Journal of Advances and Scholarly Researches in Allied Education
Vol. XV, Issue No. 2, (Special Issue) April-2018, ISSN 2230-7540

Study on Compressive Strength and Flexural Strength of Nominal Concrete and Tripple Blend Concrete

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Abstract – Concrete is most widely used material in civil engineering for the construction of different structure in the world. The continuous researches are carried out in this field with reference to mechanical properties as well as chemical reactions. Which result in High Strength Concrete (HSC), Self Compacting Concrete (SCC), High Performance Concrete (HPC), and Fiber Reinforced Concrete? The partial replacement of cement is made on the trial bases with Fly Ash (FA), Ground Granulated Blast Furnace Slag (GGBS) And Condensed Silica Flume (CSF). In this present experimental investigation, the Ordinary Portland cement (OPC) is partially replaced by Flay ash and Ground granulated blast furnace slag (GGBS) for a mix design of M20 grade without affecting on its strength.

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1. INTRODUCTION

Concrete is one of the most widely used construction material which having great compressive and flexural strengths and solid properties among other. Now a day, the cost of production of cement is increasing at alarming rate and natural resources giving the raw material for its manufacturing are depleting. Many efforts are being made in order to reduce the use of Portland cement in concrete. The fly ash (FA), ground granulated blast furnace slag(GGBS) was waste product, which may be used as partial replacement of cement in concrete due to its inherent cementations properties. In this project we are going to discuss about the partial replacement of ordinary cement by ground granulated blast furnace slag (GGBS) and fly ash. Our study is to compare the results of three mixes of M20 grade namely conventional aggregate concrete.

2. LITERATURE REVIEW

S. Vijaya Bhaskar Reddy, P. Srinivasa Rao (1)was investigated the optimization of a Ternary Blended Cementitious system based on Ordinary Portland Cement (OPC)/ GGBS / Micro Silica for the development of Ternary Concrete. Compressive Strength of Ternary Blended Concrete at the ages of 7, 28, 60, 90 days for various combinations of Micro Silica and GGBS mixes. Micro Silica of 0%, 5%, and 10% and15% along with GGBS was replaced by 20%, 30% 40% and 50%. All the mixes were studied at water cement ratio of 0.45. The study reveals that, the compressive strength of ternary concrete increases gradually until GGBS content reaches to 30%, and there after it falls even increase of GGBS content al all curing times, and it is found that the micro silica improves the early age strength of concrete with GGBS by refining the properties of hardened concrete continuously as it matures.

Sundar J, Manivel.S, (2) were studied on mechanical properties of concrete with multi-component composite cement. The fly ash (FA),ground granulated blast furnace slag (GGBS), metakaolin(MK), and silica flume(SF) are some of the pozzolanic materials which can be used in concrete as partial replacement of cement. The concrete mix M30 grade is prepared as per the procedure given in the IS:10262: 2009, and proposition of mix were 1:1.52:25.48. The replacement of OPC with waste product are made on equal weight basis. The w/c ratio is taken 0.4% for all the mixes.

P. Ramyasree1, Arunika Chandra2, M. Bhaske, B.L.P. Swami were studied on compressive strength concrete with fly ash and condensed silica flume. The high strength concrete is made possible by reducing porosity, homogeneity and micro cracks in the hydrated cement paste and the transition zone. The target w/c ratio should be in the range 0.30-0.35 or even lower.

K. Saikumar Chary, A. Kartik were studied on experimental research on Triple Blended Concrete.

Replacement of cement with three materials is also giving same amount of strength, it is reducing carbon dioxide emission effect and finally it is reducing the economically budget of the structure. In the present experimental investigation triple blending of ordinary Portland cement was carried out so as to arrive at a mix with optimum properties. With the increase in fly ash percentage beyond 20% 28 day's strength decreased and with the increase of silica fume % up to an optimum of 10% strength get increased.

K. Prasanna1, K S Anandh2 and S. Ravishankar3 were studied on experimental study on strengthening of concrete mixed with ground granulated blast furnace slag (GGBS) Reduced in co2 emission the producer of standard of standard concrete results in the outflow of 930 kg of co2/t of bond (British cement association ,2009) generally a large portion of a large portion of a rate from de-carbonation of the limestone crude material (process discharge), 40% of fossil fuel utilization and 10% from fulfilling the power utilized as a part of the procedure. GGBS make normally discharges 35kg of co2 for each tone of GGBS i.e., under 4% of the carbon impression of cement bond.

3. MATERIAL USED

Cement 43 grade: Ordinary Portland cement of 43 grade from the local market was used and tested for physical and chemical properties as per IS: 4013-1988 and found to be confirming to various specifications of are 12269-1987.

Fine Aggregate: In the present investigation, fine aggregate is natural river sand which was obtained from local market. The physical properties of fine aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS-2386.

Coarse Aggregate: The crushed coarse aggregate of 10mm maximum size was obtained from the local crushing point. The physical properties of coarse aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS-2386.

Fly ash: In the present investigation work, the TYPE-II fly ash was used as cement replacement material. It is obtained from Vijayawada thermal power station in Andhra Pradesh. The specific surface of fly ash is found to be 4750 cm2/gm by Blaine's permeability apparatus.

GGBS: Ground-granulated blast-furnace slag (GGBS) is obtained by quenching molten iron slag from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. GGBS is used to make durable concrete structures in combination with ordinary Portland cement and/or other pozzolanic materials.

4. PROPERTIES OF MATERIAL

Table No:-1 Properties of Cement

Properties	Observed Value
Specific Gravity	2.74
Finesse Modules	2.56
Bulk Density	1587Kg/m3
Percentage Bulking	35%
Water Absorption	1.21%

Table No:-2 Properties of Fine Aggregate

Properties	Observed Value
Specific Gravity	2.75
Finesse Modules	6.89
Bulk Density	1537Kg/m3
Aggregate crushing value	30.2
Aggregate Impact value	34.1
Minimum size of aggregate	20mm
Water Absorption	0.69

5. METHODOLOGY

1) Mixing: A Designed mix ratio of 1:2:3 was used for triple blend concrete. Batching was by weight and a constant Water/cement ratio of 0.55 used. Mixing was done manually on smooth concrete pavement.

2) Casting: For casting the cubes and beams, standard cast iron metal modules were used. Whole casting procedure is confirmed to Indian standard:10086-1882. The following specimen were prepared for both conventional concrete(CC) triple blend concrete(TBC) to perform tests at 7 & 28 days.

(i) 150x150x150 mm cubes (18 for CC and 6 for TBC) for compressive strength as per IS 516-1999.

(ii) 100x100x700mm beams (6 for CC and 4 for TBC) for flexure test as per IS 516-1959.

3) Curing: After casting, the molded specimen is stored in the laboratory free from vibration, in moist air and at room temperature for 24 hours. After this period, the Specimens are removed from the molds and immediately submerged in the clean fresh water of curing tank. The cured water is removed after 3 days. The specimen is cured for 7 days and 28 days.

4) Testing of Specimen: At the Age of 7 days and 28 Days, the specimen was taken out of water and allowed to dry under shade and then tested for strengths at room temperature.

(i) Compressive strength: Cube Compression tests were performed on standard cubes of size 150x150150 mm after 7 days and 28 days curing as per IS: 516-1959.

Compressive strength of specimen was calculated by the expression:

Fuc = Pu/A

Where,

Pc= Failure load in compression, KN

A = Loaded area of cube, mm2

(ii) Flexural strength test: Flexural strength test were performed on beam specimens according to IS: 516-1959. Standard beam size 100mmx100mmx700mm where supported symmetrically over a span of 400 mm and subjected to two points loading till failure of specimen. After failure the distance(D) between the crack and nearest support is measured. The flexure strength of the specimen is expressed as the modules of rupture. The test results are presented in the table. The flexural strength of the beam was calculated by the following expressions:

Fcr=PL/bd2 (when D is greater than 13.3 cm)

Fcr=3PD/bd2(When D is in between 11.00cm)

Where,

fcr = Flexural strength, MPa

D = distance between the line of fracture and the nearest support

b = width of beam, mm

d = depth of beam, mm

P = Central load, KN

6. RESULT TABLE

Compression test result

TRIAL	CONTENT (%)	WEIGHT (KG)	7 DAY`S COMP. LOAD(N)	COMPRESIVE STRENGTH (N/MM)
1.	CEMENT (100%)	i. 9.43 ii. 8.94 iii. 9.27	i. 480×10^3 ii. 465×10^3 iii. 460×10^3	i. 21.33 ii. 20.94 iii. 20.44
2.	CEMENT: FLY-ASH (75%+25%)	i. 8.73 ii. 8.82 iii. 8.64	i. 420×10^3 ii. 415×10^3 iii. 409×10^3	i. 17.43 ii. 17.19 iii. 16.83
3.	CEMENT: GGBS (70%+30%)	i. 8.65 ii. 8.76 iii. 8.71	i. 310×10^3 ii. 290×10^3 iii. 250×10^3	i. 13.78 ii. 12.89 iii. 11.11
4.	CEMENT: FLY-ASH: GGBS (60%+20%+20%)	i. 9.35 ii. 9.46 iii. 8.94	iv. 480×10^3 v. 450×10^3 vi. 460×10^3	i. 21.33 ii. 20.00 iii. 20.44
5.	CEMENT: FL-YASH: GGBS (50%+25%+25%)	i. 8.50 ii. 8.44 iii. 8.61	i. 440×10^3 ii. 470×10^3 iii. 460×10^3	i. 19.56 ii. 20.89 iii. 20.44

7. FLEXURAL STRENGTH TEST:

Flexural strength test was performed on beam specimens according to IS: 516-1959. Standard beam size 100mmx100mmx700mm where supported symmetrically over a span of 400 mm and subjected to two points loading till failure of specimen. After failure the distance(D) between the crack and nearest support is measured. The flexure strength of the specimen is expressed as the modules of rupture. The test results are presented in the table.

The flexural strength of the beam was calculated by the following expressions:

Fb=PL/bd2 (when D is greater than 13.3 cm)

Fb=3PD/bd2(When D is in between 11.00cm)

Where,

fb = Flexural strength, MPa

D = distance between the line of fracture and the nearest support

b = width of beam, mm

d = depth of beam, mm

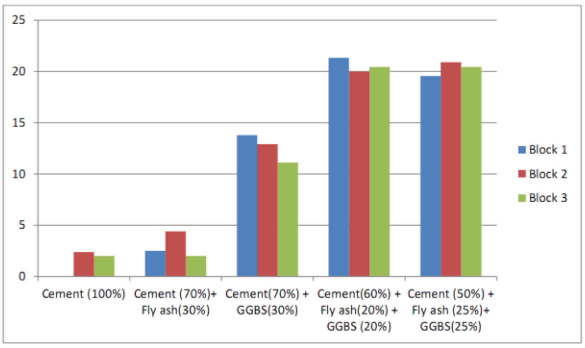
P = Central load, KN

SAMPLE CALCULATION :-

FLEXURESTRENGTH = PL/bd2

=[(24.797 × 103) × (700)] ÷ [150 × 1502]

= 14.51 N/mm2



8. CONCLUSION

The partial replacement of cement which gives a better result for a certain percentage that is trial no 4, This result in reduction in green house gauses.

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