EFFECT OF STRENGTH PARAMETERS ON CONCRETE BY A PARTIAL REPLACEMENT OF CEMENT USING BAGASSE ASH

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ABSTRACT

This task is an effective study on Sugarcane Bagasses Ash as a partial substitution of cement. Cement Concrete possesses a significant role in the fields of structural building. The strength of the concrete is known to shift with certain factors, for example cement content, type of aggregate, water cement ratio, mixed proportion etc.., endeavors have been made and kept on supplanting these components particularly cement with the intend to lessen cost without unfavorable impact on strength characteristics of concrete. Sugarcane is one of the most significant horticultural plants that developed in india. Bagasse is a result of the sugarcane business. The consuming of Bagasse leaves, Bagasse ash as a waste which has a pozzolanic property that would conceivably utilized as a cement substitution material. It develops modern waste management system by utilizing industrial waste. The strength characteristics such as compressive strength, split tensile strength and flexural strength of concrete mix are tested for 7days, 28days and 56 days of curing period and Results are analyzed by comparing with conventional concrete mix. Test for grade according to determined methodology of IS codes. Consequently, it is a natural benevolent technique for development to build up methodologies, to discover conservative methods for development by utilizing Bagasse Ash.

Keywords: *Concrete mix, Bagasse ash, Compressive Strength, Spilt tensile Strength and Flexural Strength.*

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1. INTRODUCTION

The industrial and economical development saw in ongoing decades has carried with to increase in the age of various types of waste (urban, industrialization, construction etc.) in spite of the waste management system which have been embraced broadly and universally the act of dumping and the insufficient management of waste from the different manufacturing areas have notably affected the getting condition. Simultaneously, these practices speak to a financial expense. Notwithstanding if squander is overseen accurately it tends to be changed over into an asset which adds to reserve funds in crude materials, protection of characteristic assets and the atmosphere, and advances practical turn of events.

Sugarcane is one of the most significant plants that developed in India. Bagasse is a byproduct effect of the sugarcane industry. The burning of bagasse leaves bagasse debris as a waste, which has a pozzolanic property that would conceivably be utilized as a concrete substitution material. It has been realized that the overall complete creation of sugarcane is more than 1500 million tons. In spite of assortment utilization of bagasse, for creation of wood, papers, creature food, fertilizer and warm protection, measurements show that around one million tone extra of bagasse debris stays in the nation.

This investigation examines the impact of SCBA in concrete by in part substitution of concrete at the proportion of 0%, 5%, 10%, 15%, 20%, and 25% by weight. The exploratory investigation inspects the compressive quality, spilt elasticity and flexural quality of cement. The fundamental fixings comprise of Portland concrete, SCBA, stream sand, coarse total and water. In the wake of blending, solid examples were casted and in this way all test examples were restored in water at 7 days, 28 days and 56 days.

2. MATERIALS

In this section, materials and their properties utilized in concrete and tests conducted on various materials were presented detailed.

Materials and their Properties

Raw materials required for the concrete use in the present work are

1) Cement 2) Coarse Aggregates 3) Bagasse ash 4) Fine aggregate 5) Water

Testing on Cement

The following tests as per IS: 4031-1988 is done to ascertain the physical properties of the cement. The results of the tests are compared to the specified values of IS: 4031-1988.

1) Consistency 2) Specific gravity 3) Initial and Final Setting Time

Table 2.1 Physical Properties of Cement

S. No	Property	Test results
1	Normal consistency	28%
2	Specific gravity	3.10
3	Initial setting time	92 minutes
4	Final setting time	195 minutes

Aggregates

Aggregate are the significant constituents in concrete. They offer body to the solid, lessen shrinkage and impact economy. Aggregate involve 70 to 80 percent of volume of cement. Aggregate are acquired either normally or falsely. Aggregate can be characterized based on size as fine Aggregate and coarse Aggregate.

Fine Aggregate (sand)

The size of the fine Aggregate is underneath 4.75mm.Fine Aggregate can be common or fabricated. The evaluation must be all through the work. The dampness substance or assimilation qualities must be firmly observed. The fine Aggregate utilized is common sand acquired from the waterway adjusting to reviewing zone-II of table 3 of IS: 10262-2009. The consequences of different tests on fine Aggregate are given in table 3.2.

The following tests have been conducted on fine aggregates.

1) Specific Gravity 2) Bulk density 3) Sieve analysis (fineness modulus)

Specific Gravity

Specific Gravity is characterized as the proportion of mass of material to the mass of a similar volume of water at the expressed temperature. The test was directed according to Seems to be IS: 2386-1963 and the qualities are arranged in table 2.2

Bulk Density

Mass thickness is characterized as mass of material to the volume of the holder. The analysis was directed and the qualities are arranged in table 2.2

Table 2.2 Physical Properties of Fine Aggregate

S. No	Property	Value
1	Specific gravity	3.08
2	Fineness modulus	2.28
3	Bulk density: Loose Compacted	$14kN/m^3$ $15kN/m^3$
4	Grading	Zone-II

Sieve Analysis (fineness modulus)

The process of dividing a sample of aggregates into fractions of same particle size is known as a sieve analysis and its purpose is to find fineness. The sieve analysis was carried out using locally available river sand and tabulated in table 2.3.

Table 2.3 Sieve Analysis of Fine Aggregate

Sieve size	Retained	% retained	Cumulative % retained	%passed
4.75	-----	----	-----	100
2.36	6.5	0.65	0.65	99.3
1.18	80.5	8.05	8.7	91.3
600	149	14.9	23.6	76.4
300	733	73.3	96.9	3.1
150	15	1.5	98.4	1.6
Pan	16	1.6	100	0

Fineness Modulus =2.2

Coarse Aggregate

The material whose particles of size are 4.75mm is named as coarse Aggregate and containing just so a lot better material as is allowed for the different sorts portrayed in IS: 383-1970 is considered as coarse Aggregate.

The tests conducted on coarse aggregates.

1) Specific Gravity
2) Fineness modulus
3) Bulk density and Sieve analysis

Specific Gravity

Specific Gravity is defined as the ratio of mass of material to the mass of the same volume of water at the stated temperature. The experiment was conducted as per IS 2386-1963 and the values are tabulated in table-2.4.

Sieve Analysis (fineness modulus)

The process of dividing a sample of aggregates into fractions of same particle size is known as a sieve analysis and its purpose is to find fineness. The sieve analysis was carried out using locally available river sand and tabulated in table 2.5.

Bulk Density

Bulk density is defined as mass of material to the volume of the container. The experiment was conducted and the values are tabulated in table-2.4.

Table 2.4 Physical Properties of Coarse Aggregate

S. No	Property	Value
1	Specific gravity	2.69
2	Fineness modulus	6.02
3	Bulk density Loose Compacted	14 kN/m^3 16 kN/m^3
4	Nominal maximum size	20 mm

Table 2.5 Sieve Analysis of Coarse Aggregate

Sieve size	Retained	% retained	Cumulative % retained
40	0	0	0
20mm	3.78	37.8	37.80
16mm	3.74	37.4	75.20
12.5mm	1.42	14.2	89.40
10.0mm	1.0	10.7	100
480mm	0	0	100
240mm	---	---	100
120mm	---	---	100
Aggregate	10		602.4

$$\text{Fineness Modulus} = \frac{\text{Cumulative \% Retained}}{100} = 602.4/100 = 6.02$$

Sugarcane Bagasse Ash

The prime utilization of bagasse ash in cement would be as pozzolana, that is, as an incomplete substitution for concrete. Another chance is its utilization as a fine aggregate, despite the fact that the amounts accessible are little contrasted and the national yearly utilization of about 1.2 million tons of fine aggregate. The last necessity is as of now being fulfilled by squashing basalt rock and quarrying in diminishing stores of common coral sand. Just a limited quantity (around 3750 tons for every year) is utilized for making pitch reinforced sheets.

Chemical Properties of Bagasse Ash

Pulverized fuel ash, shall conform to the chemical requirements given in Table- 1 in IS 3812-2003, part-1. The fly ash, supplied in dry or moist condition as mutually. However, in case of dry condition, the moisture content shall not exceed 4 percent. All tests for the properties specified in code shall, however, are carried out on oven dry samples. The chemical properties of bagasse ash are showed below table 2.6.

2.6 Chemical Composition of Bagasse Ash

Components	**Mass %**
Silica as SiO_2	70.5
Calcium as CaO	4.7
Potassium as k_2O	12.16
Iron as Fe_2O_3	1.89
Sodium as Na_2O	3.82
Aluminum as Al_2O_3	1.36
Magnesium as MgO	4.68
Titanium as TiO_2	< 0.06
Loss of ignition	0.78

Physical Properties of Bagasse Ash

The cinders are granular, harsh, vascular particles whose greatest sizes can change broadly as the material structures knots in the heater. The overall thickness of the remains on a soaked surface dry premise extend somewhere in the range of 1.90 and 2.12. The cinders additionally have extremely high assimilation estimations of 10 ± 2 percent. The evaluating of the cinders can be very factor, the rate passing 600 um strainer extending from 34 percent to 80 percent.

2.7 Physical Properties of Bagasse Ash

Properties	**Values**
Specific Gravity	2.20
Colour	Black

Density (gm/cm^3)	1.20
Moisture content	6.28%
Surface area	1150 m^2/kg
Fineness Modulus	2.32

Fig.2.1 Sugarcane Bagasse Ash

3. MIX DESIGN

All the mixes prepared are corresponds to M-25 grade. For the design of mix IS: 10262-2009 recommendations are adopted. Design mix proportions of M-25 grade Concrete are given in the following.

Concrete = 378 kg/ m³

Water = 159litre

Fine aggregate: = 797kg

Coarse aggregate = 1238kg

Water Concrete ratio = 0.42

Water	Concrete	Fine aggregate	Coarse aggregate
0.42	1	2.1	3.2

4. EXPERIMENTAL WORK

In this chapter, concepts of experimental work are presented. Objective of testing, i.e. ordinary Portland concrete, fine aggregate, coarse aggregate, potable water and Bagasses ash process of manufacturing of concrete, workability of fresh concrete and testing of hardened concrete procedures are explained in details**.**

Objective of Testing

It was proposed to investigate the properties of concrete, cast with partial replacement of cement with bagasse ash in the ratio of 0%, 5%, 10%, 15%, 20% and 25% proportions and cured in water.

Table 4.1 No. of specimens prepared for determining hardened properties.

Specimens	**No. of specimen cured in water**					
	NORMAL MIX	SCBA 5%	SCBA 10%	SCBA 15%	SCBA 20%	SCBA 25%

Cubes	9	9	9	9	9	9
Cylinders	9	9	9	9	9	9
Beams	9	9	9	9	9	9
Aggregate	27	27	27	27	27	27

OBSERVATIONS

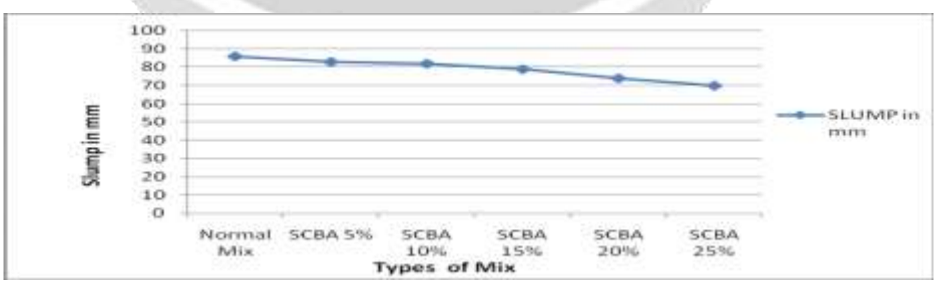
the experimental observations discussed are presented. Observations of slump and compaction factor in respect of fresh concrete are noted. The test results such as compressive strength, split tensile strength and flexural strength of hardened concrete of M25 grade replacement of cement with bagasse ash in the ratio of 0%, 5%, 10%, 15%, 20% and 25% proportions mixes at the ages of 7 days , 28 days and 56 days are detailed**.**

Slump Cone Test

The slump cone test was conducted for all the six mixes. Slump for different mixes are shown below.

Table 4.2 Slump Cone Test Results

S.No	Mix	Slump (mm)
1	NORMAL MIX	86
2	SCBA 5%	83
3	SCBA 10%	82
4	SCBA 15%	79
5	SCBA 20%	74
6	SCBA 25%	70



Graph 4.1 Slump test vs mixes

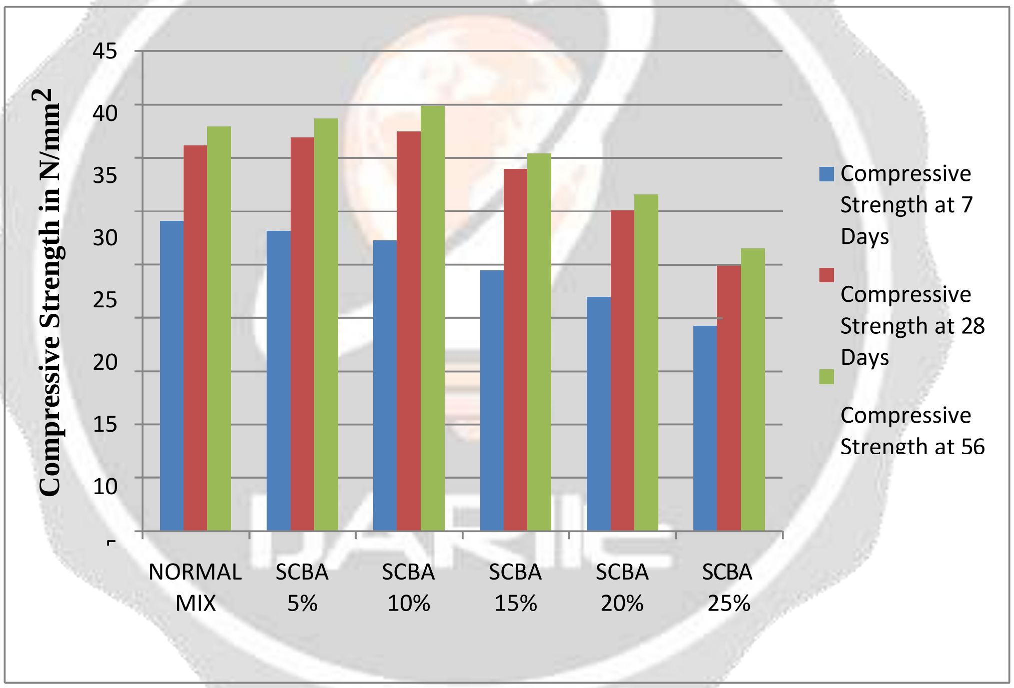
From the above diagram the graph of slump for SCBA 5% has reduced to 4.7% when compared with Normal Mix. The droop for SCBA 10%, SCBA 15%, SCBA 20% and SCBA 25% has decreased by 6.9 %, 10.5%, 16.3% and 21% when compared with ordinary mix. The droop esteem was bit by bit decreased. when compared with ordinary mix. This difference in height in mm is consider as slump of concrete.

Compressive Strength

The compressive strength of the concrete was done on 150 x 150 x 150 mm cubes. Testing were done at 7 days, 28 days and 56 days.

Table 4.3 Compressive Strength Test Results

S.No	Mix	Compressive Strength (N/mm^2)		
		7 Days	28 Days	56 Days
1	NORMAL MIX	29.13	36.18	37.11
2	SCBA 5%	28.15	36.89	37.85
3	SCBA 10%	27.26	37.52	38.03
4	SCBA 15%	24.44	33.93	34.59
5	SCBA 20%	21.93	30.07	30.74
6	SCBA 25%	19.26	24.85	25.70



Graph 4.2 Compressive Strength vs Age in days

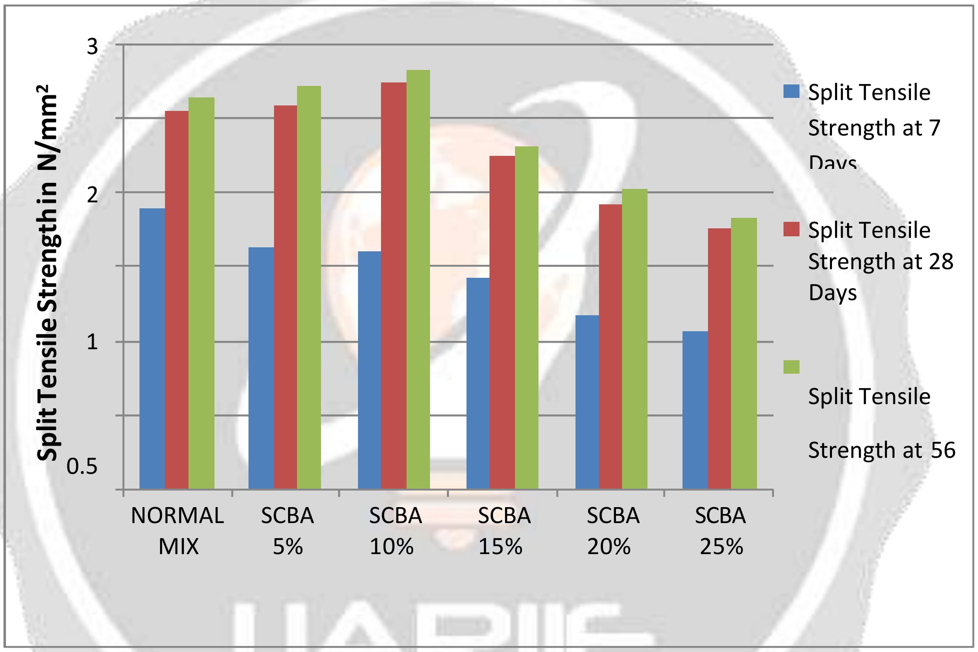
Split tensile strength

The split tensile strength was measured on 150 x 300 mm specimen.

Table 4.4 Split Tensile Strength Test Results

S.No	Mix	Split Tensile Strength (N/mm^2)		
		7 Days	28 Days	56 Days
1	NORMAL MIX	1.89	2.55	2.59

2	SCBA 5%	1.63	2.59	2.65
3	SCBA 10%	1.60	2.75	2.80
4	SCBA 15%	1.42	2.25	2.29
5	SCBA 20%	1.17	1.92	1.98
6	SCBA 25%	1.06	1.76	1.80



Graph 4.3 Split Tensile Strength graph vs age

Flexural strength

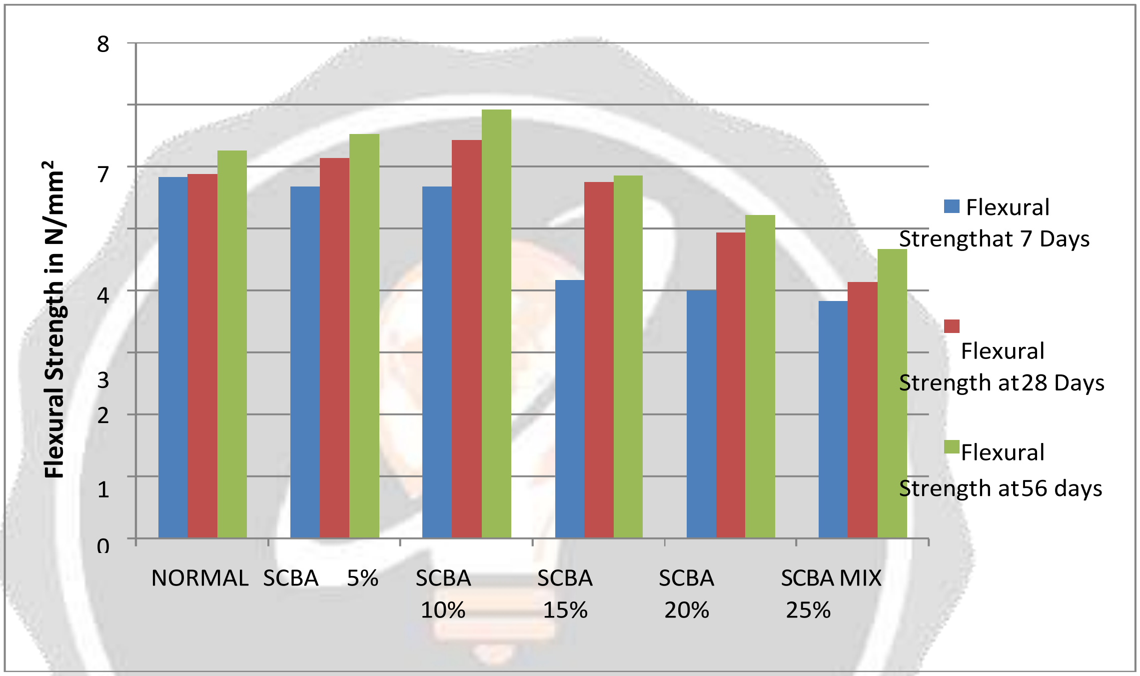
Flexural strength of the concrete was determined from modulus of rupture test on beam specimens of 100 x 100 x 500 mm size.

Here also, a total of 54 specimens were cast out of which three specimens were tested for each mix at 7days, 28 days and 56 days.

Table 4.5 Flexural Strength Test Results

S.No	**Mix**	**Flexural Strength (N/mm^2)**		
		7 Days	**28 Days**	**56 Days**
1	NORMAL MIX	4.67	5.87	6.10
2	SCBA 5%	4.53	6.13	6.46

3	SCBA 10%	4.53	6.43	6.65
4	SCBA 15%	3.33	5.75	5.83
5	SCBA 20%	3.20	4.93	5.02
6	SCBA 25%	3.07	4.13	4.58



Graph 4.4 Flexural Strength graph vs Age

5. Conclusions

Based on the study, following conclusions can draw.

i. There is an adjustment in droop for SCBA 5% has diminished 3.5% when contrasted and ordinary blend.

ii. The droop for SCBA 10%, SCBA 15%, SCBA 20% and SCBA 25% has decreased by 4.7%, 8.2%, 14% and 18.7% individually when compared to the normal mix.

iii. To get the necessary droop utilize the admixtures.

iv. The compressive strength of SCBA mixs at 7 days was slowely reduces its strength when compared to the ordinary mix due with pozzolanic action.

v. It was seen that the compressive strength of SCBA 5% and SCBA 10% at 28 days has arrived at its objective mean strength; anyway the compressive strength was increased by 2.04% and 6.55% when compared to the ordinary mix.

vi. It was seen that the compressive strength of SCBA 15%, SCBA 20% and SCBA 25% at 28 days has reduced its compressive strength by 6.15%, 16.92% and34.13% separately when compared to the ordinary mix.

vii. The split tensile strength of mix SCBA 5% and SCBA 10% at 28 days has gain its strength by 4.42% and 9.5% separately when compared to the ordinary mix.

viii. The split tensile strength of mix SCBA 15%, SCBA 20%, SCBA 25% at 28 days has decrease it strength by 11.8%, 24.8% and 32.7% when compared to the ordinary mix.

ix. The flexural strength of SCBA 5%, SCBA 10% at 28 days has gains its strength by 4.42%, 9.5% when

compared to the ordinary mix.
xi. The strength of SCBA 5% and SCBA 10% at 56 days increase its compressive, split tensile and flexural strength , when compared to the normal mix.
x. The flexural strength of SCBA 15%, SCBA 20% and SCBA 25% at 28 days has reduced it strength by 2.4%, 16.1% and 26.5% when compared to the mix.
xii. Similarly the strength of SCBA 15%, SCBA 20% and SCBA 25% at 56 days reduced its compressive, split tensile and flexural strength when compared to the ordinary mix.
xiii. Finally I presume that cement alternates with bagasse ash up to 10% least loss of its compressive strength.
xiv. Considerable lessening in compressive strength was seen from 15% cement substitution.
xv. It has been appeared in this investigation that 10% sugarcane bagasse ash can be utilized as a halfway concrete supplanting material with specialized and natural advantages. Concerned partner, for example, sugar enterprises, concrete ventures and applicable government foundations, ought to be made mindful about this potential concrete substitution material and advance its normalized creation and use.
xvi. To improve the strength of SCBA 15%, SCBA 20% utilizing compound admixtures like miniaturized scale silica and super plasticizers for improving the quality.

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