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# Experimental Study on High Strength Concrete with Recycled Aggregate

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**ABSTRACT—**

In this project, Concrete is a brittle material and hence steel is provided to improve its tensile strength. Addition of steel fibres in concrete enhances the tensile strength. Researches show that Steel fibre reinforced concrete increases the flexural strength, flexural toughness and cracking strength of concrete. In this study, experimental investigation on Steel fibre reinforced specimens has been carried out using bagasse ash as partial replacement for cement. Bagasse ash is a residue resulting from the burning of sugarcane bagasse in boilers for power generation. This ash contains cementitious properties and hence used as a partial replacement for cement. Cement production causes CO2 emission and hence this partial replacement will minimize the cement quantity production and thereby reducing CO2 emission. The present work started with design mix calculation for M25and compressive strength of cubes was arrived for various percentage of bagasse ash (10%, 20%, 30%). For the optimum mix, split tensile strength of Steel fibre reinforced specimens were studied for different percentage (0.6%, 0.8%, 1%), of volume fraction. 10% replacement of Bagasse ash and addition of 1% steel fibre was found to be optimum.

***Keywords*— Bagasse ash, steel fibre**

## 1. INTRODUCTION

Concrete is a brittle material and adding steel fibres into the concrete may increase the toughness property of concrete matrix. Mechanical properties of concrete will improve when fibres are added into the concrete. SFRC is well suitable for heavy loaded structures, dynamic and impact loading structures. Aspect ratio of fibre and orientation of the fibre is very important in SFRC. Bagasse ash is a residue obtained from the burning of sugarcane bagasse ash generation plant.

Aluminium ion and silica are present in this generated ash. Bagasse ash generated plants situated all over the country will yield large quantity of bagasse ash and it can be used in concrete. It is an eco friendly alternative to disposal.

## 2. OBJECTIVES

- To study the waste minimizing techniques by adoption waste materials.
- Introduction of new construction material in the preparation of materials.
- To find mix ratio which gives good strength while replaced with Bagasseash and Steel Fibre.
- To study the Bagasse Ash, Steel Fibre and its effect as waste management in constructions.
- To compare the mechanical properties of normal concrete and bagasse ashsteel fibre replaced concrete.

## 3. MATERIALS

Materials required for making conventional concrete and bagassh ash steel fibre concrete are collected from the near by source the various material required are cement, fine aggregate, coarse aggregate,bagasse ash and steel fibre. 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 tests were used in mix design. The preliminary tests were conducted for the following materials.

1. **Cement**

Cement is the most widely used cementations ingredient in present day concrete. The function of cement is first, to find the fine aggregate together and second to fill the voids in between fine aggregate and coarse particles to form a compact mass. Although cement constitutes only about 10 % of the volume of the concrete mix, it is the active portion of the binding medium and the only scientifically controlled ingredient of concrete. Ordinary Portland Cement (OPC) 53 Grade conforming to Indian Standard IS 12269:1987 was used as a binder.

**2. Fine Aggregate**

The various properties of fine aggregate such as specificgravity, fineness modulus, bulk density were determinedas per IS 456:2000. Locally available sand was used asfine aggregate in the experimental work. The test iscarried out for deciding the fineness modulus. Also thesieve analysis is carried out. Fineness modulus of sand isfound to be 3.25 and it confirms to grading zone II as pergrading limit for fine aggregate as per IS 383:1970.Fineness modulus is well within 2.5 to 3.37.the bulkmodulus is found to be 2.65.

**3. Coarse Aggregate**

Coarse aggregate of maximum size 10 mm used in theexperimental work. Coarse aggregate were tested fordifferent properties such as fineness modulus, bulkmodulus as per IS 383:1970(3). The natural coarse aggregates obtained fromthe locally available quarries with maximum size of 20 mm and satisfying the grading requirements of BIS (IS: 383-1970) is used in both normal and recycled aggregate concretes. The specific gravity of coarse aggregate is 2.5 and the fineness modulus of 2.88. the crushing value of the coarse aggregate used as 31.25% , the ideal aggregates should be clean, cubical, angular, cent present crushed with a minimum of large enlarged surface.

**4. Water**

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required has to be looked into very carefully. In this project, RO water was used for mixing and normal water was used for curing purposes. The water to cement ratio by weight plays a very significant role in concrete strength and durability. Lower the water cement ratio, higher is the strength and durability of concrete. It is very important to accurately batch water such that it doesn't exceed more than 0.55%. In this project, water cement ratio for concrete mix is 0.6% was adopted.

**5. Bagasse Ash**

Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% of residual ash.

The residue after combustion presents a chemical composition dominates by silicon dioxide (sio2). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests. In this sugarcane bagasse ash was collected during the cleaning operation of a boiler in the sugar factory.

**6. Steel Fibre**

The most important parameter describing a fibre is its aspect ratio. Aspect ratio is the length of fibre divided by an equivalent diameter of the fibre, where equivalent diameter is the diameter of the circle with an area equal to the cross sectional area of fibre.

## 4. TESTING OF MATERIALS

**Specific Gravity**

Specific gravity is the ratio of weight of the sample in air for its taken volume dry conditions to the weight of an equal volume of distilled water. Specific gravity of aggregate is made use in design calculations of concrete mixes with specific gravity of each constituent known, its weight can be converted into a solid volume and hence a theoretical yield of concrete per unit volume can be calculated. Specific gravity of aggregate is also required in calculating the compaction factorin connection with the workability measurements. Similarly the specific gravity of aggregate has to be considered when dealing the light weight and heavy weight concrete. Average specific gravity of rocks varies from 2.6 to 2.8.

**Procedure**

- The clean dry Pycnometer (a standard bottle with a brass cap and washer) is weighed.
- About 500gms of oven dried sample are filled to 1/3 of the Pycnometer and weighed off.
- The balance space in the Pycnometer is filled with distilled water and the entrapped air is removed by steering with glass rod. Then it is weighed up.

**Specific Gravity For Fine Aggregate**

Specific gravity is determined by obtaining the following weights

$w1$ = Empty weight of pycnometer

$w2$ = Wt. of pycnometer + FA

| | | |
|---|---|---|
| $w3$ | = | Wt. of pycnometer + FA + water |
| $w4$ | = | Wt. of pycnometer + water |

**Specific Gravity For Coarse Aggregate**

| | | |
|---|---|---|
| W1 | = | Empty wt. of pycnometer |
| $W2$ | = | Wt. of pycnometer + CA |
| $W3$ | = | Wt. of pycnometer + CA + water |
| $W4$ | = | Wt. of pycnometer + water |

## 5. TESTING OF FRESH CONCRETE

**Workability**

The workability of a fresh concrete is a composite property which includes the diverse requirements of stability, mobility, placing of ability and finishing ability. There are different methods for measuring the workability. Each of them measures only particular aspects of it and there is no unique test which measures workability of concrete in its totality. The test measures the relative effort required to change a mass of concrete from definite shape to another by means of vibration.

**Slump Cone Test**

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in the laboratory or at the site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of conveniently as a control test and gives an indication of the uniformity of concrete from batch to batch.

**Procedure**

The apparatus for conducting the slump test essentially consists of a metallic mould in the form of a frustum of a cone having the internal dimensions as under. The thickness of the metallic sheet for the mould should not be thinner than 1.6 mm. Sometimes the mould is provided with suitable guides for lifting vertically up. For tamping the concrete, a steel tamping rod 16 mm dia, 0.6 meter along with bullet end is used. The internal surface of the mould is thoroughly cleaned and freed from superfluous moisture and adherence of any old set concrete before commencing the test. The mould is placed on smooth, horizontal, rigid an non- absorbent surface. The mould is then filled in four layers, each approximately 1/4 of the height of the mould. Each layer is tamped 25 times by the tamping rod taking care to distribute the strokes evenly over the cross section. After the top layer has been roded, the concrete is struck off level with a trowel and tamping rod. The mould is removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside This subsidence is referred as slump of concrete. The difference in level between the height of the mould and that of the highest point of the subsidence of concrete is measured. This difference in height in mm is taken as Slump of Concrete.

**Calculation**

| | | |
|---|---|---|
| Grade | = | M25 |
| Mix proportion | = | 1:1:2 |
| Cement taken | = | 3 Kg |
| Fine aggregate | = | 6.3 Kg |
| Coarse aggregate | = | 8.45 Kg |
| Volume water added | = | 750 ml |
| The nature of the slump observed is 5 | = | 30 - 5 |
| Slump measured | = | 25 cm |

## 6. CONCLUSION

Based on the test results of the experimental investigation concrete prepared using SCBA with steel fibre the following conclusions have been drawn :

- It can be concluded that the bagasse ash is a valuable pozzolanic materialand it can be potentially be used as a partial replacement for cement.
- Up to 10% SCBA in concrete can be considered as the optimum replacementlevel.

- It also concluded that the inclusion of sugarcane bagasse ash in concrete with and without steel fibre up to 30% considerably improved the chemical resistance of concrete by reducing the weight loss.
- The minimum weight loss obtained 1.6% at 60 days for normal concrete.
- Also the minimum weight loss obtained at 30 days was observed as 0.7% for normal concrete and 0.8% for bagasse ash with the addition of steel fibre concrete.
- Similarly, the minimum weight loss observed as 1.2% and 1.4% for normal concrete at 30 days and 60 days, respectively.
- Therefore bagasse ashcan be used in the concrete to reduce the cement quantity and also it could be reduce the environmental pollution. It can be made economical
- Design for concrete structure. It avoids very much the air pollution and environment point of view. It can be used in the building construction to get the green building certificate from government organization.

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