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Studies on Flexural Strength of Concrete with Demolished Concrete as Coarse Aggregate(Partial Replacement) and Manufactured Sand as Fine Aggregate(Total Replacement) using Admixtures

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Abstract -*Flexural Strength is one of the important Engineering Properties of Concrete to be used as a Structural Member in any building. In the research work done demolished concrete is used as a partial replacement(50%) of natural coarse aggregate, and manufactured sand is used as a total replacement(100%) of natural fine aggregate. M40 Grade Concrete was prepared as per IS 10262-2019. Flexural Tests were carried out for Concrete prism beams for Concrete with demolished concrete and m-sand as Coarse and fine aggregates(CA & FA) respectively, and for Concrete prism beams with demolished concrete & m-sand as CA and FA with admixtures Nano Silica/Wollastonite Powder/Basalt Fibres, individually and Collectively. It was observed that there was an increase of Flexural strength by 33% in Concrete prism beams with the addition of all the admixtures Collectively in comparison to the Concrete beams without these admixtures. Thus the tests indicate there is an improvement in the Flexural Strength Properties of Concrete beams with demolished concrete & m-sand as CA & FA, using the three admixtures Collectively.*

Key Words: Demolished Concrete 1, Manufactured sand2, Nano Silica3, Wollastonite Powder4,Super plasticizer5,Basalt fibre6,

1. INTRODUCTION

Throughout the world due to some reasons or the other the existing building ownership may change, because of this the existing buildings will be demolished, hence lots of huge quantities of demolished concrete is available.(As per the data available it is 2.2 Billion tons every year throughout the world and in India it is 12 Million tons per annum). Shifting these Construction and Demolition waste to outskirts of a city where the public will not reside is a costly affair, and also natural fine aggregate is scarce and also is very very costly. Hence the demolished concrete is used as a partial replacement(50%)of natural coarse aggregate, and manufactured sand is used as total replacement(100%) of natural fine aggregate in the preparation of M40 Grade Concrete as per IS 10262-2019. Thus when the demolished concrete and manufactured sand are utilized in concrete, it leads to Economical Green Buildings. Also if the Construction and Demolition waste is dumped in open spaces within in layouts it spoils the health of the Citizens and also punishable in some of the states in India.

(1) Divyasrinath et.al,[1], (2019), observed an increase of around 25% increase in the Compressive Strength and 33% increase in the Flexural Strength of Concrete with RCA, using the Additives.(Nano Silica +Wollastonite powder+Basalt fibres).

(2) Fathima Irene IA,[2], (2014), has mentioned 14% increase in Compressive Strength for Concrete cubes with Basalt Fibres. The Flexural Strength increased by 54% with Basalt fibres at 4kg/$m^{3,}$ Formation of Cracks was found less in Basalt fibres reinforced concrete, The Ductility characteristics of Basalt fibres showed improvement in comparison to that of brittle failure of plain concrete.

(3) Farood Torabian Isfahani et.al [3], (2016) have said that by the incorporation of 1.5% of Nano Silica with w/c ratio 0.55, there was an increase of 6.5% in the Compressive Strength.

(4) Hyder Jahim [4], (2010), has said theat Wollastonite powder is effective in modifying the Compressive Strength of Mortor when 5% of it replaces sand as replacement, Wollastonite powder gives good results in Compressive strength of Concrete when mixing 10% of it as sand replacement, Wollastonite powder is a non pozzolonic material, Wollastonite powder can be used as an inert filler in Self Compacting Concrete.

(5) Kandula Mohan Krishna Reddy et.al [5],(2016) has told that 23.74% increase was observed in Compressive strength of M35 grade concrete with 10% Wollastonite powder and 10% Silica fume, Flexural strength increased by21.44% with same combination of the additives.

(6) Khaleel H Younis et.al[6], (2018), has observed an increase of 22% in the Compressive strength of Concrete with the addition of 1.2% of Nano Silica.

(7) Krishnan Pareek[7], (2009), has said that adding additives Microsilica, GGBS, Flyash improves the Compressive strength, Flexural Strength and Split Tensile Strength of Concrete with Recycled Aggregates,And the structural elements made using Recycled aggregates with the additives have comparable Engineering Properties and are Economical, Environmently friendly, sustainable materials.

(8) Manish Saini et.al[8], (2016), has observed an increase of 12.8% in the Flexural Strength of Concrete with Recycled aggregates when Silica Fume(10%) was added, The Compressive strength was even greater than the Control Normal Aggregate Concrete.

(9) Nayan Rathod et.al,[9], (2013), say that Benefit of using Basalt Fibres in concrete is that it is Non Corrosive, the strength is very good, the Heat Resistance power is also good which is very important for every building.

(10) Renu Mathur et.al[10], (2007), says adding Wollastonite powder(10%) in Concrete the Compressive strength(28 -56 days) improved by 28-35%, and the flexural strength by 36-42%, also reduction in water absorption, drying shrinkage abrasion loss of concrete, and enhancement in durability against freezing and thawing and sulphate attack were observed.

(11) Rutuja Mininath Sarade et.al[11],(2017), observed Compressive Strength increase in Concrete of 10.3%, 15%, 19.43%, using Nano Silica as additive.

(12) Shaikh et.al[12], (2014), has reported that the addition of Nano Silica increased the Compressive strength of Concrete with Recycled aggregates at all ages upto 56 days.

(13) Tehmina ayub et.al[13],(2014), has told that adding Silica Fume to Concrete the Compressive Strength increased to 15.37%), and the Flexural Strength by 4.81%, and the addition of Basalt Fibres (2%) increased the Flexural Strength by 36.12%) in HPFRC.

(14) Varun R et.al[14], (2017), observed for various percentages of Nano Silica upto 1.5% the Compressive Strength, Flexural Strength, and the Split Tensile Strength increased in Concrete with Recycled aggregagtes.

1.1 METHODOLOGY

Concrete of M40 grade with the proportions 1:2.56:3.26 by weight was prepared as per the IS Code 10262-2019. The dimensions of the Concrete prism beam was 150mm x 150mm x 500mm. They were cured for 28 days. The various types of beams casted and tested are (i)Concrete beam with demolished concrete as coarse aggregate(50%) and m-sand (100%).(ii)Concrete beam with demolished concrete, m-sand and with optimum percentage of Nano silica(1.5% by weight of cement),(iii)Concrete beam with demolished concrete, m-sand and with optimum percentage of Wollastonite powder(10% by weight of cement),(iv) Concrete beam with demolished concrete, m-sand and with optimum percentage of Basalt fibres(1% by weight of cement),(v) Concrete beam with demolished concrete, m-sand and with optimum percentages of Nano silica,Wollastonite powder and Basalt fibres, added collectively. Water cement ratio adopted was 0.4, and 53 grade Ordinary Portland Cement was used. Super plasticizer (Liquifix) was applied to improve the workability. The above said various types of beams were tested for Pure Bending using two point loads at distances of one third of the span from either ends. The optimum percentages of Nano Silica, Wollastonite power and Basalt fibres have been found out using Compression Tests for M40 Grade Concrete[1].

2.1 RESULTS OF EXPERIMENTS: Table-1

Results of the -Bending Tests of M40 Concrete (twenty eight day strength)

Types of concrete Beams-M40 Grade.	Concrete Beam with DC(50%) and m sand (100%)	With NS 1.5%	With WSP 10%	With BF 1%	With all The additives-NS+WSP+BF
Twenty eight day flexural stress	5.4 MPa	7.02 MPa	7.08 Mpa	7.13 MPa	7.2 MPa

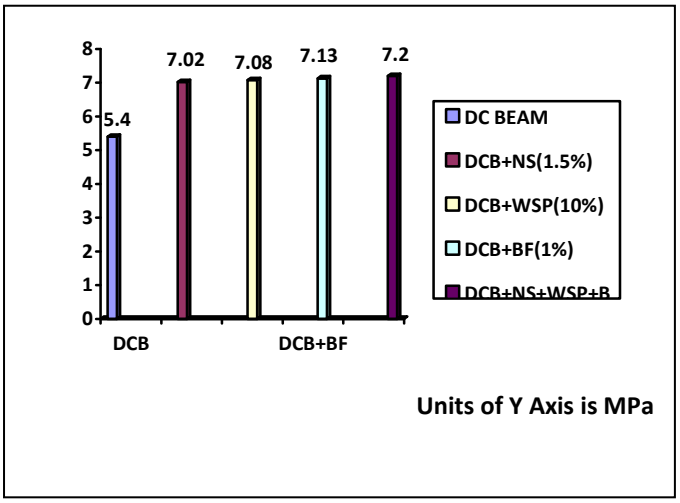

Chart -1: Results of the -Bending Tests of M40 Concrete (twenty eight day strength)

Figure 1: Photograph of Flexural Test Set Up

Figure 2: Photograph of Flexural Test(Broken beam)

3. CONCLUSIONS

(1) Without addition of any of the additives the 28day flexural stress is found to be 5.4 Mpa, for concrete prism beam, with demolished concrete(50%) as coarse aggregate, and with m-sand (100%).

(2) With the addition of the optimum percentages of the additive Nano silica(1.5%), the 28 day flexural stress found to be 7.02 Mpa.

(3). With the addition of the optimum percentages of the additive Wollastonite powder(10%), the 28 day flexural stress is found to be 7.08 Mpa.

(4). With the addition of the optimum percentages of the additive Basalt fibre(1%), the 28 day flexural stress is found to be 7.13 Mpa.

(5) With the addition of the optimum percentages of all the additives(Nano slilica,Wollastonite powder, Basalt fibre, the 28 day flexural stress is found to be 7.2 Mpa.

(6) Thus it is observed there is an increase of flexural strength by about 33%, when the three additives are added, to the concrete prism with demolished concrete aggregate and m-sand as fine aggregate.

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