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STUDY ON MECHANICAL PROPERTIES OF M30 GRADE CONCRETE USING STEEL FIBERS AND GLASS FIBERS

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ABSTRACT *In construction industry the cementations substances are one of the most required and used materials. These cement based materials are easily treated and prepared into required designed shapes and structural configurations at an early stage, i.e. earlier than the curing process. However the major weak spot of these cement based materials is their brittleness, associated with their rigid properties, which is responsible for the formation of cracks and in addition to propagation when subjected to stresses. Such weak spot leads to the deterioration of their mechanical properties, which suggests costly maintenance or even reconstruction of such materials in a relatively short existence time.*

Hence, new cement based substances with higher durability properties, for instance, that provide higher cracking resistance, are needed in the constructing industry. Since historic time, fiber reinforced concrete has been replaced with plain concrete which is brittle material. Although, the involvement of single type fiber may improve mechanical properties of concrete, the hybridization can compensate the disadvantages of 2 fiber types and represent their advantages. The impact of using glass fiber and polypropylene fiber for reinforcing the concrete to quantify them mechanical properties of concrete matrix explores in this thesis.

In the present study an experimental investigation was conducted on M30 grade concrete by using steel, fibers and glass fibers. The steel fibers and glass fibers are used at the dose of 0%+0%, 0.25%+0.25%, 0. 5%+0. 5%, 0.75%+0.75%, 1%+1%, 1.25%+1.25% and 1.5%+1.5%. The strength values related to compressive strength, split tensile strength and flexural strength are determined at the age of 7days, 14days and 28 days curing period.

1. INTRODUCTION

Concrete is the mixing of cementitious material, coarse aggregates, and fine aggregates and with addition of this materials suitable quantity of water is one of most important material. Ternary concrete mixtures include three different cementitious materials. This report addresses those combinations of Portland cement, slag cement, and a third cementitious material. The mixing of these three cementitious materials in concrete mix is generally known as ternary blended concrete. For this study the cement is used as primary material, fly ash is used as secondary material, micro silica is used as the ternary material the mixing of this constituent materials with proper mix design will make as ternary blended concrete. Strength of concrete can be find out with the help of compressive test, tensile test and flexural

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strength test. The strength of the concrete can be increased by using the steel fibers with suitable percentages of addition of steel fibers for the specified grade of concrete.

The main objectives of the study are to study the shear behavior of fiber reinforced concrete (combination of glass fiber and steel fiber) using M30 grade of concrete, to determine the optimum dosage of glass fiber and steel fiber, to study the mechanical properties like Compressive strength, Split tensile strength, Flexural strength and to study the shear behavior of FRC

Steel fibers

Stainless steel wire of 0.5 mm distance across has been utilized as a part of the arrangement of SFRC. The steel fiber of length 40 mm and of perspective proportion 80 has been utilized as a part of this exploratory work. All the steel filaments are tied down, snared, disintegrated fit as a fiddle. The run of the mill distance across lies in the scope of 0.25-0.75 mm snare end steel strands are being utilized as a part of this undertaking. Length of these strands is 30 mm and the angle proportion of 55. Thickness of steel fiber is 7900 kg/cum.

Steel fibers

Glass fibers

Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. Although not as rigid as carbon fiber, it is much cheaper and significantly less brittle when used in composites. Glass fibers are therefore used as a reinforcing agent for many polymer products; to form a very strong and relatively lightweight fiber-reinforced polymer (FRP) composite material called glass-reinforced plastic (GRP), also popularly known as "fiberglass".

Glass fibers

2. LITERATURE STUDIES

AnandM,et al., (2017), . Hybrid fiber reinforced concrete with different proportions was tested for compressive strength, split tensile and flexural strength for M40 grade of concrete. Normal concrete, M40 grade was taken as control With the same grade of concrete hybrid fiber reinforced viz.,**0**.0%,0.5%, 1.0%, 1.5% and 3.0 % and the same were examined for compressive strength, flexural strength.

S. Sharmila (2013) et al. This research paper explains the “Behavior of reinforced concrete flexural member with hybrid fiber under cyclic loading”. The first crack load carrying capacity of SFRC and HFRC has been increased by 40% than that of conventional concrete. The cumulative ductility factor of SFRC and HFRC beam is about 1.7 & 1.8 times that of conventional beam. Cumulative energy absorption capacity of SFRC & HFRC beam is

about 1.77& 2.62 times that of conventional beam. In general, it is concluded that the effect of adding hybrid fibers influence the behaviour of beams by increasing the ductility characteristics by 80% and energy absorption characteristics by more than 160%.

Senali (2014) et al. This research paper explains the "Influence of hybrid fiber on reinforced concrete". The Compressive strength of HFRC (S0.7P0.25) was increased by 75% and 25% over NC. The Split tensile strength of HFRC (S0.7P0.5) shows slight increase in strength.

B.Barr (1987) et al. This research paper explains the Shear performance of fiber reinforced concrete materials. Three types of fibers (steel, polypropylene and glass fiber) have been used to study the shear performance of fiber reinforced concrete specimens using double notched specimens. Shear performance of fiber reinforced concrete has been increased by the addition of fibers by weight.

3. METHODOLOGY

In this present experimental study workability, strength of concrete can be done for ternary blended concrete. Casting of cubes, cylinders and prism specimens were done to check the compressive strength, split tensile strength, flexural strength of fiber reinforced concrete

Collection of materials

The project materials like cement, fly ash, micro silica, fine aggregates, coarse aggregates were collected from various locations depending upon the availability. After collecting the materials we need to determine the material properties for calculating the trial mixes.

Mix design of concrete

In this study the M30 Grade concrete mix design is used mix ratios are calculated as per IS 10262 and IS 456 code standards

Mix for M30 concrete = 1 : 0.5 : 1.73 :2.83

Mix Ratios used

1. M0 - 0% Glass fibers+0% Steel fibers
2. M1 – 0.25% Glass fibers+0.25% Steel fibers
3. M2 – 0.5% Glass fibers+0.5% Steel fibers
4. M3 – 0.75% Glass fibers+0.75% Steel fibers
5. M4 - 1% Glass fibers+1% Steel fibers
6. M5 – 1.25% Glass fibers+1.25% Steel fibers
7. M6 – 1.5% Glass fibers+1.5% Steel fibers

Batching: In batching process, concrete mix ingredients are processed either by mass or by volume and and then added to the mixture. Usually batching is considered by volume but now mass mix is regarded as more accurate and also is preferred for accurate mixes. Batching when done correctly affects workability by reducing the bleeding and segregation in the mix. It also provides a smooth surface of the concrete. It helps in speedy construction and decreases the wastage of material. Hence, batching is considered as an essential step while preparing concrete mix.

Mixing of concrete: Measured quantities of coarse aggregate, fine aggregate and cement were spread out over an impervious concrete floor. Fly ash aggregates were added randomly while mixing the concrete. The mixture was rolled over and over until uniformity of color was achieved the time of mixing was between 10 15 minutes.

Casting of the specimens casting process is done in order to find the compressive strength, split tensile strength and flexural strength of concrete for cube specimens we need calculate the compressive strength, for cylindrical specimens and beam

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specimens were casted for flexural strength under different elevated temperatures.

Placing and compacting: The mould sections were coated with oil and a thin coating of oil was applied between the contact surfaces of the bottom of the moulds and the base plate to create a water tight boundary. Then the concrete is filled in the moulds layer wise by proper compaction. And finally the moulds were leveled once they fully filled the slurry paste was applied to remove any voids

Workability of concrete Workability of the concrete was determined by using slump cone test and compaction factor test with different percentages of steel fibers under different elevated temperatures.

Curing: The specimens namely cubes, prisms and cylinders were stored on the platform such that it was away from any vibrations, and at a temperature of 27 ± 2c and at 90% of relative humidity in moist air for 24 hours ± ½ hour from the time of mixing of water to the dry constituents. Then the concrete cubes, prisms and cylinders are removed from moulds and placed for curing for 7 , 14 , and 28 days.

4. RESULTS AND ANALYSIS

Slump cone test: In this test we measure the behavior of a inverted cone that is compacted concrete under self weight due to gravity.

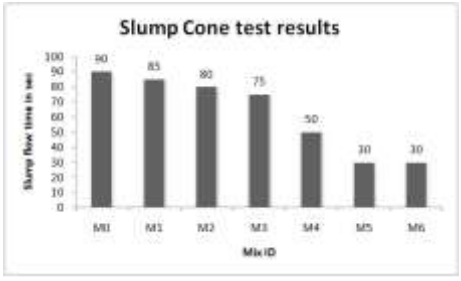


Fig 3: Slump test of concrete

Compaction factor test: It is the ratio of weight of a partially compacted concrete mix to fully compacted concrete mix.

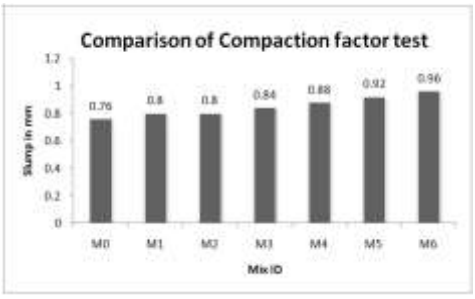
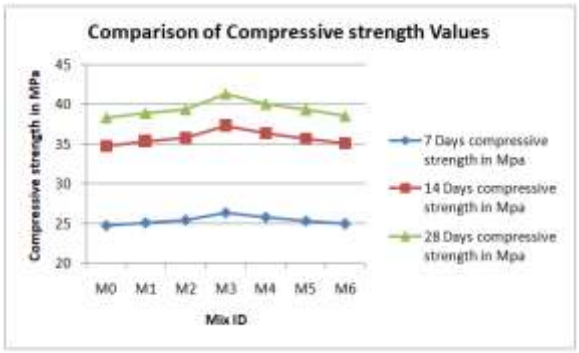


Fig 4: compaction test of concrete

Tests on Strength of concrete:

Compressive strength: In this test the cubes were casted of dimensions 150mm× $150mm$ × $150mm$ and checked for compressive strength at intervals of 7, 14 and 28 days. Cubes were casted with increasing the percentage of steel fibers.



Comparison of compressive strength

Spilt tensile strength: The concretes compatibility to withstand the pulling force (Tensile Stress) without breaking is called the Tensile Strength of concrete. Its unit is (N/Sqmm or Mpa). The split tensile strength is calculated as loading condition such that the load is applied on top and bottom of the cylinder on its lateral surface, to the area equal to the lateral surface area of the cylinder. The split tensile strength = (2P/πdl) N/mm2. The split test was done on cylinders with dimensions 300mm height and 150mm diameter.

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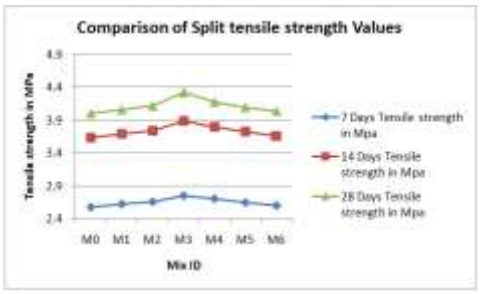
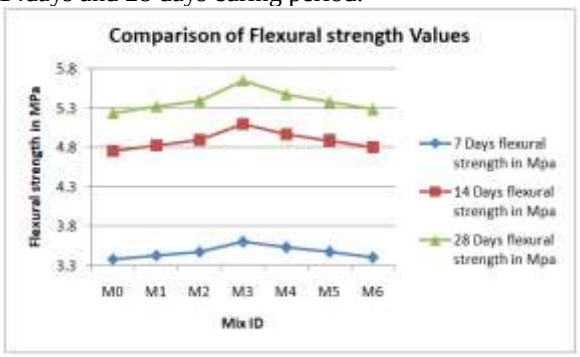


Comparison of split tensile strength

Flexural strength of concrete

The flexural strength of concrete was determined for prism specimens having size is 500mmX100mmX100mm for the respective 7days, 14days and 28 days curing period.



Comparison of flexural strength

5. CONCLUSIONS

The Following Conclusions are drawn from the Experimental Investigation in present study

1. The use of glass and steel fibres in replacing cement definitely increases the fundamental properties of concrete but could only be done up to a certain percentage after which the concrete starts to loose strength.
2. Use of fibres reduce workability of concrete and hence could only be used in little amount.
3. Improvement in the surface integrity and reduction in bleeding is observed in most of the cases when using fibre reinforced concrete.
4. The brittleness of concrete could be improved with addition steel fibres and not so much with glass fibres.
5. As the ratio of glass fibers and steel fibers in M30 grade concrete increases, the severity of the slump cone value decreases.
6. As the ratio of glass fibers and steel fibers in M30 grade concrete grows, so does the severity of the compaction factor value.
7. The best value for compressive strength values related to compressive strength, split tensile strength, and flexural strength was found at the M3 mix, which contains 0.75% of glass fibers and 0.75percentages of steel fibers after curing for 7, 14, and 28 days.
8. The optimal value for tensile strength values related to compressive strength, split tensile strength, and flexural strength was found at the M3 mix, which contains 0.75% of glass fibers and 0.75percentages of steel fibers after curing for 7, 14, and 28 days.
9. The optimal value for flexural strength values related to compressive strength, split tensile strength, and flexural strength was found at the M3 mix, which contains 0.75% of glass fibers and 0.75percentages of steel fibers after curing for 7, 14, and 28 days.

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