# STRUCTURAL PERFORMANCE OF HIGHSTRENGTH CONCRETE BEAMS INCORPORATING SUGARCANE BAGASSE ASH

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**ABSTRACT**

We made an attempt to utilize the sugarcane bagasse ash as cement replacement material in making the concrete specimen. The utilization of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economical, environmental, and technical reasons. Sugar-cane bagasse ash is a fibrous waste-product of the sugar refining industry, along with ethanol vapor. This waste product is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash mainly contains aluminum ion and silica. In this paper, Bagasseash has been chemically and physically characterized, and partially replaced in the ratio of 5% by of cement in concrete. The effect of addition of silica fume in the bagasse ash based concrete specimen has also investigated. concrete specimen were cast with bagasse ash as cement replacement material at zero, and5 percent for the concrete grade M60 and silica fume at 5percent were also added for the above all the combinations of the concrete specimen. Tests on the compressive strength at 7 days and 28 days, flexural strength and split test at 28 days were conducted on the concrete specimen. The result shows that the strength of concrete increased as percentage of bagasse replacement increased. Flexural behaviour of control beam and bagasse beam was studied by using 2 point load .The result indicated that the load carrying capacity of bagasse beam more than control beam.

## 1.INTRODUCTION

The sugarcane industry is one of the oldest and largest sectors in India. sugar industry, India is all set continue its domination at the global level. The largest number of sugar companies in the private sector are located in southern India, in the states of Tamil Nadu, Andhra Pradesh and Karnataka. Out of 453 sugar mills in the country, 252 are in the co-operative sector, 134 arein the private sector and 67 are in the public sector. Besides 136 units in the private sector are in various stages of implementation. A Few such units are under implementation in the co-operative sector as well. But no new units have been proposed in the public sector. The latter is considered to be a rural industry and enjoys much greater freedom than sugar mills. sugar processing consumes enormous quantity of water and chemicals for various operations like washing, etc. Low efficiency of chemical operations and spillage of chemicals cause a significant pollution hazard and make the treatment of discharged wastewater a complex problem. But in this process, a significant amount of effluent is generated which needs to be treated and during the process of treatment significant amount of bagasse is generated. Many studies have been conducted in those areas and it needs for an alternative bagasse management. The industrial solid waste of different nature is effectively utilized in Building materials as light weight cement. Although some of the bagasse is disposed in an engineered landfill, much of the bagasse is openly dumped, which leads to soil, surface water and groundwater contamination. The inorganic salts and toxic metals in the bagasse pose a threat to residents. There is a growing need to find alternative solutions for sugarcane bagasse management.

The need of the utilization of the sugarcane effluent bagasse and the pollution due to the bagasse is the scope of this project. Hence the replacement of the bagasse in cement in the manufacturing of the concrete specimen is done in this project. For that the physical and chemical properties of the sugarcane effluent Treatment plant bagasse had been studied and the other construction materials are easily available locally. Various tests are conducted in the used construction materials and their test results are analyzed.

## II. LITERATURE SURVEY

1.Ali Behnood , Hasan Ziari,Effects of silica fume addition and water to cement ratio on the properties of high-strength concrete after exposure to high temperatures, With regard to the results of the present work, it can be concluded that the positive effect of the increased permeability is more than negative effect of the increased moisturecontent in concretes with higher w/c

2.Dilip Kumar Singha Roy, Amitava Sil Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete Lastly with good quality control, high early strength can be achieved in SF concrete which may be useful in various structural constructions such as high-rise buildings, bridges, chimneys, machine foundations, run ways etc., wherein, the timeframe of completion vis-à-vis the economy is an important driven factor for the targeted purpose as well as for the contractors and owners alike as this concrete will provides quick stage by stage or floor to floor construction.

3.N. K. Amudhavalli1, Jeena Mathew EFFECT OF SILICA FUME ON STRENGTH AND DURABILITY PARAMETERS OF CONCRETE Consistency of cement depends upon its fineness. Silica fume is having greater fineness than cement and greater surface area so the consistency increases greatly, when silica fume percentage increases.

4.P.Vinayagam Experimental Investigation on High Performance Concrete Using Silica Fume and Super plasticizer. A simplified mix design procedure for HPC using SF and super plasticizer is formulated by combining BIS and ACI methods of mix design and available literatures on HPC. The optimum percentage of cement replacement by SF is 10% for achieving maximum compressive, split tensile and flexural strength and elastic modulus. The use of SF in concrete reduces the workability. The compression failure pattern of concrete is due to crushing of coarse aggregate and not due to bond failure

5.Lavanya M.R, Sugumaran.B, PradeepAn Experimental study on the compressive strength of concrete by partial replacement of cement with sugarcane bagasse ash Bagasse ash is a valuable pozzolanic material and it can potentially be used as a partial replacement for cement. This could reduce the environmental problems and minimize the requirement of land fill area to dispose SBA.

## SCOPE & OBJECTIVE

1. Reduction of cement content in the building component.
2. There is a great scope in setting up the secondary industries for the recycling and use if huge solid wastes in construction materials.
3. It reduces the disposal problems of the sugarcane industrial bagasse.
4. Environment friendly, energy efficient, and cost effective alternative materials produced from textile wastes will show a good market potential to fulfill people's need in rural and urban areas.
5. The introducing the new build component will reduce the cost of construction to some extent.
6. Reduce environmental pollution.
7. Explore the utilization of sugarcane bagasse in the construction materials.
8. Identify and carry out detailed analysis of the composition of sugarcane bagasse.
9. Utilize the sugarcane bagasse in construction materials.
10. Make the concrete specimen with proper mix of the sugarcane bagasse with the concrete
11. Provide economical and durable concrete specimen.
12. Compare the properties of the developed construction materials with that of existing material

## III. PROPOSED METHOD

### SELECTION OF MATERIALS

Table 1 Physical properties of OPC (53 grade)

| Tests | Results |
|---|---|
| Compressive Strength | 53Mpa |
| Specific Gravity | 3.11 |
| Initial Setting Time | 30 minutes |
| Final Setting time | 6000 minutes |
| Consistency | 27 % |

**FINE AGGREGATES :** Fine aggregates shall conform to the requirements of IS 383. Both river/quarry sand and stone dust meeting the requirements can be used. For fine aggregates, the following test has been carried out and conforming to IS 2386 (part I)-1963.

**Table 2 Chemical composition of OPC (53 grade)**

| **Properties** | **Mass %** |
|---|---|
| Calcium Oxide | 61-67% |
| Silicon di oxide | 19-23% |
| Aluminum di oxide | 2.5-6% |
| Ferric oxide | 0-6% |
| Sulphate | 1.5-4.5% |

**COARSE AGGREGATES**

Coarse aggregates shall comply with the requirements of IS 383. As far as possible crushed/semi-crushed aggregates shall be used. For ensuring adequate durability, the aggregate used for production of blocks shall be sound and free of soft or honeycombed particles. The nominal maximum size of coarse aggregates used in production of concrete specimen shall be 12.5mm. The size of the coarse aggregate should be in the recommended range for cement concrete mixes in general. The aggregates should be sound and free from soft or honeycombed pieces. The proportion of coarse aggregate in the mix is typically 40 per cent.For Coarse aggregates, the following test has been carried out and conforming to IS 2386(part I)-1963**.**

**WATER :**

The Water used for mixing concrete should be portable drinking water having pH value lies between 6 to 8 and the water is free from organic matter and the solid contents should be within the permissible limits as per IS 456-2000 and conforming to 3025-1964.

**SUGARCANE BAGASSE :**

The sugarcane bagasse was obtained from M.R.Krishnamoorthy.Co-Op Sugar Mills LTD Tamilnadu state, India. The bagasse was collected from the bagasse drying beds and land filling areas by random sampling method. The bagasse had a roughly 30 % moisture content. The sample of the bagasse will be dried at a temperature of 105o c until the net weight will be constant. The dried sample will be then ground manually to reduce to size of large and uneven particle into powder form and then directly use.

**IV. EXPERIMENTAL PROGRAMME**

The test program consider of casting and testing of three beams of which one were control beams, all having size of 125 x 250 x 3200mm length and designed as the beam reinforced with 2-12# at bottom, 2-10# at top using 8mm diameter stirrups @165mm c/c. The beams were cast using M60 grade concrete and Fe500 grade steel, Ordinary Portland Cement, natural river sand and the crushed on maximum size 12.5mm. were used, The details of test beam are shown in Fig. dial gauge with a least count of 0.001mm is kept under the specimen at center of the span to measure deflections at mid span. The deflections are measured at a regular interval of 2.0KN and corresponding deflections are recorded. A record of development and progress of the cracks was made for each beam. The test was continued till the load reaches about 85% of the ultimate load on the descending portion. The load at first crack and ultimate load were recorded for each of the specimen tested. The ultimate flexural and shear strengths of the specimens were determined. The crack pattern in test specimens under flexural modes of failures. For all the test beams, the parameters of interest were ultimate load, mid span deflection 1/3 span (both left and right) deflection, composite action, and failure modes, all the test beam were over designed for a shear to avoid the undesirable brittle failure.

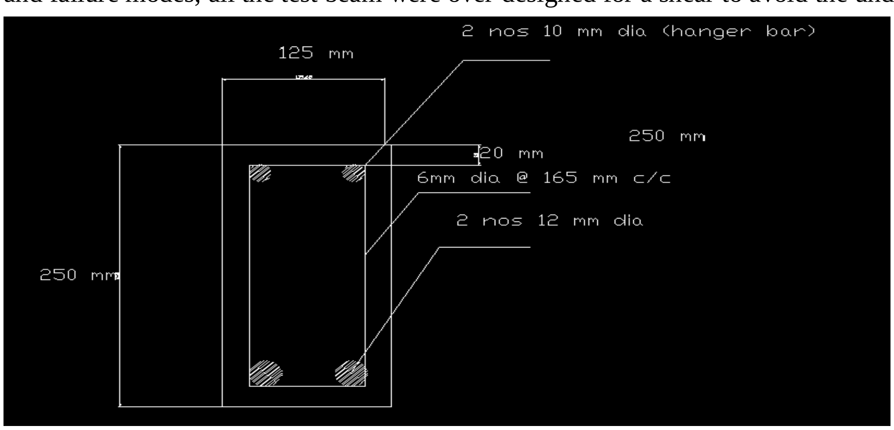



Fig.1 Details of beam reinforcement

## Experimental Test Setup

The specimens were tested in a standard load testing frame of 750kN capacity and the proving ring of 50T capacity. All the beams were simply supported over a simple span of 3m and tested under two point loading. Dial gauges capable of measuring to an accuracy of 0.01mm were placed at mid span ($D_3$) and 1/3 span ($D_1$ and $D_2$) that are used for observations of deflections. The dumec pins were fixed at the front phase of the test observation to measure concrete strain .The crack measuring gauge of 0.02mm accuracy were used for measuring effective crack width. The details of the test setup are shown in figure.

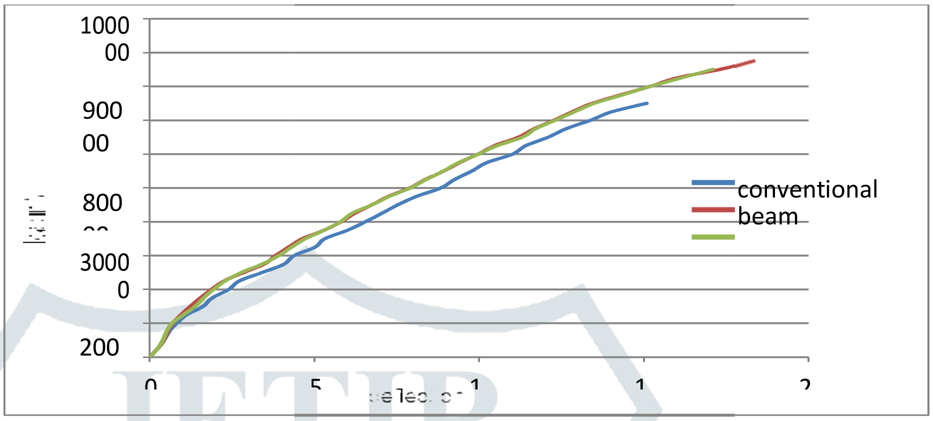
The control specimens were tested by the appropriate tests and the strength properties are obtained. Based on these material properties, the reference valves like cracking load and the corresponding deflection and crackwidth for the test beams were theoretically obtained.

The load- deflection, moment- curvature relationship corresponding to the control concrete beam show in following graphs.

| Sl no | Load | | Dial gauge reading | | | | | | Steel reding |
|---|---|---|---|---|---|---|---|---|---|
| | | | Left | | Centre | | Right | | |
| | Tonne | Newton | in div | in mm | in div | in mm | in div | in mm | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.25 | 2500 | 22 | 0.22 | 24 | 0.24 | 23 | 0.17 | 0.2 |
| 3 | 0.5 | 5000 | 38 | 0.38 | 44 | 0.44 | 39 | 0.39 | 0.4 |
| 4 | 0.75 | 7500 | 52 | 0.52 | 58 | 0.58 | 51 | 0.51 | 0.8 |
| 5 | 1 | 10000 | 68 | 0.68 | 82 | 0.82 | 65 | 0.65 | 1 |
| 6 | 1.25 | 12500 | 82 | 0.82 | 112 | 1.12 | 83 | 0.83 | 1.2 |
| 7 | 1.5 | 15000 | 118 | 1.18 | 162 | 1.62 | 112 | 1.12 | 1.4 |
| 8 | 1.75 | 17500 | 132 | 1.32 | 189 | 1.89 | 132 | 1.32 | 2 |
| 9 | 2 | 20000 | 172 | 1.72 | 240 | 2.4 | 166 | 1.66 | 2.6 |
| 10 | 2.25 | 22500 | 198 | 1.98 | 272 | 2.72 | 194 | 1.94 | 3 |
| 11 | 2.5 | 25000 | 248 | 2.48 | 341 | 3.41 | 258 | 2.58 | 3.2 |
| 12 | 2.75 | 27500 | 314 | 3.14 | 408 | 4.08 | 314 | 3.14 | 4 |
| 13 | 3 | 30000 | 332 | 3.32 | 438 | 4.38 | 330 | 3.3 | 4.4 |
| 14 | 3.25 | 32500 | 392 | 3.92 | 502 | 5.02 | 396 | 3.96 | 5 |
| 15 | 3.5 | 35000 | 404 | 4.04 | 532 | 5.32 | 410 | 4.1 | 5.2 |
| 16 | 3.75 | 37500 | 472 | 4.72 | 601 | 6.01 | 464 | 4.64 | 6 |
| 17 | 4 | 40000 | 520 | 5.2 | 655 | 6.55 | 512 | 5.12 | 6.8 |
| 18 | 4.25 | 42500 | 558 | 5.58 | 705 | 7.05 | 554 | 5.54 | 7.2 |
| 19 | 4.5 | 45000 | 594 | 5.94 | 753 | 7.53 | 592 | 5.92 | 7.8 |
| 20 | 4.75 | 47500 | 642 | 6.42 | 810 | 8.1 | 648 | 6.48 | 8 |
| 21 | 5 | 50000 | 702 | 7.02 | 884 | 8.84 | 720 | 7.2 | 8.6 |
| 22 | 5.25 | 52500 | 752 | 7.52 | 926 | 9.26 | 752 | 7.52 | 9.4 |
| 23 | 5.5 | 55000 | 788 | 7.88 | 978 | 9.78 | 791 | 7.91 | 9.8 |
| 24 | 5.75 | 57500 | 830 | 8.3 | 1024 | 10.24 | 829 | 8.29 | 10.4 |
| 25 | 6 | 60000 | 898 | 8.98 | 1102 | 11.02 | 898 | 8.98 | 11 |
| 26 | 6.25 | 62500 | 922 | 9.22 | 1142 | 11.42 | 932 | 9.32 | 11.4 |
| 27 | 6.5 | 65000 | 982 | 9.82 | 1210 | 12.1 | 984 | 9.84 | 12.2 |
| 28 | 6.75 | 67500 | 1022 | 10.22 | 1264 | 12.64 | 1024 | 10.24 | 12.8 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 29 | 7 | 70000 | 1094 | 10.94 | 1338 | 13.38 | 1080 | 10.8 | 14.4 |
| 30 | 7.25 | 72500 | 1122 | 11.22 | 1402 | 14.02 | 1127 | 11.27 | 16.2 |
| 31 | 7.5 | 75000 | 1198 | 11.98 | 1508 | 15.08 | 1180 | 11.8 | 17 |

**Fig. 2 Load-Deflection Response for combined results**




## V. CONCLUSIONS

Based on the test results and analysis, the following conclusions were made.

1.The results show that the sugarcane bagasse ash in blended concrete had significantly higher compressive strength, tensile strength, and flexural strength compare to that of the concrete without the sugarcane bagasse ash
2.Flexural behaviour of control beam and bagasse beam was studied by using 2 point load .The result indicated that the load carrying capacity of bagasse beam is more than control beam.

## V1. REFERENCES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