iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4734

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

An Experimental Investigation on Partial Replacement of Fine Aggregate by Bottom Ash in Cement Concrete

RangithBangerra K[1], K.E.Prakash[2], Yogesh[3]
[1]Civil Engineering Department,SDIT, Mangalore, India
[2, 3]Civil Engineering Department, SDIT, Mangalore, India,

Abstract: Concrete is an irreplaceable material which is being used in infrastructural development. The cost of building construction is increasing by use of conventional materials like cement, river sand and coarse aggregates. This leads to reduction of naturally available materials. In this study, an effort is made to produce cost effective concrete by replacement of fine aggregates with bottom ash in proportions of 0%, 10%, 20%, 30%, 40% and 50%. Considering the all test results it is concluded that the optimum utilization of Bottom ash is 10% in concrete as replacement to the fine aggregate to obtain a considerable design mix.
Keywords: Concrete, cement, water, fine aggregates, Bottom ash

I. INTRODUCTION

Concrete is a material synonymous with strength and longevity. It has emerged as the dominant construction material for the infrastructure needs of the twenty-first century. In addition to being durable, concrete is easily prepared and fabricated from readily available constituents and is therefore widely used in all types of structural systems. In general the fine aggregates used in the production of concrete was natural river sand.

Now a days these natural sources like river sand are exhausting gradually around the world so, their protection of environment and saving of natural resources the construction industry is look for the alternative constituent material for making concrete so, there is need for replacement of sand in India.

The challenge for the civil engineering community in the near future is to realize projects in harmony with the concept of sustainable development and this involves the use of high performance materials and products manufactured at reasonable cost with the lowest possible environmental impact energy is the main backbone of modern civilization of the world over, and the electric power from thermal power stations is a major source of energy, in the form of electricity.

In India, over 70% of electricity generated in India, is by combustion of fossil fuels, out of which nearly 61% is produced by coal-fired plants. This results in the production of roughly 100 ton of ash. Most of the Bottom the ash has to be disposed of either dry, or wet to an open area.

A. Role of Fine Aggregate in Concrete

The fine aggregate plays a very important role for imparting better properties of concrete in its fresh and hardened state. Aggregate in concrete is structural filler. Aggregate occupies most of the volume of the concrete. It is the stuff that the cement paste coats and binds together. The composition, shape, and size of the aggregate all have significant impact on the workability, durability, strength, weight, and shrinkage of the concrete. Aggregate can also influence the appearance of the cast surface, which is an important consideration inmixes.

B. Alternative Fine Aggregates

Following are the some of the alternative fine aggregates

Quarry dust, Manfactured sand, Foundary sand, Crushed bricks, Crushed granite, Glass powder, Bottom Ash.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

C. Bottom Ash.


Fig 1 Bottom Ash

Table Iand II shows Physical and chemical characteristics of Bottom Ash

Table I Physical properties of Bottom Ash

Sl. No	Properties	Description
1	Specific gravity	2.12
2	Bulk density (gm /cc)	0.642-0.747
3	Fines modules	6.28
4	Maximum dry density (KN/M^3)	7.20
5	Water absorption (%)	14.10
6	Sizes produced (mm)	3.47-4.75
7	Aggregate impact value (%)	18.25
8	Aggregate crushing strength (%)	19.30
9	Aggregate abrasion value (%)	30.12

Table II Chemical characteristics of Bottom Ash

SL.NO	Constituents	Percentage (by weight)
1	SiO2	68.0
2	AhO3	25.0
3	Fe2O3 + Fe3O4	2.18
4	TiO2	1.45
5	CaO	1.66
6	MgO	0.02
7	So4	Nil
8	Loss on igniation	1.69

D. Tests on Bottom Ash

Bottom ash is a by-product of combustion of pulverized coal. This coal bottom ash is physically coarse, porous, glassy, granular, greyish and incombustible materials that are collected from the bottom of furnaces that burn coal. The physical properties of coarse bottom ash given in the below Table 4.5.

Table III Physical properties of Bottom ash

Sl. No	Material property	Test Results
1	Specificqgravity	1.98
2	Fineness modulus (%)	2.55
3	Bulk density (kg/m^3)	1448
4	Water absorption (%)	1.52

E. Methodology

The methodology has been adopted to study the fresh and hardened properties of bottom ash (replacement of fine aggregate). The study work includes the following procedure.The M30 grade mix design was prepared by using as per IS 10262:2009 codal provisions. The concrete mixes are prepared varying the bottom ash content as 0%, 10%, 20%, 30%, 40% and 50% by weight with replacement of fine aggregate. The prepared mixes are studied for both fresh as well as hardened properties.

II. RESULTS AND DISCUSSION

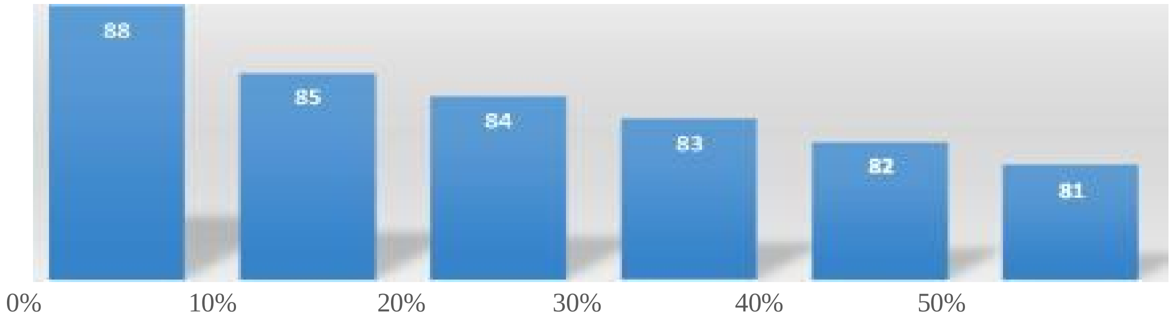
A. Workability Test Results

Table IV
Workability Test Results

Percentage replacement of Fine Aggregate by Bottom Ash	Fresh properties tested		
	Slump (mm)	Compaction Factor	Vee-Bee Degree (Sec)
0%BA+100% FA	88	0.90	6
10% BA+90% FA	85	0.89	8
20% BA+80% FA	84	0.87	12
30% BA+70% FA	83	0.86	20
40% BA+80% FA	82	0.84	22
50% BA+50% FA	81	0.83	30

Slump Cone Test

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com



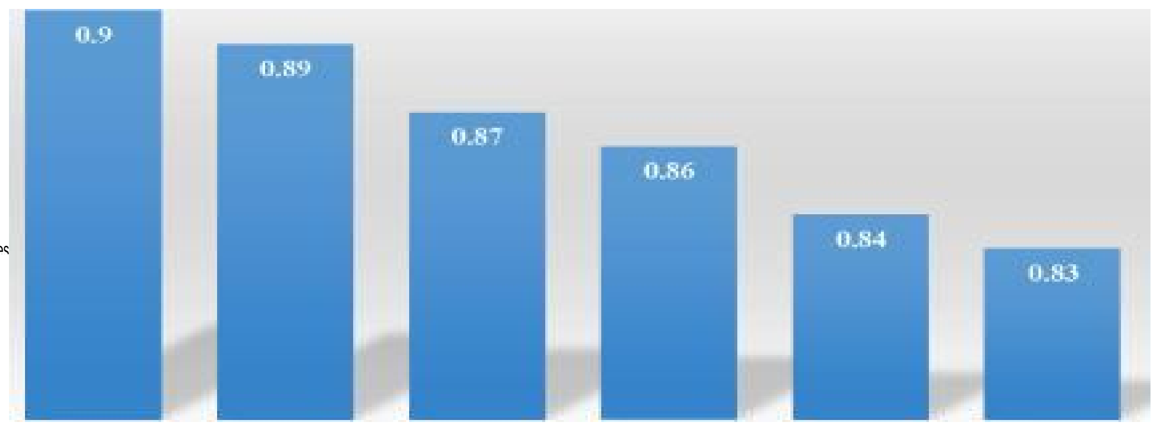
% of replacement of Fine Aggregate by Bottom ash Fig.1: Variation of Slump

The Fig.1 indicates the variations of slump value. From the graph it can be observed that the slump is gradually decreasing with increase of bottom ash content and the maximum slump is obtained for 0% BA + 100% F.A.

Compaction Factor Test

% of replacement of Fine aggregate by Bottom ash Graph No.

Fig.2: Variation of Compaction Factor



The Fig.2 indicates the variations of compaction factor value. From the graph it can be observed that the compaction factor is

0% 10 20% 30% 40% 50%

gradually decreasing with increase of bottom ash content and the maximum compaction factor is obtained for 0% BA + 100% F.A.

Vee Bee Test

Fig.3: Variation of Vee bee

% of replacementlof Fine Aggregate by Bottom ash

The Fig.3 indicates the variations of vee bee time. From the graph it can be observed that the compaction factor is gradually increasingiwith increase of bottom ash content and the maximum compaction factor is obtained for 50% BA + 50% F.A.

Table V

Overall results of Compressive Strength Test for 7 days and 28 days curing period.

% Replacement of Bottom ash	7 days		28 days	
	Compressive Strength (N/mm^2)	% increase or decrease in Compressive strength compared to Nominal Mix	Compressive Strength (N/mm^2)	% increase or decrease in Compressive strength compared to Nominal Mix
0% (Nominal Mix)	24.5	0	37.2	0
10%	27.65	14.02	42.8	15.05
20%	26.5	9.27	40.6	9.13
30%	24.55	1.23	38.0	2.15
40%	22.33	-8.32	34.0	-8.60
50%	18.5	-23.7	28.3	-23.92

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

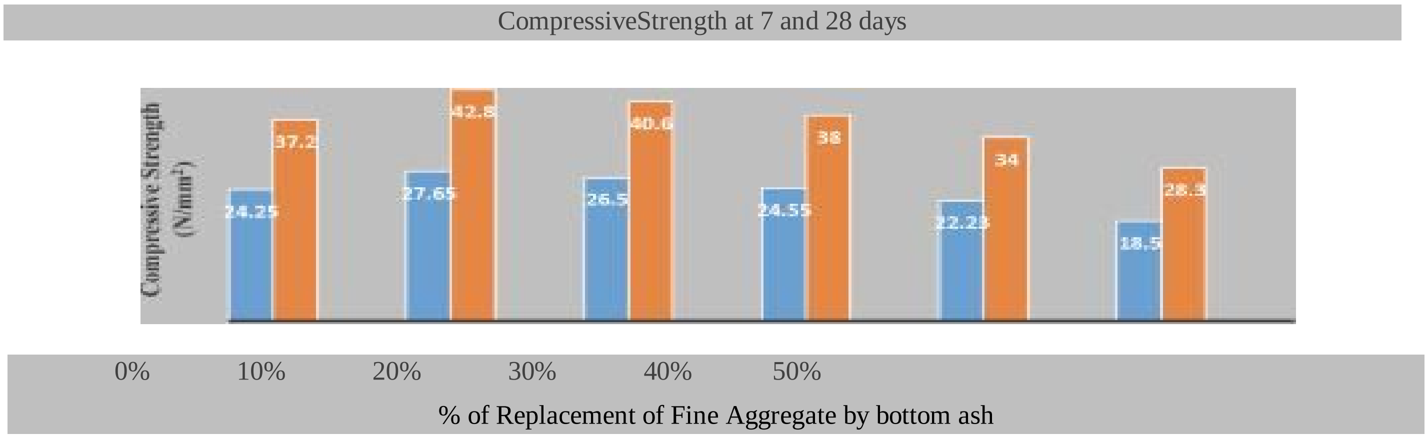


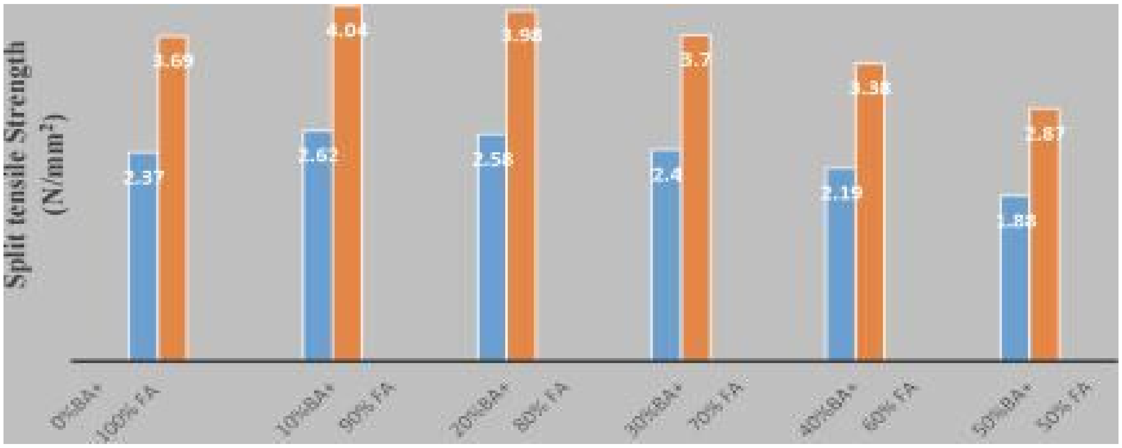
Fig 4.Overall Compressive Strength of Cubes of curing period 7 and 28 days

Table VI
Overall results of Split Tensile Strength for 7 and 28 days curing perio

% Replacement of Bottom ash	7 days		28 days	
	Split tensile Strength (N/mm^2)	% increase or decrease in Split tensile strength compared to Nominal Mix	Split tensile Strength (N/mm^2)	% increase or decrease in Split tensile strength compared to Nominal Mix
0% (Nominal Mix)	2.37	0	3.69	0
10%	2.62	10.5	4.04	9.4
20%	2.58	8.86	3.98	7.85
30%	2.40	1.26	3.70	0.25
40%	2.19	-7.59	3.38	-8.4
50%	1.88	-20.6	2.87	-22.2

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Split tensile strength at 7 and 28 days



% of Replacement
of Fine Aggregate by bottom ash

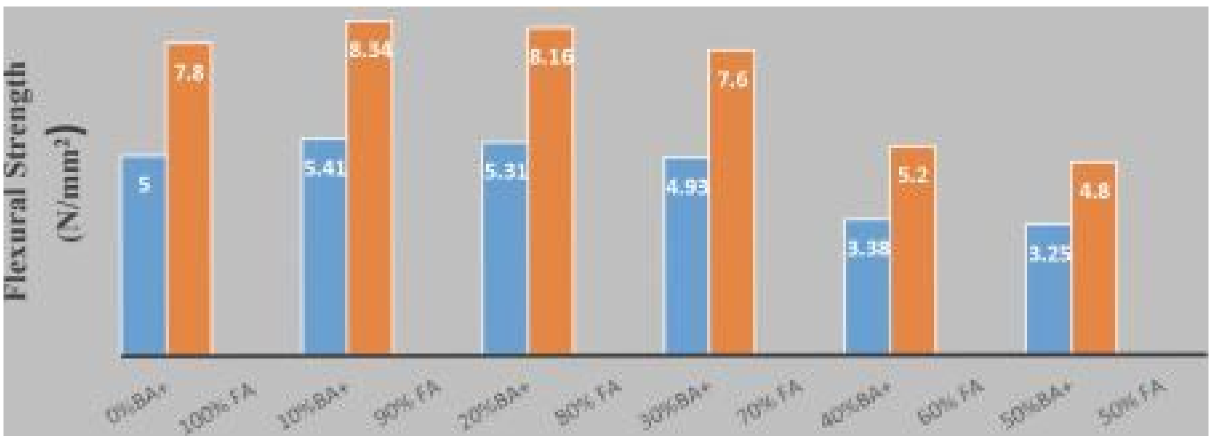
Fig.5: Overall Split Tensile Strength of Cylinders of curing period 7 and 28days

Table No. VII: Overall results of Flexural Strength test for 7 and 28 days curing period

%Replacement ofBottom ash	7 days		28 days	
	Flexural Strength (N/mm^2)	% increase or decrease in Flexural strength compared to Nominal Mix	Flexural Strength (N/mm^2)	% increase or decrease in Flexural strength compared to Nominal Mix
0% (Nominal Mix)	5.0	0	7.8	0
10%	5.41	8.2	8.34	6.92
20%	5.31	6.2	8.16	4.61
30%	4.93	-1.4	7.6	-2.56
40%	3.38	-32.4	5.2	-33.3
50%	3.25	-35	4.8	-38.5

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Flexural Strength at 7 and 28 days



% of Replacement
of Fine Aggregate by bottom ash

Fig.6: Overall Flexural Strength of beams of curing period 7 and 28 days

III. CONCLUSION

The workability of fresh concrete with slump cone test is gradually increasing with increase of bottom ash content in concrete and the maximum slump is obtained for 0% Bottom ash+ 100% Fine aggregate and compaction factor is gradually decreasing with increase of bottom ash content in concrete and the maximum compaction is obtained for 0% BA + 100 % F.A.The specimens with bottom ash as replacement with fine aggregate was found to be better in compression which has compressive strength of 14.02% and 15.05% more than that of nominal mix concrete after 7 days and 28 days curing period respectively for 10% Bottom ash + 90% Fine aggregate.Better split tensile strength was achieved with the replacement to fine aggregate with Bottom ash in concrete. The split tensile strength was increased up to 10.5% and 9.4% when compared to that of the nominal mix concrete after 7 days and 28 days curing period respectively for 10% Bottom ash + 90% Fine aggregate.Good flexural strength was achieved with the replacement to fine aggregate with bottom ash in concrete. The flexural strength was increased up to 6.92% and 8.2% when compared to that of the nominal mix concrete after 7 days and 28 days curing period respectively for 10% Bottom ash + 90% Fine aggregate.Considering the all above points it is concluded that the optimum utilization of Bottom ash is 10% in concrete as replacement to the fine aggregate to obtain a considerable design mix.

REFERENCES

[1] Aggarwal. P (2007): "Effect of bottom ash as replacement of fine aggregates in concrete". ASIAN JOURNAL OF CIVIL ENGINEERING (BUILDING AND HOUSIN G), VOLUME 8.

[2] Dilip Kumar. (2014): "Uses of Bottom ash in the Replacement offineagregate for Making Concrete''. International Journals of Current Engineering and Technology, Volume 4.

[3] RemyaRaju, Mathews M. Paul, & K. A. Aboobacker, al. (2014): "Strength performance of concrete using bottom ash as fine Aggregate ". International j ournal of Research in Engineering & Technology, Volume 2.

[4] Subramani T, C. Sumathi, (2014): "Experimental Investigation of Partial Replacement of Cement with Fly Ash and Sand with Bottom Ash and Glass Used in Concrete". International Journal of Application or Innovation in Engineering Management, Volume 4, Issue 5.

[5] AbhishekSachdeva, Gobindkhuran, (2015): "Strength Evaluation of Cement Concrete Using Bottom Ash as a Partial Replacement of Fine Aggregates". International Journal of Science Engineering and Technology, Volume 3, Issue 6.
[6] Sathyaprabha K, Rajasekar J. (2015): "Experimental Study on properties of Concrete Using Bottom Ash with Addition of Polypropylene Fibre". International Journal of Scientific and Research Publication, Volume 5, Issue 8.
[7] Vikas R Nadig. (2015). "Bottom Ash as Partial Sand Replacement in Concrete -A Review". Journal of Mechanical and Civil Engineering, Volume 12, Issue 2.
[8] Brindha M, Sakthieswaran N, Shinny Brintha G, (2016): "Durability Study of Cement Mortar Replaced by Bottom Ash and Green Sand as a Fine Aggregate ''. International Journal for research in Applied Science and Engineering Technology, Volume 4.
[9] Ranapratap P, Padmanabham K. (2016): "Effect of replacement fine aggregate with bottom ash in M40 grade of concrete with OPC-53S cement". International of Research in Engineering and Technology.
[10] . K. L. Bidkar, K. T. Phalak, Prof. R. T. Pardeshi, (2016): "Sieved Coal bottom ash concrete".*Internationa*l Journal for Research in Engineering Application & Management, Volume 2, Issue 3.