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Research Paper

STUDY ON MECHANICAL PROPERTIES OF CONCRETE WITH SILICA FUME AND SYNTHETIC FIBRES

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Abstract- The majority of the world's buildings, bridges, and other structures are constructed with concrete. To complete this infrastructural development, a massive amount of concrete is needed. There has been a push tos find alternatives to cement in developing nations due to concerns about the material's impact on the environment, the energy required to produce it, and the rapid depletion of natural resources. It is well-known that cement is one of the most costly components of concrete.

This research aims to examine the effects of adding rice husk ash and silica to regular Portland cement on the concrete's strength characteristics. "silica fume Fibre reinforced concrete" is the name given to the composite matrix that is created by mixing aggregates, fibres, cement, and rice husk ash. Cement matrices made of rice husk ash include fibres that serve as crackarresters, limiting the expansion of microcracks when subjected to stress. In place of cement, silica fume and synthetic fibres have been the subjects of experimental research into their effects. Under typical curing conditions, the compressive strength was achieved after3,7, and 28 days.

1. Introduction

Concrete is considered as sturdy and solid material. Strengthened concrete is a standout amongst the most well known materials utilized for development around the globe .Reinforced concrete is presented to decay in a few areas particularly in beach front locales. There fore scientists around the globe are coordinating their endeavors towards building up another material to defeat this issue. Innovation of huge development plants and gear's far and wide added to the expanded utilization of material. This situation prompted the utilization of added substance materials to enhance the nature of concrete. As a result of the analyses and looks into bond based solid which meets unique execution as for workability, quality and strength. Utilization of high strength concrete in development segment, has expanded because of its enhanced mechanical properties contrasted with standard concrete. High-quality solid alludes to solid that has a uniaxial compressive strength more prominent than the typical strength concrete got in a specific locale. This definition does exclude a numerical strength for compressive strength demonstrating an exchange from a typical strength to high strength concrete. In 1950's, concrete with a compressive strength of M35 MPa was considered as high strength concrete. In the 1990's solid with a Compressive strength more noteworthy than 110MPa was utilized as a part of created nations.

In any case this numerical strength (110MPa) could be impressively lower contingent upon the attributes of the neighborhood materials utilized for these solid items. Report of ACI council 363 in 1979 characterized high-strength concrete as having compressive strength more than 41.37 MPa (6000 Psi). at present days high strength and superior concrete are in effect broadly utilized everywhere throughout the world. Most utilizations of high strength concrete have been in elevated structures, long traverse spans and in some uncommon applications in structures. In created nations, utilizing high strength concrete as a part of structures today would bring about both specialized and practical preferred standpoint. In high strength concrete , it is important to lessen the water/bond proportion and which all in all expands the concrete substance. To overcome low workability issue, various types of pozzolanic mineral admixtures (flyash, rice husk fiery remains, metakaoline, and so on and substance admixtures are utilized to accomplish the required workability. In the present test examination, the mechanical and durable properties of concrete of evaluations M25, at 28 and 56 ,90days trademark quality with various supplanting levels of concrete with silica sfume and manufactured fiber are considered

Objectives of the study

The principle goal of the proposed work is are

1. The grade of concrete evaluations M30.
2. To consider Effects of silica fume and Marble dust doses on Compressive Strength, split elastic, flexural of cement.
3. To clarify the adjustment in properties of cement, if any by clarifying the microstructure.
4. To think about the crisp and solidify properties (i.e. compressive quality, functionality test) fractional substitution of bond by Silica smoke and Marble dust in various rate.
5. After assessing the mechanical properties for the different blend and it is contrasted and the best outcome.

2. Literature review

Rukhsana Rashid,Nishant Kumar observed and concluded as it is apparent that when concrete is supplanted by silica fume, water request expands, super plasticizer prerequisite increments as silica fume (%) increments. at the point when concrete is supplanted by silica fume, compressive strength first increments and after that decreases . The ideal trade level for compressive strength is 8%.

BertilPersson (2001) carried out an experimental and numerical study on mechanical properties, such as strength,elastic modulus, creep and shrinkage of self-compacting concrete and the corresponding properties of normalcompacting concrete. The study included eight mix proportions of sealed or air-cured specimens with water binder ratio (w/b) varying between 0.24 and 0.80. Fifty percent of the mixes were SCC and rests were NCC. The age at loading of the concretes in the creep studies varied between 2 and 90 days. Strength and relative humidity were also found. The results indicated that elastic modulus, creep and shrinkage of SCC did not differ significantly from the corresponding properties of NCC.

Sri Ravindra rajah et al (2003) made an attempt to increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. They reported about the development of self-compacting concrete with reduced segregation potential. The systematic experimental approach showed that partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation potential as assessed by the V-Funnel test. The results of bleeding test and strength development with age were highlighted by them. The results showed that fly ash could be used successfully in producing self-compacting high-strength concrete with reduced segregation potential. It was also reported that fly ash in self-compacting concrete helps in improving the strength beyond 28 days.

3. Materials and mix design

The properties of materials utilized for making concrete blend are resolved in research facility according to applicable codes of training. Distinctive materials utilized in show consider were Cement, Coarse aggregates, Fine aggregates, Silica fume, synthetic Steel fibers and super-plasticizer. The point

of an investigation of different properties of material is utilized to check the appearance with codal necessities and to empower an architect to outline a solid blend for a specific quality. The portrayal of different materials which were utilized in this examination is given beneath:

Portland cement

Portland cement is the most widely recognized sort of concrete all in all utilization around the globe as a fundamental element of solid, mortar, stucco, and non-forte grout. A few sorts of Portland bond are accessible. The most well-known, called common Portland bond (OPC), is dark in shading, however white Portland concrete is additionally accessible.



OPC 53 Grade Cement

Aggregates

Aggregates constitute the main part of a concrete blend and give dimensional soundness to concrete. To build the thickness of coming about blend, the totals are oftentimes utilized in at least two sizes. The most critical capacity of the fine total is to help with creating usefulness and consistency in blend.

Coarse aggregates

Those particles that are prevalently held on the 4.75 mm (No. 4) sifter and will go through 3-inch screen are called coarse total. The coarser the aggregate, the more temperate the blend. Bigger pieces offer less surface region of the particles than a comparable volume of little pieces.



Coarse aggregates

Fine aggreagtes:

Those particles passing the 9.5 mm (3/8 in.) Sieve, essentially passing the 4.75 mm (No. 4) strainer, and transcendently held on the 75 µm (No. 200) strainer are called fine total. For expanded usefulness and for economy as reflected by utilization of less concrete, the fine total ought to have an adjusted shape.



Fine aggregates

Synthetic fiber

Synthetic fibers or synthetic fibres (in British English; see spelling differences) are fibers made by humans through chemical synthesis, as opposed to natural fibers that are directly derived from living organisms, such as plants like cotton or fur from animals. They are the result of extensive research by scientists aimed at replicating naturally occurring animal and plant fibers. In general, synthetic fibers are created by extruding fiber-forming materials through spinnerets, forming a fiber. These are called synthetic or artificial fibers. The word 'polymer' comes from the Greek prefix 'poly,' which means 'many,' and the suffix 'mer,' which means 'single units'. (Note: each single unit of a polymer is called a monomer).



Synthetic fibers

Silica fume (sf)

Silica fume, otherwise called microsilica, (CAS number 69012-64-2, and EINECS number 273-761-1) is a shapeless (non-crystalline) polymorph of silicon dioxide, silica. It is a ultrafine powder gathered as a side-effect of the silicon and ferrosilicon amalgam generation and comprises of round particles with a normal molecule distance across of 150 nm. The primary field of use is as pozzolanic material for superior cement.



Silica fume

Mix design of concrete

Mix design is a methodology of choosing the appropriate elements of cement and their relative extents with a goal to get ready cement of certain base quality, wanted usefulness and sturdiness as financially (esteem built) as would be prudent.

Final for M30 grade concrete is 1:1.67:2.68 at w/c of 0.45

In this Chapter, the test results are presented and discussed. The test results cover the strength properties of concrete using cement is replaced with silica fume and synthetic fibers are added to the concrete as in amount of (0%, 20%, 30%, 40%).The strength and fresh concrete test include compressive, splitting tensile and flexural strength, v-funnel ,L-Shape, slump cone test of concrete at different curing periods. The compressive strength values tested at 7,28,56,90 days of curing , flexure strength, spilt tensile strength values of concrete mixes were measured after 28 and 56 days of curing.

Mix Trials used in the study

- M1-(silica fume (SF) 0% and synthetic fiber (SYF)0%)
- M2 –(SF 5% and SYF 0.5%),
- M3-(SF 10% and SYF 1%)
- M4-(SF20% and SYF1.5%)
- M5-(SF 30%and SYF2%)
- M6-(SF40% and SYF2.5%)

4. Experimental investigation

Casting of cubes and cylinders

Casting of concrete shapes and chambers as improved the situation M25 review concrete, the blend extent is for which we are casting cubes and cylinders for typical cement, with the incomplete substitution of solid silica fume and Marble dust.

Compaction with compacting bar

150 mm molds ought to be filled in three roughly break even with layers (50 mm profound). A compacting bar is accommodated compacting the solid. It is a 380 mm long steel bar, weighs 1.8 kg and has a 25 mm square end for smashing.

Curing

The concrete specimens were relieved utilizing six unique strategies until when their compressive qualities were resolved at ages



Curing of specimens

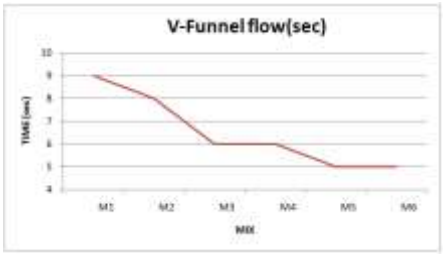
Tests to be conducted on concrete

1. Slump Cone test
2. Compaction factor test
3. Compressive strength
4. Split tensile strength

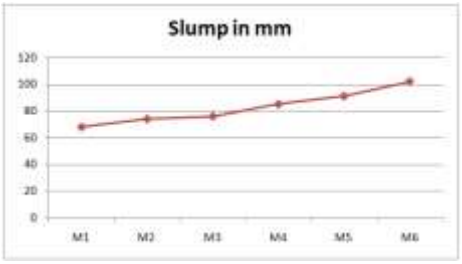
5. Flexural strength
6. Durability

5. Results and analysis

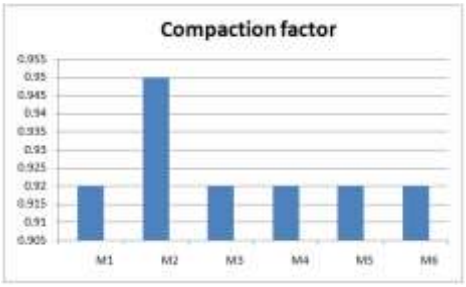
V Funnel flow



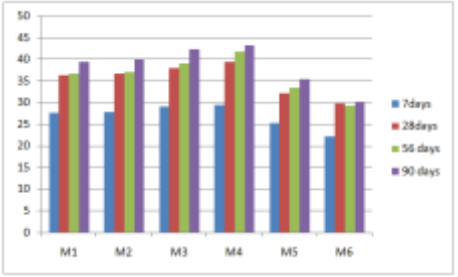
Slump cone test results



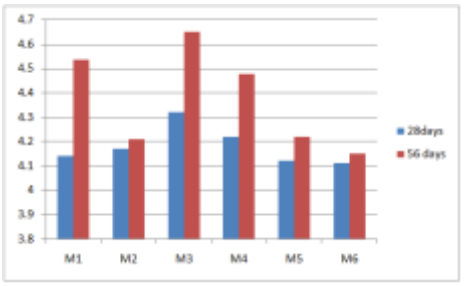
Compaction factor test



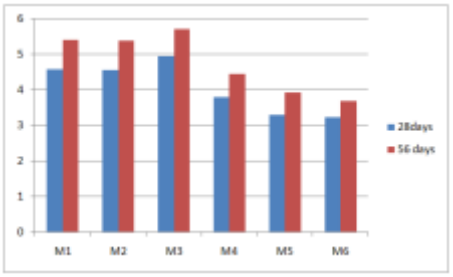
Compressive strength of concrete



Split tensile strength



Flexural strength



6. Conclusions

From the above study the following conclusions were made

1. The compression strength of the concrete increases with increase in the silica fume and synthetic fibers up to replacement and adding 20 % after that the values compressive strength decreases gradually.
2. The flexure strength of the concrete is increased up to 10 % replacement of silica fume and adding of the synthetic fiber when compared with conventional concrete.
3. The splitting tensile values are also increases up to 10 % replacements and after that gradually decreases.
4. The tests made on the fresh concrete results shows that the workability of the concrete increases with increase in silica and synthetic fiber.
5. Passing ability of concrete with silica fume is low when compared with conventional concrete.
6. Compact ability of the concrete with silica fume and synthetic fiber is more better when compared with normal concrete.

REFERENCES

[1]. Ramasamy,V.; Biswas,S. "Mechanical properties and durability of rice husk ash concrete"(Report), International Journal of Applied Engineering Research December 1, 2008.
[2]. Bayasi, Zing, Zhou, Jing, (1993) "Properties of Silica Fume Concrete and Mortar", ACI Materials Journal 90 (4) 349 - 356.
[3]. Venkatesh Babu DL, Nateshan SC. Investigations on silica fume concrete, The Indian concrete Journal, September 2004, pp. 57-60.
[4]. Khedr, S. A., Abou - Zeid, M. N., (1994) "Characteristics of Silica-Fume Concrete", Journal of Materials in Civil Engineering, ASCE 6 (3) 357 - 375.
[5]. Bhanja Santanu, and Sengupta, Bratish, (2003) "Optimum Silica Fume Content and its Mode of Action on Concrete," ACI Materials Journal, V (100), No. 5, pp. 407-412.
[6]. Sensualle GR , Strength development of concrete with rice husk ash, Cement and Concrete Composites 2006.
[7]. ACI234R – 96 "Guide for the use of silica fume in concrete" by ACI committee 234
[8]. Papayianni , G. Tsohos, N. Oikonomou, P. Mavria, "Influence of superplasticizer type and mix design parameters on the performance of them in concrete mixtures", Cement & Concrete Composite, Vol. 27, 2005, 217-222
[9]. V.Bhikshma, K.Nitturkar and Y.Venkatesham, "Investigations on mechanical properties of high strength silica fume concrete." Asian journal of civil engineering (building and housing) vol. 10, no. 3(2009) pp.335-346.
[10].Aravindhan.C ,Anand.N ,Prince Arulraj.G "Development of Self Compacting Concrete with Mineral and Chemical Admixtures – State of the Art" IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.2, No.6, December 2012
[11]. Khayat, K.H., 1999. "Workability, Testing, andPerformance of Self-Consolidating Concrete", ACIMaterials Journal, 96(3): 346-353.
[12]. Hwang, C.L. and M.F. Hung, 2002. "DurabilityConsideration of Self-Consolidating Concrete",Proceedings of the First North AmericanConference on the Design and Use of Self-Consolidating Concrete, Hanley-Wood, LLC,Illinois, USA, pp: 343-348.
[13]. Westerholm, M., P. Skoglund and J. Trägårdh,2002. "Chloride Transport and RelatedMicrostructure of Self-Consolidating Concrete",Proceedings of the First North AmericanConference on the Design and Use of Self-Consolidating Concrete, Hanley-Wood, LLC,Illinois, USA, pp: 319-324.
[14]. Trägårdh, J., P. Skoglund and M. Westerholm,2003. "Frost Resistance, Chloride Transport andRelated Microstructure of Field Self-CompactingConcrete", Proceedings of the 3rd InternationalRILEM Symposium on Self-compacting Concrete,RILEM, France, pp: 881-891.
[15].Md. Safiuddin, J.S. West, and K.A. Soudki, "Durability Performance of Self-consolidating Concrete" Journal of Applied Sciences Research, 4(12): 1834-1840, 2008