Evaluation of Optimum Percentages of Additives In Concrete With Recycled Aggregates.

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Abstract- *Construction and Demolition waste is available in very large quantities in all Urban Areas of all Cities in any Country throughout the World year after year, since Demolition takes place due to some reason or the other. Disposal of this waste is highly expensive, and normally these are dumped in open spaces, which are very harmful to the public health, and pollute the atmosphere. Also Natural Fine Aggregate is very costly these days. Hence an attempt is made to utilize the demolished concrete as a Partial replacement for Natural Coarse Aggregate, and Manufactured Sand as a Total replacement for Natural Fine Aggregate in Concrete, leading towards Green Buildings Concepts, and economical structures.*

As per the IS :10262-2019, Proportions by weight for Cement, Natural Coarse aggregate, Natural fine aggregate, water cement ratio, were followed for M40 grade concrete. Compressive Strength on Concrete cubes were evaluated for seven days and twenty eight days with Natural Coarse aggregate(50%), and Demolished concrete(50%),and m-sand (100%). It was observed that the twenty eight day compressive strength was less than 40Mpa which is not satisfactory. The reason may be because of the use of demolished concrete being used as a partial replacement for Natural coarse aggregate and m-sand being used as a total replacement for natural fine aggregate. Additives like Nano Silica, Wollastonite Powder and Basalt fibres which are available at competent rates, were tried individually and compressive strength for seven days and twenty eight days were evaluated with various percentages of Nano silica like 1%, 1.5%, 2% by weight of cement added to Concrete. It was found that 1.5% Nano silica by weight of cement gave the maximum compressive strength. Similarly Wollastonite powder was mixed in concrete with 5%, 10%, 15% by weight of cement, and 10% wollastonite powder by weight of cement was the optimum percentage obtained. Also basalt fibres were added to concrete with 1%, 2% and 3% by weight of cement, and experimental results showed that 1% basalt fibre was the optimum percentage. Thus using these optimum percentages of Nano silica, Wollastonite powder and Basalt fibres in concrete we have got the compressive strength of concrete for twenty eight days exceeding 40Mpa.

Thus we can conclude that the addition of optimum percentages Nano silica, Wollastonite power and Basalt fibres individually helps to regain the compressive strength of concrete to satisfactory levels, so that the concrete with demolished concrete as coarse aggregates and m-sand as fine aggregates could be used in all structural members of any structure. Water cement ratio of 0.45 was adopted. And super plasticizer(LIQUIFIX) was used to enhance the workability as per the IS code provisions.

Keywords- Construction & Demolition waste, Concrete, m-Sand, Nano Silica, Basalt fibres, Wollastonite powder.

I. INTRODUCTION

In all the Major Cities of any country, demolition of buildings takes place may be due to change in ownership or any other reason. Such demolition waste instead of being disposed, an attempt is made to reutilize in concrete of all structural members of any building in the industry, leading to economical structures and towards Green building concepts.
From the review of literature of research papers, it is observed that addition of Nano silica/Wollastonite powder/Basalt fibres, individually there is an improvement in the various structural properties of the concrete. Here we have evaluated the optimum percentages of Nano silica/Wollastonite power/Basalt fibres to be added for satisfactory performance of concrete. Bibhuti Bhutan et al.[1], finds there is a very good improvement in the properties of concrete, on adding Nano Silica. Fathima Irene I A [2], observes there is a considerable increase in Compressive Strength, Flexural Strength and Split Tensile Strength ofconcrete, with the addition of Basalt Fibres.Hyder Jahim [3], indicates a remarkable improvement in Compressive strength at all ages, when Wollastonite powder is added to concrete, also this

concrete can be used as a inert filler in Self Compacting Concrete.

II. METHODOLOGY

The design mix proportions for M40 grade concrete were followed as per the IS Code 10262-2019, the proportions for cement, natural coarse aggregate, and natural fine aggregate are1:2.56:3.26 by weight. Six cubes of size 150mm x 150mm x 150mm were cast with 50% natural coarse aggregates and 50% demolished concrete coarse aggregates, and 100% m-sand was used in place of natural fine aggregates. Three cubes were tested for seven day compressive strength, the other three cubes were tested for twenty eight day compressive strength. Similarly another six cubes were cast by adding Nano silica (1% by weight of cement). Three cubes were tested for seven day compressive strength and the other three for twenty eight day compressive strength. The same procedure was repeated with Nano silica 1.5% and 2% by weight of cement. In the same manner compressive strength of cubes were found out with Basalt fibres 1%, 2% and 3% by weight of cement, and also with Wollastonite powder 5%, 10% and 15% by weight of cement.

III. EXPERIMENTAL RESULTS

Table. 1 Seven day and Twenty eight day compressive strength test results to compute optimum percentage of nano silica.

Types of concrete cubes	Concrete with demolished concrete(50%) as CA and m sand (100%) as FA, without any additives	With nano silica (1%)	With nano silica (1.5%)	With nano silica (2%)	Optimum % of Nano silica = 1.5%
Seven day compressive strength	22.22MPa	24.44MPa	26.66MPa	25.55MPa	26.66MPa
Twenty eight day compressive strength	32.22Mpa	37.33MPa	42.66MPa	41.77MPa	42.66MPa

Table. 2 Seven day and Twenty eight day compressive strength test results to compute optimum percentage of Wollastonite powder.

Types of concrete cubes	Concrete with demolished concrete(50%) as CA and m sand (100%) as FA, without any additives	With wollastonie (5%)	With wollastonite (10%)	With wollastonite (15%)	Optimum %of wollastonite=10%
Seven day compressive strength	22.22MPa	24MPa	26.22MPa	25.77MPa	26.22MPa
Twenty eight day compressive strength	32.22Mpa	36.89 MPa	41.77MPa	40.89MPa	41.77MPa

Table.3 Seven daysand Twenty eight dayscompressive strength test results to compute optimum percentage of basalt fibres.

Types of concrete cubes	Concrete with demolished concrete(50%) as CA and m sand (100%) as FA, without any additives	With basalt fibres (1%)	With basalt fibres (2%)	With basalt fibres (3%)	Optimum % of basalt fibres =1%
Seven day compressive strength	22.22MPa	25.33MPa	24.88MPa	24.66MPa	25.33MPa
Twenty eight day compressive strength	32.22Mpa	41.33MPa	40.44MPa	39.55MPa	41.33MPa

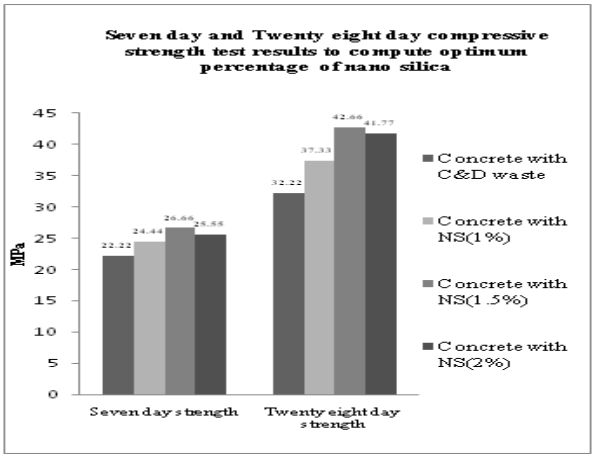

Fig. 1Comparative strength for different dosages of nano silica

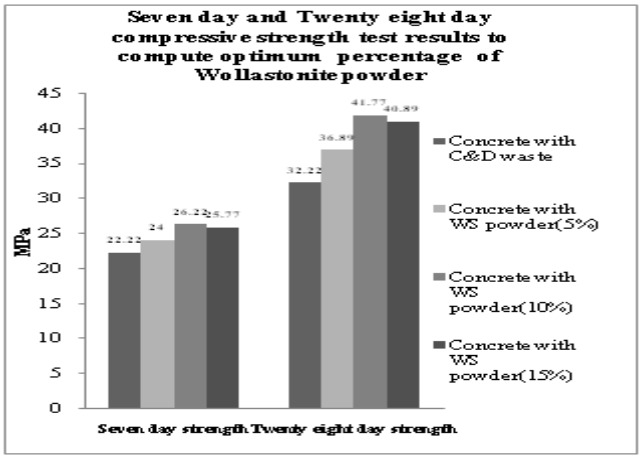

Fig. 2Comparative strength for different dosages of wollastonite powder

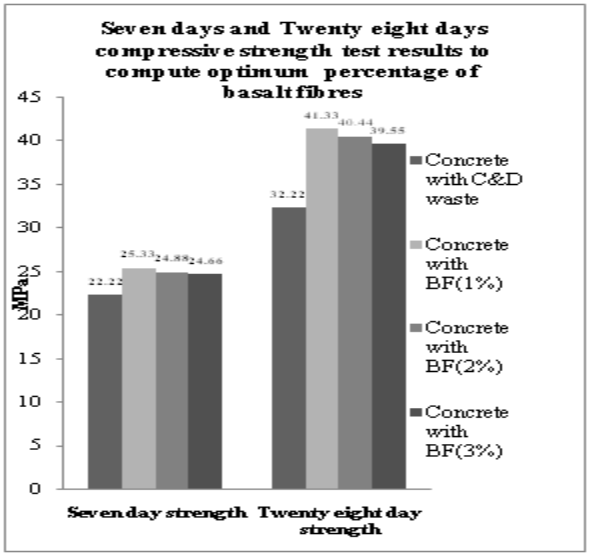

Fig. 3Comparative strength for different dosages of basalt fibres

IV. CONCLUSIONS

Based on the observations of the experimental results, the following are the conclusions, using the Tabular columns 1 to 3 and Figures 1 to 3.

1. The addition of Nano silica by 1.5% gives the maximum compressive strength, and with 2% Nano silica the compressive strength decreases, hence 1.5% Nano silica is considered the optimum percentage.
2. Wollastonite powder 10% by weight of cement gives the maximum compressive strength, and at 15% the compressive strength decreases, thus 10% Wollastonite powder is the optimum percentage.
3. With the addition of 1% by weight of cement Basalt fibres gave the maximum compressive strength, and with 2% and more percentages the compressive strength, decreased, thus for Basalt fibres 1% is the optimum percentage.
4. Since demolished concrete coarse aggregates(50%),and m-sand (100%) are used in place of natural coarse and fine aggregates, with such concrete we are not getting the required strength of 40MPa, and by adding the additives Nano silica/Wollastonite powder/Basalt fibres individually we are getting the compressive strengths at the end of twenty eight days above 40MPa, hence it is concluded that addition of Nano silica/Wollastonite powder/Basalt fibres helps to regain the compressive strength to acceptable levels .
5. Thus the demolished concrete can be recycled in concrete with m-sand and used in the construction industry in all structural components leading towards Green Building Concepts and economical structures.

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