A Study on Mechanical Properties of Fibre Reinforced High Strength Concrete

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Abstract – Concrete is probably the most extensively used construction material in the world. Cement production is consuming significant amount of natural resources. Silica fume is a new mineral admixture, whose potential is not fully utilized. Moreover only limited studies have been carried out in India on the use of silica fume for the development of high strength concrete with addition of steel fibers and glass fibers. The study focuses on the compressive strength performance containing different percentage of silica fume and steel fiber as a partial replacement of HSC. The cement in concrete is replaced accordingly with Silica fume content was use from 0% to 20%. So to improve the strength of concrete steel fibers and glass were added0%, 0.5%, 1%, 1.5% by weight of steel fiber. Concrete cubes are tested at the age of 28 days of curing. Finally, the strength performance of silica fume is compared with the performance of conventional concrete. From the experimental investigations, it has been observed that, the optimum replacement silica fume to cement and steel fiber, glass fibers \without changing much the compressive strength respectively for M50, M60 and M70 grades of Concrete.

Index Terms – Cement, High strength Concrete, Steel Fiber, glass fibers,Silica Fume,splitting tensile strength.

1. INTRODUCTION

Concrete is a composite material made with cement, aggregates, admixtures or super plasticizers and water. Although aggregates make up 75% of the volume of concrete, the active constituent of concrete is cement paste. Concrete is a versatile, critical material for the construction of infrastructure facilities throughout the world mainly contains of water, aggregate, and cement. Then, additives and reinforcements are included in the mixture to achieve the physical properties of materials.. Portland cement is the most important ingredient in making concrete. Production of 1 ton of cement emits about 1 ton of carbon dioxide. In order to address the environmental effects associated with Portland cement, there is need to develop alternative binders to make concrete. concrete is one of the most important material used for construction in the world. Reinforced concrete is exposed to deterioration in coastal regions. so researchers round the world square measure directive their efforts to beat this drawback. Invention of huge construction equipments round the world value support to using of redoubled fabric. This state of affairs results in the employment of addition of materials to achieve the standard of concrete. In the modern batching plants is produced in a mechanical manner of course, one has to take care about mix proportioning aggregates shape, use of supplementary materials, super plasticizers along with silica fume.it is designed to give the characterstics of materials like, usage, requirement of cost, life span,durability. it is related to any property of concrete .it is not one product that includes a range of materials with special properties with in the conventional concrete and general construction methods.compressive strength concrete is between 50-100 Mpa. The concrete properties with compressive strength above 40MPa of 50MPa are highly influenced by the properties of aggregate in addition to that of the w/c ratio. it is need to use the lowest possible water-cement ratio with more content of cement which invariably affects which invariably affects the workability of the mix and necessitates for the using of special vibration techniques for proper compaction then it achieves high strength. It may gives large amount of heat of hydration which may affect the setting and excessive in shrinkage In the present state-of-the-art, concrete which has a desired 28-day compressive strength up to 70 MPa can be made by suitably proportioning the ingredients and using normal vibration techniques for compacting the mix. A number of methods for designing high strength concrete mixes are available.

2. RELATED WORK

To achieve the objectives of the study, an extensive experimental programme was planned which included evaluation of workability, properties at fresh stage and split tensile strength, compressive strength at the age of 28 days containing fibre reinforced concrete by adding of steel and glass fibers with cement silica fume as a partial replacement . The main objectives of this project is to provide some basic information on mechanical properties of concrete using steel fibers. fiber reinforced concrete were obtained by partial replacing of silica fume .In addition , the effects of steel and glass fibers on compressive strength, tensile strength were investigated. To examine, the benefits of fibre reinforced concrete by adding admixtures. In the study , the effects of steel

and glass fibers on fresh and hardened concrete investigated . It is proposed to develop high strength fibre reinforced concrete of M50,M60,M70 grades of concrete with steel and glass fibers at different percentages. In this study we used concrete mixes with Silica Fume of 0%, 5%, 10%,15%and 20%, with addition of crimped steel fibers and glass fibers at different dosages as 0%, 0.5 %, 1.0 % and 1.5 % by the volume of concrete on M50,M60,M70 grades of concrete. The effect of mineral admixtures as cement replacement material on mechanical properties were analyzed and compared with normal concrete.

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3. MIX DESIGN

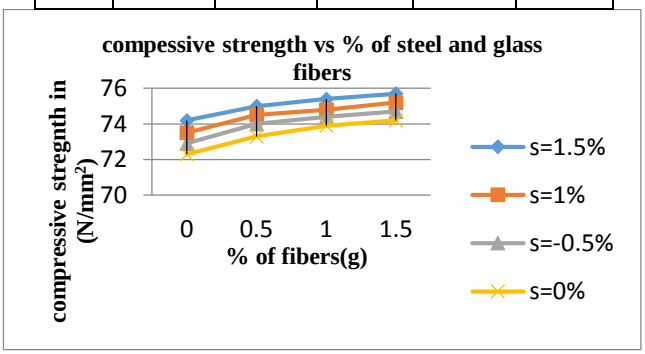
Standard cubes moulds of 150 x 150 x150 mm made up of cast iron used for the concrete cubes for casting. It is proposed to develop M50 FRC with the addition of steel and glass fibers at different dosages(0% to 1.5%) along with silica fume as(0%to 20%).The experimental program consists of developing M60 FRC ,to finding its fresh and hardened properties like compressive strength ,split tensile strength.The compressive strength test was conducted after 28 days of curing. Standard cast iron moulds of dimensions 150 x 150 x 150 mm were used to cast the specimen. The capacity of the compressive strength testing machine used was 2000KN. The Compressive Testing Machine. To find the strength of the concrete specimen and along with split tensile strength also therefore,Assuming concrete specimen behaves as an elastic body a uniform lateral tensile stress of f_t acting alone the vertical plane causes the failure of the specimen ,which can be calculated from the formula,$fb_t = pl/bd^2$. where P= load at failure b= width of cube, D= depth of cube and l=length of the cube.The loading condition produces a high compressive stress immediately below the two generators to which the load is applied. It is estimated that the compressive stress is acting for about 1/6 depth and the remaining 5/6 depth is subjected to tension. Strength determined in the splitting test is believed to be closer to the true tensile strength of concrete, than the modulus rupture. Splitting strength gives about 5 to 12% higher value than the direct tensile strength. But the larger portion corresponding to depth is subjected to a uniform tensile stress acting horizontally. .The main advantage of this method is that the same type of specimen and the same testing machines as are used for the compression test can be employed for this test. Experimental investigation is carried out to study the properties of M60 grade of concrete. Silica Fume of 0%, 5%, 10% ,15% and 12% with addition of 0.5 diameters of crimped steel fibers with various percentage as 0%, 0.5%, 1% &1.5% by the volume of concrete .The 150 X 150 X 150 mm cubes were casted. The compressive strength and split tensile strength was carried out at the age of 28 days, at various % of silica fume and steel and glass fibers.

For conventional cube :mix proportion:1:1.35:2.19.sum of proportions:1+1.35+2.19=4.54i,e.,wt of cement=504.21 kg,wt of fine aggregate=683.24kg,wt of coarse aggregate=1108.13kg .material content to be used for 6 cubes i.e,wt of cement for 6 cubes=3025.26kg , wt of fine aggregate=4099.44kg,wt of coarse aggregate=6648.78 kg.water/ cement ratio=0.29,amount of water to be added=141.61lit/m^3. After the completion of the casting, the specimens were vibrated on the table vibrator for 2 minutes. At the end of vibration the top surface was made plane using trowel. After 24 hours of a casting the moulds were removed and kept for wet curing for the required number of days before testing.

4. RESULTS AND DISUSSIONS

Table 1 shows the compressive strength of various combination of steel and glass fibers with silica fume content.

S.No	Steel fibers	Compressive strength MPa at 28 days N/mm^2			
		Glass fibers 0%	Glass fibers 0.5%	Glass fibers 1%	Glass fibers 1.5%
1	0%	72.3	73.3	73.9	74.2
2	0.5%	72.9	74	74.4	74.8
3	1.0%	73.5	74.5	74.9	75.4
4	1.5%	75.2	76	76.4	76.7



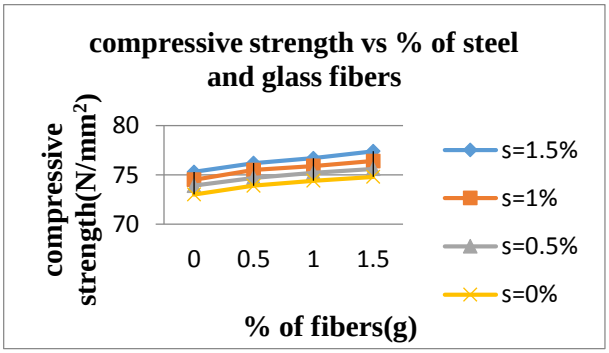
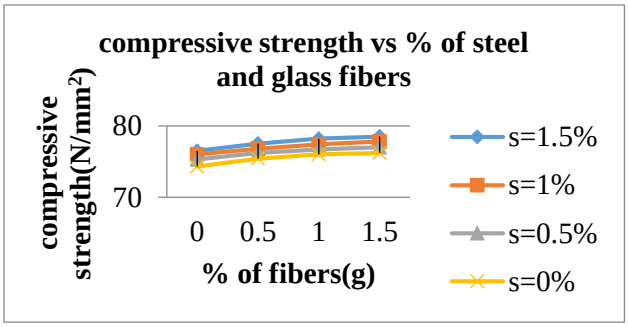
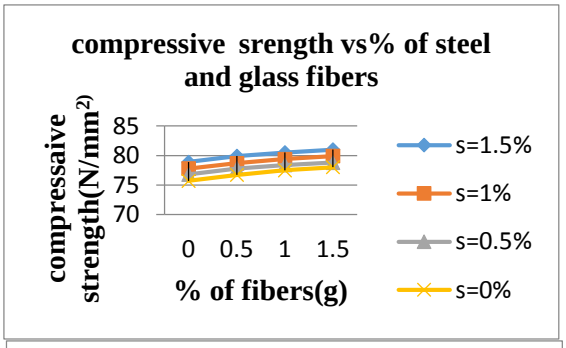


Fig shows different percentages of steel and glass fibers were added to the concrete with partial replacement of silica fume at compressive strength at m60 grade of concrete.





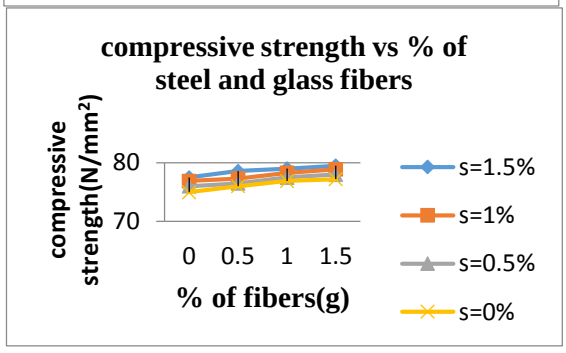


Fig shows different percentages of steel and glass fibers were added to the concrte with partial replacement of silica fume at compressive strength at m60 grade of concrete.

5. CONCLUSION

1. The compressive strength 16 to 20% increases with the increase in silica fume when compared with conventional concrete.
2. The increases in compressive strength with the addition of steel fiber 12 to 17% was marginal as compared with silica fume concrete
3. The compressive strength increases with the addition of glass fiber 15 to 20% was marginal as compared with silica fume concrete.
4. All the properties of concrete, compressive strength increases by addition of steel fiber and glass fibers.
5. The various strengths is observed with the inclusion of steel fibers in the plain concrete then significant improvement to be done .
6. For Strengthening of materials, addition of crimpled steel fibers to silica fumes concrete chances the basic characteristics to be obtained.
7. Compatibility of glass fiber with concrete or mortar helps us to use it easily in our daily project especially for facade of buildings, as we said AR(alkaline resistant) glass fiber that have good resistance to alkalinity that contains in cement (pH > 12.3) with high level.
8. AR-glass fiber 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 fiber.

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