applied centrally and without subjecting the specimen to any tensional stresses and restraints. The axis of the specimen shall be carefully aligned with the axis of the loading device. The load shall be applied without any shock and increasing continuously at specified rate.

4.1.3 Split tensile strength Test (Ref: IS: 5816-1999)

Split tensile strength of concrete is usually found by testing plain concrete cylinders. Cylinders of size 150mm x 300 mm were casting using M₂₅ grade concrete. Specimens with Conventional Concrete and SCC of two different percentages were casted. During casting the conventional concrete cubes were manually compacted using tamping rods. After 24hours, the specimens were removed from the mould and subjected to water curing for 7, 14, 28 days. After curing, the specimens were tested for compressive strength as per IS: 5816-1999 using a calibrated compression testing machine of 2000KN capacity.

Two packing strips of plywood 3mm thick were provided between the specimen one at top and another at bottom. The specimen was placed on the plywood strip and aligned so that, the central horizontal axis of the specimen is exactly perpendicular to the load applying axis. The second plywood strip was placed length wise on the cylinder and the top platen was brought down till it touched the plywood. The load was applied without shock and increased continuously until the resistances of the specimen to the increasing load broke down and no greater load can be sustained.

Tensile strength of concrete	f_t	=	$\frac{2p}{\pi dl}$
Where ,	P	=	Maximum load in N applied to the specimen
	L	=	Measured length in cm of the specimen
	D	=	Measured diameter in cm of the specimen

V.RESULTS AND DISCUSSION

5.1 GENERAL

This chapter deals with the results obtained from the various experiments conducted to access mechanical properties. The aim of the study is to determine the compressive strength, flexural strength and split tensile strength. So the results of test specimens are presented. The discussion on the results also presented in this chapter.

5.2 MECHANICAL PROPERTIES

The mechanical properties of concrete such as compressive strength, flexural strength and split tensile strength are determined from the standard experiments. They are as follows.

5.2.1 Compressive Strength

The compressive strength of stamped concrete is arrived. The compressive strength value for dosage of alkaline resistant glass fibre 0.3% and 0.5%. Table 5.1 Shows compression test results.

Table 5.1: Compressive Strength of Cubes with alkaline resistant glass fibre

Curing days	COMPRESSIVE STRENGTH N/mm ²	
	Mix 1(0.3%)	Mix 2(0.5%)
7 days	22.82	24.90
28 days	42.25	43.27

5.2.2 FLEXURAL STRENGTH

The flexural strength of stamped concrete is arrived.. Table 5.2 shows flexural strength test results

Table 5.2: Flexural Strength of beams with Partial Replacement of metakaolin

Curing days	FLEXURAL STRENGTH N/mm ²	
	Mix 1(0.3%)	Mix 2(0.5%)
28 days	6.27	6.87

5.2.3 SPLIT TENSILE STRENGTH

The variation of split tensile strength at the age of 28 days with different percentage of alkaline resistant glass fibre, and colour powder from the test results, it was observed that the maximum split tensile strength was obtained for mix of 0.3% and 0.5% dosage of glass fibre. Table 5.3 flexural strength test results

Table 5.3: split tensile strength of Cylinder with Partial Replacement of metakaolin

Curing days	SPLIT TENSILE STRENGTH N/mm ²	
	Mix 1(0.3%)	Mix 2(0.55%)
28 days	3.42	3.61

VI . CONCLUSION

M30 Concrete grade is used in study and the tests are conducted for various proportions of above results and comparison it can be stated that the alkali resistant glass fibers shown good results as compared to conventional concrete. Compressive strength, flexural strength and split tensile strength for these AR glass fibers are more as compared to conventional concrete. It can also be concluded that Flexural strength and split tensile strength shows almost 10 to 20% increase in strength as compared to 0% glass fibers. Also the percentage increase of compressive strength of glass fiber concrete mixes compared with 28 days compressive strength is found to be 20 to 25 %.

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