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EFFECT OF STRENGTH IN SELF COMPACTING CONCRETE BY USING INDUSTRIAL BY-PRODUCTS

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ABSTRACT

Concrete consists of cement, fine aggregate, coarse aggregate and water which becomes solid and strong and is used as a material for all concrete structures. Concrete is vibrated heavily to flow through congested reinforcing bars in molds. To overcome this problem, the self-compacting concrete is used. Self-compacting concrete is a flowing concrete that will settle under its own weight. It can also help to lessen the hearing-related damage on the work site due to vibration of concrete. The present situation in the world is to utilize the industrial by-products, domestic waste etc., as a raw material in concrete, which encourages an Eco-friendly process to the concrete preparation. This practice not only helps in the reuse of waste material but also creates the safe and green environment. In this paper, experimental studies are carried out to understand the fresh and harden properties of self-compacting concrete in which cement is replaced by ground granulated blast furnace slag, limestone powder and pond ash in fine aggregate various proportions for M40 grade concrete. The proportions in which cement replaced 20%,40%and 60% in that GGBS is 75%, limestone is 25%and pond ash is 20%,40%and 60%. Superplasticizer GLENIUM B233 a product from BASF is used to maintain workability with constant water binder ratio. After repetitive trial mixes the water-cement ratio was selected as 0.40. The self-compacting mixture produced, tested and compared in terms of compressive, split tensile strength and flexural strength with conventional concrete for 3,7 and 28 days.

Key words: Self-Compacting Concrete; Pond Ash; Ground Granular Blast Furnace Slag; Lime Stone Powder.

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1. INTRODUCTION

Concrete that requires little vibration or compaction has been used in Europe since the early 1970's but self-compacting concrete was not developed until the Late 1980's, in Japan. In Europe, it was probably used in civil works for transportation networks in Sweden in mid-1990's.the European country funded a multinational, industry lead project in 1977-2000.since then SCC has found increasing use in all European countries. Self-compacting concrete is a concrete, which its plastic state, flows silently under its own and maintain homogeneity by completely filling the formwork of any shape, even around congested reinforcement. Compaction of concrete is achieved by its own movement. Self-compacting concrete offers a rapid rate of concrete placement with faster construction times. SCC is often produced low water cement ratio providing the potential for high early strength, earlier demoulding and faster use of structures. So it has become more prominent in all parts of the world for construction. The necessity of this type of concrete was proposed by Okamura in 1986.A committee was formed to study the properties of self-compacting concrete, inducing the fundamental investigation on the workability of concrete, which was carried out by Ozawa at the University of Tokyo. The first usable version of SCC was completed in 1988 and was named "high-performance concrete", and later proposed as "self-compacting concrete.

2. OBJECTIVE

- To simulate and study the strength and durability studies of self-compacting concrete replacement of pond ash, ground granular blast furnace slag and lime stone.
- Analyse the behaviour of the self-compacting concrete under different load conditions in loading frame.

3. MATERIALS

3.1. Cement

In the present work ordinary Portland cement of 53 grade, Birla Super Grade conforming to IS 12269:1987 Has been used the properties of cement used to show in below.

Table 1 Physical properties

SI.NO	l Properties	Results
1	Fineness by dry sieve	5%
2	Normal consistency	31%
3	Initial setting time	205
4	Final setting time	317
5	Specific gravity	3.1

3.2. Ground Granular Blast Furnace Slag

Ground granular blast furnace slag is a non-metallic powder consists of silicates and aluminates of calcium and other bases. The molten slag is rapidly chilled by quenching in water from the glassysand-like material. The quality of slag is governed by IS 12089:1897. Shows properties of GGBS below.

Table 2 Physical Properties

SI.NO	Properties	Result
1	Colour	Dull white
2	Consistency %	36.0
3	Specific gravity	2.83

3.3. Super Plasticizer (GLENIUM B233)

GLENIUM B233 is an admixture of a new generation based on modified polycarboxylic either. The product has been primarily developed for application in high-performance concrete where highest durability and performance is required. The properties are shown below.

Table 3 Chemical Properties

SI.NO	Properties	Results
1	Aspect	Yellowish free-flowing liquid
2	Relative density	1.09, 0.01 at 25 C
3	PH	7 +/- 1
4	Chorine iron content	<0.2%

3.4, Pond Ash

Pond ash is the waste product from boilers, where coal is burnt to heat the water for preparing the stream; it is a common procedure in most of the thermal power plants. It is obtained from the wet disposal of fly ash. The properties are shown below.

Table 4 Physical & Chemical properties

SI.NO	Properties	Results	Properties	Results
1	Specific gravity	2.16	Silica(SIO2)	67.40
2	Bulk density	824 KG/m^3	Alumina	19.44
3	Liquid limit	47.3	Iron oxide	8.5
4	Grain size distribution sand% slit% clay%	72, 28, NIL	Calcium oxide	2.7

3.5. Fine aggregate

River sand which is used for present investigation is procured locally and confirming zone III.

3.6. Coarse aggregate

A coarse aggregate of size 12 mm tends to use in this investigation which was brought from a local market near Vijayawada satisfying the conditions of IS 383-1970.

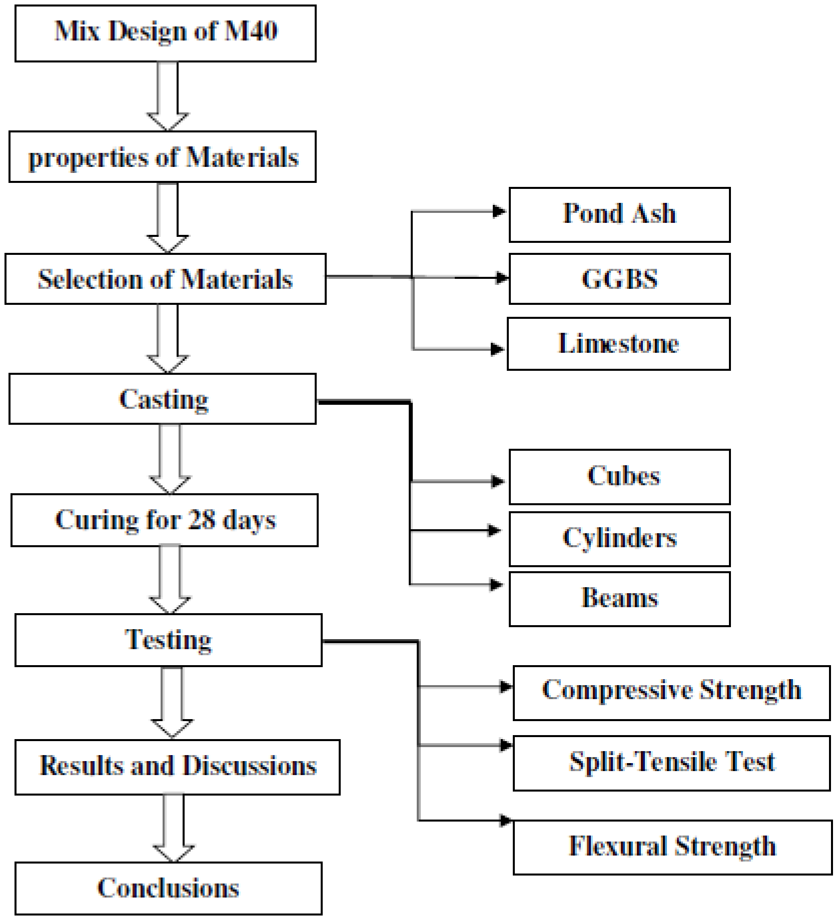
3.7. Limestone powder

Limestone powder consists of calcite and it is used in self-compacting concrete when strengths are to be maintained without decreasing the amount of powder material.

3.8. Water

Potable water was used for mixing and curing.

4. METHODOLOGY



5. EXPERIMENTAL PROGRAMME

Scc mixes with the different replacement of mineral admixture were prepared and examined to qualify the properties of SCC. The replacement of pond ash in fine aggregate with the percentage of 20%, 40% and 60%. and also the replacement of ggbs and limestonepowder in cement is 20% 40% and 60% in that ggbs is replaced 75% and limestone powder is 25% mixing percentages are shown in the below.

Table 5 Mix Proportion of Concrete

SI.NO	Material	Quantities(kg/m^3)
1	Cement	412.5
2	Limestone powder	38
3	Ground granular blast furnace slag	102
4	Pond ash	270
5	Fine aggregate	902
6	Course aggregate	1017.6
7	Water	190 lit
8	Super plasticizer(GLENIUM B233)	5.07 lit
9	Viscosity modifying(Aura mix 400)	0.17 lit

6. RESULTS AND DISCUSSIONS

6.1. Fresh properties of SCC

Once a satisfactory mix is arrived at, it is tested in the lab for properties like flowing ability, passing ability and blockage by adopting T50 Slump flow, L-Box, U-Box and V-funnel tests as per EFNARC guidelines to assess the property of the mix to qualify as SCC. Table 6 gives the acceptance criteria for SCC, and Table 6 gives the results of the tests conducted for the fresh SCC mixes prepared using pond ash, ground granular blast furnace slag, andlimestonepowder.

Table 6 Test results of SCC

SI.NO	Test	Limits	20%	40%	60%
1	T50 slump	2-5 sec	5.78 sec	5 sec	5.2 sec
2	V-funnel	6-12 sec	6 sec	7 sec	5 sec
3	L-box	0.8-0.10	0.8	0.7	0.5
4	U-box	0-30mm	15 mm	12 mm	5 mm

6.2. Tests on Hardened SCC

The concrete is tested for the hardened properties like compressive strength, split tensile and flexural strengths each for 03 days, 07 days and 28 days. All tests were performed in accordance with the provisions of IS: 516- 1959 (Methods of tests for strength of concrete) and IS: 5816-1970 (Splitting tensile strength of concrete – Method of the test). The test results are listed in below.

Table 7 Nominal Test Results

S.NO	PROPERTY	3 days	7 days	28 days
1	Compressive strength	18.13	26.8	42.9
2	Split tensile strength	2.19	2.5	2.6
3	Flexural strength	3.1	3.68	3.91

Table 8 Test Results on hardened SCC (MPa)

S.NO	PROPERTY	CURING PERIOD	20% REPLACEMENT	40% REPLACEMENT	60% REPLACEMENT
1	Compressive strength	3 days	19.9	21.95	16.83
		7 days	27.8	30.1	23.6
		28 days	46.2	49.52	27.3
2	Split tensile strength	3 days	2.225	2.41	2.1
		7 days	2.53	2.73	2.26
		28 days	2.67	2.87	2.34
3	Flexural strength	7days	3.58	3.756	2.9
		14 days	3.72	3.98	3.26
		28 days	3.95	4.12	2.72

6.3. Comparison between the normal concrete & SCC

In order to know the nominal properties of concrete, 9 cubes, 9 cylinders, and 6 beams are cast to know compressive quality, split tensile strength & flexural strength and are tested for 3, 7 and 28 days respective. The comparison between nominal concrete & SCC shown below.

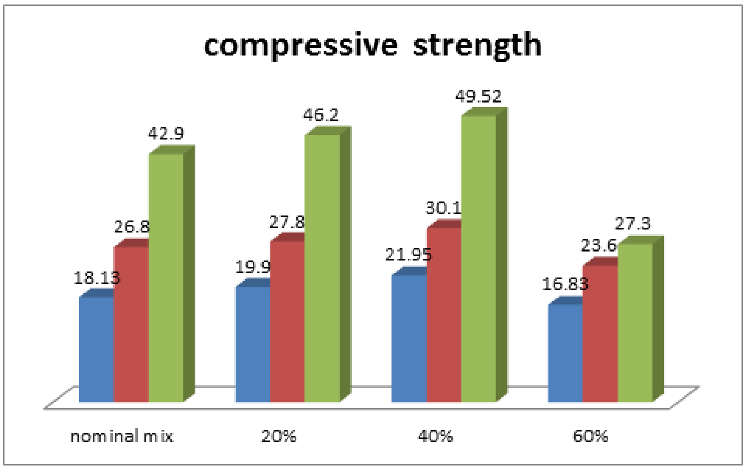


Figure 1 compressive strength

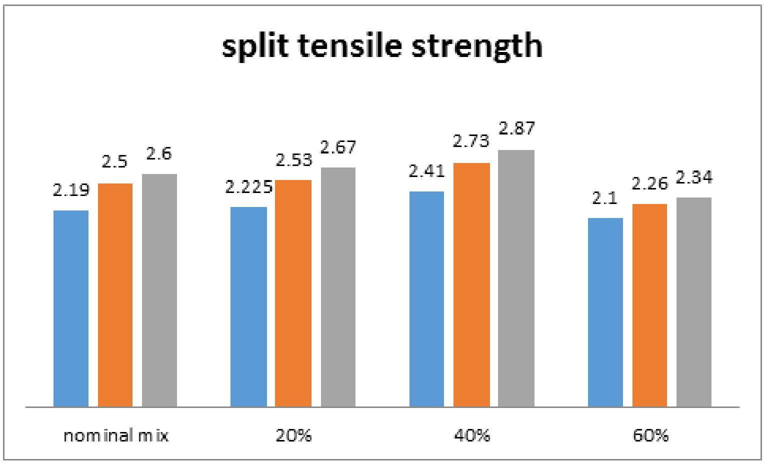


Figure 2 split tensile strength

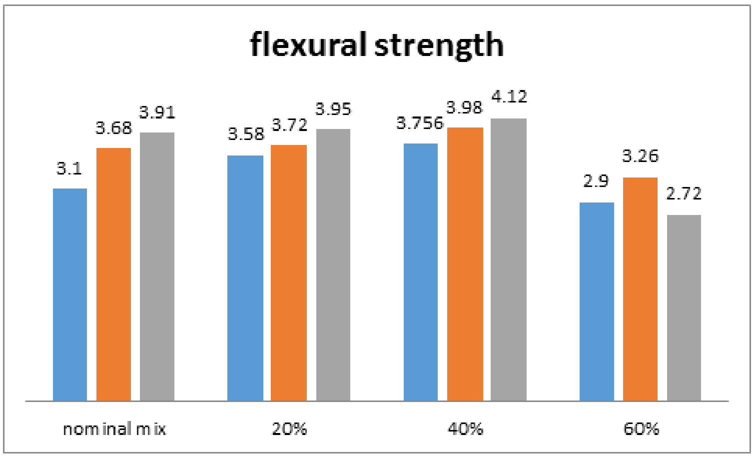


Figure 3 flexural strength

6.4. Stress-Strain behaviour of self-compacting concrete

A stress-strain curve is a graph derived from measuring load stress versus strain for a sample of material. In concrete, the rate of increase of stress is less than that of increase in strain because of formation of microcracks between the interfaces of aggregate and cement paste. The stress-strainbehavior of concrete is a prime parameter as it is a very much important aspect of designing, predicting the flexural behavior and estimating toughness of concrete the graph is shown below.

6.4.1. Stress-Strain calculations for 20% replacement

The stress-strain calculations for 20% replacement peak value of stress is 46.24 N/mm^2 at the strain is coming 0.00271.

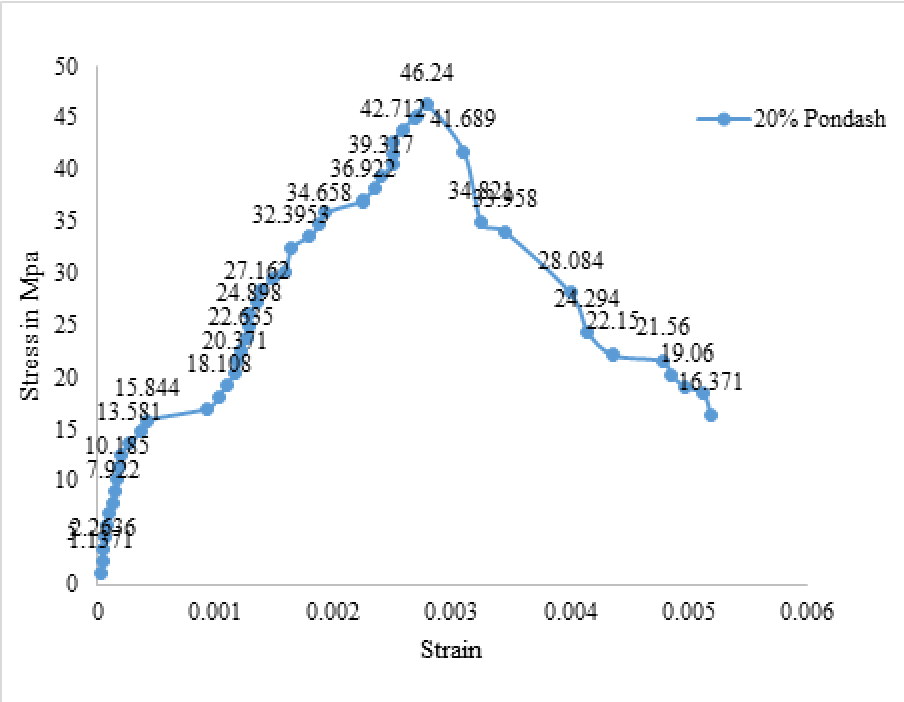


Figure 4 Stress strain relationship for M40 &20% Replacement

6.4.2. Stress-Strain calculations for 40% replacement

The stress-strain calculations for 40% replacement peak value of stress is 49.635 N/mm^2 at the strain is coming 0.0029.

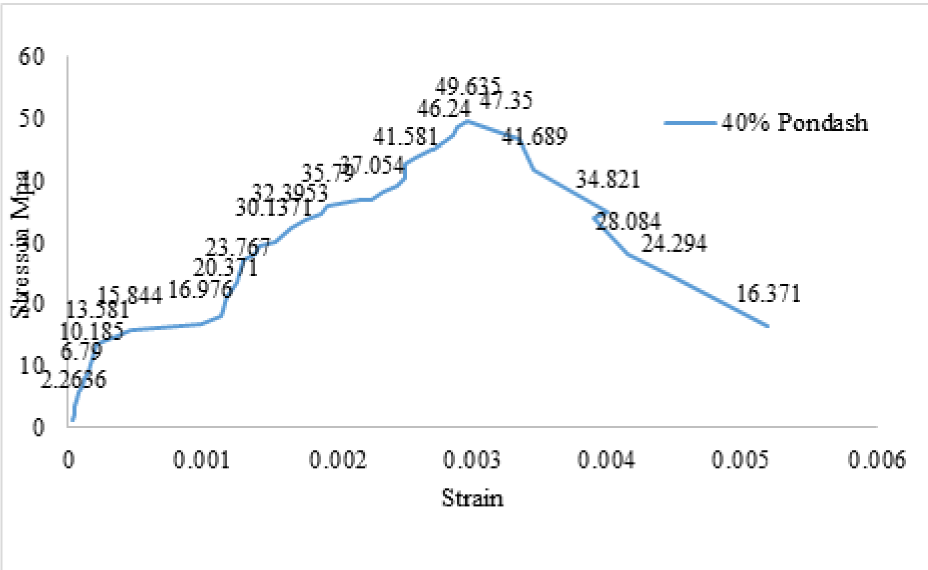


Figure 5 Stress strain relationship for M40 & 40% replacement

6.4.3. Stress-Strain calculations for 60% replacement

The stress-strain calculations for 60% replacement peak value of stress is 27.162 N/mm^2 at the strain is coming 0.00278.

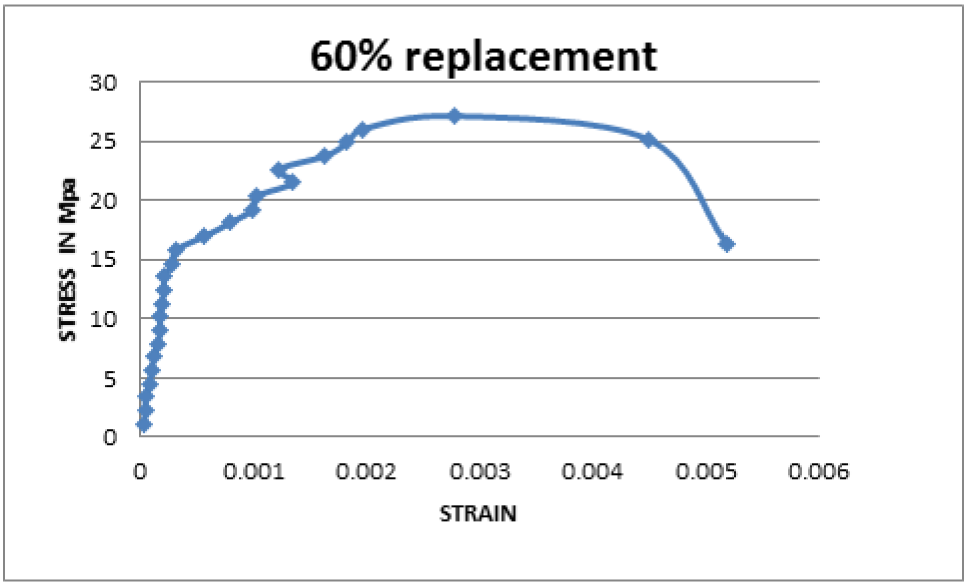


Figure 6 Stress strain relationship for M40 &60% replacement

STRESS STRAIN BEHAVIOUR

7. CONCLUSION

- Now a days the latest trend is using the industrial by-products in concrete works. In this project we have used industrial by-products such as pond ash, ground granular blast furnace slag and limestone and these by-products is evaluated in terms of self-compatibility, compressive strength, split tensile strength and flexural strength. From the experimental investigations above, the following conclusions may be drawn.
- By seeing the experimental work above at 40% replacement the results coming is optimum.
- The using pond ash, we noticed settlement undergoes long time to settle.
- After that 60 % replacement of any by-product was not good for usage.
- Pond ash-poor to use as fine aggregate due to lack of initial setting time and strength obtained.
- The use of pond ash within the SCC will decrease the flow ability and workability and this ash addition has not suffered in early age strength and continued to increase as % replacement later age strength.
- From the above experimental work we can reduce the using of fine aggregate in concrete works. From that cost of concrete is also reduced.
- We can reduce the waste which is coming out from the industrial by-products.
- By using of super plasticizer it take less time to mix and

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