Self-Compacting Concrete using Fly ash and Fibers

Mr.B.Pradeep Kumar [1] , Mr.D.Srinath [2], Mr.J.Mohan [3]
Department of Civil Engineering, Samskruti College of Engineering and Technology

***Abstract*- Self compacting concrete is a relatively invention in concrete and the addition of fibers to it shows improved strength properties. Several studies has been done on self compacting concrete with fiber addition. In this work, an attempt has been made to make glass fiber and polyester fiber self compacting concrete(FRSCC). FRSCC mixtures had a cement replacement of 25% fly ash and addition of glass fiber and polyester fiber at 0.05%, 0.10%, 0.15% and 0.2% on total volume of mix. For testing its properties in the fresh state, slum−flow test, L−box and V−funnel were used. Compression (strength of 7 and 28 days), flexural and split tensile strength tests were carried out.**

Key Word- Fly ash,Glass fiber, polyester fiber, Self compacting concrete, Super plasticiser

I. INTRODUCTON

Self Compacting Concrete is a concrete which compacted under its own weight. Self Compacting Concrete is not influenced through the profile and quantity of reinforcement or else the arrangement of a pavement and structures, the abilities of labors, owing to its hindrance to segregation and more fluidity, SCC can be driven extended distances. SCC has developed as an advanced material, proficient of attaining remarkable development in the arena of concrete technology.

For SCC, no need fill up the formwork entirely and condense the vibration which can flow on all sides of obstacles, reinforcement. Self Compacting Concrete had better enriched durability and strength related to orthodox concrete, because of inferior W/C and greater content of cementitious constituents. Also Self Compacting Concrete has a brittle characteristic even with other kinds of cementitious materials.

Concrete possesses high compressive strength and stiffness but it is brittle and weak in tension. Addition of fibres in concrete helps in arresting the crack growth and helps in increasing the flexural and tensile strength. Self Compacting Concrete (SCC) has been used since last few decades, Fibre Reinforced Self Compacting Concrete (FRSCC) is relatively new invention.

Considering the advantages of SCC and FRSCC an attempt has been made to combine these two to produce Fibre Reinforced Self Compacting Concrete (FRSCC) and to study the mechanical properties of both SCC and FRSCC incorporating fly ash as the mineral admixture by addition of glass fibres and polyester fibres in various percentages to the mix. A study has been done on the compressive, flexural and split tensile strength with these various mixes.

Fly ash is an industrial by-product, generated from the combustion of coal in the thermal power plants.The increasing scarcity of raw materials and theurgent need to protect the environment againstpollution has accentuated the significance ofdeveloping new building materials based on industrial waste generated from coal fired thermal powerstations creating unmanageable disposal problems due to their potential to pollute the environment. Fly ash,when used as a mineral admixture in concrete,improves its strength and durability characteristics.Fly ash can be used either as an admixture or as apartial replacement of cement. It can also be used a partial replacement of fine aggregates, as a totalreplacement of fine aggregates and as supplementaryaddition to achieve different properties of concrete.

OBJECTIVE OF THE PROJECT

- In this work the cement is partially replaced by fly ash and hence the emission of co_2 is reduced.
- Addition of glass fiber and polyester fiber possesses increase of strength in SCC.
- Crack resistance and durability properties are also increased due to addition of fibers.
- Partial replacement of cement by fly ash results in the reduction of cost.
- The addition of polyester fibers control plastic shrinkage cracking in concrete.

II. LITREATURE REVIEW

KAMAL.M et al.,(June 2013) studied the Characterization of recycled self compacting concrete prepared with glass fiber .An investigation was performed to improve the properties of recycled self-compacting concrete (RSCC) using demolitions as a coarse aggregate (crushed red brick and crushed ceramic). Glass fibers were used in RSCC to achieve the purpose of this investigation. Glass fiber volume fraction varied from 0.0 to 0.4% by the volume of concrete with aspect ratio 480, 960 and 1920. Forty seven concrete mixes were prepared. Slump flow, J-ring and V-funnel tests were performed to assess the fresh properties of RSCC. Using Ceramic as a recycled aggregate improved the workability of the concrete mixture compared to use red brick as a recycled aggregate

Manjunatha J.K, et al., (February 2015)*:* Fiber reinforced self compacting concrete. In Concrete industry, it is widely

accepted that the conventional concrete mixes are face down to plastic shrinkage during the phase of setting and this can often lead to cracking. Inclusion of relatively small amounts of fibre can adequately diminish this crunch by regulating this early age plastic shrinkage cracking. This paper discusses a comprehensive review on various aspects of Glass and Steel Fibre Reinforced Self Compacting concrete.

Ronzhya et al.,(2015) *:* Durability Study of Self Compacting Concrete using Hybrid Glass :Compacting concrete with hybrid glass fibers. The durability is studied by addition of glass fibre and polypropylene. In this research work, M50 grade concrete is used and tests were conducted by casting cubes with proportion of GF 0.06% + 0.1% PP and GF 0.06% + 0.2% Tests were conducted for flow properties, mechanical properties and durability. Results show that the PFSSCC mixes compared to normal SCC mixes have shown an improvement in compressive strength by 17%, split tensile strength by 18% and flexural strength by 21%respectively.

Ravi Shanker Yadav , et al(September 2015) :To Study the Properties of Self-Compacting Concrete Using Recycled Aggregate and Glass Fiber. This paper investigates the study of workability and durability characteristics of Self-Compacting Concrete (SCC) with Viscosity Modifying Admixture (VMA), and containing fly ash. The mix design for SCC was arrived as per the Guidelines of European Federation of National Associations Representing for Concrete (EFNARC). In this investigation, SCC was made by usual ingredients such as cement, fine aggregate, coarse aggregate, water, mineral admixture fly ash and demolished concrete at various replacement levels (5%, 10%, 15%, and 20%). To enhance the property of SCC made with the use of demolish concrete and fly ash, glass fiber has been added to the mix. Glass fiber in various % (i.e. 0.15%, 0.20% 0.30%, of Wt. of cement) has been added in the mix which contain demolish concrete and gave highest strength i.e. (10% demolish concrete).

Manjunatha J.K.,etal(December 2015) :Performance of Glass Fiber Reinforced Self Compacting Concrete.“Glass Fibre Reinforced Self Compacting Concrete” (GFRSCC) is composed of cement, different sizes of coarse and fine aggregates, which integrate with distinct, uneven glass fibres”.Glass fibres control the cracking in concrete caused by drying and plastic shrinkage. Uniformity, surface integrity of the concrete enhanced and possibility of cracks get reduced due to the decrease in bleeding. From the investigation carried out it is found that incorporation of glass fibres of aspect ratio 1285 and percentage of volume fraction 0.5 to SCC attains better compressive and flexural strength compare to other mixtures and also incorporation of glass fibres of aspect ratio 1285 and percentage of volume fraction 0.75 to SCC attains better split tensile strength compare to other mixtures

Manohar.K,etal, August-(2015): Strength Characteristics of Glass FiberReinforced Self-CompactingConcrete with FlyAsh and Silica Fume. Self-compacting concrete (SCC) is a concrete that has a high flowing ability with no segregation. It is considered to be one of the revolutionary developments in concrete technology in recent times. It reduces noise at sites, precast factory and neighborhood. Self-compacting concrete and glass fibers are combined to create glass fiber reinforced self-compacting concrete (GFRSCC).The present work deals with the workability and strength studies on glass fiber reinforced selfcompacting concrete of grade M40 with fly ash and silica fume. The mix proportions for self-compacting concrete were arrived at by performing mix design and then fine-tuning using EFNARC guidelines. The cement was replaced by 20% fly ash and 12% silica fume .

Shahana Sheril P.T. (September-2013) *:* Self Compacting Concrete Using Fly Ash and Glass Fiber .Self compacting concrete is a relatively invention in concrete and the addition of Fibers' to it shows improved strength properties. In this work, an attempt has been made to make a comparative study on the fresh and hardened state properties of M20 and M30 grades of concrete mixes of self compacting concrete(SCC) and glass fiber reinforced self compacting concrete(GFRSCC). The SCC and GFRSCC mixtures had a cement replacement of 25% fly ash and addition of glass fiber at 0.05%, 0.10%, 0.15% and 0.2% on total volume of mix. For testing its properties in the fresh state, slum−flow test, L−box and V−funnel were used.Compression (strength of 7 and 28 days), flexural and split tensile strength tests were carried out.

Dhiyaneshwaran S,etal.,(2013): Study on Durability Characteristics of Self-Compacting Concrete with Flyash. This paper investigates the study of workability and durability characteristics of (SCC) with Viscosity Modifying Admixture (VMA), and containing Class F fly ash. The mix design for SCC was arrived as per the Guidelines of European Federation of National Associations Representing for Concrete (EFNARC). In this investigation, SCC was made by usual ingredients such as cement, fine aggregate, coarse aggregate, water and mineral admixture fly ash at various replacement levels (10%, 20%, 30%, 40% and 50%). The super plasticizer used was Glenium B233 and the viscosity modifying agent used was Glenium Stream 2. The experiments are carried out by adopting a water-powder ratio of 0.45. Workability of the fresh concrete is determined by using tests such as: slump flow, T50, V-funnel, L-Box and U-box tests. The durability of concrete is tested by acid resistance, sulphate attack and saturated water absorption at the age of 28, 56 and 90 days.

III .MATERIALS AND METHODOLOGY

Fly ash, Glass fiber, Polyester fiber, Super plasticizers and the materials required for the conventional concrete are collected from the nearby sources; the various materials required are cement, fine aggregate, coarse aggregate. The various materials collected are prepared and batched for casting.

Materials that are used for making concrete were tested before casting the specimens. The properties obtained

from the testes were used in mixed design. The preliminary tests are conducted for the following materials.

- Cement
- Fine aggregate(river sand)
- Coarse aggregate
- Fly ash
- Glass fiber
- Polyester fiber

The overall methodology is shown in the fig.1

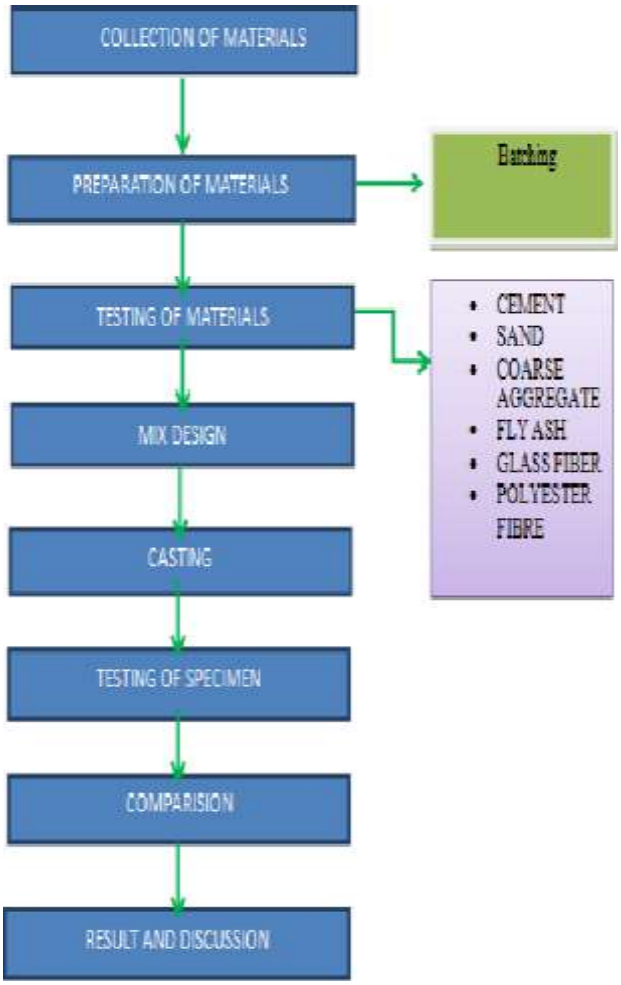

Fig 1: Flowchart of Methodology

IV.PROPERTIES OF MATERIALS

1 .Cement

In the present investigation Ordinary Portland Cement(OPC) of 43 grade confirming to IS specifications was used.The properties of cement are shown in the table1

Table 1: Properties of Cement

S.No	Property	Value
1	Specific Gravity	3.15
2	Normal Consistency	33 %
3	Setting Time i) Initial Setting time ii) Final setting time	 40 Min 6 hours

2 Fine Aggregate

Locally available river sand confirming to IS specifications was used as the fine aggregate in the concrete preparation. The properties of fine aggregate are shown in Table 2.

Table 2: Properties of Fine Aggregate

S.No	Property	Result
1	Specific Gravity	2.6
2	Fineness Modulus	2.8
3	Bulk Density (Loose)	15.75 kN/m^3
4	Grading of Sand	Zone - II

3. Coarse Aggregate

Coarse aggregate of nominal size 20 mm and 10 mm, obtained from the local quarry confirming to IS specifications was used. The properties of coarse aggregate are shown in Table.3. The coarse aggregate used for the preparation of concrete is a mixture of 20 mm and 10 mm size aggregates in ratio 1.5: 1.0.

Table 3: Properties of Coarse Aggregate

S.No	Property	Result
1	Specific Gravity	2.60
2	Bulk Density (Loose)	14.15 kN/m^3
3	Water Absorption	0.5%
4	Fineness Modulus	7.2

4. Fly ash

In the present experimental investigation 'Class F' Fly ash obtained from a Thermal Power Plant is used. Cement is replaced by 20% and 30% of fly ash by weight of cement. The properties of fly ash are shown in Table 4.

Table 4: Properties of Fly Ash

S.No.	Ingredient	Value
1	Silica (SiO_2)	56.88 %
2	Aluminum trioxide (Al_2O_3)	27.65 %
3	Ferric oxide ($Fe_2O_3 + Fe_3O_4$)	6.28 %
4	Titanium dioxide (TiO_2)	0.31 %
5	Calcium oxide (Cao)	3.6 %
6	Magnesium oxide (MgO)	0.34 %
7	Sulphate (SO_4)	0.27 %
8	Loss of ignition (LOI)	4.46 %
9	Specific gravity of Fly Ash	2.12

5. Water

Water used for casting and curing of concrete test specimens is free from impurities which when present can adversely influence the strength of concrete.

6. Glass Fiber

Glass fiber is a material consisting of numerous extremely fine fibers of glass. The high dose of glass fibers leads to high tensile strength while the high polymer content makes the concrete flexible and resistant to cracking. The glass fibres used are of Cem-FIL AntiCrack HD with modulus of elasticity 72 GPa, Filament diameter 14 microns, specific gravity 2.68, length 12 mm and having the aspect ratio of 857, the number of fibres per kg is 212 million fibres.

7. Polyester Fiber

Polyester fiber is a hydrophobic fiber. The glass transition temperature for a typical polyester resin decreases by approximately 15-20^0 c for a 2% moisture weight gain.

V .SUMMARY AND FUTURE WORK

Glass fibers control the cracking in concrete caused by drying and plastic shrinkage. Uniformity, surface integrity of the concrete enhanced and possibility of cracks get reduced due to increase in bleeding. it has been found that with the increase in super plasticizer dosage the workability is increased. So the required slump value fulfilling the criteria can be obtained. Compression strength loss decreases with the increase in fly ash in concrete. Saturated water absorption percentage decreases with the decrease in fly ash. For 30% replacement of fly ash , the low water absorption level is a good indicator of limited open porosity that can inhibit high flow of water into the concrete. by the addition of glass fiber and polyester fiber it results in increase of strength and crack resistance.

REFERENCES

[1] P Srinivasa Rao, G K Vishwanadh, P Sravana and T Seshadri Sekhar, “Flexural Behavior of Reinforced Concrete Beams Using Self Compacting Concrete”, 34th Conference on Our World in Concrete & Structures: 16 – 18 August 2009, Singapore.

[2] T. Suresh Babu, M.V. Seshagiri Rao and Rama Seshu, “Mechanical properties and stress-strain behavior of self compacting concrete with and without glass fibers”, Asian journal of civil engineering (building and housing), vol. 9, no. 5 (2008), pages 457-472

[3] P. Bhuvaneshwari and R. Murali, “strength characteristics of glass fibre on bottom ash based concrete ”, International Journal of Science, Environment and Technology, Vol. 2, No 1, 2013, pages 90 – 102.

[4] Chandramouli K, Srinivasa Rao P, Pannirselvam N, Seshadri Sekhar T and Sravana P, “strength properties of glass fiber concrete”, vol. 5, no. 4, April 2010, ISSN 1819-6608.

[5] K. Rajesh Kumar and Dr. N. Mahendran,’” Experimental Studies on Strength, Durability and Behavior of Beam Using S.C.C. With E-Glass Fiber Strands”, International Journal of Engineering Research & Technology (IJERT), Vol. 2, Issue 4, April – 2013, ISSN: 2278-0181.

[6] Rama Mohan Rao. P,Sudarsana Rao H & Sekar S.K., “Effect of Glass

[7] Antonios Kanellopoulos., Michael F. Petrou., and Ioannis Ioannou., 2012, Durability Performance of Self Compacting Concrete, Construction and Building Materials 37, pp. 320-325.

[8] K.L Radhika., P. Rathish Kumar., and S. Venkateswara rao, 2012, The Performance Studies on Standard and High Strength Self Compacting Concretes.,ICI Journal.

[9] P. Srinivasa Rao., Seshadri Sekhar T., and P. Saravanan., 2009, Durability Studies on Glass Fibre SCC Addition of Glass Fibres Improved Durability of SCC, The Indian Concrete Journal.

[10] J Vengala, M. S Sundarsan., and R. V Ranganath. 2003, Experimental Study for Obtaining Self-Compacting Concrete, Indian Concrete Journal, Vol.77, No.8, pp. 1261-1266.

[11] H. Okamura., and M. Ouchi., 2003, Self Compacting Concrete,Journal of Advanced Concrete Technology, Vol.1, pp. 5-15.

[12] Ozawa K., and Okamura H., 1995, Evaluation of Self Compatibility of Fresh Concrete,Japan Society ofSSSSSCivil Engineers, Vol. 25, pp. 59-75.