Review Article

Review on Strength Properties of BFRC Concrete by Addition of GGBS and Fly Ash

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ABSTRACT

The popularity of the Internet has exploded in recent years. The field of study that analyses people's opinions, sentiments, assessments, attitudes, and emotions from written language is known as sentiment analysis and opinion mining. Users contribute a large amount of user-generated material. The rise of social media platforms such as reviews, forum discussions, blogs, microblogs, Twitter, and social networks has increased the importance of sentiment analysis. Analyzing and summarizing user-generated content is tough. The majority of users express their opinions and thoughts on blogs, social media sites, and e-commerce sites, among other places. As a result, these contents are critical for individuals, businesses, and research projects to make decisions. Sentiment analysis and opinion mining research, which falls under the Natural Language Processing umbrella, is a hot research field in this regard. R is a free and open-source programming language. In this paper, we examine the many ways to sentiment analysis and opinion mining for various datasets in order to determine which strategy is optimal for which dataset, hence assisting researchers in selecting an approach and dataset. In the proposed work, we used the R tool to gather tweets from different events on Twitter, pre-processed them, and calculated sentiment scores from them. We created a Wordcloud for each event, highlighting the most frequently used terms from tweets, as well as calculating the amount of positive, negative, and neutral tweets for each event.

KEYWORDS

Sentiment Analysis and Opinion mining, Natural language processing, SentiWordNet, General Inquirer

1. INTRODUCTION

Concrete is the most widely used material for construction purpose and the most common material cement was mostly used in concrete. In the development of cement, into our atmosphere to the causes of environmental pollution is emitted bulk amount of CO2.The workable solution to this problem is substituting cement with Ground Granulated Blast Furnace Slag (GGBS) and Fly Ash (FA) [2]. The fibers are used for concrete to overcome definite insufficiency. The most common fibers are basalt, glass, polypropylene, carbon fibers and steel. The workability of ternary mixes with Fly ash & GGBS was greater than that of close relative concrete and it increased by increasing the percentage of mineral admixtures. The workability of binary mix containing higher percentage substitution with GGBS and fly ash was higher and lower respectively. Improvement of properties can be observed for mixes designed appropriately [3]. Long term compressive strength of both Fly ash and GGBS mixes can be improved. Addition of 0.25% of basalt fibers (by volume of concrete) showed increment in flexural strength. Addition of varied percentage of fibers made with steel to the optimum percentage of compressive & flexural tensile strength as 15% & 27% respectively. The fly ash and GGBS with 40% as replacement of cement and 3 kg/m3 basalt fibers dosages in concrete developed the better compactness of concrete microstructure, showed Compressive and Flexural tensile strength approximately 10% and 25% higher.

Rishabh Joshi studied the Effect on Compressive Strength of Concrete by Partial Replacement of cement by fly ash and concluded that optimum replacement of cement by fly ash is 30% [4]. Shivakumara B, Dr. Prabhakara H R, Dr. Prakash K B studied Effect Of Sulphate Attack On Strength Characteristic Of Fiber Reinforced High Volume Fly Ash Concrete and concluded that compressive strength and Compressive Strength and flexural strength increased after sulphate attack [5]. Jayeshkumar Pitroda, Dr F S Umrigar studied Evaluation of Soroptivity and Water Absorption of Concrete with Partial Replacement of Cement by Thermal Industry Waste (Fly Ash) and concluded that water absorption and soroptivity increased with increase in fly ash content [6].

2. MATERIALS USED

A. Concrete

Concrete is a product obtained artificially by hardening of the mixture of cement, Sand, gravel and water in predetermined proportions. When these ingredients are mixed, they form a plastic mass which can be poured in suitable moulds, called forms, and so on standing into hard solid mass[1]. The chemical reaction of cement and water, in the mix is relatively slow and require time and favorable temperature for its completion. The time, known as setting time may be divided into three distinct phases.

The first phase designated as time of initial set, requires from 30 minutes to about 60 minutes for completion. During this phase, the mixed concrete decreases its plasticity and develops pronounced resistance to flow [9].

The second phase, known as final set, may vary between 5 to 6 hours after the mixing operation. During this phase, concrete appears to be relatively soft solid without Surface hardness.

The third phase consists of progressive hardening and increase in strength. The process rapid in the initial stage, until about one month after mixing, at which time the concrete almost attains the major portion of its potential hardness and strength [12].

Based on Perspective Specifications:

The cement concrete is specified by proportions of different ingredients, e.g., 1 (cement) :1.5 (fine aggregate):3(coarse aggregate). It is presumed that by adhering to such perspective specifications satisfactory performance may be achieved. The usual mix proportions of cement concrete are given in Table 1. Here, M refers to the mix. This type of concrete mix is also known as nominal mix. Conventional nominal mix proportions have limited significance, since the quantity of fine aggregate is fixed irrespective of the cement content, water-cement ratio and the maximum size of aggregate to be used. The proportions of materials of nominal mix concrete as given in Table 1 are prevalent in field. However, IS: 456 restrict its use only up to M-30 grade[9].

Table 1 Mix Proportions of Cement Concrete

Grade of concrete	M10	M15	M20	M25
Mix proportion	1:3:6	1:2:4	1:1.5:3	1:1:2
Perspective characteristic Strength	10	15	20	25

Based on Grade of Cement Concrete:

Depending upon the strength (N/mm2) of concrete cubes (150mm side) at 28 days, concrete is classified as given in Table 2.

Table 2 Grades of Cement Concrete

Grade of concrete	M5	M7.5	M10	M15	M20	M25	M30	M35	M40	M45	M50
Characteristic Strength	5	7.5	10	15	20	25	30	35	40	45	50

Based on Bulk Density:

On the basis of density, concrete is classified super heavy (over 2500 kg/m3), dense (1800-2500 kg/m3), light weight (500-1800 kg/m3) and extra light weight concrete (below 500 kg/m3).

B. ***Cement*** is a well-known building material and has occupied an indispensable place in construction works. There are a variety of cements available in the market and each type is used under certain conditions due to its special properties [8]. A mixture of cement and sand when mixed with water to form a paste is known as cement mortar whereas the composite product obtained by mixing cement, water, and an inert matrix of sand and gravel or crushed stone is called cement concrete. The distinguishing property of concrete is its ability to harden under water. The cement commonly used is Portland cement, and the fine and coarse aggregates used are those that are usually obtainable, from nearby sand, gravel or rock deposits.

C. ***Aggregates*** can be classified in three different ways as given below:

1. Depending on particle size, aggregates can be classified either as in aggregate (75-micron to 4.75-mm) or coarse aggregate (4.75-mm to 80-mm).

2. Depending upon the bulk density, aggregates can be classified as normal weight (1520 kg/m to 1630 kg/m), lightweight (less than 1220 kg/m) and heavyweight above 2000 kg/m3).

3. Depending on the source, the aggregates could be either naturally available or synthetically manufactured. The former category includes naturally occurring sand, pebbles, gravel or crushed stone while the latter includes located clay aggregates, etc[14].

D. ***Fine Aggregate***

Sand or fine aggregate includes all particles which will pass through a 10-mm IS sieve. Natural sand is by far the most commonly used fine aggregate, though sometimes fine stone and gravel crushing are used when natural sand is not economically available. Sand may be further classified as fine, medium or coarse in accordance with its fineness modulus (FM) as given below:

1. Fine sand, FM 2.20 to 2.60
2. Medium sand, FM 2.60 to 2.90
3. Coarse sand, FM 2.90 to 3.20.

Table 3 Grading Limits for Fine Aggregates (Clause 4.3 of IS:383-1970)

IS sieve	Percentage passing tor grading			
	Zone I	Zone II	Zone III	Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.8 mm	30-70	55-90	75-100	90-100
600 µ	15-24	35-59	60-79	80-100
300 µ	05-20	08-30	12-40	15-50
150 µ	0-10	0-10	0-10	0-15

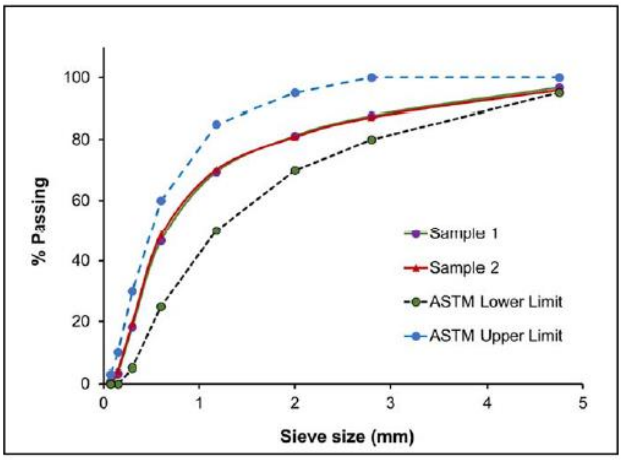

Figure 1 Sieve analysis of fine aggregate or sand

E. Coarse Aggregates

Coarse aggregates are those which range from 10-mm size upwards to 80-mm maximum size, namely all material that is retained on a 10-mm IS sieve. Coarse aggregate may consist of natural picked gravel, crushed gravel, crushed stone and the like. Coarse aggregates also have to be graded from 10-mm up to the maximum size used on the job, usually 63-mm. The grading of aggregates varies with the mix desired. Coarse aggregate used should conform as nearly as possible to the grading limits indicated in Table 4 for its nominal size as per IS:383-1970 [14].

The maximum size of aggregate is conventionally designated by the sieve size on which is percent or more particles are retained. In general, larger the maximum aggregate size, the smaller will be the surface area per unit volume which has to be covered by the cement paste of a given water-cement ratio. Therefore, it may be economical to use as large a size of maximum aggregate as possible, provided of course, strength, workability and durability properties are satisfied.

Table 4 Grading Limits for Coarse Aggregates (Clause 4.1 and 4.2 of IS:383-1970)

IS sieve designation	Percentage passing for single-sized aggregate of nominal size						Percentage passing for grade aggregate of nominal size			
	63mm	40mm	20mm	16mm	12.5mm	10mm	40mm	20mm	16mm	12.5mm
80mm	100	-	-	-	-	-	100	-	-	-
63mm	85-100	100	-	-	-	-	95-100	100	-	-
40 mm	0-30	85-100	100	-	-	-	95-100	100	-	-
20mm	0-5	0-20	85-100	100	-	-	30-70	95-100	100	100
16mm	-	-	-	85-100	100	-	-	-	90-100	-
12.5mm	-	-	-	-	85-100	100	-	-	-	90-100
10mm	0-5	0-5	0-20	0-30	0-45	85-100	10.-35	25-55	30-70	40-85
4.75mm	-	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36mm	-	-	-	-	-	0-5	-	-	-	-

F. Water

The purpose of water in concrete is three-fold. Water distributes the cement evenly so that every particle of the aggregate is coated with it and brought into intimate contact with other ingredients. It reacts chemically with the ingredients of cement; the reaction called hydration of cement, and brings about the setting and hardening of cement. Water also lubricates the mix and gives it the workability required to place and compact it properly. Cement requires about 25 to 50 percent of water for hydration. Additional water is required for the workability of concrete

This should be restricted since excess water makes the concrete weak. Finally curing of concrete with water pounding is a widely prevalent practice in the country.

G. Basalt fibers can be produced from the melt of basalt stones. In principle two different kinds of basalt fibers are distinguished—staple fibers and filaments. For both types different production methods have been reported. The production of staple fibers is possible directly from small and molten basalt stones. However, these staple fibers possess asymmetrical properties and only a low mechanical performance in mentioned. The product of this process consists usually of several hundred monofilaments building up the roving. This process is quite similar to the production of glass fibers.

H. Conplast SP430

Conplast SP430 is a chloride free, super plasticizing admixture based on selected sulphonated naphthalene polymers. It is supplied as a brown solution which instantly disperses in water.

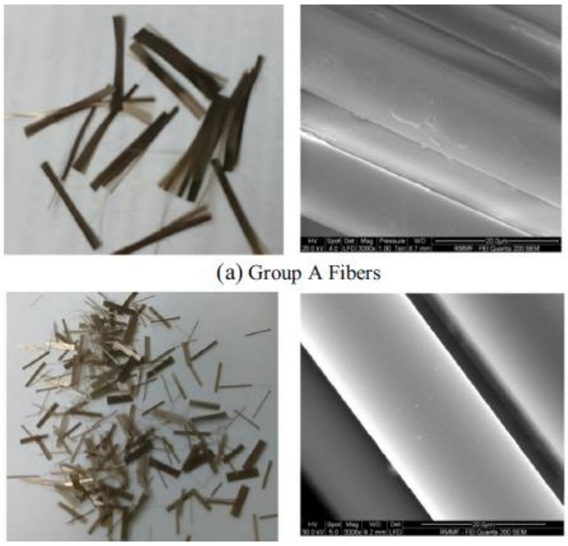

Fig. 2 Basalt fibers.

1. To provide improved durability by increasing ultimate strength and reducing concrete permeability.
2. To provide excellent acceleration of strength gain at early ages and major increases in strength at all ages by significantly reducing water demand in a concrete mix.
3. To significantly improve the workability of site mixed and precast concrete without increasing water demand.
4. Particularly suitable for precast concrete and other high early strength requirements.

3. FLY ASH REPLACEMENT OF CEMENT

This simple replacement for up to 15 to 30 per cent of cement reduces the strength at ages up to 3 months, but once sufficient calcium hydroxide has been liberated to start the pozzolanic action, the rate of development of strength increases rapidly and equality can be attained after1 to 3 months. After this stage, the pozzolanic reaction continues at a higher rate than the cement hydration, and higher strength can be obtained. The optimum amount of pozzolana as a replacement may normally range between 10 and 30 per cent, but is usually nearer the lower limit and may be as low as 4 to 6 per cent for natural pozzolana, A fine grinding of silica and high temperature curing increase the reactivity of pozzolana. The part replacement results in an increased workability, which can be used to reduce water content and, in turn, increase strength. Thus, the water content can be sufficiently reduced to limit the loss at early ages to 25 percent.

Fig. 3 fly ash

4. GROUND GRANULATED BLAST-FURNACE-SLAG (GGBS)

It's a waste industrial by-product obtained during the production of iron. The blast furnace-slag is non-metallic product having oxide composition similar to that of Portland cement clinker, i.e. it consists essentially of silicates and aluminates of calcium and other bases but it contains lesser calcium oxide. Air-cooled crystalline slag has no cementing properties. However, when cooled rapidly it solidifies in a granulated (glassy) form, which is reactive with water having alkaline medium. The molten slag is chilled rapidly, either by quenching it in water (i.e. pouring it into a Large body of water) or subjecting the slag stream to jets of water, or of air and water, to form a sand like glassy material. The granulated slag is used for the production of blast-furnaces cement. To produce this cement the slag is mixed with Portland cement clinker and gypsum, and ground together 1he grinding in this procedure can result in different particle sizes of two constituents due to difference in their hardness. However, the blast-furnace-slag ground alone to cement fineness can be used as additive and mixed with Portland cement at the point of use. The alkaline medium required to initiate the hydration can be provided by lime sodium hydroxide or gypsum. The slags with high sodium or potassium oxide content are self activating as these oxides provide the alkaline medium.

Figure 4 Ground Granulated Blast-Furnace-Slag (GGBS)

The effects of blast furnace slag on the workability are much less than those of fly ash due to lesser specific surface of 325 +_ 25 m2/kg. The improvement in workability is probably equivalent to about 5 per cent increase in water content, which is insignificant.

5. METHODOLOGY AND EXPERIMENTAL VIEW

In this thesis has attempted to examine mechanical properties of M30 grade of concrete as designed by using IS: 10262 (2000) with water binder ratio of 0.45. To reduce the deleterious effects of the production of cement on the environment, concrete is being developed by substituting admixtures like GGBS (Ground Granulated Blast-furnace Slag) and Fly Ash in place of cement. Multi blended concrete developed with Fly ash and GGBS showed depletion in the mechanical properties. Basalt fibers were added to this mix additionally to overcome these deficiency Basalt fibers were added to this mix additionally to overcome this deficiency.

OPC 53 Grade Cement confirming to IS: 12269-1987 was used [13]. The cementations materials such as Fly Ash and GGBS were used. Physical properties and chemical compositions for OPC and the cementations materials were presented in Tables 5 and 6. Sand confirming to Zone- II, obtained from river Narmada and gravel obtained locally from near about Jabalpur location were used as fine & coarse aggregates. 10mm long, 13 microns diameter of Basalt fibers and Conplast SP 430 super plasticizer were used. Basalt fibers properties were tabulated in Table 7.

Table-5 Physical Properties of OPC & Cementations Materials

Physical properties	OPC	Fly ash (F)	GGBS (G)
Specific Gravity	3.14	2.32	2.92
Fineness Modulus (% retained on 45µm sieve)	7%	33.7	23.5

Table-6 Chemical Composition of OPC & Mineral Admixtures

Materials	SiO (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	SO_3 (%)
OPC	21.4	6.02	3.77	62.93	2.49	1.72
Fly ash	58.8	31.3	3.9	4.3	0.2	0.27
GGBS	34.5	21.5	0.2	33.2	9.5	0.66

Table 7 Properties of Basalt Fibers

Properties	Values
Density(g/cm^3)	2.75
Filament diameter (microns)	15
Tensile strength (MPa)	4800

PC – Specimen without fiber or plain concrete

B- Basalt, 10 mm long at 3 kg/m3

2. Procedure for Measuring the Slump Time of mixes of fly ash and GGGBS as (40% replacement)

The dimensions of the apparatus and the test set-up. The concrete is placed in the same manner as in the standard slump test. The steps involved in the procedure are

1. The rod attached to the horizontal base of the standard slump test apparatus is carefully cleaned and greased down to the stop.

2. The base and the inside wall of the slump cone are moistened using a wet sponge.

3. The slump cone is placed on the base with the rod centered with respect to the opening at the top of the cone. The cone is fitted on the base with attachments provided for this purpose.

4. The cone is filled in three layers of equal volume with each layer being tamped 25 times with the standard tamping rod.

5 The part of the rod that projects above the concrete specimen is cleaned using a rag.

6. The sliding or the upper plate disk is brought down along the rod until contact is made with the surface of the concrete. The disk is provided with a rubber O-ring seal to prevent fine materials from interfering with its fall.

7. The mould is raised vertically while starting the stopwatch having a least count of 0.01 s.

8. While the concrete is slumping, the disk is observed continually (through the top of the cone) and the stopwatch is stopped as soon as the disk stops moving.

9. Once the slump has stabilized, or no later than one minute after the start of the test, the disk is removed and the slump is measured with a ruler.

Table 8: Test matrix for Cube

Mix Design Codes	Cement (in %)	Fly Ash (Total dosage (i.e.40%) by weight of cement)	GGBS (Total dosage (i.e.40%) by weight of cement)	Fiber Quantity (kg/m3)	Number of Cubes for 7 day compression test	Number of Cubes for 28 day compression test
MIX-M30	100%	0%	0%	0	1	1
C1-MIX	60%	100%	0%	3	1	1
C2-MIX	60%	80%	20%	3	1	1
C3-MIX	60%	60%	40%	3	1	1
C4-MIX	60%	40%	60%	3	1	1
C5-MIX	60%	20%	80%	3	1	1
C6-MIX	60%	0%	100%	3	1	1

The final slumps obtained with the standard and the modified tests are compared in Fig.6.10. Semi-empirical models have been proposed for the yield stress and for the plastic viscosity as a function of the final slump and slumping time. The modified slump test can be used as a field quality control test.

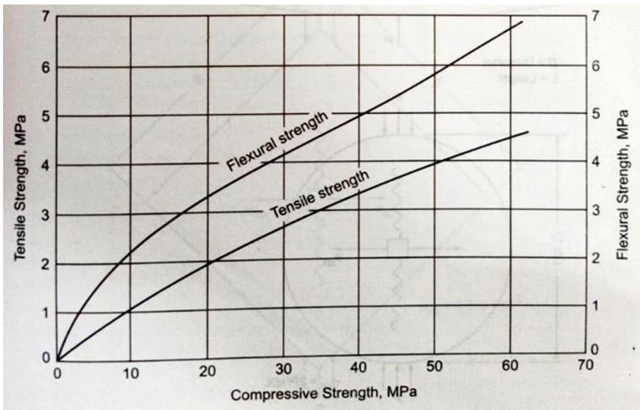

Figure 5 : Relationship between flexural strength, tensile strength and compressive strength

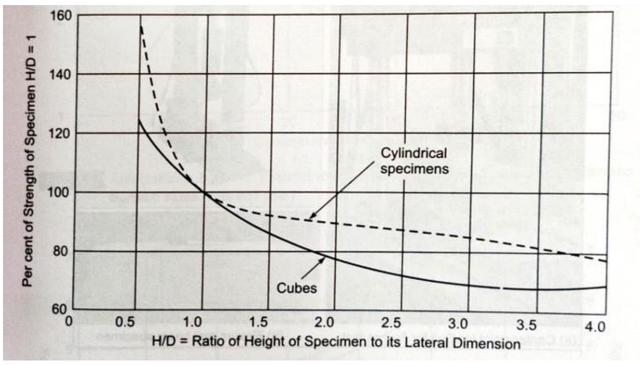

Figure 6 : Effect of ratio of height /lateral dimension of specimen of the compressive strength

3. Compressive strength

Compressive strength of the various strength of concrete the determination of compressive strength has received a large amount of attention because the concrete is primarily meant to withstand compressive stresses [10]. Cubes types of compression test specimens used to determine the compressive strength on testing machines. The cubes are 150 mm x 150mmx150mm in size. The specimens are cast, cured and tested as per standards prescribed for such tests. When cubes are used, they have to be suitably capped before the test, an operation not required when other types of specimens are tested. The compressive strength given by different specimens for the same concrete mix are different. The effect of height/lateral dimension ratio of specimen on compressive strength is given in Figure 6.

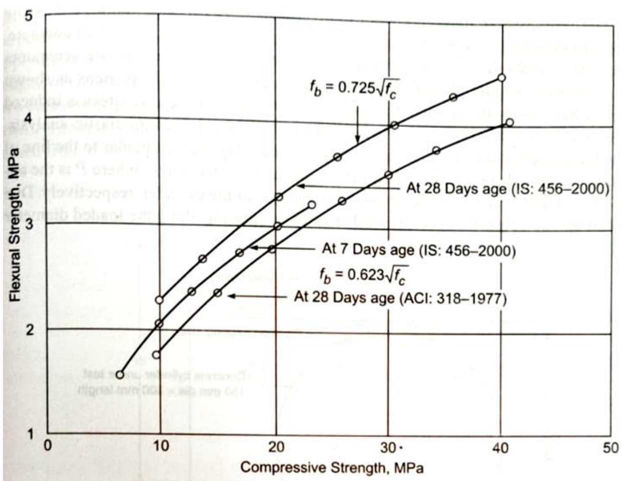

Figure 7; Relationship between flexural strength and compressive strength at various ages.

4. Flexural Strength

The determination of flexural tensile strength is essential to estimate the load at which the concrete members may crack. As it is difficult to determine the tensile strength of concrete by conducting a direct tension test, it is computed by flexure testing. The flexural tensile strength at failure or the modulus of rupture is thus determined and used when necessary [11]. Its knowledge is useful in the design of pavement slabs and airfield runway as flexural tension is critical in these cases. The modulus of rupture is determined by testing standard test specimens of 100 mm x 100 mm x 500 mm over a span of under symmetrical two-point loading. The modulus of rupture is determined from the size of the specimens; casting, curing and moisture conditions; manner of loading (third point or central point loading); rate of loading, etc. The test is conducted and the strength determined according to the prescribed standards. Typical test into machines is shown in Fig7.

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