EXPERIMENTAL BEHAVIOUR OF SELF COMPACTING CONCRETE USING GGBS WITH PARTIAL REPLACMENT OF CEMENT

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ABSTRACT

Concrete is Most widely used construction Material in the Modern Era because of its good Compressive strength and high durability. As we know Concrete comprises a Mixture of cement, sand (fine aggregate), course aggregate and water which makes up normal plain concrete, to increase the strength of concrete we can design the mix with greater Flexibility, but the problems Arises in structure as load age, increaseof floors which demands increase of high strength concrete and more steel. So, especially at the beams, columns joints heavy reinforcement meshing is done so that it becomes impossible.

If the concrete is not compacted then strength may not be achieved, so the solution for the problem is SCC which we call it asself-compacting concrete. Were this SCC has ability to compact by itself Gravity and self-flow ability same strength can be achieved.

Here in the research, it is carried out self-compaction concrete to improve strength & make concrete economical so, a mix is dispend of M30,M40 Grades with adding chemical admixture named poly carboxylic ether (ADVA960) , a Retarder Basically Which also increases strength and workability &replacing cement with GGBS (Ground Granulated Blast Furnace Slag) 40%&50% .

The tests are carried out to find the increase in strength by adding chemical admixture & replacing GGBS 40% & 50%.By the chemical admixture adding up to 2% Max were previous strength shows that adding of chemical admixture greater than 2% which results to increase the initial setting time and decrease in the w/c ratio. Test will be conducted for 3,7,28 days find the increase of strength and its other properties.

Test on materials

Cement

The most common cement currently used in construction is type I/I I Portland cement. This cement conform to the strength requirement of a Type I and the C3A content restriction of a Type II. This type of cement is typically used in construction and is readily available from a variety of sources. The Blaine fineness is used to quantify the surface area of

NORMAL CONSISTENCY OF FINENESS OF CEMENT

Aim: To determine the percentage of water required for preparing cement paste of standard consistency, used for other tests.

Apparatus: Vicat apparatus with plunger,
I.S. Sieve No. 9,
Measuring jar,
Weighing balance

Procedure:

- The vicat apparatus consists of a D-frame with movable rod. An indicator is attached to the movable rod, which gives the penetration on a vertical scale.
- A plunger of 10 mm diameter, 50 mm long is attached to the movable rod to find out normal consistency of cement. Take 300 gm of cement sieved through I.S. Sieve No. 9 and add 30% by weight (90 ml) water to it.
- Mix water and cement on a non-porous surface thoroughly with in 3 to 4 minutes.
- The cement paste is filled in the vicatmould and top surface is leveled with a trowel. The filled up mould shall be placed along with its bottom non-

porous plate on the base plate of the vicat apparatus centrally below the movable rod.

- The plunger is quickly released into the paste. The settlement of plunger is noted. If the penetration is between 33 mm to 35 mm from top (or) 5 mm to 7 mm from the bottom, the water added is correct.
- If the penetration is less than required, the process is repeated with different percentages of water till the desired penetration is obtained.

S.NO	AMOUNT OF WATER	PENETRATION OF PLUNGER FROM TOP
1	80	33.3
2	85	33.8
3	90	34.2

Table no :1

Vicat Apparatus

Result:-The normal consistency of cement= 33.6 mm

4.1.2 INITIAL AND FINAL SETTING TIMES OF CEMENT

Aim: To find initial and final setting times of cement.

Apparatus:

Vicat apparatus with mould, I.S. sieve No. 9,

Initial and final setting time needles,

Measuring jar, weighing balance,etc.

Procedure:

Initial setting time:

- Initial setting time is defined as the time elapsed between the moment that the water is added to the cement, to the time that the paste starts losing its plasticity i.e. the initial setting time needle fails to penetrate the cement paste kept in the mould by about 33-35 mm from the top or 5-7 mm from bottom of the indicator is called initial setting time.
- Take a cement sample weighing 300 gm, sieved through I.S. sieve No. 9 and mixed with percentage of water as determined in normal consistency test.
- Stopwatch should be started at the instant when water is added to the cement. Now the prepared cement paste is filled in vicat'smould and leveled with trowel.
- themould filled with cement paste kept on the non porous plate is now placed under the movable rod with initial setting time needle of cross section 1mm x 1mm the needle is quickly released and it is allowed to penetrate the cement paste.
- In the beginning the needle penetrates completely. It is then taken out and dropped at a fresh place. This procedure is repeated at regular intervals till the needle does not penetrate the block for about 5 mm measured from the bottom of indicator. Note the time for initial setting of cement.
- The initial setting time of an ordinary Portland cement shall not be less than 30 minutes.

Final setting time:

- After noting the time for initial setting of cement,
- the needle shall be replaced by the final setting time needle. The movable rod is slowly released on to the cement paste.
- In the initial stages the needle and collar may pierce through the paste. But after some time the same procedure is followed.
- Such trials shall be carried out until the needle only makes as impression on the top surface of the cement paste and the collar of the needle fails to do so.
- Note the time for final setting time of cement. The final setting time of an ordinary Portland cement shall not be more than 10 hours

.

Vicat apparatus

Result: 1. Initial setting time of cement= 180 Min

2. Final setting time of cement = 342 Min

SOUNDNESS OF CEMENT

Unsoundness of cement means, that the cement having excess lime, magnesium sulphates, etc. due to excess of these items there will be volume changes and large expansions, there by reduces the durability of the structures.

AIM: - To find out the soundness of cement.

APPARATUS: - Le-Chatelier Apparatus Cement,

Water,

Glass plate.

Procedure :-

- The cement is gauged with 0.78 times the water required for standard consistency (0.78P) in a standard manner and filled in to the Le-Chateliermould kept on the glass plate.
- The mould is covered on the top with another glass plate.
- The whole assembly is immersed in water at temperature of 27^{o}C to 32^{o}C and kept there for 24 hrs.
- Measure the distance between the indicator points.
- Submerge the mould again in water, heat the water up to boiling point in 30 minutes and keep it boiling for 3 hrs.
- Remove the mould from hot water and allow it to cool and measure the distance between the indicator points.
- The distance between these two measurements gives the expansion of cement.
- This must not exceed 10mm for OPC, RHC, LHC, etc.
- If the expansion is more than 10mm, the cement is unsound.

Soundness of cement:- 8mm

Aggregate

The coarse aggregate chosen for SCC is typically round in shape, is well graded, and smaller in maximum size than that used for conventional concrete typical conventional concrete could have a maximum aggregate size of 40 mm or more. In general, a rounded aggregate and smaller aggregate particles aid in the flow ability and deformability of the concrete as well as adding in the prevention of segregation and deform mobility of the concrete as well as aiding in the prevention of segregation. Gradation is an important factor in choosing a coarse aggregate, especially in typical uses of SCC where reinforcement may be highly congested or the formwork has small dimensions. Gap – graded coarse

Aggregate promotes segregation to a greater degree than well-graded coarse aggregate. As with conventional concrete construction, the maximum size of the coarse aggregate for SCC depends upon the type of construction. Typically, the maximum size of coarse aggregate used in SCC ranges from approximately 10 mm to 20 mm.

Generally aggregates occupy 70% to 80% of the volume of concrete and have an natural rock(crushed stone, or natural gravels) and sands, although synthetic materials such as slag and expanded clay or shale are used to some extent, mostly in lightweight concretes (Miness et al.,2003).

In addition to their use as economical filler, aggregates generally provide concrete with better dimensional stability and wear resistance. Although aggregate strength can play sometimes an important role, for example in high –strength concretes, for most applications the strength of concrete and mix design are essentially independent of the composition of aggregates.

However, in other instances, a certain kind of rock maybe required to attain certain concrete properties, e.g., high density or low coefficient of thermal expansion (Neville, 1993).

In order to obtain a good concrete quality, aggregates should be hard and strong, free of undesirable impurities, and chemically stable (Garber and Hoel, 1998). Soft and porous rock can limit strength and wear resistance, and sometimes it may also break down during mixing and adversely affect workability by increasing the amount of fines. Rocks that tend to fracture easily along specific planes can also limit strength and wear resistance (Neville, 1993). Aggregates should also be free of impurities like silt, clay, dirt or organic matter. If these materials coat, thesurfaces of the aggregate, they will isolate the aggregate particles from the surrounding concrete, causing reduction in strength. Silt, clay and other fine materials will increase the water requirements of the concrete, and the organic matter interfere with the cement hydration.

All normal concreting sands are suitable for SCC. Both crushed and rounded sands can be used. Siliceous or calcareous sands can be used. The amount of fines less than 0.125 mm is to be considered as powder and is very important for the theology of the SCC. A minimum amount offines (arising from the binders and the sand) must be achieved to avoid segregation.

Fine aggregate

All nor mal concreting sands are suitable for SCC. Either crushed or rounded sands can be used. Siliceous or calcareous sands can be used. The amount of fines less than 0.125 mm is to be considered as powder and is very important for the theology of the SCC. A minimum amount of fines (arising from the binders and the sand) must be achieved to avoid segregation.

4.2.2 Course Aggregate

All types of aggregates are suitable. The normal maximum size is generally 16 – 20 mm. however particle size up to 40 mm more have been used in SCC. Consistency of grading is of vital importance. Regarding the characteristics of different types of aggregate, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates Improve the flow because of lower internal friction. Gap graded aggregates are frequently better than those continuously graded, which might experience greater internal friction and give Reduces flow.

BULKING OF SAND

The volume of fine aggregate may increase by 1% to 5% due to presence of moisture. This property of increase in volume of fine aggregate due to moisture is called bulking.

AIM:- To find out the bulking factor of fine aggregate.

APPARATUS: - Container,
Sand,
Water,
Mixing Pan.

Procedure :-

i) Take about 6 liters of dry compacted sand and weigh it and dump it into a mixing pan.

ii) Add a certain known percentage of water by weight of dry sand.

iii) Mix rapidly and thoroughly till a uniform color is obtained and fill the container with the wet sand without any tamping.

iv) Now strike off the top surface and weigh and thus find the weight of wet sand.

v) Repeat the experiment No. of times increasing in water content from 2% to 8%.

vi) **Calculation :-**

W_1=Wt. of 1m^3 of compacted dry sand.

W_2=Wt. of dry sand contained in 1m^3 of wet loose sand.

W_3=Wt. of 1m^3 of wet sand

X = Percentage of water added

W_3=Wt. of dry sand + Wt. of water

$$W_3 = W_2\left(1+\frac{x}{100}\right)$$

$$W_2 = \frac{w_3}{1+x/100}$$

$$\therefore \text{ \% of bulking } = \frac{W_1 - W_2}{W_1} x100$$

$$\text{Bulking factor} = \frac{W_1}{W_2}$$

S.NO	VOLUME OF DRY LOOSE SAND V1	% MOISTURE CONTENT ADDED	VOLUME OF WET LOOSE SAND V2	% BULKING (V2-V1)/V1

1	200ml	2%	150	33.3
2	200ml	4%	154	28.2
3	200ml	6%	156	29.9

Average value of bulking of sand = (33.3+28.2+29.9)÷3

Percentage Bulking of sand =30.5%

RESULT: Percentage Bulking of sand =30.5%

Admixtures

GGBS (GROUND GRANULATED BLAST FURNACE SLAGE)

The chemical composition of a slag varies considerably depending on the composition of the raw materials in the iron production process. Silicate and aluminates impurities from the ore and coke are combined in the blast furnace with a flux which lowers the viscosity of the slag. In the case of pig iron production the flux consists mostly of a mixture of limestone and forsterite or in some cases dolomite. In the blast furnace the slag floats on top of the iron and is decanted for separation. Slow cooling of slag melts results in an unreactive crystalline material consisting of an assemblage of Ca-Al-Mg silicates. To obtain a good slag reactivity or hydraulicity, the slag melt needs to be rapidly cooled or quenched below 800 °C in order to prevent the crystallization of merwinite and melilite. To cool and fragment the slag a granulation process can be applied in which molten slag is subjected to jet streams of water or air under pressure. Alternatively, in the pelletization process the liquid slag is partially cooled with water and subsequently projected into the air by a rotating drum. In order to obtain a suitable reactivity, the obtained fragments are ground to reach the same fineness as Portland cement, chemical component of GGBS

- In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength.
- The MgO and Al_2O_3 content show the same trend up to respectively 10-12% and 14%, beyond which no further improvement can be obtained.
- Several compositional ratios or so-called hydraulic indices have been used to correlate slag composition with hydraulic activity; the latter being mostly expressed as the binder compressive strength.
- The glass content of slag suitable for blending with Portland cement typically varies between 90-100% and depends on the cooling method and the temperature at which cooling is initiated.
- The glass structure of the quenched glass largely depends on the proportions of network-forming elements such as Si and Al over network-modifiers such as Ca, Mg and to a lesser extent Al.
- Increased amounts of network-modifiers lead to higher degrees of network depolymerization and reactivity.
- Common crystalline constituents of blast-furnace slag are merwinite and melilite.
- Other minor Components which can form during progressive crystallization, arebelite, monticellite, rankinite, wollastonite and forsterite. Minor amounts of reduced sulphur are commonly encountered as oldhamite.
- The performance of slag largely depends on the chemical composition. Glass content and fineness of grinding. The quality of slag is governed by IS 12089 of 1987

Poly Carboxylic either:-

- For the past 5 years the super plasticizers which are widely used to enhance the plasticity or fluidity of the concrete
- To increase its strength. Apart from our range of Super plasticizers which include Sulphonated Melamine Formaldehyde (SMF), Sulphonated Naphthalene Formaldehyde (SNF), we also manufacturing the third Generation of Super plasticizers i.e. Ultra plasticizers called the Polycarboxylic Ether (PCE).
- Polycarboxylic Ether Super Plasticizer show extremely high water reduction in concrete with improved workability and increase in strength by almost 20-30% depending on use. These show good workability in concrete at even at water cement ratios as low as 0.23.

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Viscosity Modifying Admixtures for Pumping Concrete

- For both economic and technical reasons pumped concrete has gained increasing importance over recent years but as a result of developments in construction practice,
- The requirements on pumped concrete have become more demanding and have approached the limits of normal concrete technology.
- VMA is used to meet these demands and to reduce fluctuations in concrete performance.
- The most common problem with pumping concrete occurs when the coarse aggregate particles start to lock together, usually at a bend or other slight constriction.
- The pump pressure forces the lubricating mortar fraction to separate from the mix, leaving a plug of coarse aggregate which eventually blocks the line.
- Traditionally this has been solved by increasing the fines content of the mix but is not always technically and economically acceptable
- It may not be effective in the most demanding applications.
- The VMA is a more effective solution, preventing this segregating effect by making the concrete more cohesive without the need to change the mix design.

Properties of Fresh SCC

SCC differs from conventional concrete in that its fresh properties are vital in deter mining whether or not it can be placed satisfactorily. The various aspects of workability which control its filling ability, its passing ability and its Segregation resistance all need to be carefully controlled to ensure that its ability to be placed remains acceptable.

Slump Test

Theory and Scope: -

The workability of fresh concrete is a composite property which includes the diverse requirements of stability, mobility, compatibility, place ability and finish ability. There are different methods for measuring the workability. Each of them measures only particular aspects of it and there is really 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 one definite shape to another by means of vibration. The amount of effort called remolding effort is taken as the time in seconds required to complete the change.

Aim: To determine the workability of the cement concrete by slump test.

Apparatus: Ingredients for the cement concrete, slump mould, IS standard tamping rod, non- porous base plate, etc.

- Initially, a known volume of cement concrete is prepared with a required proportion of ingredients and water - cement ratio.
- The slump mould is cleaned for any

remaining cement particles or impurities and is properly oiled at the inner surface.

- Then the prepared concrete sample is put into the mould which is laced on a non-porous plate, in 3 layers with a tapping of 25 times for each layer by a standard tamping rod. The extra heap of concrete present on the top of the mould is cut off or leveled off.
- Then the mould is lifted up vertically by taking care not to disturb the cast cement in the mould.
- The nature of slump is analyzed to get the workability of the given cement concrete sample.

Result: The average slump observed for given M30 sample = 711.5 MM

The average slump observed for given M40 sample = 760.8 MM

4.1.2 V-funnel test:-

The V-funnel flow time is the period a defined volume of SCC needs to pass a narrow opening and gives an indication of the filling ability of SCC provided that blocking and/or segregation do not take place; the flow time of the V-funnel test is to some degree related to the plastic viscosity

Equipment:

- Metal funnel, shown in the figure.
- The funnel width is constant and is always 75 mm.
- The top section is 450 mm high,
- The top opening is 515 mm long (the inclination of the funnel top part sides must be 2:1).
- The bottom, narrow part of the funnel is always 150 mm high and the size of the bottom opening with a movable bottom is 65/75mm.
- The funnel holder must provide stability and vertical position of the funnel during filling and emptying.

Measuring Procedure:

- Place the cleaned V-funnel vertically on a stable and flat ground, with the top opening horizontally positioned.
- Wet the interior of the funnel with the moist sponge or towel and remove the surplus of water, e.g. through the opening. The inner side of the funnel should be ‘just wet’.
- Close the gate and place a bucket under it in order to retain the concrete to be passed.
- Fill the funnel completely with a representative sample of SCC without applying any compaction or rodding
- Remove any surplus of concrete from the top of the funnel using the straightedge.
- Open the gate after a waiting period of (10 ± 2) seconds. Start the stopwatch at the same moment the gate opens.
- Look inside the funnel and stop the time at the moment when clear space is visible through the opening of the funnel.
- The stopwatch reading is recorded as the V-funnel flow time, noted as t_V.
NOTE Dot not touch or move the V-funnel until it is empty.

RESULTS

- The definition of repeatability r and the reproducibility.
- Based on the inter-laboratory test organized in the EU-project “Testing-SCC” (GRD2- 2000-30024/G6RD-CT-2001-00580) with 2 replicates and 20 operators from 10 laboratories, the precision of the V-funnel flow time can be expressed by the following equations:
- $r = 0.335\ tV - 0.62$, with $R2 = 0.823$, when $3 \leq t_V \leq 15$; and $r = 4.4$ when $t_V > 15$ (8)

- R = 0.502 t_V – 0.943, with R2 = 0.984, when 3 ≤ t_V ≤ 15; and R = 6.6 when t_V> 15 (9) where R2 is the square correlation coefficient.

Some values are listed:-

V-funnel flow time t_V [sec]	3	5	7	10	≥ 15
Repeatability r [sec]	0.38	1.05	1.7	2.7	4.4
Reproducibility R [sec]	0.58	1.56	2.57	4.07	6.58

L-BOX TEST

Principle

- The method aims at investigating the passing ability of SCC. It measures the reached height of fresh SCC after passing through the specified gaps of steel bars and flowing within a defined flow distance. With this reached height, the passing or blocking behavior of SCC can be estimated.

Equipment

L- Box,
Two types of gates can be used, one with 3 smooth bars and one with 2 smooth bars,
The gaps are 41 and 59 mm,
Suitable tool for ensuring that the box is level i.e. a spirit level.
Suitable buckets for taking concrete sample

Test procedure

- Place the L-box in a stable and level position.
- Fill the vertical part of the L-box, with the extra adapter mounted, with 12.7 liters of representative fresh SCC.
- Let the concrete rest in the vertical part for one minute (± 10 seconds). During this time the concrete will display whether it is stable or not (segregation).
- Lift the sliding gate and let the concrete flow out of the vertical part into the horizontal part of the L-box.
- When the concrete has stopped moving, measure the average distance, noted as Δ*h*(see Figure 4), between the top edge of the box and the concrete that reached the end of the box, at three positions, one at the centre and two at each side.

Expression of results

- The passing ratio *P*L or blocking ratio BL is calculated using equation (2) or (2'), and expressed in dimensionless to the nearest 0.01.
  P_L=H/H_{MAX} or
  B_L=1-H/H_{MAX}
  Where Hmax = 91 mm and H = 150
  The definition of repeatability *r* and the reproducibility R.
- Based on the inter-laboratory test organized in the EU-project "Testing-SCC" (GRD2-2000-30024/G6RD-CT-2001-00580) with 2 replicates and 22 operators from 11 laboratories, the precision of the L-box passing or blocking ratio can be expressed by the following

Preparations of scc specimen

Proportioning

The quantity of cement, fine and coarse aggregates, fly ash, water and SP for each batch of proportion is prepared as mentioned in design of SCC.

Mixing of concrete

Mixing of concrete was carried out by machine. Machine mixing is not only efficient but also economical. Before the materials are loaded in to drum about 25 percent of the total quantity of water required for mixing is poured in to the mixer drum and to prevent any sticking of cement on the bodies or at the bottom of the drum. Then discharging all the materials i.e. coarse aggregate and cement in to the drum. Immediately after discharging the dry material in to the drum the remaining 75 percent of water is added to the drum .The time is counted from the moment all the materials are placed particularly the complete quantity of water is fed in to the drum.

MOULDS

The concrete is casted in to cube moulds of size 100mm×100mm,beam moulds of size100×100×500mm and cylindrical moulds of 200 mm height ×150 mm dia. The moulds used for the purpose are fabricated with steel seat. It is easy for assembling and removal of the mould specimen without damage. Moulds are provided with base plates, having smooth to support. The mould is filled without leakage .In assembling the moulds for use joints between the section of the mould are applied with a thin coat mould oil and similar coating of mould oil is applied between the contact faces of mould and the base plate to ensure that no water escape during filling .The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of concrete.

Placing Of Mix InMoulds

After mixing the proportions in the mixing machine, it is taken out into the bucket. The concrete is placed in to the moulds (cubes, beams & cylinders), which are already oiled simply by means of hands only without using any compacting devises.

Curing

After 24 hours the specimens were removed from the moulds and immediately submerged in clean fresh water and kept there until taken out just prior to testing.

Properties OfScc specimen

Workability

The level of fluidity of the SCC is governed chiefly by the dosing of the Super plasticizer. However overdosing may lead to the risk of segregation and blockage. Consequently the characteristics of the fresh SCC need to be carefully controlled using preferably two of the different types of test.

Segregation Resistance

Due to the high fluidity of SCC, the risk of segregation and blocking is very high. Preventing segregation is therefore an important feature of the control regime. The tendency to segregation can be reduced by the use of a sufficient amount of fines (<0.125mm), or using a ViscosityModifying Admixture (VMA).

Open Time

The time during which the Scc maintains its desired rheological properties is very important to obtain good results in the concrete placing. This time can be adjusted by choosing the right type of super plasticizers or the combined use of retarding admixtures. Different admixtures havedifferent effects on open time and they can be used according to the type of cement and the timing of the transport and placing of the SCC

Properties of Hardened SCC

Shrinkage And Creep

None of the results obtained indicates that the shrinkage and the creep of the SCC mixes were significantly greater than those of traditional vibrated concrete.

Some Aspects Of Durability

Elements of all types of concrete have been left exposed for future assessment of durability but some preliminary tests have been carried out.

The permeability of the concrete, a recognized indicator of likely durability, has been examined by measuring the water absorption of near surface concrete. The results suggest that in the SCC mixes, the near surface concrete was denser and more resistant to water ingress than in thereference mixes. Carbonation depths have been measured at one year. The civil mixes (both SCC and reference) show no carbonation. The evidence in hand and data from other source suggest that the durability performance of SCC is likely to be equal or better than that of traditional vibrated concrete.

Structural Performances

The structural performance of the concrete was assessed by loading the full-size reinforced columns and beams to failure.For the columns, the actual failure load exceeded the calculated failure load for both types of concrete (SCC and traditional vibrated concrete).

For the beams the only available comparison is between SCC and traditional vibrated concrete in the civil engineering category. Here the behavior of the two concretes in terms of cracking moment, crack width & load-deflection was similar

Mortar:-

Mortar also plays a vital role as solid particle in SCC. This property is so called "pressure transferability" which can be apparent when the coarse aggregate particles approach each other and mortar is in between coarse aggregate particles. Here the mortar is subjected to normalstress. The degree of the decrease in shear deformability of mortar largely depends on the physical characteristics of the solid pattern in the mo tar. It was found that the relation between the flow ability of mortar and concrete couldn't always be same due to differences in thecharacteristics of the solid particles in the mortar.

Water /Cement Ratio and S.P Dosage:-

The characteristics of powder and S.P largely affect the mortar property and so the proper water cement ratio and S.P dosage cannot be fixed without trail mixing. Therefore once the mix proportion is decided self-compatibility has to be formulated. So that we can establish a rationalmethod for adjusting the water cement ratio and S.P dosage to achieve appropriate deformability and viscosity.

Compressive strength

In all SCC mixes compressive strengths of standard cube specimens were comparable to those of traditional vibrated concrete made with similar water-cement ratios – if anything strengths were higher

In-situ strengths of SCC are similar to those of traditional vibrated concrete, indeed somewhat higher when limestone powder is used as filler, probably because of a dignifying mechanism and the observed lower susceptibility to imperfect curing, both attribute to this type of filler.

The in-situ strengths of both types of civil engineering concrete, SCC and traditional vibrated concrete were closer to standard cube strengths than those of the housing mixes again; this is typical of higher strength concrete.

In vertical element, in-situ strengths of both SCC and traditional vibrated concrete are higher at the bottom than at the top, vibration of in-situ strengths, for both types of concrete is much lower in horizontal elements, in this case the beams. These observations are characteristic of traditional vibrated concrete. The in- situ strengths of elements cast and cured outdoors in winter (the beams), whether SCC or conventional, were lower than those cast indoors at the same time (the columns).

Overall, we might conclude that the fresh self-compacting properties of the concrete have little effect on the in-situ strengths.

Tensile Strength

Tensile strength was assessed indirectly by the splitting test on cylinders. For SCC, both the tensile strengths themselves, and the relationships between tensile and compressive strengths were of a similar order to those of traditional vibrated concrete.

Bonding Strength

The strength of the bond between concrete and reinforcement was assessed by pullout tests, using deform med reinforcing steel of two different diameters, embedded in concrete prisms. For both civil engineering and housing categories, the SCC bond strengths, related to the standard compressive strengths, were higher than those of the reference concrete were.

Modulus Of Elasticity

Results available indicate that the

relationships between static modulus of elasticity and compressive strengths were similar for SCC and the reference mixes. A relationship in the form of $E/(f_c)$ 0.5 has been widely reported, and all values of this ratio were close to the onerecommended by ACT for structural calculations for normal weight traditional vibrated concrete.

RESULTS:

Mix design ratios for M30 and M40 replacing 40%&50% GGBS:-

S.No	Mix	(Cement +ggbs)	F.A	C.A	S.P %	W/C	VMA %
1	M30 SCC40% GGBS	1	2.32	2.95	2	0.41	0.5
2	M30SCC 50% GGBS	1	2.28	2.91	2	0.41	0.5
3	M40 SCC40% GGBS	1	1.67	2.73	2	0.36	0.5
4	M40SCC 50% GGBS	1	1.69	2.77	2	0.36	0.5

M30 Compressive Strength Replacing 40% ggbs in KN/M^2

S.No	Cube Size	3 Days	7 Days	28days
1	150mm	11.40	18.78	33.40
2	150mm	11.92	19.12	34.18
3	150mm	12.21	19.80	34.80

M30 Compressive Strength Replacing 50% ggbs in KN/M^2

S.No	Cube Size	3 Days	7 Days	28days
1	150mm	12.73	20.09	35.70
2	150mm	14.21	21.20	35.10
3	150mm	13.19	19.80	36.24

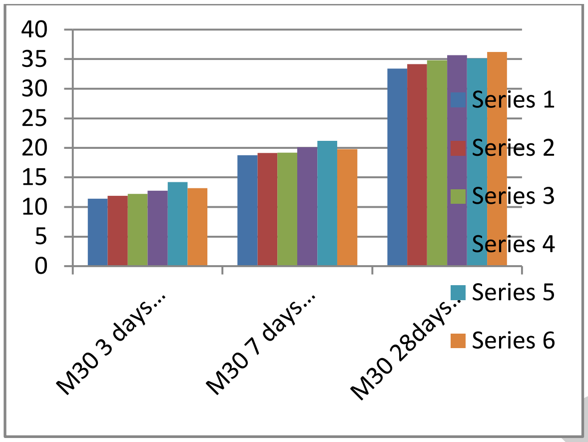
M40 Compressive Strength Replacing 40% ggbs in KN/M^2

S.No	Cube Size	3 Days	7 Days	28days
1	150mm	14.90	33.70	44.25
2	150mm	15.76	34.30	44.80
3	150mm	16.80	34.80	45.10

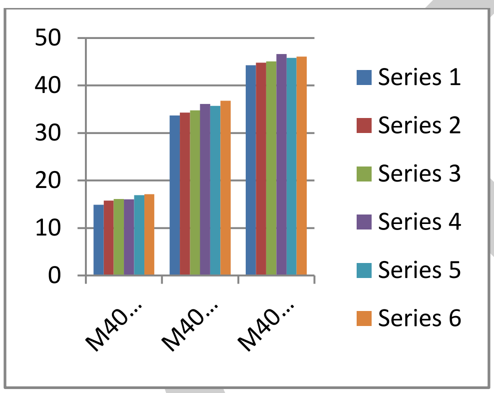
M40 Compressive Strength Replacing 50% ggbs in KN/M^2

S.No	Cube Size	3 Days	7 Days	28days
1	150mm	16.40	36.14	46.66
2	150mm	16.90	35.70	45.80
3	150mm	17.10	36.80	46.10

M30compressive strength replacing 30%&40% ggbs



M40compressive strength replacing 30%&40% ggbs



Conclusion

- When compare to the previous papers test's on replacing GGBS above 30% the compressive strength have reduced, for every interval of replacing 5%. Added Conplast SP430 as super plasticizer and maintained w/c ratio is kept constant throughout the investigation as 0.45.
- as per Results suggest that as much of 50% of cement can be replaced without any significant consequences on the concrete, by using the chemical admixture as super plasticizer ADVA960 (poly carboxylic either) is a retarder increase the initial setting time
- Compressive strength is increased by replacing 50% of GGBS for cement and maintained w/c ratio as per mix design obtained, the mineral admixture replacement have a better workable concrete.
- Avg Compressive Strength For M30scc Replacing 40%GGBS 3 days=11.84 KN/M^2
- Avg Compressive Strength For M30scc Replacing 40%GGBS 7 days=19.23 KN/M^2
- Avg Compressive Strength For M30scc Replacing 40%GGBS 28 days=34.12 KN/M^2
- Avg Compressive Strength For M30scc Replacing 50%GGBS 3 days=13.37 KN/M^2
- Avg Compressive Strength For M30scc Replacing 50%GGBS 7 days=20.36 KN/M^2
- Avg Compressive Strength For M30scc Replacing 50%GGBS 28 days=35.69 KN/M^2
- Avg Compressive Strength For M40scc Replacing 40%GGBS 3 days=15.82 KN/M^2
- Avg Compressive Strength For M40scc Replacing 40%GGBS 7 days=34.26 KN/M^2
- Avg Compressive Strength For M40scc Replacing 40%GGBS 28 days=44.71 KN/M^2
- Avg Compressive Strength For M40scc Replacing 50%GGBS 3 days=16.80 KN/M^2
- Avg Compressive Strength For M40scc Replacing 50%GGBS 7 days=36.21 KN/M^2
- Avg Compressive Strength For M40scc Replacing 50%GGBS 28 days=46.18 KN/M^2
- SCC can be replaced upto 50% further test can be carried out by increasing percentage and maintain w/c ratio as per mix design, Since there is no standard method of mix design is available for SCC. Hence the mix proportion is obtained as per the guidelines of IS10262-2009 so further study's can be carried out to find the Durability

&serviceability factors, temperature effect and flexural strength add present of GGBS more than 50% may shows variation in obtaining strength.

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