International Journal For Technological Research In Engineering
Volume 4, Issue 11, July-2017 *ISSN (Online): 2347 - 4718*

INVESTIGATION ON STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT BY FLY ASH AND SAND BY GGBS

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ABSTRACT: Our goal it is to study the residences of concrete by using in part changing cement by means of fly ash and fine aggregate (sand) by using granulated blast furnace slag. On this Look at, cement was partially replaced by way of fly ash and best mixture were in part changed by means of granulated blast furnace slag in concrete. a combination layout became executed for m20 grade of concrete by using is technique. the utilization of fly-ash and blast furnace slag in concrete as partial alternative of cement and first-class mixture (sand) is gaining gigantic significance in today's concrete works, mainly on account of the development in long term sturdiness alongside ecological benefits. three grades of Normal port land cement (opc) particularly: 33, 43 and fifty three as labeled by means of Bureau of Indian Standard (BIS) or commonly utilized in production industry. now in this mission most effective 53 grade of cement is used. this paper reports comparative have a look at on consequences of concrete residences by using in part alternative of opc of 53 grades with fly ash and sand had been partially changed by way of blast furnace slag. the principle variable investigated in the take a look at of version of fly ash dosage of 10% and slag dosage of 10%, 20%, 30%,Fly ash dosage of 20% and slag dosage of 10%, 20, 30%, fly ash dosage of 30% and slag dosage of 10%, 20%, and 30%. the compressive power and split tensile strength & acid assault of concrete were specially studied. test outcomes indicates that, inclusion of fly ash and GBFS commonly improves the concrete houses up-to positive percentage of substitute in 53 grade of cement.

I. INTRODUCTION

Concrete is a widely used construction fabric for various sorts of systems due to its structural stability and strength. the everyday portland cement (opc) is one of the main components used for the manufacturing of concrete and has no alternative in the civil creation industry. In this thesis, the extraordinary admixtures had been used to examine their sole and combined effects at the resistance of concrete further to their consequences on mechanical and balance properties By way of the replacement of cement via 10% fly ash and sand replacement 10%, 20%, 30% of slag, cement by using 20% fly ash and sand substitute 10%, 20, 30% of slag, cement substitute of 30p.cfly ash and sand substitute 10%, 20%, 30% of slag.The secondary materials utilized in our undertaking are pozzolanic substances. the time period pozzolana is a siliceous or a siliceous and aluminous material which itself possesses no cementitious price but in presence of water, chemically react with calcium hydroxide to Shape compounds possessing cementitious residences .the fabric which having the pozzolanic belongings called pozzolanic cloth. thepozzolanic substances which might be utilized in our challenge are

1. Fly ash
2. Granulated blast furnace slag

SCOPE AND OBJECTIVES

This research mainly focusing on studying the effect of fly ash and Slag on the properties of concrete mixtures as a partially replacement of cement and sand. The scope of this study, the main goal is to improve compressive and split tensile strength of concrete at different percentage of replacement of fly ash and slag. Fly ash and slag is the cheapest materials of all concrete constituents and is much less expensive than natural aggregate and sand as possible to save money. The main aim of the research is to study the effect of partially replacement of fly ash and slag in to the concrete. The main objectives are study in this theory is

- To study normal consistency, initial and final setting times, soundness and fineness of cement.
- To study specific gravity, water absorption of coarse aggregate.
- To study specific gravity, water absorption of fine aggregate of river sand and slag.
- To study the compressive strength of normal concrete and partially replacement of cement by fly ash and sand by GBFS.
- To study split tensile strength of normal concrete and partially replacement of cement by fly ash and sand by GBFS.

RESEARCH METHODOLOGY

The following are to be performed so as to gain the studies objectives.

- To gather the fly ash from thermal electricity plant RTPP and accumulate the blast furnace slag from metallic plant.
- Sieve the slag by way of using of 4.75mm sieve.
- To take a look at about the fly ash and slag.
- To observe approximately the electricity of substitute of fly ash and slag in concrete.
- Take a look at on acid attack in concrete
- Evaluation of experimental consequences to draw conclusions.

II. MATERIALS USED:

Fly Ash:

The fly fiery remains are gathered from neighborhood squander scrubbers. Fly fiery debris is a pozzolana substance containing aluminous and siliceous material that structures bond within the sight of water. Concrete is currently mostly supplanted by its weight by fly slag at as 2different rates, for example, 10%, 20%,30%.

Slag:

Because of shortage of reasonable stream sand for use as fine total in development applications and late development blast has prompted an extreme increment in cost.

Cement:

The OPC (53 grade) utilized as a part of the present work is of Zuari bond.

Fine Aggregates

The sand is free from clayey issue, residue and natural pollutions and so on. Thus utilized as a fine total in concrete. The measure of sand is that going through 4.75 and held on 150 micron IS strainer. The particular gravity of Sand is taken as 2.62. Sand is tried for particular gravity, as per IS: 2386-1963.

Coarse aggregates:

The coarse total is free from clayey issue, residue and natural contaminations and so forth. The particular gravity of Sand is taken as 2.65. Coarse total is tried for particular gravity, as per IS: 2386-1963. The greatest size of 20 mm is utilized as a coarse total in concrete.

Water: Portable water has used.

III. RESULTS AND DISCUSSIONS

Table 1 : Workability of concrete with replacement of fly ash and slag

S.NO	Details of Material	Slump in mm
1	90%cement +10%FA and 90%sand+10%slag	45
2	90%cement +10%FA and 80%sand+20%slag	47
3	90%cement +10%FA and 70%sand+30%slag	50
4	80%cement +20%FA and 90%sand+10%slag	53
5	80%cement +20%FA and 80%sand+20%slag	56
6	80%cement +20%FA+70%sand30%slag	58
7	70%cement +30%FA and 90%sand+10%slag	54
8	70%cement +30%FA and 80%sand+20%slag	57
9	70%cement +30%FA and 70%sand+30%slag	59

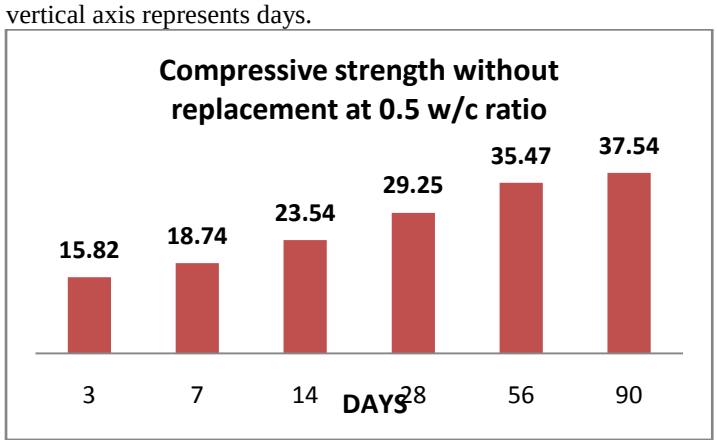
COMPRESSIVE STRENGTH RESULTS

Compressive Strength without Replacement:

Table 2: Normal concrete compressive strength

S.No.	Days	Compressive strength in N/mm^2
1	3	15.82
2	7	18.74
3	14	23.54
4	28	29.25
5	56	35.47
6	90	37.54

The below graph shows compressive strength V_s no of days .the horizontal axis represents the compressive strength and vertical axis represents days.



Compressive strength for cubes at10% fly ash and 10%,20%,30% of slag:

S. No.	Days	10%FA+10%GBFS	10%FA+20%GBFS	10%FA+30%GBFS
1	3	20.66	20.88	19.33
2	7	32.66	23.55	20.66
3	14	33.33	24.22	20.44
4	28	36.88	25.99	22.88
5	56	39.77	32.22	25.15
6	90	42.55	35.55	28.66

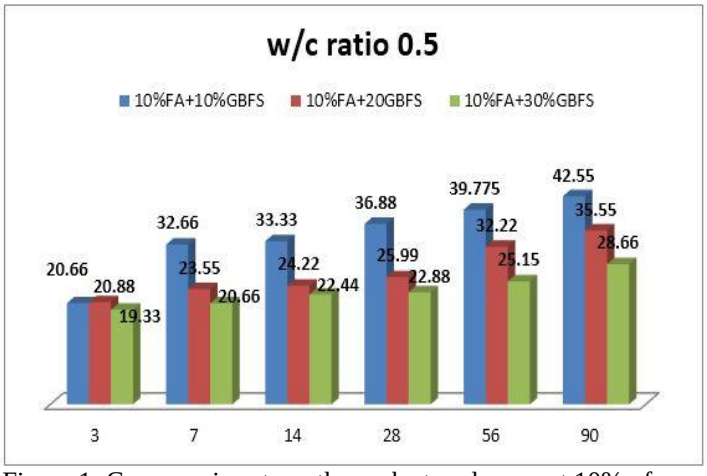


Figure 1: Compressive strength graph at replacement 10% of fly ash &10%,20%,30% of Slag

The chart is drawn between compressive quality Vs. days at fly fiery debris measurements of 10% and slag dose of 10%, 20%, 30%,.The level pivot speaks to the days and compressive quality appeared in vertical hub. From diagram when contrasted with the ordinary cement (0% fly fiery remains and 0% slag), the 3,7 14,28,56,90 days compressive quality is expanded at fly powder measurements of 10% and slag dose of 10%, 20%, 30%.

The Compressive quality of cement for 10% FA and 10% GBFS is more contrasted with that for 10% FA and 20% GBFS and 10% FA and 30% GBFS.

Compressive strength for cubes at 20% fly ash and 10%,20%,30% of Slag:

S. No.	Days	20%FA+10%GBFS	20%FA+20%GBFS	20%FA+30%GBFS
1	3	23.77	18.88	14.22
2	7	26.44	20.44	19.11
3	14	26.22	23.77	21.77
4	28	31.32	29.99	24.88
5	56	33.11	31.11	26.21
6	90	35.11	32.66	27.77

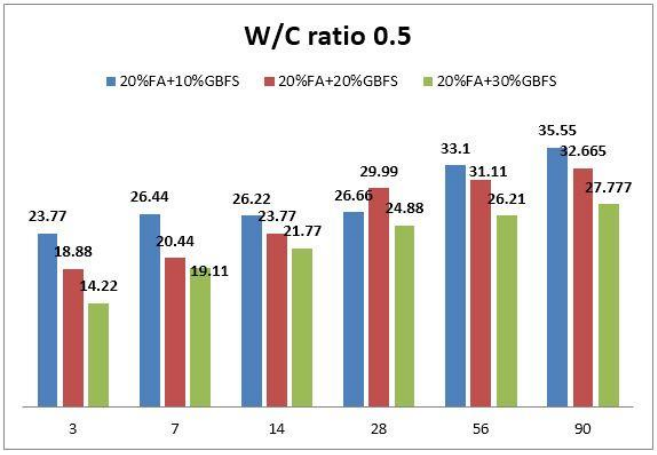


Figure 2: Compressive strength at 20% replacement of fly ash and 10%,20%,30% replacement of GBFS

The diagram is drawn between compressive quality Vs. days at fly fiery debris dose of 20% and slag measurement of 10%, 20%, 30%,.The even pivot speaks to the days and compressive quality appeared in vertical hub. From chart when contrasted with the typical cement (0% fly fiery remains and 0% slag), the 3,7 14,28,56,90 days compressive quality is expanded at fly powder measurement of 20% and slag dose of 10%, 20%, 30%.

Compressive strength for cubes replacement of 30% of fly ash and 10%,20%,30% of GBFS:

S.No.	Days	30%FA+10%GBFS	30%FA+20%GBFS	30%FA+30%GBFS
1	3	14.44	13.77	11.77
2	7	20.66	19.77	17.22
3	14	21.11	20.55	18.22
4	28	23.33	21.33	18.99
5	56	28.22	27.55	23.55
6	90	30.22	29.33	27.66

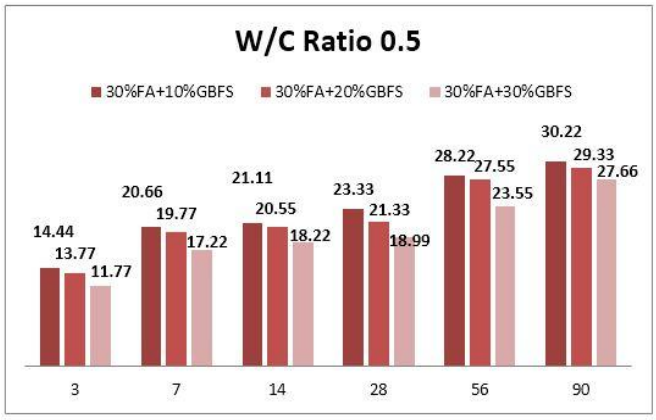


Figure 3: Compressive strength graph strength at 30% replacement of fly ash and 10%,20%,30% replacement of GBFS

The chart is drawn between compressive quality Vs. days at fly fiery debris measurement of 30% and slag dose of 10%, 20%, 30%,.The level hub speaks to the days and compressive quality appeared in vertical hub. From chart when contrasted with the typical cement (0% fly fiery remains and 0% slag), the 3,7 14,28,56,90 days compressive quality is expanded at fly powder measurements of 30% and slag dose of 10%, 20%, 30%. In the present examination the Fly Ash and slag has been utilized as a substitution of bond and rate, the level of increment or diminishing in compressive quality other rate is computed. Considering the ordinary M20 review with zero rate admixtures the compressive quality is 37.54 N/mm2 at 90days.

Table 3: Percentage of Compressive Strength Vs % of Cement Replacement by Fly Ash and Sand Replacement by Slag

S.No	% of fly ash and slag	3 days compressive strength (N/mm²)	% of increase in strength	7 days compressive strength (N/mm²)	% of increase in strength	14 days compressive strength (N/mm²)	% of increase in strength	28 days compressive strength (N/mm²)	% of increase in strength	56 days compressive strength (N/mm²)	% of increase in strength	90 days compressive strength (N/mm²)	% of increase in strength
1	0	15.82	0	18.74	0	23.54	0	29.25	0	35.47	0	37.54	0
2	10%FA+10%Slag	20.66	39.59	32.66	74.24	33.33	41.5	36.88	26.08	39.77	12.12	42.55	13.34
3	10%FA+20%Slag	20.88	31.98	23.55	25.66	24.22	2.88	25.99	-12.54	32.22	-10.08	35.55	-5.59
4	10%FA+30%Slag	19.33	22.18	20.66	10.12	22.22	-5.94	22.88	-27.8	25.15	-41.00	28.66	-30.98
5	20%FA+10%Slag	23.77	50.25	26.44	41.08	26.22	11.38	26.66	-9.71	33.11	-7.12	35.55	-5.59
6	20%FA+20%Slag	18.88	19.34	20.44	9.07	23.77	0.97	29.99	2.46	31.11	-14.01	32.66	-14.94
7	20%FA+30%Slag	14.22	-11.25	19.11	1.97	21.77	-8.13	24.88	-17.56	26.21	-35.33	27.77	-35.18
8	30%FA+10%Slag	14.44	-10.61	20.66	10.2	21.11	-11.51	23.33	-25.37	28.22	25.69	30.22	-24.22
9	30%FA+20%Slag	13.77	-12.95	19.77	5.49	20.55	-12.70	21.33	-37.10	27.55	-28.74	29.33	-27.99
10	30%FA+30%Slag	11.77	-25.60	17.22	-8.11	18.22	-22.59	18.99	-35.07	23.55	-51.66	27.66	-26.31

From this the above table the qualities; plainly the 3 days, 7 days and 14 days compressive quality is increments as the slag and fly fiery debris rate increments. 28, 56, 90 days compressive quality is diminishes as the slag and fly cinder rate increases.28, 56, 90 days compressive quality at the 10% of fly fiery remains and 10%slag measurements. This is on the grounds that at early age there is no pozzolanic activity of fly cinder and slag. Preferred standpoint in utilizing slag as a sand substitution and fly fiery debris as concrete substitution is up to a most extreme of 10%. However 10% substitution can be taken as ideal measurements which can be blended in bond concrete for giving ideal conceivable compressive quality at any stage.

SPLIT TENSILE TEST:

Split Tensile Strength without Replacement:

Cement by Fly powder and sand by slag supplanted in cement to decide the split elasticity for 3, 7, 14, 28 days. The curing of solid barrels by utilizing compressive quality testing machine. At room temperature these 3D squares were cured. The water concrete proportion was taken as 0.50. By lead the split pliable test the barrels is put on a level plane on the compressive testing machine and two parallel plates are kept in best and base of the chamber as a result of the reason is the heap is consistently circulated on the chamber. At that point the heap is connected on the example and to watch the devastating burden esteems and they are recorded. Subsequent to knowing the devastating burden esteems by utilizing split tractable recipe and to figure the split elastic esteems they are appeared in beneath tables

Table 4: Normal concrete split tensile strength

S. No.	Days	Split tensile strength in N/mm²
1	3	2.55
2	7	2.68
3	14	2.41
4	28	2.68

Figure 4: shows split tensile strength of normal concrete

Split tensile strength for cylinders at replacement of 10%fly ash and 10%,20%,30% of Slag:

S.No.	Days	10%FA+10%GBFS in N/mm²	10%FA+20%GBFS in N/mm²	10%FA+30%GBFS in N/mm²
1	3	2.05	1.50	2.12
2	7	1.76	1.32	1.41
3	14	2.05	2.90	1.98
4	28	2.97	2.61	2.05

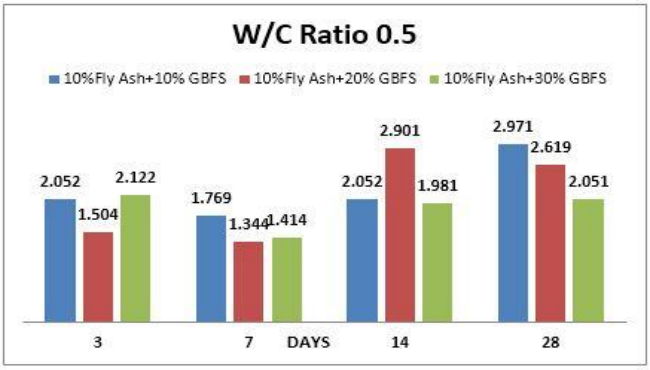


Figure 5: Split tensile strength at replacement of 10%fly ash and 10%,20%,30% GBFS

Spilt tensile strength at replacement of 20% fly ash and 10%,20%,30% GBFS:

S. No.	Days	20%FA+10%GBFS in N/mm²	20%FA+20%GBFS in N/mm²	20%FA+30%GBFS in N/mm²
1	3	1.76	1.20	1.13
2	7	2.05	1.14	1.20
3	14	2.47	2.90	2.68
4	28	2.54	1.98	1.76

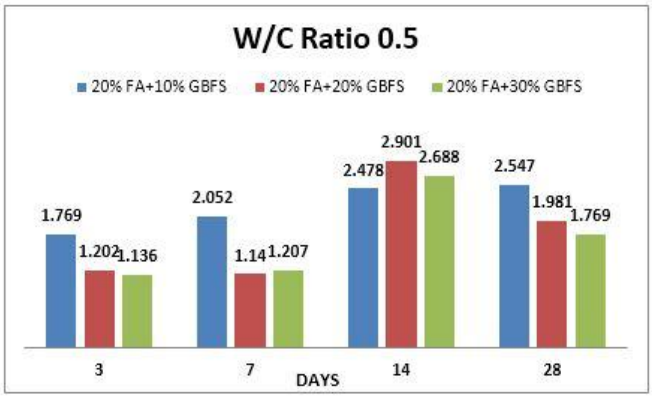


Figure 6: Split tensile strength at replacement of 20%fly ash and10%, 20%, 30% GBFS

Spilt tensile strength at replacement of 20% fly ash and 10%, 20%, 30% GBFS:

S. No.	Days	30%FA+10%GBFS in N/mm²	30%FA+20%GBFS in N/mm²	30%FA+30%GBFS in N/mm²
1	3	1.70	1.34	1.41
2	7	2.33	1.13	1.20
3	14	3.94	2.19	11.89
4	28	2.40	2.33	1.69

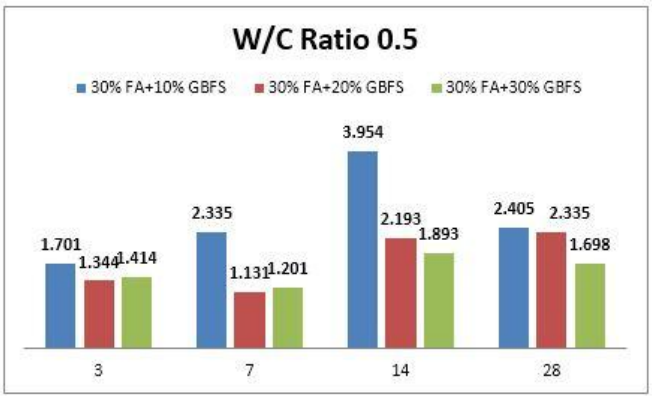


Figure 7: Split tensile strength at replacement of 30%fly ash and10%,20%,30% GBFS

By including distinctive level of fly fiery debris and slag in concrete the split malleable esteems are recorded in the above tables. With expanding of fly fiery debris and slag in concrete the split pliable esteems are marginally diminishing. By including 10% substitution of fly cinder as bond and slag as and in concrete the split elastic esteem is diminishing. At 20% substitution the split rigidity esteem is diminished .At 30% likewise substitution the split elasticity esteem is diminished when contrasted with ordinary cement.

In this undertaking the consequences of split rigidity esteems with substitution of fly fiery remains and slag in concrete got

are contrasted with the outcomes got without substitution of fly powder and slag in concrete. The accompanying conclusions are gotten from this undertaking.

IV. CONCLUSIONS

Fly Ash and GBFS is utilized as a part of generation of solid 3D shapes and chambers substitution concrete by fly fiery remains measurement of 10% at substitution sand by slag dose of 10%, 20%, 30%, substitution bond by fly powder dose of 20% at substitution of sang by slag dose of 10%, 20, 30%, substitution of bond by fly cinder dose of 30% at substitution of sand by slag dose of 10%, 20%,30%.These 3D squares and barrels were cured and tried for compressive quality and split elasticity for 3days, 7days, 14days, 28days, 56days, 90days and comes about were noted. In view of exploratory examination directed after conclusions are made.

- With expanding of fly powder and slag rates in solid then the workability ought to be expanded slowly when contrasted with ordinary cement.
- By utilizing of fly fiery debris and slag in concrete the water ingestion amount ought to be expanded step by step on account of slag consumed greater amount of water.
- The most intriguing finding was that Fly Ash impedes the underlying setting and quickens the last setting of solid mortar.
- The exploratory outcomes demonstrate that the pozzolanic movement of fly cinder and slag squander increments with increment of time.
- The physical properties of bond with the substitution of fly fiery debris and slag were observed to be increment with the expanding of the rates of admixtures.
- Although the soundness of bond was observed to be increment after substitution of admixtures.
- The Compressive quality of cement for 10% FA and 10% GBFS is more contrasted with that for 10% FA and 20% GBFS and 10% FA and 30% GBFS.
- The Compressive quality of cement for 20% FA and 10% GBFS is more contrasted with that for 20% FA and 20% GBFS and 20% FA and 30% GBFS.
- The Compressive quality of cement for 30% FA and 10% GBFS is more contrasted with that for 30% FA and 20% GBFS and 30% FA and 30% GBFS.
- The greatest quality had accomplished 39.59% expanded at 10 % FA and 10% GBFS substitution when contrasted with controlled cement.
- The split elasticity esteems were observed to be bit by bit diminished while the mix of rate substitution of admixtures is expanded.

REFERENCES

[1] B. Mather, "Concrete--Year 2000, Revisited", ACI journal, vol-144, pp 31-40, 1994
[2] Taiwan, Concrete International, vol-17, pp 71-76, 1995 etc.
[3] International Symposium on "innovative world of concrete", Vol- II , IWC-98 proceedings.
[4] Proceedings of Seventh International Conference on Fly Ash, Silica Fume,Slag and Natural Pozzolans in Concrete, Vol-II Editor, V.M.Malhotra.
[5] The Indian Concrete Journal, Vol.80, June 2006.
[6] Magazine of Concrete Research, Vol.58, June 2006.

IS Codes

[1] IS 456-2000 -Code of practice for plain & reinforced cement concrete.
[2] IS 12269-1987-Specification for OPC 53 grade.
[3] IS 10262-2009-Recommended guide line for concrete mix design.
[4] IS 1727-1967-Methods of test for pozzolonicmaterials.
[5] IS 3812-1981-Specifications of fly ash for use as pozzolana& admixtures (First Revision).
[6] IS 3812(Part1)-2003-Specifications for pulverized fuel ash for use as cement, cement mortar and concrete (Second Revision).
[7] IS 9103-1999-Concrete admixture –Specifications.
[8] IS 516-1965-Method of Test for Strength of Concrete.
[9] IS 383-1970-Specification for coarse aggregate and fine aggregate from natural sources.
[10] IS 650-1966-Specification for standard sand for testing of cement.
[11] IS 2386 (Part 3)-Method of test for aggregates for concrete-Specific gravity, density, voids, absorption and bulking.

