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Experimental Study on Fully Replacement of River Sand by Bottom Ash and Lime Stone Filler

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Abstract : This paper presents the use of hydro sluiced bottom ash and lime stone filler as fine aggregate. part of a study investigating the structural characteristics of concrete using various combinations of bottom ash sand and lime stone filler as complete replacement for conventional river sand fine aggregate. The lime stone filler obtained from limestone quarries. The concrete are made using varying contents of bottom ash and lime stone filler as fine aggregate. The quantity of bottom ash was varied from 0% to 100% against lime stone filler at intervals of 25%. Samples of concrete (eg.cubes) are made in three different grades, namely: M15, M20 and M25. It was found that 0.55 water/cement ratio produced higher compressive strengths, tensile strength and better workability for M20 mix, proportion. Specifically compressive and tensile strength ranged from 21.06 -35.2 N/mm^2 and 10.06 -15.5 N/mm^2 for the mixes considered. These results compare favourably with those of conventional concrete. The concrete was found to be suitable for use as structural members for buildings and structures, where bottom ash content did not exceed 50%.
Key words: compressive strength, bottom ash sand, lime stone filler and tensile strength.

1. **Introduction**

In this project a study was made to evaluate the potential use of industrial wastes bottom ash by partially replacing the sand .this project work is more sustainable and environmentally friendly and avoids the use of natural resources such as sand**.** This paper is part of a study investigating the objective is to minimize the cost of construction material and also save the environment for future generation by leaving the non renewable resource materials like lignite, sand aggregate etc. Structural characteristics of concrete using various combinations of bottom ash sand and lime stone filler as complete replacement for conventional river sand fine aggregate. Limestones are sedimentary rocks primarily of calcium carbonate. Limestones are generally obtained from the calcareous remains of marine or fresh water organisms embedded in calcareous mud. They change from the soft chalks to hard crystalline rocks. The use of limestone as a concrete aggregate has sometimes been suspect on account of the unsuitability of the poorer grade rocks, and also because of a widespread fallacy that limestone concrete is less resistant to the action of fire than concrete made from other aggregates. He suggested that the use of limestones might not be beneficial in concrete products, which are to be cured in high-pressure steam**.** For many years has been increasingly used in concrete as coarse aggregate, lime stone filler or as a main cement constituent. It is applied in high performance concrete as well as in normal or low performance concrete. Compared to plain concrete with the same w/c ratio and cement type, concrete with high limestone filler content with suitable particle size distribution possesses generally improved strength characteristics. Replacement of cement with 0.75% of nanosilica gives more strength than the bottom ash mix and also the durability has been increased compared to the bottom ash sand Mix. The self weight of the Nano mix is lighter than the bottom ash sand and the conventional mix. The workability decreases with the addition of Nano-Silica compared to the conventional mix and the bottom ash sand mix.The penetration level of chlorides and acids are less in Nano concrete compared to that of conventional and fully replacement of bottom ash sand**[1].**

Concrete using various combinations of lateritic sand and quarry dust as complete replacement for conventional river sand. The result is found better workability and high compressive strength **[2]**. Limestone filler is regularly used as mineral addition in self-compacting concrete. In this overview, some interesting results are summarized concerning hydration, microstructure development, transport properties, and durability **[3].** The additions of limestone filler or fly ash – taken separately or altogether, determine a decrease of the setting time for the blended cements in comparison with Portland cement, the effect being stronger in the case of cements with greater addition of fly ash (20-30%) **[4].** In India, the conventional concrete is produced using natural sand from river beds as fine aggregate. Decreasing natural resources poses the environmental problem and hence government restriction on sand quarrying resulted in scarcity and significant increase in its cost The cheapest and the easiest way of getting substitute for natural sand is obtained from limestone quarries , lateritic sand and crushing natural stone quarries is known as manufactured sand The ordinary Portland cement is partially replaced with nano-silica by 0.75% and natural sand is fully replaced with manufactured sand, the better compressive strength, flexural strength and better durability and corrosion resistance **[5].**In Konkan region of Maharashtra, the laterite stone is commonly used for the construction purpose. There are several laterite stone quarries in Konkan region. During excavation of laterite stone, around 25 – 30 per cent laterite stone scrap is generated. It is estimated that about 2.83 cum of the laterite stone scrap is generated during excavation of about 11.33 cum of the laterite stone. This laterite stone scrap creates problem in quarries and needs removal for further excavation. In order to add value to this waste material, it is felt necessary to manufacture the blocks using different constituents that are suitable for the construction. In this In this overview determine the Compressive strength, toughness index and water absorption capacity of the laterite stone scrap blocks **[6].** The cheapest and the easiest way of getting substitute for natural sand is obtained from limestone quarries, lateritic sand and crushing natural stone quarries is known as manufactured sand. Concrete made with limestone filler as replacement of natural sand in concrete can attain more or less same compressive strength, tensile strength, permeability, modulus of rupture and lower degree of shrinkage as the control concrete **[7]** In India, the conventional concrete is produced using natural sand from river beds as fine aggregate. Decreasing natural resources poses the environmental problem and hence government restriction on sand quarrying resulted in scarcity and significant increase in its cost. Normally particles are not present in river sand up to required quantity. Digging sand, from river bed in excess quantity is hazardous to environment. The deep pits dug in the river bed, affects the ground water level. In order to fulfill the requirement of fine aggregate, some alternative material must be found. The cheapest and the easiest way of getting substitute for natural sand is obtained from limestone quarries, bottom lateritic sand and crushing natural stone quarries is known as manufactured sand. laterite is a highly weathered material rich in secondary oxide of iron, aluminum or both. It is nearly devoid of base and primary silicates but may contain large amount of quarts, and kaolinite. Bottom laterite has been used for well construction around the world. It is cheap, environmentally friendly and abundantly available building material in the tropical region. Concrete using various combinations of bottom lateritic sand and quarry dust as complete replacement for conventional river sand. The result is found better workability and high compressive strength **[8]** Concrete is the most commonly used material for construction and their design consumes almost the total cement production in the world. The use of large quantities of cement produces increasing CO_2 emissions, and as a consequence the green house effect. A method to reduce the cement content in concrete mixes is the use of silica fines**.** The ordinary Portland cement is partially replaced with silica fume and natural sand is replaced with manufactured sand by four proportions. The results indicated that there is an increase in the compressive and Flexural strength **[9]** The self compacting concretes with the limestone filler show higher water permeability and lower freeze – thaw resistance in the presence of de-icers than the concretes with the fly ash additive. These parameters can be improved by the higher fineness of limestone flour. The shortage of freeze – thaw resistance and the resistance to the attack of de-icers in case of the limestone containing self compacting concretes is the consequence of the microstructure of cement matrix **[10]**. Concrete made with bottom ash sand and lime stone filler as complete replacement for conventional river sand fine aggregate in concrete can attain more or less same compressive strength, tensile strength, permeability, modulus of rupture and lower degree of shrinkage as the control concrete. There are three different grades are used, namely: M15, M20 and M25. For both conventional sand and bottom ash sand and lime stone filler. It is found that 0.55 water/cement ratio produced higher compressive strengths and better workability for M20 mix, proportion.

Since we are replacing the proportion of 25% bottom ash to 75% lime stone filler produced higher values of compressive strength.

II. Aim of the Study

Fully replacement of bottom ash sand and lime stone filler by natural sand .The study is mainly done to find the compression strength, corrosion resistance, tensile strength and economy in practice.

III .Experimental Investigation

3.1 Materials

3.1.1 Cement: Portland pozzolanic cement 53 grade conforming to IS 8112 – 1989, and specific gravity of cement is found to be 3.15.

3.1.2 Bottom ash sand: Bottom ash sand is partially replacement of river sand .it is collected from thermal power station NEYVELI LIGNITE CORPORATION government of India. The bulk density of bottom ash sand 1460 kg/m^2 and the specific gravity 3.14 and fineness modulus of rive Sand is 2.76.The properties of bottom ash sand given in Table 1

Table 1 Chemical properties of Bottom ash sand

Chemical properties of Bottom ash sand	
SiO_2	79.65
Fe_2O_3	3.20
Al_2O_3	14.71
CaO	0.39
MgO	0.55
SO_3	0.70
LOI	0.67

Table 2 Chemical analysis of lime stone filler

Component	Limestone powder
SiO_2	1.81
Fe_2O_3	0.23
Al_2O_3	0.26
CaO	52.38
MgO	1.68
SO_2	0.26
Blaine specific surface [m2/kg]	390

Table 3 Sieve analysis of limestone filler & bottom ash sand

3.1.3 Lime stone filler: crushed limestone filler retained on the sieve No.300 is used with the specific gravity 2.64.The chemical compositions of lime stone filler given in table 2 and sieve analysis of limestone filler & bottom ash sand given in table 3

3.1.4 Fine aggregate: Locally available river sand having bulk density 1762 kg /m^3 is used and the specific gravity 2.73 and fineness modulus of river sand is 3.01

3.1.5 Course aggregate: Considering all the above aspects, blue granite crushed stone aggregate of 12 mm as maximum size and of typical particle shape "average and cubic" are used as the course aggregate for the present investigation. The aggregates are tested as per the procedure given in BIS: 2386- The bulk density of coarse aggregate 1690 kg/m2 and the specific gravity 2.78 and fineness modulus of coarse aggregate 6.43

IV. Experimental Procedure

The mix ratio is prepared for 1:2:4, 1:1.5:3 and 1:1:2, for both conventional and also bottom ash and lime stone filler.The fine aggregate portion of the mix is achieved by combining bottom ash and lime stone filler in ratio with 25%-75%, 50%-50% and 75%-25%. The materials are then mixed thoroughly before adding the prescribed quantity of water and then mixed further to produced fresh concrete. Water cements ratios of 0.55 were adopted. The specimen is prepared for compressive strength for cube size (150 x 150 x 150 mm. The cylinder of height 30 cm and 15 cm diameter is prepared for tensile strength totally 108 cubes and 108 cylinders are made. The specimens are tested for 7 days, 14 days and 28 days with each proportion of conventional and bottom ash and lime stone filler. (50x50x50) mm mortar specimen were prepared for durability test totally 36 cube are made for three mix ratio. The specimen size of (70x10x10) cm is used for flexural strength test, for durability test mortar specimen is prepared in a mix ratio of 1:3, the cube size of (50 x50 x 50) mm is prepared for water absorption test, acid penetration test and 10cm height & 5cm diameter is prepared for percentage of corrosion resistance measurement using LCR -Q meter test method. All the specimens are demoulded after 24 hours, and curing is done in water for 7 days, 14 days and 28 days.

V. Result and Discussion

5.1. Compressive strength of concrete.

The test is carried out conforming to IS 516 -1959 to obtain compressive strength of concrete at the 7days, 14 days and 28 days. The cubes are tested using 400 tonne capacity HELICO compressive testing machine (CTM) .The results are presented in Fig.1, 2, 3, and 4

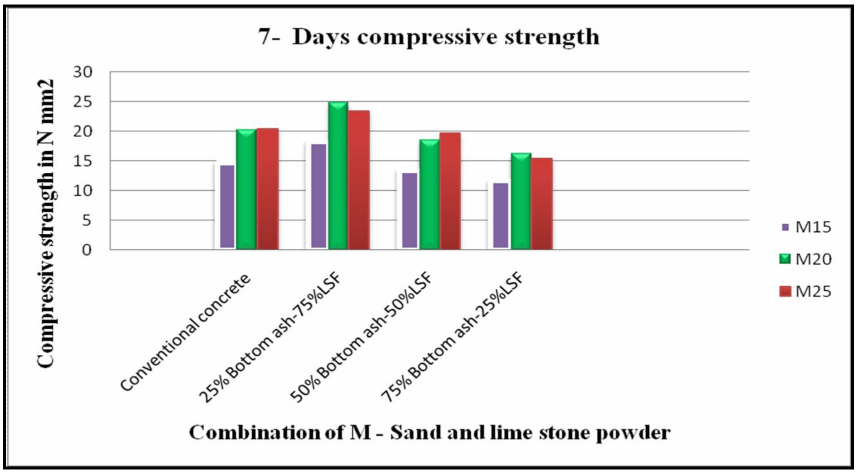

Figure:1 7 Days compressive strength

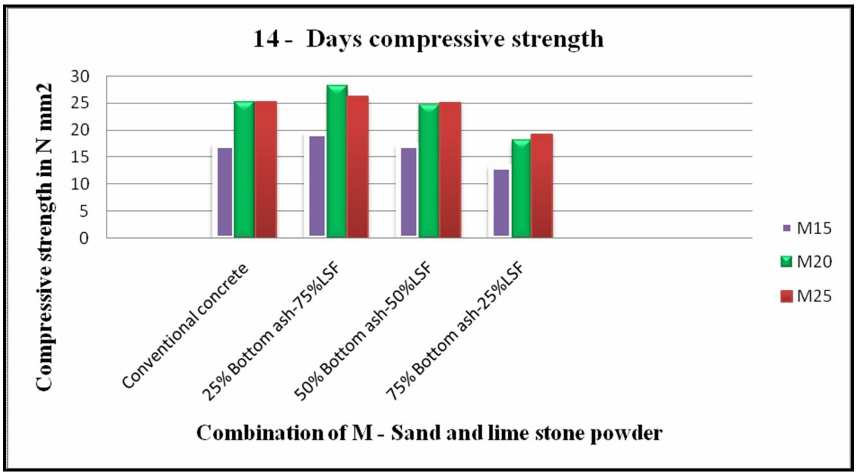

Figure: 2 - 14 Days compressive strength

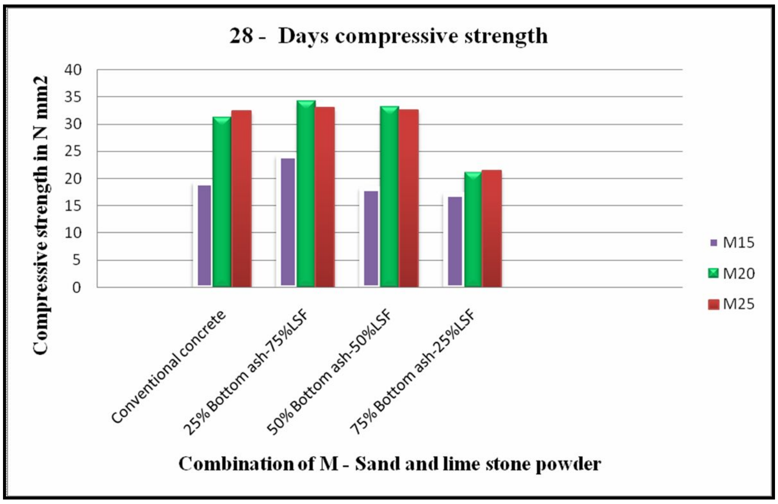

Figure 3 28 Days compressive strength

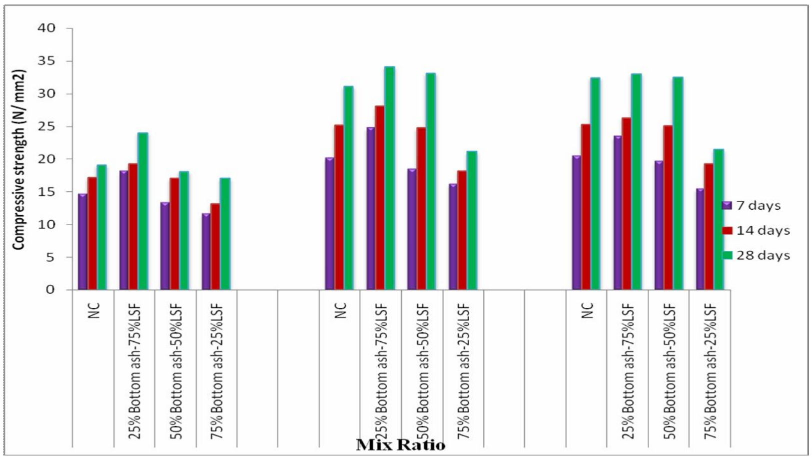

Figure 4 Compressive strength of concrete various mix ratios

Table 3- Sieve analysis of limestone filler & bottom ash sand

IS sieve designation	bottom ash sand% Passing	limestone filler % Passing
4.75 mm	98.4	94.1
2.36mm	90.2	90.23
1.18mm	88.2	47.35
600nm	72.9	34.6
300um	32.8	23
150um	6.2	5.3

Table 4- The Compressive of concrete are presented in table below

% BOTTOM ASH / Lime stone filler	Water cement ratio	Mix ratio	Compressive strength for various mix ratio		
			7 days	14 days	28 days
Normal concrete	0.55	1:2:4	16.64	19.16	21.06
		1:1.5:3	22.12	27.12	33.12
		1:1:2	22.43	27.26	34.43
25% BOTTOM ASH:75lime stone filler	0.55	1:2:4	20.14	21.26	26.01
		1:1.5:3	26.72	30.12	36.12
		1:1:2	25.43	28.26	35.03
50% BOTTOM		1:2:4	15.34	19.06	20.06

ASH :50lime stone filler	0.55	1:1.5:3	20.42	26.72	35.12
		1:1:2	21.63	27.06	34.53
75% BOTTOM ASH :25lime stone filler	0.55	1:2:4	13.64	15.16	19.06
		1:1.5:3	18.12	20.12	23.12
		1:1:2	17.43	21.26	23.43

7 - Days compressive strength of concrete.

The 7days compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25%(Bottom ash & LSF) concrete 21.03% ,31.29% and47.6% of compressive strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25 % (Bottom ash & LSF) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .5

Table 5- 7 Days compressive strength of concrete in various mix ratios

Mix ratio	**Conventional concrete**	**25% Bottom ash-75%LSF**	**50% Bottom ash-50 %LSF**	**75% Bottom ash-25%LSF**
M15	14.64	18.14	13.34	11.64
M20	20.12	24.72	18.42	16.12
M25	20.43	23.43	19.63	15.43

Table 6 14 Days compressive strength of concrete in various mix ratios

Mix ratio	**Conventional concrete**	**25% Bottom ash-75%LSF**	**50% Bottom ash-50 %LSF**	**75% Bottom ash-25%LSF**
M15	17.16	19.26	17.06	13.16
M20	25.12	28.12	24.72	18.12
M25	25.26	26.26	25.06	19.26

14 **- Days compressive strength of concrete.**

The 14 days compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) concrete 10.96 % ,11.54 % and40.23% of compressive strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) more or less same having M20 and M25 grade of cocrete. The Results of this test are show in table .6

28 - Days compressive strength of concrete.

The 28 days compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) concrete 23.30 % ,22.74 % and 36.64 % of compressive strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) more or less same having M20 and M25 grade of concrete. The Results of this test are show in table .7

Table 7- 28 Days compressive strength of concrete in various mix ratios

Mix ratio	**Conventional concrete**	**25% Bottom ash-75%LSF**	**50% Bottom ash-50 %LSF**	**75% Bottom ash-25%LSF**
M15	19.06	24.01	18.06	17.06
M20	31.12	34.12	33.12	21.12
M25	32.43	33.03	32.53	21.43

Table 8 - Tensile strength of concrete are presented in table below

% BOTTOM ASH / Lime stone filler	Water cement ratio	Mix ratio	Tensile strength for various mix ratio		
			7 days	14 days	28 days
Normal concrete	0.55	1:2:4	16.64	19.16	21.06
		1:1.5:3	22.12	27.12	33.12
		1:1:2	22.43	27.26	34.43
25% BOTTOM ASH:75lime stone filler	0.55	1:2:4	20.14	21.26	26.01
		1:1.5:3	26.72	30.12	36.12
		1:1:2	25.43	28.26	35.03
50% BOTTOM ASH :50lime stone filler	0.55	1:2:4	15.34	19.06	20.06
		1:1.5:3	20.42	26.72	35.12
		1:1:2	21.63	27.06	34.53
75% BOTTOM ASH :25lime stone filler	0.55	1:2:4	13.64	15.16	19.06
		1:1.5:3	18.12	20.12	23.12

Concrete made with bottom ash sand and lime stone filler as complete replacement for conventional river sand fine aggregate in concrete attain more compressive strength 25% Bottom Ash & 75% Lime stone filler at M20 grade of concrete.

5.2 . Tensile strength of concrete

The test is carried out conforming to IS 516 -1959 to obtain tensile strength of concrete at the 7days, 14 days and 28 days. The cylinder are tested using 400 tonne capacity HELICO compressive testing machine (CTM) .The results are presented in Fig.5, 6 & 7

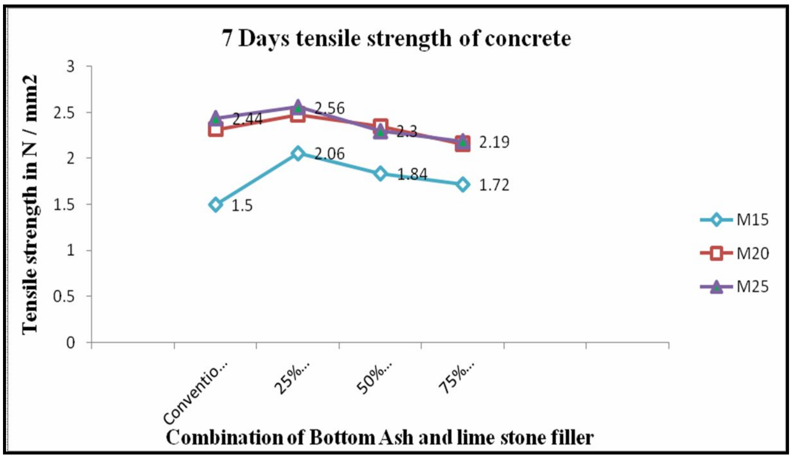

Figure 5 7 Days Tensile strength of concrete.

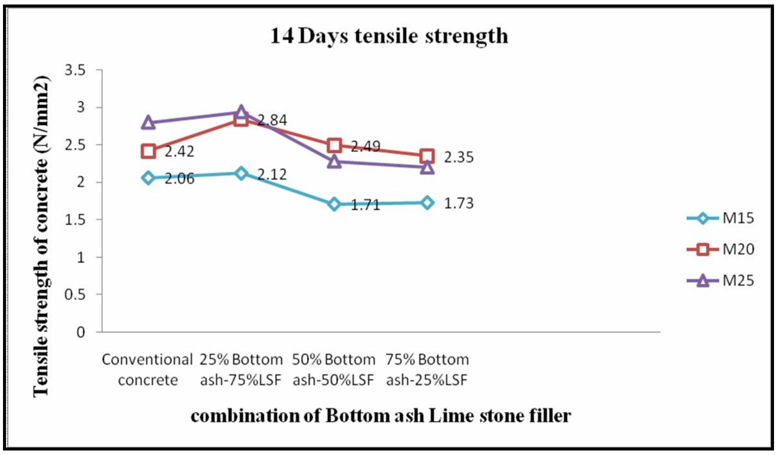

Figure 6 14 Days Tensile strength of concrete.

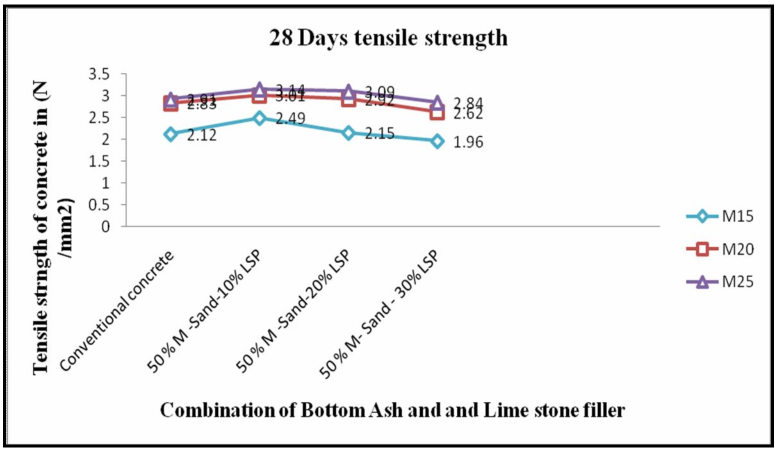

Figure 7 28 Days Tensile strength of concrete

7 - Days Tensile strength of concrete.

The 7days tensile strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) concrete 4.47% ,8.94 % 17.88 % of tensile strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .9

Table.9- 7 Days tensile strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	1.5	2.06	1.84	1.72
M20	2.32	2.48	2.35	2.16
M25	2.44	2.56	2.3	2.19

Table 10- 14 Days tensile strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	2.06	2.12	1.71	1.73
M20	2.42	2.84	2.49	2.35
M25	2.8	2.94	2.28	2.2

14 - Days tensile strength of concrete.

The 14 days tensile strength of conventional concrete, 50%-50% (Bottom ash & LSF)and 75% - 25%(Bottom ash & LSF) concrete 6.50 % ,18.01 % and 23.54% of tensile strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25 %(Bottom ash & LSF) more or less same having M20 and M25 grade of concrete. The Results of this test are show in table .10

28 - Days tensile strength of concrete.

The 28 days tensile strength of conventional concrete and 25% - 75% (Bottom ash & LSF) concrete is more or less same. The tensile strength of , 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) concrete 9.84 % and 11.38 % of tensile strength is reduced when compared to the 25% - 75%(Bottom ash & LSF) concrete which is found that 1:2:4 mix ratio. The tensile strength of conventional concrete, 50%-50% (Bottom ash & LSF) and 75% - 25% (Bottom ash & LSF) more or less same having M20 and M25 grade of concrete. The Results of this test are show in table.11

Table 11- 28 Days tensile strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	2.12	2.49	2.15	1.96
M20	2.83	3.01	2.92	2.62
M25	2.91	3.14	3.09	2.84

Table 12- 7 Days flexural strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	5.21	4.88	4.03	5.01
M20	5.86	5.02	4.62	5.62
M25	5.91	5.32	5.01	6.01

5.3 . Flexural Strength of concrete

The test is carried out conforming to IS 516 -1959 to obtain flexural strength of concrete at the 7days, 14 days and 28 days. The flexural strength are tested using 400 tonne capacity HELICO compressive testing machine (CTM) .The results are presented in Fig. 8 ,9 & 10

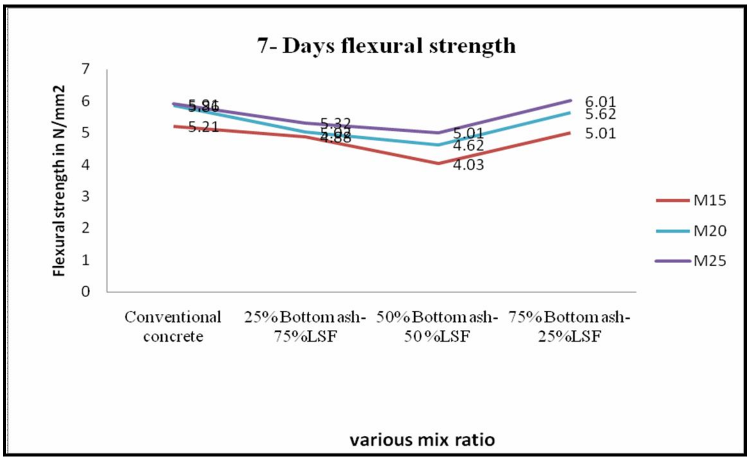

Figure: 8 7 Days Flexural strength of concrete

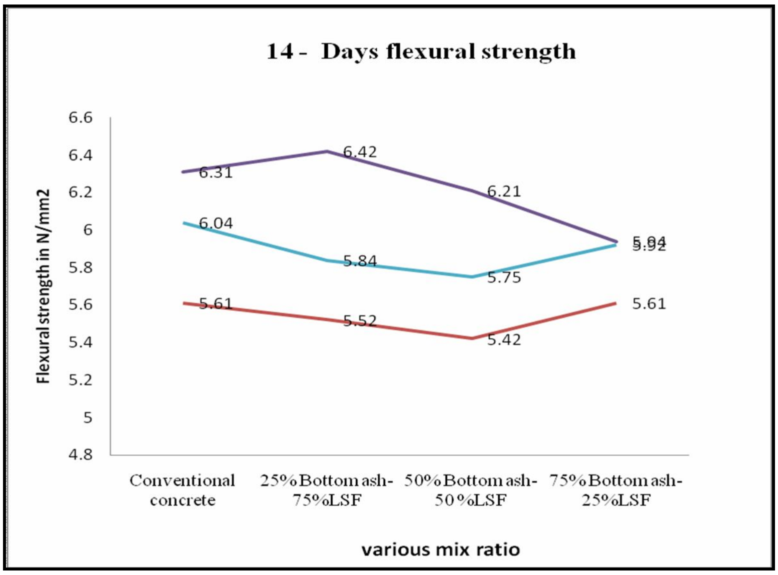

Figure 9 14 Days Flexural strength of concrete

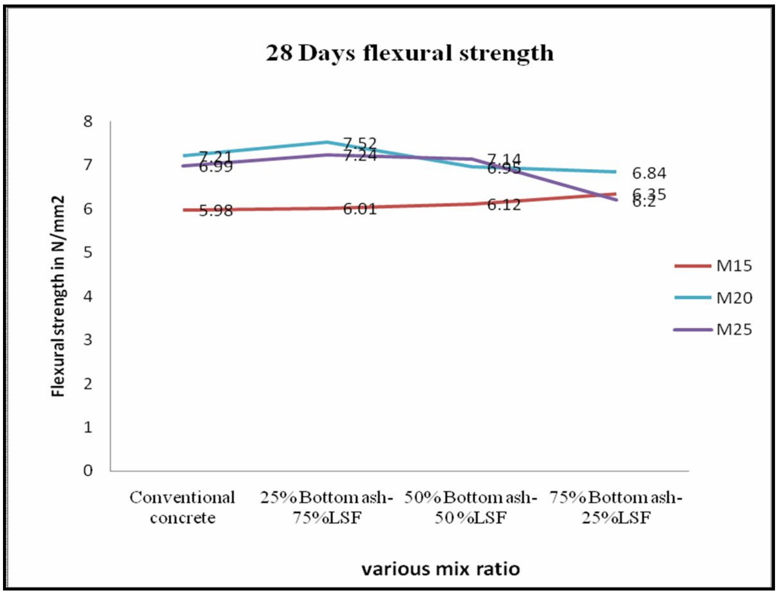

Figure: 10 28 Days Flexural strength of concrete

7 - Days flexural strength of concrete.

The 7days flexural strength of concrete, 50%-50% (Bottom ash & LSF) and 25% - 75% (Bottom ash & LSF) concrete 22.64% and 6.76 % of flexural strength is reduced when compared to the conventional concrete. 75% - 25% (Bottom ash & LSF) and conventional concrete have more or less same strength in all mixes. M25 grade of concrete mix which is found that better flexural strength compare than M15 & M20 grade of concrete and more or less same having flexural strength of concrete in all mixes. The Results of this test are show in table .13

Table 13- 14 Days flexural strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	5.61	5.52	5.42	5.61
M20	6.04	5.84	5.75	5.92
M25	6.31	6.42	6.21	5.94

Table 14- 28 Days flexural strength of concrete in various mix ratios

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50 %LSF	75% Bottom ash-25%LSF
M15	5.98	6.01	6.12	6.35
M20	7.21	7.52	6.95	6.84
M25	6.99	7.24	7.14	6.20

14 - Days flexural strength of concrete.

The 14 days flexural strength of concrete, 50%-50% (Bottom ash & LSF) and 25% - 75% (Bottom ash & LSF) concrete mix have low flexural when compared to the conventional concrete. 75% - 25% (Bottom ash & LSF) and conventional concrete have more or less same strength in all mixes. M25 grade of concrete mix which is found that better flexural strength compare than M15 & M20 grade of concrete and more or less same having flexural strength of concrete in all mixes. The Results of this test are show in table .14

28 - Days flexural strength of concrete.

The 28 days flexural strength of concrete, 25% - 75% (Bottom ash & LSF) concrete mix has better flexural strength when compared to the other mixes. 75% - 25% (Bottom ash & LSF) , 50%-50% (Bottom ash & LSF) and conventional concrete have more or less same strength in all mixes. M25 grade of concrete mix which is found that better flexural strength compare than M15 & M20 grade of concrete and more or less same having flexural strength of concrete in all mixes. The Results of this test are show in table .15

Table 15 -The flexural strength of concrete are presented in table below

% BOTTOM ASH / Lime stone filler	Water cement ratio	Mix ratio	Tensile flexural for various mix ratio		
			7 days	**14 days**	**28 days**
Normal concrete	0.55	1:2:4	5.21	5.61	5.98
		1:1.5:3	5.86	6.04	7.21
		1:1:2	5.91	6.31	6.99
25% BOTTOM ASH:75lime stone filler	0.55	1:2:4	4.88	5.52	6.01
		1:1.5:3	5.02	5.84	7.52
		1:1:2	5.32	6.42	7.24
50% BOTTOM ASH :50lime stone filler	0.55	1:2:4	4.03	5.42	6.12
		1:1.5:3	4.62	5.75	6.95
		1:1:2	5.01	6.21	7.14
75% BOTTOM ASH :25lime stone filler	0.55	1:2:4	5.01	5.61	6.35
		1:1.5:3	5.62	5.92	6.84
		1:1:2	6.01	5.94	6.20

Table 16 - % of water absorption test

Mix ratio	Conventional concrete	25% Bottom ash-75%LSF	50% Bottom ash-50%LSF	75% Bottom ash-25%LSF
M15	5.65	7.18	8.12	9.3
M20	4.41	7.62	8.51	9.82
M25	4.43	5.99	6.51	7.36

5.4 . Water absorption test

This test is done as per procedure given in ASTM C 642-97 by oven-drying method. The results are presented in Fig.11 for this test 50mm x 50mm x 50mm cubes is cast. After 24 hours of remolding, the specimens are kept immersed in water. At the end of 28 days, the specimens are taken from the curing tank and air-dried to remove the surface moisture then taken the initial weight (W1) is taken. The final weight (W2) is taken to the specimens are dried in an oven at a temperature of 100+10^o C for 48 hrs, and allowed to cool at room temperature.

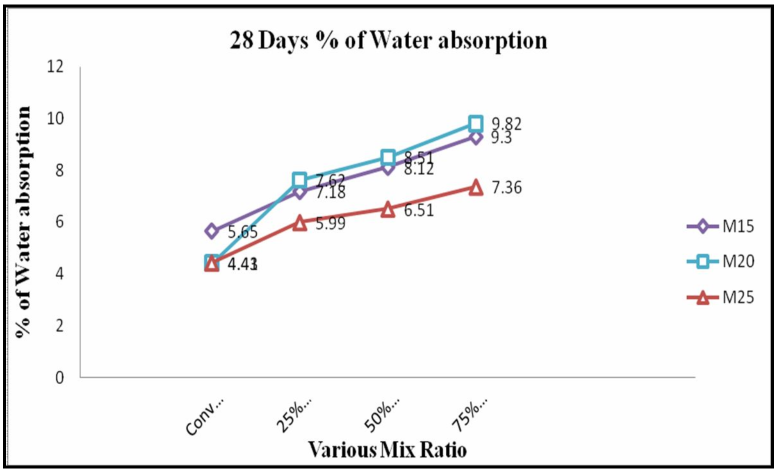

Figure 11- % of water absorption test

The 28 days water absorption of conventional concrete are found to be M25 mix ratio 27 %, 41% and 34.08% of water absorption is reduced when compared to M20 and M15 for the all the mix preparation. 25% Bottom ash-75% LSF has, 50% Bottom ash-50 %LSF has more durability and 75% Bottom ash-25% high permeability of concrete. The mix ratio of 75% Bottom ash-25%LSF has more quantity water observed compared than25% Bottom ash-75%LSF, and 50% Bottom ash-50%LSF. Results of this test is show in table .16

% of Water absorption

% of water absorption = [(W2 – W1)/W1] x 100
Where,
W1 = weight of oven dried sample in air.
W2 = weight of surface dry sample in air after immersion in water

5.5. Acid Penetration Test

This test is done as per procedure given in ASTM C 642-97 by oven-drying method. The results are presented in Fig.12, 13 & 14 for these tests 50mm x 50mm x 50mm cubes are cast. After 24 hours of remolding, the specimens are taken the initial weight (W1) after kept immersed in different three type of solution (Nacl, Na_2So_4 **&** HCL (pickling solution). At the end of 28 days, the specimens are taken the finial weight (W2) is taken. The 28 days acid penetration of bottom ash with 25% Bottom ash-75%LSF concrete is high resistance low permeability and high durability of concrete in solution of Nacl compare to the other mix ratio. Conventional concrete is more resistance and high durability in solution of Na2So4 compare to other mixes. 75% Bottom ash-25%LSF has more durability and high resistance in solution of Hcl compare to other mixes. M25 grade of concrete is more resistance and high durability in given all type solution. Results of this test are show in table .17, 18 & 19

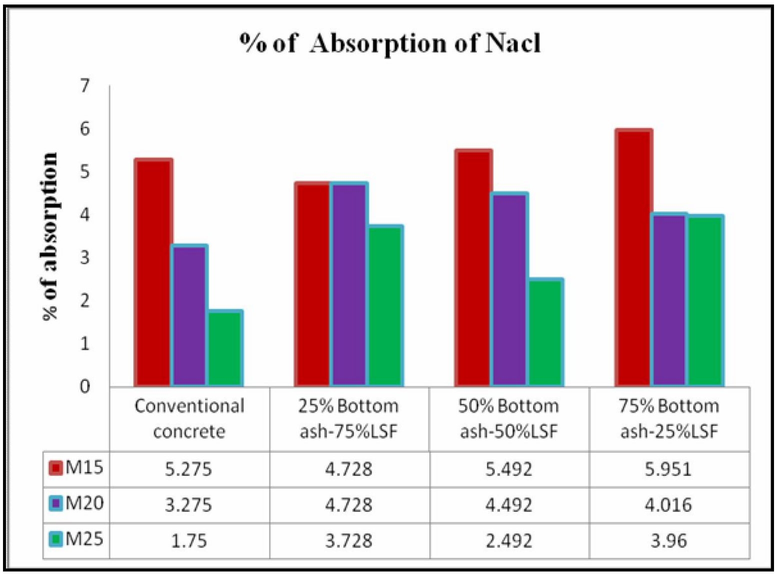

Figure 12 % of absorption of Nacl test

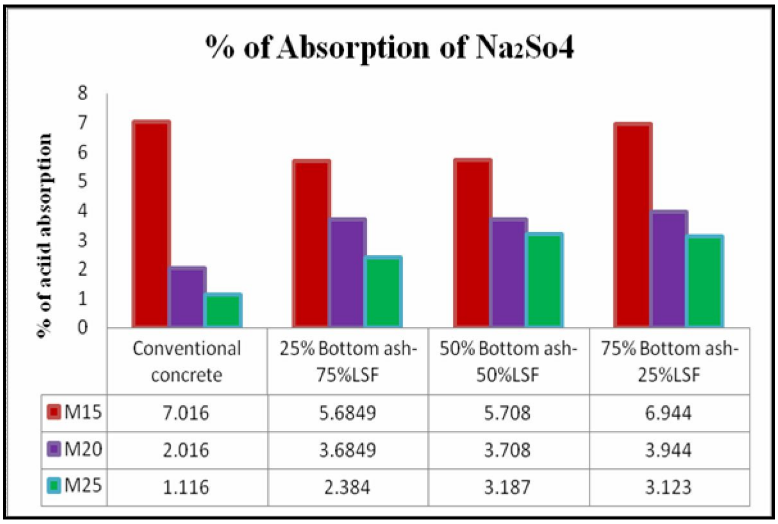

Figure 13 % of absorption of Na_2So_4 test

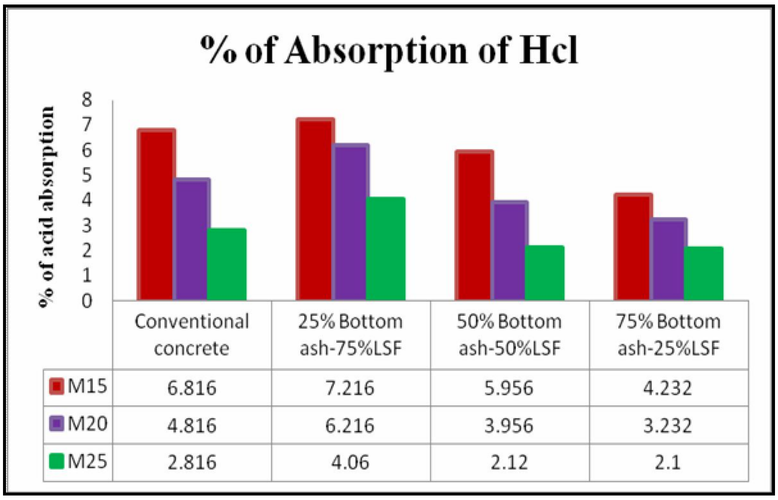

Figure 14 % of absorption of Hcl test

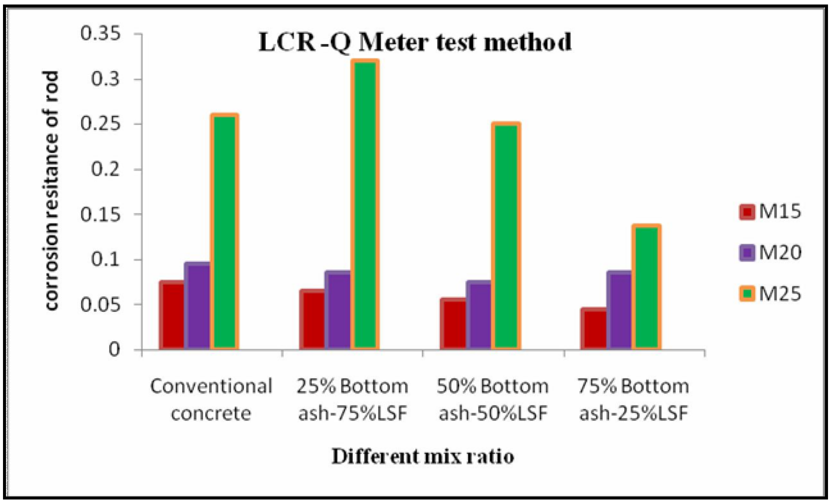

Figure 15 % corrosion resistance measurement using LCR – Q Meter test method

Table 17- % of Absorption of Nacl

Different mix design	**% of Absorption of Nacl**		
	M15	**M20**	**M25**
Conventional concrete	5.275	3.275	1.75
25% Bottom ash-75%LSF	4.728	4.728	3.728
50% Bottom ash-50%LSF	5.492	4.492	2.492
75% Bottom ash-25%LSF	3.016	4.016	3.96

Table 18- % of Absorption of Na_2So_4

Mix design	**% of Absorption of Na_2So_4**		
	M15	**M20**	**M25**
Conventional concrete	7.016	2.016	1.116
25% Bottom ash-75%LSF	5.6849	3.6849	2.384
50% Bottom ash-50%LSF	5.708	3.708	3.187
75% Bottom ash-25%LSF	6.944	3.944	3.123

Table 19- % of Absorption of Hcl

Mix design	**% of Absorption of Hcl**		
	M15	**M20**	**M25**
Conventional concrete	6.816	4.816	2.816
25% Bottom ash-75%LSF	7.216	6.216	4.06
50% Bottom ash-50%LSF	5.956	3.956	2.12
75% Bottom ash-25%LSF	4.232	3.232	2.1

Penetration test in Nacl solution

28 days penetration test the M25 grade of concrete is more durability and low permeability in Nacl solution. M20 and M15 grade concrete is high permeability compare than M25 grade of concrete. The M15 grade of concrete the 75% Bottom ash-25% LSF mix has high durability and low permeability in compare to other mix ratio. Results of this test is show in table .17

Penetration test in Na_2So_4 solution

28 days penetration test the M25 grade of concrete is more durability and low permeability in Na_2So_4 solution. M20 and M15 grade concrete is high permeability compare than M25 grade of concrete. M15 grade

concrete is high permeability and low permeability compare than M25 & M20 grade of concrete. Results of this test is show in table .18

Penetration test in Hcl solution

28 days penetration test the M25 grade of concrete is more durability and low permeability in Na_2So_4 solution. M20 and M15 grade concrete is high permeability compare than M25 grade of concrete. M15 grade concrete is high permeability and low durability compare than M25 & M20 grade of concrete. 75% Bottom ash-25% LSF mix has high durability and low permeability in compare to other mix ratio. Results of this test is show in table .19

Table 20- LCR-Q Meter Test method for Corrosion: Resistance of Rod (In Ohm)

Mix Designation	M15	M20	M25
Conventional concrete	0.075	0.095	0.26
25% Bottom ash-75%LSF	0.065	0.085	0.32
50% Bottom ash-50%LSF	0.055	0.075	0.25
75% Bottom ash-25%LSF	0.045	0.085	0.137

5.6 - LCR -Q meter method .

In this Method 100x60 mm size mortar cylinders of 12 mm dia. rebar of 7.0cm length were embedded at 25 mm cover from one side of the specimen. Initially the resistance of the rod is checked before it is kept inside the specimen. After that the specimen is casted and subject to 28 days of curing in water. After that 5% Nacl Solution is prepared as an electrolyte solution and Stainless steel covering is prepared to keep the specimen inside. With the help of the Rectifier the positive side of the terminal is connected with the Reinforcement bar and negative side of the terminal is connected with the Stainless steel covering. A constant Voltage of 12 V is applied for a constant period of 5 Days. After that period specimen is broken down and resistance of the rod is noted down. It can be used to compare the rate of corrosion of metals in different mixes. The Rod resistance is very high in 75% Bottom ash-25% LSF mix has high corrosion.

V. Conclusion

It can be seen from the results of this study that the combination of bottom ash and lime stone filler replaces the conventional river sand in the production of concrete for construction industry.

The compressive strength and tensile strength of concrete using bottom ash sand lime stone filler are measured in the laboratory. Compressive strength and tensile strength is found to increase with age as for normal concrete. The 28 – days compressive and tensile strength is M20 grade of concrete found 21.06 -35.2 N/mm^2 and 10.06 -15.5 N/mm^2 percentage of strength increase when compare than other mixes. The above strength properties the proportion of 25% bottom ash to 75% lime stone filler produced higher values of compressive strength. For the same proportion of 25% bottom ash to 75% lime stone filler at 1:15:3 mix and 0.55 water cement ratio, a logarithmic model has been developed for predicting the compressive strength and tensile of concrete between 0 and 28 days.

The 28 days flexural strength of concrete, 25% - 75% (Bottom ash & LSF) concrete mix has better flexural strength when compared to the other mixes. M25 grade of concrete mix which is found that better flexural strength compare than M15 & M20 grade of concrete.

The 28 days water absorption test found to be in conventional concrete M25 grade of concrete 27 %, 41% and 34.08% of water absorption is reduced when compared to M20 and M15 for the all the mix preparation. 75% Bottom ash-25%LSF has more quantity water observed compared than other mix and all grade of concrete.

The 28 days acid penetration of bottom ash with 25% Bottom ash-75%LSF concrete is high resistance low permeability and high durability of concrete in solution of Nacl compare to the other mix ratio. Conventional concrete is more resistance and high durability in solution of Na2So4 compare to other mixes.

75% Bottom ash-25%LSF has more durability and high resistance in solution of Hcl compare to other mixes. M25 grade of concrete is more resistance and high durability in given all type solution.

M20 grade of concrete the mix ratio 25% bottom ash to 75% lime stone filler has more strength and low durability and high permeability.

Conventional concrete is better water absorption and durability of concrete. Acid penetration test is depends upon the concrete mix and grade of concrete.

The Rod resistance is very high in 75% Bottom ash-25% LSF mix has high corrosion.

References

1. A. Jayaraman (2014), "Fully Replacement of Natural Sand With hydro Sluiced Bottom Ash in High Performance Concrete with Nanosilica", International Journal of ChemTech Research issue Vol.6, No.2, pp 938 – 947 April-June 2014.
2. K. Ganesan, K. Rajagopal, K. Thangavel,(2008). "Rice husk ash blended cement: Assessment of optimal level of replacement for strength and permeability properties of concrete." Constr. Build. Mater., 22 (8) (2008) pp.1675-1683.
3. A.Jayaraman, V.Senthil kumar, and M.Saravanan (2014). "Compressive & tensile strength of concrete using lateritic sand and lime stone filler as fine aggregate". International Journal of Research Engineering and Technology. Volume 3, Issue 1, January 2013)
4. Maria Georgescu , Nastasia Saca ,(2009) "Properties of blended cements with limestone filler and fly ash content**"**. U.P.B. Sci. Bull., Series B, Vol. 71, Iss. 3, 2009 ISSN 1454-2331
5. A.Jayaraman, V.Senthil kumar,(2013). "Optimization of fully replacement of natural sand by M-sand in high performance concrete with nanosilica". International Journal of Emerging Technology and Advanced Engineering. Volume 3, Issue 11, November 2013)
6. S.K. Jai1, P.G. Patil, N.J. Thakor,(2011) "Engineering properties of laterite stone scrap blocks". Agricultural Engineering International: CIGR Journal. Vol.13, No.3, 2011. ManuscripNo.1738.
7. 7.Joseph O. Ukpata, Maurice E.Ephraim and GodwinA. Akeke.(2012). "Compressive strength of Concrete using Bottom asheritic Sand and Quarry Dust as Fine Aggregate."Arpn Journal of Engineering and Applied Sciences, Junuary 2012.Volume 7,No.1
8. Joseph O. Ukpata, Maurice E.Ephraim and GodwinA. Akeke.(2012). "Compressive strength of Concrete using Lateritic Sand and Quarry Dust as Fine Aggregate."Arpn Journal of Engineering and Applied Sciences, Junuary 2012.Volume 7,No.1.
9. By Tarun R. Naik, Fethullah Canpolat, Yoon-moon Chun, (2003) "Limestone powder use in cement and concrete". Department of Civil Engineering and Mechanics College of Engineering and Applied Science the university of wisconsin – Milwaukee.
10. Stefania Grzeszczyk ,Piotr Podkowa,(2009) "The Effect of Limestone Filler on the Properties of Self Compacting Concrete". Annual transactions of the nordic rheology society, vol. 17, 2009

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