An Experimental Study on Flexural Behaviour of Nano Ggbfs Concrete

V.Johnpaul , N.Balasundharam, S.Sanothini. Pragadheesh , Kameshwaran J, Satheesh kumar.M, M.Balajimanikandan

Abstract*:*In the fast developing countries like our India, we are consuming a larger quantity of cement for the infrastructure development, In this connection we are over using the natural resource their by questioning our future climatic condition for our country as well it leads to the global warming. To reduce the conception of these resource we need to start practising the usage of pozzolanic content which is already available in south India's Manchester Coimbatore, Tamilnadu. In this study GGBFS (Ground granulated blast furnace slag) which is available in plenty as a waste from mortar manufacturing companies in Coimbatore used as a Nano mineral admixtures which contains pozzolanic properties. It is similar to that of cementit is used as a Nano material obtained by grinding in a ball mill machine. In Nano technology area research have been done but particularly for GGBFS is not available. The GGBFS is available only were the steel manufacturing areas are more. In this paper we studied the mechanical properties of NanoGGBFS and compared the results with normal concrete (M30). The percentages of Nano mineral admixtures added to cement are 1%, 2%, 3%, 4% & 5% in this we got 4% Nano mix to the weight of cement is the optimum value after which the strength starts to decrease. To determine the size of particle and the chemical composition we have done the particle size analysis , SEM analysis as well the EDOX test.We conclude by saying that it contains silica and little amount of iron which is controllable and contain more amount of lime it will help in binding along the cement and gives good compressive strength. Through this the material will be used for construction purpose and we can avoid in dumping into the agricultural lands during rainy season the materials mixes with rain water and damaging the ground water with high hardness.

Index terms*:*Nano-particle, Ground Granulated Blast Furnace Slag(GGBFS), Mechanical& Flexural properties,

I.INTRODUCTION

With the ever increasing demand for reducing cost and creating economic alternatives in construction projects, more efficient structural materials are preferred.)from blast furnaceinwaterorstream,toproduceaglassy,granularproducti. e.,whendried, The quantity of their on and the blast furnaces lag are in dependent is formed by the constituents of iron ore with limestone flux.GGBFS as the by-product are necessarily the outcome of the binding to the required particle Nano size. Theseproductsareaddedwith thecementby replacing thecementinavariouspercentageof2%, 4%, 6%,8%,10% ,12%,14% toattainmorestrength.Thematerial providesahugesavingin connectiontocarbondioxide emissionwhichisanextraet. boon. [1] Christina mary .V et.al they find the strength and durability characteristics of high performance concrete using GGBS and M-sand in their project. [2] T. Shanmugapriya et.al they find the Strength and Durability properties of high performance concrete by using manufacturing M-sand in their project.[3]MariyaRajeshAntonymaladhas et.al They have done a project on performance and Behaviour of Ground Granulated Blast Furnace slag imparted to Geopolymer concrete structural elements analysed with ANYSYS .[4] A , Kmitta (2017) et.al By Implementation of Nano particles in materials applied in foundry engineering. The Nano materials are applied in several fields of industry for many purposes.[5] Santosh kumar karri,(2015)et.al They have done a project on strength and durability studies on GGBS Concrete . In this they have said that the concrete is most extensively used construction material in the world.

II.EXPERINMENTAL PROGRAMME

A. Material used

In this investigation the materials like cement ,fine aggregate,coarse aggregate, water, superplasticizer and GGBFS were used.

1)Cement: Portland pozzolanic cement (OPC) 53 grade was used to confirming to BIS :12269-1987 was used.The cement sample was tested as per the procedure given in BIS : 4031-1988 and BIS:4032-1985.the specific gravity of cement is 3.15.

2) Fine aggregate: M-sand was used as fine aggregate. The sand was screened at site to remove deleterious materials and tested as per the procedure given in BIS : 2386-1968 and they were confirming to the grade zone 2. The specific gravity of fine aggregate that we got in M-sand is 2.61.

3) Coarse Aggregate: The coarse aggregate is the strongest and the least porous component of concrete In this study, blue granite crushed stone aggregate of 12.5mm and 20mm maximum size and typical particle shapes " average and cubic". the specific gravity of coarse aggregate is 2.628.

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4) Water:It is confirming to the requirements of BIS:456-2000 is found to be the suitable for making high strength concrete. It is generally stated that water fit for drinking is fit for making concrete the PH range of water we used is 7.5.

5) Superplasticizer:It is also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required We used superplasticizer as SP 430 is a chloride free, super plasticizing admixture based on selected sulphonated naphthalene polymers. We added a super plasticizer in 6% to the volume of concrete.

6) GGBFS (Ground Granulated blast furnace slag): It is a recycled material created when molten slag from melted iron core is quenched rapidly and then ground into a powder. This material has cementitious properties it has been used as a replacement for cement. It is a by product of steel industry. The physical properties of Ground Granulated blast furnace slag (GGBFS) provides advantages to concrete in fresh state as well as in its hardened state. We used GGBFS as Nano particles we increased in the range of 1% , 2% 3%, 4% , 6%, 8%, 10%, 12%, 14%. It attained a maximum strength in 4%

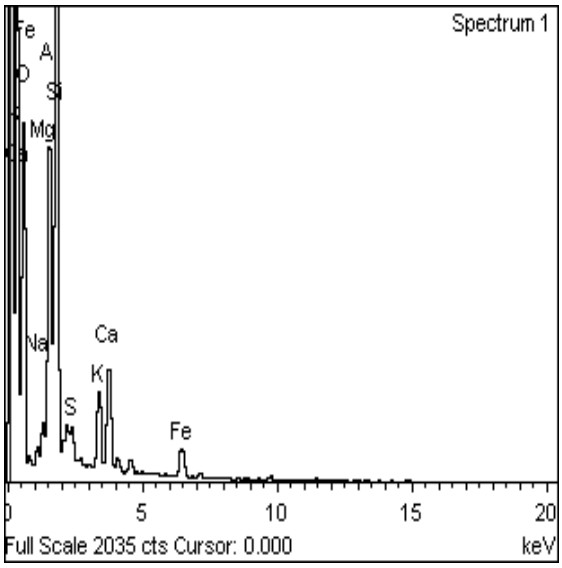

Fig 1. EDOX test result showing chemical Composition of GGBFS as equivalent of cement.

III. MIX DESIGN & M IX PROPORTION

As per the Bureau code of Indian standard IS :10262-1982, The specific gravity, water absorption test and other materials test are discussed for the design proportion. The mix proportion for the coarse aggregate, fine aggregate, Cement and water cement ratio is 0.5 used in project as per the design mix for M30 grade concrete.

IV. TEST DETAILS

We partially replaced the GGBFS as Nano mineral admixture in the concrete in various percentage, by maintain water cement ratio of 0.5. The tested specimens areof cubes 150mm x 150mm x150mm, Cylinder of size 150mm dia. and 300mm height and 2 beams of size 1500mm x 100mm x150mm are casted and the test results were found by testing compressive strength test, spilt tensile test, modulus of elasticity these test are done for cubes and cylinders and flexural test was conducted on the beam.

A. Mechanical properties of concrete

1) Compression Test:

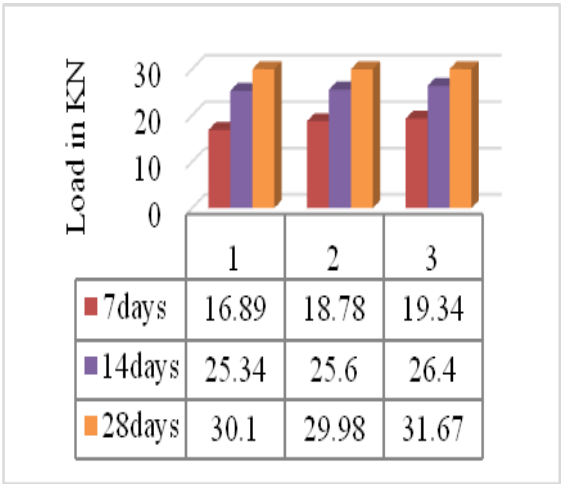

Fig 2: The compression strength of concrete cube with Nano GGBFS.

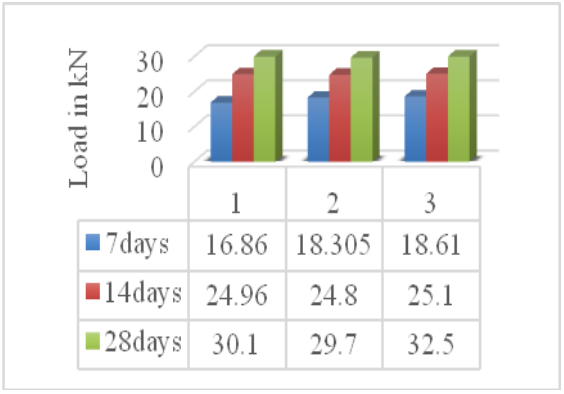

Fig 3: The compression strength of concrete cube without Nano GGBFS.

From the Fig 3& 2 it is clear that the concrete with Nano GGBFS gains earlier strength than the concrete without Nano GGBFS.

2) spilt tensile test:
The test was conducted according to IS :5816 – 1970 in the laboratory . curing is done for 28 days and the specimen 150mm dia.&300mm height is placed horizontally in the compressive testing machine for experiment to find out the result. When compared to conventional concrete the Nano used specimen attains more strength because the

bonding is increased more in the concrete.

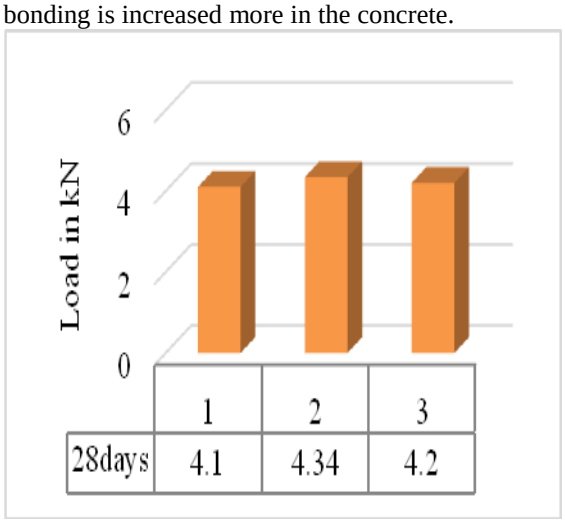

Fig 4: The Split tensile strength of concrete cube with Nano GGBFS.

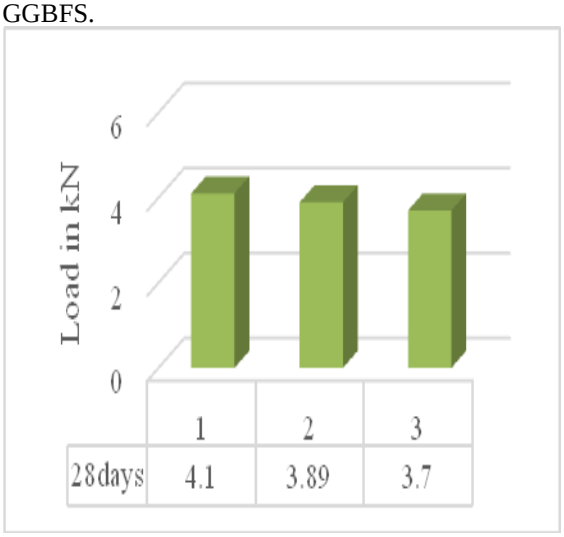

Fig 5: The Split tensile strength of concrete cube without Nano GGBFS.

From the Fig 4 & 5 it is clear that the concrete with Nano GGBFS gains more strength through good bond than the conventional concrete specimen.

3) Flexural strength of beam:

Flexural strength test was conducted according to IS 516 – 1959 and determined the flexural strength of the specimen size 1500mm x 100mm x 150mm, capacity of the loading frame which is used for the testing purpose is 100 ton.

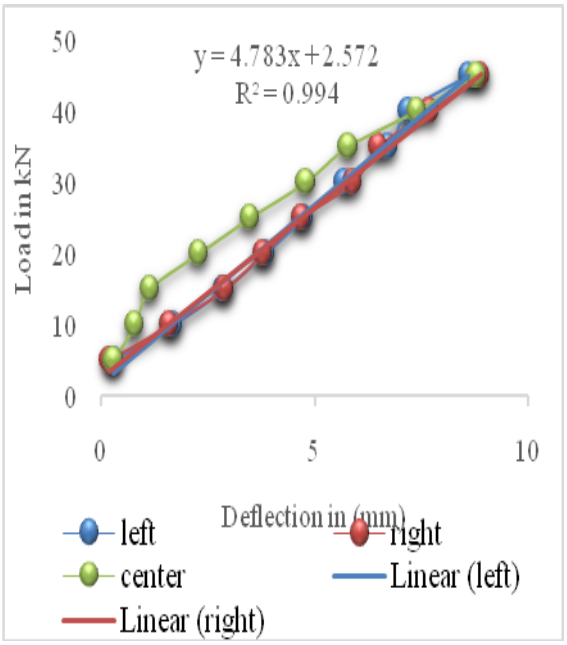

Fig 6: The Flexural strength of concrete beam without Nano GGBFS.

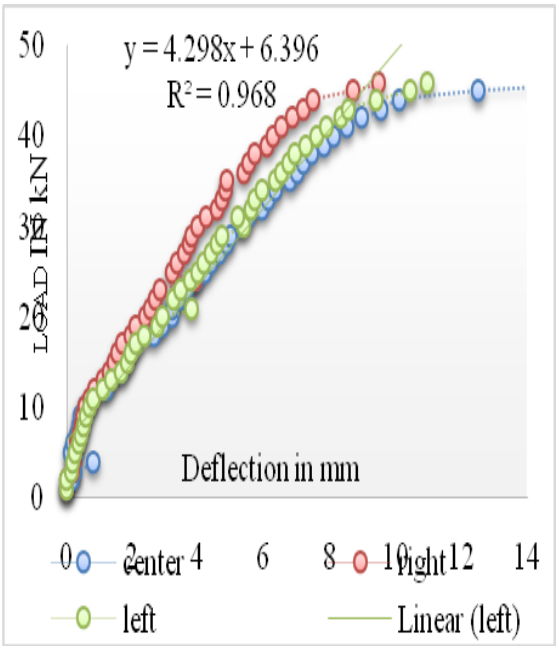

Fig 7: The Flexural strength of concrete beam with Nano GGBFS.

From the above figure 6 & 7 the flexural test on beam states that the first crack load for both the beam exhibits almost similar but in the ultimate load it was higher in Nano GGBFS concrete by 1kN. If you consider in terms of cracking in the beam specimens the one with 4% Nano mix shows very less shrinkage and flexural cracks before it get failure. Almost the centre portion of the beam in compression zone got crushed in the Conventional concrete beam as you can notice from the picture 8 shown below as compared to that of the beam with Nano mineral admixture.

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Fig 8. Showing test setup and failure modes of two specimens without and with Nano GGBFS.

V CONCLUSION

The following are the major points from the above experimental work on flexural behaviour of Nano GGBFS concrete are as follows:

- The optimum percentage of concrete mix is found to be 4% by replacing cement by its weight
- The specimen with Nano mineral admixture gains more earlier strength than conventional concrete compressive strength by 1-2%.
- In the flexural strength test the cracks are very less and it absorbs more energy
- The width of the cracks are very less when compared to conventional concrete.
- Ultimate load of flexural members reaches 2-3% more when compared.

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