iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: III Month of publication: March 2022

DOI: https://doi.org/10.22214/ijraset.2022.40616

Assessment of M30 Grade Self Compaction Concrete by Partial Replacement of Bagasse Ash in Place of Cement and Glass Powder in Place of Fine Aggregate

Polisetti Veerendra[1], Ch. Gangabhavani[2]
[1]*M. Tech (Structural Engineering), Department of Civil Engineering, Kakinada Institute of Technology And Science. Divili*
[2]*Asst.Professor, Department of Civil Engineering, Kakinada Institute of Technology And Science. Divili*

Abstract: Self-compacting concrete (SCC), a recent innovation in concrete technology, has numerous advantages over conventional concrete. Self-compacting concrete, as the name indicates, is a type of concrete that does not require external or internal compaction, because it becomes leveled and consolidated under its self weight. SCC can spread and fill all corners of the formwork, purely by means of its self- weight, thus eliminating the need of vibration or any type of consolidating effort. This report demonstrates the possibilities of using Bagasse ash and Glass powder as partial replacement of cement and fine aggregate in concrete. This experimental investigation was performed to evaluate the strength properties of concrete, in which the cement is partially replaced by Bagasse ash and fine aggregate was partial replaced with Glass powder. Cement was replaced by weight with five percentages (0%, 5%, 10%, 15%, 20%) and fine aggregate was replaced with only one percentage (20%) of Glass powder by weight. Fresh properties of self-compacting concrete were studied. Compression test, splitting tensile strength and flexural strength test were carried out to evaluate the strength properties of concrete at the age of 7, 14, and 28 days.
Keywords: Bagasse ash, Glass powder, Self-compacting concrete, splitting tensile strength, Compressive strength, flexural strength.

I. INTRODUCTION

A. General

Concrete is the man-made material which has the vast utilization worldwide. This fact leads to important problems regarding its design and preparation to finally obtain an economic cost of the product on short and longtime periods. The material has to be also "friendly with the environment" during its fabrication process and also its aesthetical. Appearance when it is used in the structures. Its success is when its raw materials that have a large spreading into the world, the prices of raw materials that are low and the properties and the performances of the concrete that confers it a large scale of application. Concrete's performances have continuously rise in order to accomplish the society needs. Many studies have been made concerning the use of additives and super–plasticizers in the concrete by using minimum water content for a good workability of a concrete. As a result of this, high performance concretes developed having a superior durability. Self-compacting concrete, as the name indicates, is a type of concrete that does not require external or internal vibration for placing and compaction but it gets compacted under its self-weight. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. At the same time it is cohesive enough to fill spaces of almost any size and shape without segregation or bleeding. This makes SCC particularly useful wherever placing is difficult, such as in heavily reinforced concrete members or in complicated formwork.

B. Development Of Self-Compacting Concrete

For several years beginning in 1983, the problem of the durability of concrete structures was a major topic of interest in Japan. To make durable concrete structures, sufficient compaction by skilled workers is required. However, the gradual reduction in the number of skilled workers in Japan's construction industry has led to a similar reduction in the quality of construction work. One solution for the achievement of durable concrete structures independent of the quality of construction work is the employment of self-compacting concrete, which can be compacted into every corner of a formwork, purely by means of its own weight and without the need for vibrating compaction. The necessity of this Introduction, type of concrete was proposed by Professor Hajime Okamura in 1986. Studies to develop self -compacting concrete, including a fundamental study on the workability of concrete, were carried out by Ozawa and Maekawa at the University of Tokyo.SCC technology in Japan was based on using conventional super plasticizers to create highly fluid concrete, while also using viscosity - modifying agents (VMA) which increase plastic viscosity thus preventing segregation up to a level of fluidity that would normally cause segregation.

The prototype of self-compacting concrete was first completed in 1988 using materials already on the market. The prototype performed satisfactorily with regard to drying and hardening, shrinkage, heat of hydration, denseness after hardening, and other properties (Okamura and Ouchi , 2003). This concrete was named "High Performance Concrete." and was defined as follows at the three stages of concrete:

1) Fresh: self- compactable
2) Early age: avoidance of initial defects
3) Hardened: protection against external factors

At almost the same time, "High Performance Concrete" was defined as a concrete with high durability due to low water - cement ratio by Professor Aitcin. Since then, the term high performance concrete has been used around the world to refer to high durability concrete. Therefore, Okamura has changed the term for the proposed concrete to "Self -Compacting High Performance Concrete."

II. PROPERTIES OF SELF-COMPACTING CONCRETE

Fresh SCC must possess at required levels the following key properties related to workability:

1) *Filling Ability:* This is the ability of the SCC to flow, spread and fill into all spaces within the formwork under its own weight.
2) *Passing Ability:* This is the ability of the SCC to flow through tight openings such as spaces between steel reinforcing bars, under its own weight without blocking them.

A. Advantages And Disadvantages Of Self-Compacting Concrete

1) Advantages

a) No vibration of fresh concrete is necessary during placement into forms.
b) Placement of concrete is easier.
c) Faster and more efficient placement of fresh concrete is achieved. Total concreting time is reduced.
d) Energy consumption is reduced.
e) Required number of workers on construction site is reduced.
f) Safer and healthier working environment is obtained.
g) High quality of placed concrete is achieved, regardless the skill of the workers.
h) Good bond between concrete and reinforcement is obtained, even in congested reinforcement.
i) High quality of concrete surface finish is obtained with no need for subsequent repair.
j) Improved form surface finish and reduced need to repair defects such as bug holes and honeycombing.
k) Improved ability of concrete to flow into intricate spaces and between congested reinforcement.
l) Reduced construction costs due to reduced labour costs and reduced equipment purchase and maintenance costs.
m) Increased construction speed due to fewer construction tasks.
n) Faster unloading of ready mixed concrete trucks.
o) Improved working conditions with fewer accidents due to elimination of vibrators.
p) Improved durability and strength of the hardened concrete in some cases.
q) Reduced noise generated by vibrators.

2) Disadvantages

a) Increased material costs, especially for admixtures and cementitious materials.
b) Increased formwork costs due to possibly higher formwork pressures and to prevent leakage.
c) Increased technical expertise required to develop and control mixtures.
d) Increased variability in properties, especially workability.
e) Increased quality control requirements.
f) Reduced quality of hardened properties in some cases possibly including modulus of Elasticity and dimensional stability—due to factors such as high paste volumes or finer combined aggregate grading.
g) Delayed setting time in some cases due to the use of admixtures.
h) levels of properties and its composition remains uniform throughout the process of transport and placing that is keeps the sand and aggregate in suspension

3) Limitations Of Self-Compacting Concrete

a) Production of SCC requires more experience and care than the conventional vibrated concrete. The plant personnel would need training and experience to successfully produce and handle SCC. In the beginning, it may be necessary to carry out more tests than usual to learn how to handle SCC and gain the experience.

b) Before any SCC is produced at the plant and used at the job site, the mix must be properly designed and tested to assure compliance with the project specifications. The ingredients and the equipment used in developing the mix and testing should be the same ingredients and equipment to be used in the final mix for the project.

c) Most common concrete mixers can be used for producing SCC. However, the mixing time may be longer than that for the conventional vibrated concrete. SCC is more sensitive to the total water content in the mix. It is necessary to take into account the moisture/water content in the aggregates and the admixtures before adding the remaining water in the mix. The mixer must be clean and moist, and contains no free water.

d) Admixtures for the SCC may be added at the plant or at the site. There is cost benefit in adding the admixtures at the site. Conventional ready-mix concrete can be bought at a lower cost than the cost of SCC bought from a ready-mix supplier.

In this study, only 20% of Glass powder is used constant and Bagasse ash is partially replaced as the mineral admixture and an attempt is made to maximize the cementitious content in Self Compacting Concrete.

B. BAGASSE ASH

Bagasse Ash was burnt for approximately 72 hours in air in an uncontrolled burning process. The temperature was in the range of 700-15500C. The ash collected was sieved through BIS standard sieve size 75µm and its colour was black. It was then measured by volume to replace the cement at 5%,10%,15%and 20%.Bagasse ash is taken from the nearing sugar mill factory. Specific gravity given by the manufacturer is about 1.84. Sugarcane Bagasse Ash was collected during the cleaning operation of a boiler operating in the Nava Bharat venturs Ltd.(sugar division) Sugar Factory, located in the city of Samalkot, Andhra pradesh.

C. Glass Powder

The chemical composition of soda lime glass which is most commonly used. The chemical composition of glass SiO_2 and (Na_2O+K_2O) of glass and much higher than fly ash and cement total reactive component (SiO_2+Al_2O_3+Fe_2O_3) of glass and fly ash is about the same. Other main constituent are in similar range to those of fly ash and cement. Glass has a potential to be used as a powder in SCC. The preferred fineness of addition for SCC is more than 70% of particle passing 0.063mm fine glass powder was reported to contribute to Micro Structural Properties due to its filler effect pozzolanic reactivity the sulphate resistance/ penetration resistance and freezing/thawing of concrete was all improvement after incorporating 20-30% glass powder compare to those of bagasse ash.

III. EXPERIMENTAL PROGRAMME

A. General

The chapter describes the details of experimental programs for the measurements of fresh properties, strength properties (compressive strength, splitting tensile strength) of self-compacting concrete mixes made with varying percentages of Bagasse ash as partial replacement of cement along with the partial use of glass powder in place of fine aggregates.

The basic tests carried out on concrete samples are discussed in this chapter, followed by a brief description about mix deign and curing procedure adopted. At the end, the various tests conducted on the specimens are discussed.

B. Materials Used

1) Cement: Ordinary Portland Cement (OPC) Grade 53 JK cement was used for casting cubes and cylinders for all concrete mixes.

Physical Properties of Ordinary Portland Cement

Physical Properties	BIS- 8112:1989	Test Result
Standard Consistency (%)		29.5
Setting time (min)		
Initial	30 Min.	92
Final	600 Max	248
Compressive Strength (MPa)		
3 day	29.15	28.85
7 day	46.22	48.21
28 day	53	57.84
Specific gravity	_	3.12

The cement was of uniform colour i.e. grey with a light greenish shade and was free from any hard lumps. It was tested as per Indian standard specification (BIS-8112:1989)

2) *Fine Aggregates:* The sand used for the experimental programme was locally procured and conformed to Indian Standard Specifications BIS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. The aggregates were sieved through a set of sieves to obtain sieve analysis. Aggregates used were in dry state and correction for water absorption was made. The fine aggregate belonged to grading zone II. Its physical properties and sieve analysis are given in Tables 3.2 and Table 3.3 respectively.

Table Physical Properties of Fine Aggregate

Characteristics	Value
Specific gravity	2.57
Bulk density	1.3
Fineness modulus	2.65
Water absorption	1.2
Grading Zone (Based on percentage passing 0.60 mm)	Zone II

Sieve Analysis of Coarse Aggregates

Sample taken: 1000g

S.no	IS sieve designation	Weight retained	Cumulative weight retained	Cumulative % weight retained	% passing
1	4.75mm	20	20	2	98
2	2mm	50	70	7	93
3	1mm	160	230	23	77
4	600µ	330	560	56	44
5	425µ	240	800	80	20
6	300µ	100	900	90	10
7	150µ	90	990	99	1
8	75µ	10	1000	100	0

Fineness modulus of fine aggregate = 2.65
The sand conforms to grading zone II as per BIS: 383-1970

3) *Coarse Aggregates:* The material which is retained on IS sieve no. 4.75 is termed as a coarse aggregate. The crushed stone is generally used as a coarse aggregate.. Locally available coarse aggregate having the maximum size of 10 mm was used. The aggregates used were dry condition and correction of absorption was taken. The aggregates were tested as per IS: 383-1970.Physical properties and sieve analysis results are given in Tables 3.4 and Table 3.5 respectively.

Physical Properties of Coarse Aggregates (10mm)

Properties	Observed values
Colour	Grey
Maximum size (mm)	10
Specific Gravity	2.65
Total Water Absorption (%)	0.70
Moisture content(%)	Nil

Sieve Analysis of Coarse Aggregates

Weight of Sample taken: 2000 gm

Sieve size in mm	Weight retained (g)	Cumulative weight retained (g)	Percentage cumulative weight retained	Percentage cumulative weight passed
25	0	0	0	100
20	404	404	20.2	79.8
10	1596	2000	100	0
4.36	0	0	0	0
Pan	0	0	0	0

Fineness modulus = (ΣF + 500)/100
= (120.2 + 500)/100
= 6.20

Fineness modulus of coarse aggregate = 6.20

Coarse aggregates conformed to BIS: 383- 1970.

WATER Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling is necessary. When it is suspected that water may contain sewage, mine water, or wastes from industrial plants or canneries, it should not be used in concrete unless tests indicate that it is satisfactory. Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent tap water is used for casting.

C. Mineral Admixtures

1) *Bagasse ASH:* Bagasse is the residue obtained from the bagasse in sugar producing factories . Bagasse is the cellular fibrous waste product after the extraction of sugarcane juice in industries. Generally the bagasse is used as bio-fuel, the ash produced in this process is about 3 tons for 10 tons sugarcane crush. The ash is rich in silica which imparts cementing properties increasing the workability and strength of Concrete. Bagasse Ash was burnt for approximately 72 hours in air in an uncontrolled burning process. The temperature was in the range of 700-1550^{0}C.The ash collected was sieved through BIS standard sieve size 75µm and its colour was black. It was then measured by volume to replace the cement at 5%,10%,15%and 20%.Bagasse ash is taken from the nearing sugar mill factory. Specific gravity given by the manufacturer is about 1.84. Sugarcane Bagasse Ash was collected during the cleaning operation of a boiler operating in the Nava Bharat venturs Ltd.(sugar division) Sugar Factory, located in the city of Samalkot, Andhra pradesh. The chemical composition of bagasse ash is listed in below.

Table Chemical Composition of The Bagasse Ash

S.No	Composition (% by mass)/property	Bagasse Ash
1	SiO_2	78.34
2	Al_2O_3	8.55
3	Fe_2O_3	3.61
4	CaO	2.15
5	Na_2O	0.12
6	K_2O	3.46
7	MnO	0.13
8	TiO_2	0.50
9	P_2O_5	1.07
10	Loss on ignition	0.42

IV. RESULTS

A. Compressive Strength

1) *Effect of Bagasse Ash and Glass Powder On Compressive Strength:* Effect of BA and GP on compressive strength of M30 Grade concrete mixes SCC-1(0%BA &0%GP), SCC-2 (5%BA &20%GP), SCC-3(10%BA &20%GP), SCC-4 (15%BA &20%GP) and SCC-5 (10%BA &20%GP), at the age of 7, 14 and 28days are shown in Fig. 4.6. Mix proportion of control concrete mix SCC-1 was 450 kg cement; 557.672 kg fine aggregate 139.418 kg of Glass powder and 1008 kg coarse aggregate per cubic meter of concrete with water-cement ratio 0.43. Compressive strength of control concrete mix was 37.13 MPa at the age of 28 days. It was found that, at the age of 7 days, compressive strength of mix SCC-1 (0%BA &0%GP) was 27.346 MPa and mixes SCC-2 (5%BA &20%GP), SCC-3 (10%BA &20%GP), SCC-4 (15%BA &20%GP) and SCC-5 (10%BA &20%GP) were 28.116, 32.506, 36.786 and 31.10 MPa, respectively. Maximum compressive strength (36.786 MPa) was observed for SCC-4 (15%BA &20%GP) concrete mix; it was 34.52 % more than the control mix SCC-1(0%BA &0%GP). At the age of 28 days, percentage increase in compressive strength was 14.66%, 23.54%, 46.143% and 20.17% for mixes SCC-2, SCC-3,SCC-4 and SCC-5 than control mix SCC-1(37.13 MPa, it was observed that compressive strength of concrete increased with the increase in BA and GP content up to 15% as partial replacement of cement and 20% of fine aggregate.

Table 4.2: Compressive strength of concrete mixes with Bagasse ash and Glass powder

Mix	Compressive Strength (N/mm^2)			Average Compressive Strength (N/mm^2)		
	7 days	14days	28 days	7 days	14days	28 days
SCC-1 CM	27.36	30.20	36.95	27.34	31.61	37.13
	28.02	32.80	36.30			
	27.35	31.85	38.15			
SCC-2	28.35	34.15	42.75	28.11	34.57	42.57
	28.05	34.26	41.95			
	27.95	35.31	43.02			
SCC-3	33.10	43.21	46.25	32.50	42.35	45.87
	31.78	41.49	45.59			
	32.64	42.35	45.78			
SCC-4	36.21	47.20	54.35	36.78	46.58	54.26
	37.35	46.35	53.24			
	36.80	46.21	55.2			
SCC-5	31.44	41.09	45.82	31.10	40.06	44.62
	29.20	40.01	44.76			
	32.67	39.08	43.33			

Figure 4.6: Compressive strength of SCC Mixes of specimen size 150x150x150 with shows the variation of percentage increase in compressive strength with replacement percentage of bagasse ash and glass powder. The results also indicate that early age strength gain i.e. at 7 and 28 days, is higher when compared to the control mix if 15% of cement is replaced by bagasse ash and 20%fine aggregate is replaced by glass powder.

Figure 4.6: Compressive Strength Results

2) *Effect of Age on Compressive Strength:* Effect of age on compressive strength of M30 Grade (37.13 MPa) concrete mixes are Shown in Fig. 4.8. Compressive strength of all concrete mixes increased with age. Concrete mix SCC-1 (0% BA and 0% GP) achieved an increase of 15.614 and 35.778 % at the age of 14 and 28 days respectively, when compared with 7 days compressive strength (27.346 MPa). For mix SCC-2(5%BA &20%GP) (28.116 MPa), compressive strength was increased by 22.965 and 51.419% at the age of 14 and 28 days respectively, whereas an increase of 30.283% was observed at 14 days and 41.11% at 28 days for SCC-3 (10%BA &20%GP). When SCC-4 (15%BA &20%GP) where as an increase of 26.624% was observed at 14 days and 47.509% at 28 days was compared with 7 days compressive strength (36.786 MPa) and for SCC-5 (20%BA &20%GP)., it was found that it increased by 28.810 and 43.472% at 14 and 28 days respectively. Comparative study of compressive strength between 7 to 28 days indicate that % increase in compressive strength was observed as 26.35,33.95,29.13,32.207 and 30.30% for mix SCC-1, SCC-2, SCC-3,SCC-4 and SCC-5 respectively.

B. *Split Tensile Strength*

1) *Effect Of Bagasse Ash And Glass Powder On Split Tensile Strength:* Split tensile strength studies were carried out at the age of 7, 14 and 28 days. Test results are given below in Table 4.3. The variations in split tensile strength with Bagasse ash and Glass powder content were similar to that observed in case of compressive strength. Split tensile strength of concrete mixes increased with the increase in BA&GP content. Split tensile strength of control mix SCC-1(0%BA&0%GP) was 2.79 MPa at 7 days. It increased by 9.318%, 18.99%, 34.26%and 12.29% for SCC-2 (5%BA&20%GP), SCC-3 (10%BA&20%GP), SCC-4(15%BA&20%GP) and SCC-5 (20%BA&20%GP) respectively. Higher value of split tensile strength was observed at 15% BA& 20%GP. At the age of 14 days, increase was 19.53%, 33.62%, 51.55% and 29.45% for SCC-2, SCC-3, SCC-4 and SCC-5 concrete mixes respectively than mix SCC-1 (3.123MPa). At 28 days, split tensile strength of mix SCC-1(0%BA&0%GP) was 3.746 MPa. Concrete mix SCC-2, SCC-3, SCC-4 and SCC-5 achieved an increase of 13.53%, 32.22%, 58.38% and 20.39%.. It was observed that up to 15%of bagasse ash and 20% of glass powder replacement cement and fine aggregate with, concrete mixture SCC-4 (15%BA&20%GP) showed higher value of split tensile strength among all mixes.

Table Split tensile strength of concrete mixes with Bagasse ash and Glass powder

Mix	Split Tensile Strength (N/mm^2)			Average Split Tensile Strength (N/mm^2)		
	7 days	14days	28 days	7 days	14days	28 days
SCC-1 CM	2.56	3.15	3.70	2.79	3.12	3.74
	2.89	3.21	3.85			
	2.92	3.01	3.69			
SCC-2	3.05	3.50	4.21	3.05	3.73	4.25
	3.11	3.80	4.30			
	2.99	3.90	4.25			
SCC-3	3.23	4.12	4.73	3.32	4.17	4.95
	3.40	4.09	4.92			
	3.35	4.31	5.21			
SCC-4	3.67	4.50	5.70	3.74	4.73	5.93
	3.72	4.90	6.10			
	3.85	4.80	6.0			
SCC-5	3.11	3.90	4.41	3.13	4.04	4.51
	3.08	4.05	4.52			
	3.21	4.18	4.60			

Figure shows the variation of split tensile strength with the percentage of Bagasse ash and Glass powder replaced. Figure 4.7 shows the variation of percentage increase in split tensile strength with replacement percentage of Bagasse ash and Glass powder. The strength gain at age of 5.933 and 28 days is highest for 15% Bagasse ash and 20% Glass powder replacement in cement and Fine aggregate respectively.

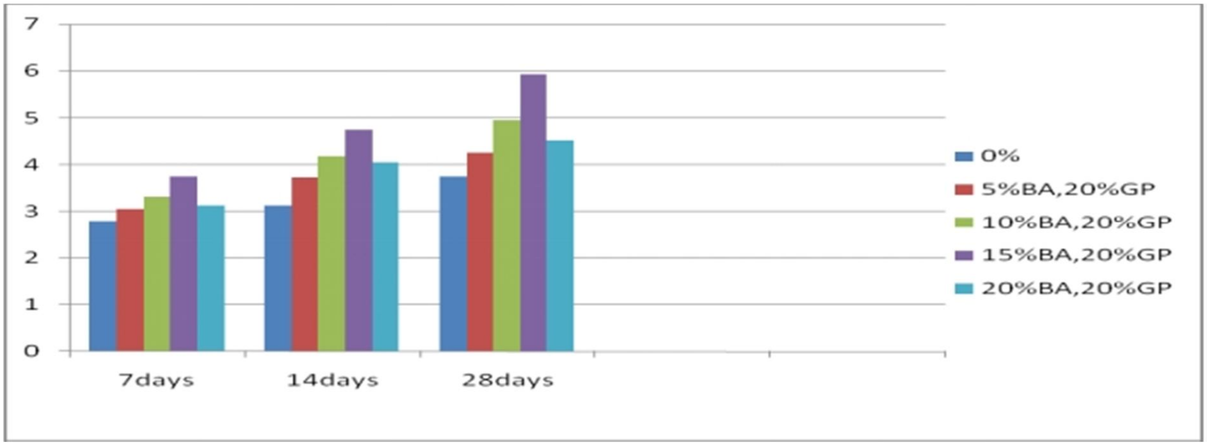

Figure Split Tensile Strength Results

C. Flexural Strength

1) *Effect of Bagasse Ash and Glass Powder on Flexural Strength:* Flexural strength studies were carried out at the age of 7, 14 and 28 days. Test results are given below in Table 4.4. The variations in flexural strength with Bagasse ash and Glass powder content were similar to that observed in case of compressive strength. Flexural strength of concrete mixes increased with the increase in BA&GP content. Flexural strength of control mix SCC-1(0%BA&0%GP) was 5.16 MPa at 7 days. It increased by 2.44%, 5.096%, 8.14%and 1% for SCC-2 (5%BA&20%GP), SCC-3 (10%BA&20%GP), SCC-4(15%BA&20%GP) and SCC-5 (20%BA&20%GP) respectively. Higher value of flexural strength was observed at 15% BA& 20%GP. At the age of 14 days, increase was 0.65%, 3.422%, 4.905% and 0.2% for SCC-2, SCC-3, SCC-4 and SCC-5 concrete mixes respectively than mix SCC-1 (7.216MPa). At 28 days, flexural strength of mix SCC-1(0%BA&0%GP) was 9.12 MPa. Concrete mix SCC-2, SCC-3, SCC-4 and SCC-5 achieved an increase of 2.302%, 4.715%, 5.921% and 0.8%.. It was observed that up to 15%of bagasse ash and 20% of glass powder replacement cement and fine aggregate with, concrete mixture SCC-4 (15%BA&20%GP) showed higher value of flexural strength among all mixes.

Table shows the details of the flexural strength of M30 grade of SCC.

Table Flexural strength of concrete mixes with Bagasse ash and Glass powder

Mix	Flexural Strength (N/mm^2)			Average Flexural Strength (N/mm^2)		
	7 days	14days	28 days	7 days	14days	28 days
SCC-1 CM	5.13	7.25	9.2	5.16	7.216	9.12
	5.20	7.18	9.05			
	5.15	7.22	9.11			
SCC-2	5.16	7.26	9.35	5.12	7.263	9.33
	5.10	7.28	9.4			
	5.12	7.25	9.24			
SCC-3	5.13	7. 41	9.48	5.15	7.463	9.55
	5.08	7.5	9.62			
	5.24	7.48	9.55			
SCC-4	5.15	7.52	9.7	5.19	7.57	9.66
	5.20	7.59	9.65			
	5.22	7.61	9.64			
SCC-5	4.72	7.24	9.22	4.69	7.23	9.2
	4.69	7.31	9.18			
	4.66	7.14	9.2			

Figure 4.8 shows the variation of flexural strength with the percentage of Bagasse ash and Glass powder replaced. Figure 4.8 shows the variation of percentage increase in flexural strength with replacement percentage of Bagasse ash and Glass powder. The strength gain at age of 4.56 and 28 days is highest for 15% Bagasse ash and 20% Glass powder replacement in cement and Fine aggregate respectively.

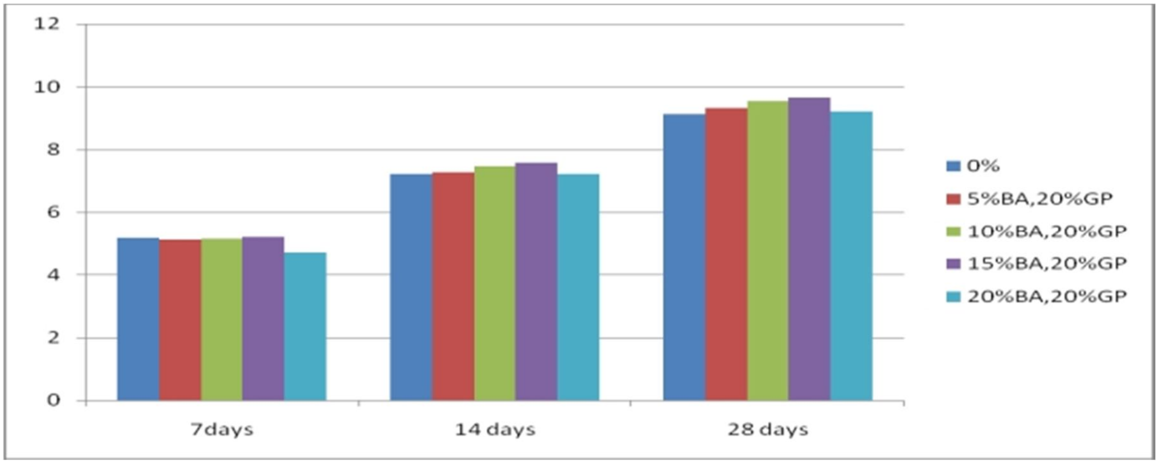

Figure 4.8: Flexural Strength Results

V. CONCLUSIONS

A. General

The present work investigated the influence of bagasse ash and glass powder as partial replacement of cement and fine aggregate (sand) on the properties self-compacting concrete. On the basis of the results from the present study, following conclusions are drawn.

B. Strength Properties

1) Compressive Strength

a) Compressive strength of concrete mixes increased due to partial replacement of fine aggregate with glass powder and partial replacement of cement with bagasse ash. However, compressive strength observed was appropriate for structural uses.

b) M30 (37.13MPa) grade concrete mix obtained increase in 28-day compressive strength from 37.12MPa to 54.263MPa on 15% replacement of cement with Bagasse ash and 20% replacement fine aggregate with Glass powder. Maximum strength was achieved with 15% replacement of cement with Bagasse ash and 20% replacement fine aggregate with Glass powder. Beyond 15% replacement of cement with Bagasse ash and 20% replacement fine aggregate with Glass powder it goes to decrease, but was still higher than control concretes.

c) Compressive strength also increased with increase in age of concrete. The rate of compressive development of bagasse ash and Glass powder concrete mixes were higher compared to no bagasse ash and Glass powder concrete mixes

2) Split Tensile Strength

a) Concrete mixes obtained linear increase in 28-day split tensile strength from 3.746 MPa to 5.933MPa for concrete mix on replacement of fine aggregate with bagasse ash at various percentages of 0% to 20% and Glass powder is maintaining a constant percentage of replacement, i.e., 20%.

b) Split tensile strength of all concrete mixes was found to increase with increase in with varying percentage of bagasse ash and constant replacement of Glass powder.

c) Maximum increase in split tensile strength was observed at 15% replacement of cement with Bagasse ash and 20% replacement of fine aggregate with Glass powder at all age for concrete mixes.

3) Flexural Strength

a) Concrete mixes obtained linear increase in 28-day strength from 9.12MPa to 9.66MPa for concrete mix on replacement of fine aggregate with bagasse ash at various percentages of 0% to 20% and Glass powder is maintaining a constant percentage of replacement, i.e., 20%.

b) Flexural strength of all concrete mixes was found to increase with increase in with varying percentage of bagasse ash and constant replacement of Glass powder.

c) Maximum increase in flexural strength was observed at 15% replacement of cement with Bagasse ash and 20% replacement of fine aggregate with Glass powder at all age for concrete mixes.

C. Scope For Futher Work

From this experimental study it is clear indicated that using sugar cane bagasse ash in concrete increase strength.

Following parameters will be study in future work:

1) The simplified mix design methodology was presented may be extended to the more number of concrete strength ranges.
2) The investigations may be conducted with different mineral admixtures like Rice Husk Ash, palm oil ash and GGBS apart from Bagasse ash.
3) To find out optimum amount of different types of mineral admixtures like Rice Husk Ash, palm oil Ash, and GGBS that can be used in concrete for partially replacement of cement without significant loss of strength.
4) To check the various properties of concrete with variation of content of different types of mineral admixtures like Rice Husk Ash, palm oil Ash, and GGBS.

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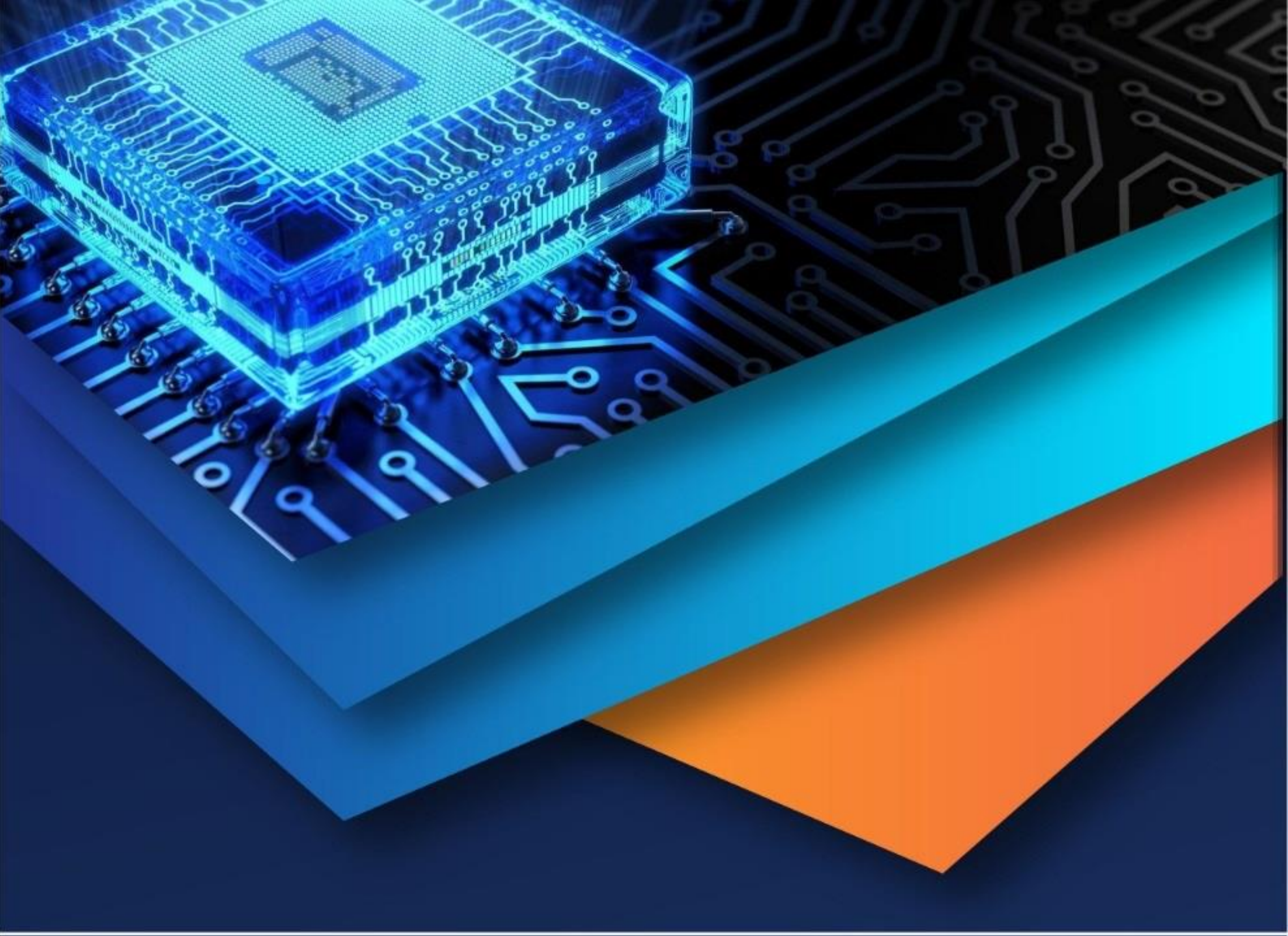

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