International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 2, February 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Study of Bricks Made Up of Different Materials in Building Construction by eTabs Software

Afzal Khan, Nitesh Kushwah

Assistant Professor, Millenium Institute of Technology, Bhopal, Madhya Pradesh, India

ABSTRACT

No construction work is possible without bricks because of bricks are used in buildings as well as in pavement. Since many centuries brick-making has been practiced by human beings, presently bricks are easily made by the use of the machine but in old day's bricks are manufactured by own hand using wooden or steel moulds. For any types of buildings, amajor part of the construction cost is just belongs to bricks work. Bricks walls are not a load bearing elements but they column. Due to high dead weight, the size of the load-bearing element needs to be increased which increase the cost of project disasterly that's why in modern engineeringlightweight and low-cost building material is needed. In this research work, hypo-sludge (waste of paper industry) and rice husk ash (waste from agriculture industry) were use. Both the materials are waste product one from paper industries and other from agriculture industry and both cause environmental pollution and disposal problem. Use of such product help to reduce the environmental pollution and they are low-cost materials which also helps to keep project cost low. In this research work, hypo-sludge is used as cementing material and rice husk ash is used as fine aggregate. In this research work, different variations of hypo-sludge and rice husk ash (RHA) is used for manufacturing bricks sample after that bricks physical properties is compare by ordinary clay bricks, fly ash bricks, and with their different composition. For this research work Dimension Analysis, Initial Rate of Absorption, Compressive Strength Test, Water Absorption Test, Soundness Test, and Efflorescence Test is conducted for the analysis of the physical properties of the bricks. from the analysis by etabs conclusion can be made that bending moments and shear forces are less in structure made up of hypo sludge bricks as compare to conventional structures (structure those are made up of either clay bricks or fly ash bricks) on every storey of building structure.

The weight of a RHA-HS Brick is approximately 2.5 to 2.7 kg while clay brick weights approximately 3.0 kg, it causes approximately 13.33% reduction in dead load of structure due to partition walls which on the other hand causes reduction in percentage of steel used in all related load carrying structure section like Beams, Columns, and Footing.

KEYWORDS: *Hypo-Sludge, Rice Husk Ash, the Initial rate of absorption, Compressive strength, Soundness, clay bricks*

How to cite this paper: Afzal Khan | Nitesh Kushwah "Study of Bricks Made Up of Different Materials in Building Construction by eTabs Software" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-2, February 2020, pp.323-335, URL: www.ijtsrd.com/papers/ijtsrd29984.pdf

IJTSRD29984

1. INTRODUCTION

1.1. GENERAL

In India as the population increasing various types of industries is also increasing and these industries produces a huge amount of waste products. These waste products are not environment friendly. India produces More than 200 million tones of agriculture and industrial waste every year. Hypo sludge is one of them which produces from paper industries. These types of waste material are not only affects the surrounding environment and the disposal of these material is also difficult for some extent. Like other industrial wastes hypo sludge is a major contaminant for the soil. In current scenario it is very important to find other option for utilizing such waste to reduce overall effect on environment. The published work shows that paper industry is one of the better sectors to get environmental objectives since raw materials are renewable, its products and wastes are recyclable and production processes are capable of technological improvements to protect the environment. The paper presents the overview of published work on utilization of hypo sludge with high performance concrete, exploring its pozzolanic properties, mechanical properties like compressive strength, splitting strength, modulus of elasticity, water absorption test, and cost analysis are presented.

2. RESULTS AND ANALYSIS

The present study was undertaken to investigate the dimension analysis, compressive strength and initial rate of absorption, water absorption test, hardness test soundness test and efflorescence test for bricks containing Hypo Sludge and Rice Husk Ash. The objectives of the research were to study the effect of partial replacement of hypo sludge with cement, with rice husk ash used as a replacement of

aggregate in non-firing bricks. Several specimens were prepared by addition of cement with hypo sludge 30%, 40, and 50% sand with rice husk ash as 30%, 40%,50 and 60%. After having a trial of mixes, the water-cement ratio selected was 0.55 and it was kept constant for all the mixes. The bricks where as the compressive strength of bricks were tested after 7, 14 and 28 days of curing. The statistical analysis was applied to results of compressive strength test of bricks was tested after 7, 14 and 28 days of curing.

2.1. MEASUREMENT OF DIMENSIONS OF BRICK:

First, separate bricks were measured for their length, width, and height. Then based on Clause 5.2.1, IS 12894:2002 the bricks were placed in contact with each other in a straight line upon a level surface. The method of arranging the bricks depended on which dimension to be measured; length, width or height. The dimension result obtain from dimension test present in TABLE4.1

2.2. Initial Rate of Absorption

Initial Rate of Absorption test conducted for 2 numbers of bricks of each Composition bricks sample and the result is shown in TABLE2.1

Sample	Weight (KG)		M2-M1 (gm)	Surface area (m^2)	Initial Rate of Absorption	Average Initial Rate of Absorption Value ($Kg/m^2/min$)
	Dry (M1)	Wet (M2)				
S1	2.315	2.395	80	0.020	4.00	4.18
	2.312	2.395	83	0.019	4.36	
S2	2.299	2.384	85	0.020	4.25	4.39
	2.295	2.381	86	0.019	4.53	
S3	2.295	2.385	90	0.020	4.50	4.45
	2.291	2.379	88	0.020	4.40	
S4	2.286	2.371	85	0.020	4.25	4.25
	2.283	2.367	86	0.020	4.30	
S5	2.276	2.366	90	0.020	4.50	4.66
	2.278	2.367	89	0.019	4.70	
S6	2.270	2.363	93	0.020	4.65	4.82
	2.270	2.365	95	0.019	5.00	
S7	2.266	2.363	96	0.020	4.80	4.77
	2.261	2.356	95	0.020	4.75	
S8	2.251	2.350	99	0.020	4.95	4.97
	2.254	2.354	100	0.020	5.00	
S9	2.244	2.347	103	0.020	5.15	5.25
	2.239	2.444	105	0.020	5.25	
S10	2.230	2.401	105	0.020	5.25	5.20
	2.229	2.300	71	0.019	5.14	
S11	2.220	2.337	103	0.020	5.56	5.60
	2.190	2.292	102	0.020	5.63	
S12	2.117	2.220	107	0.019	5.78	5.44
	2.223	2.340	117	0.019	5.10	

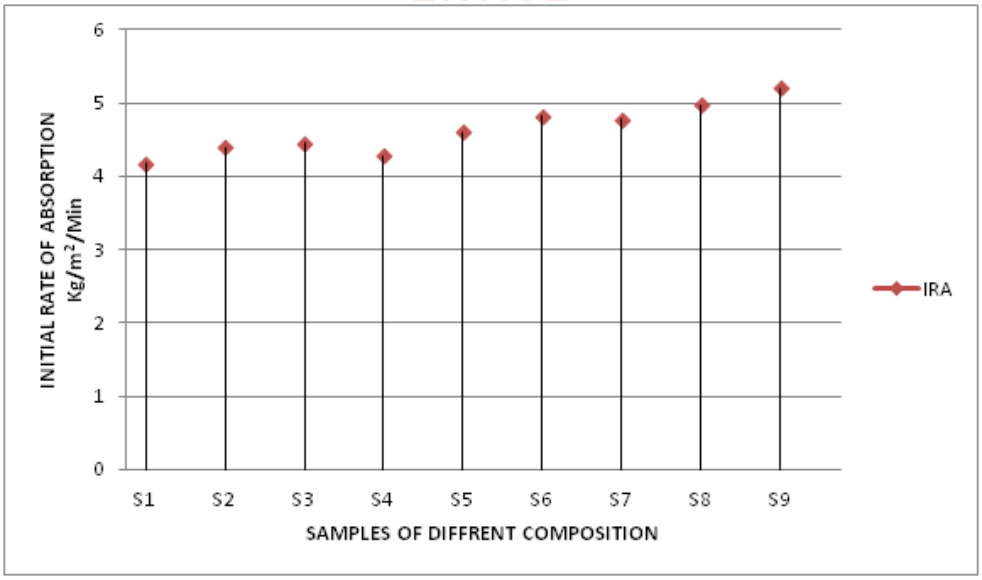


Fig2.1 – INITIAL RATE OF ABSORPTION FOR DIFFERENT MIXED

2.3. Water Absorption Test Result

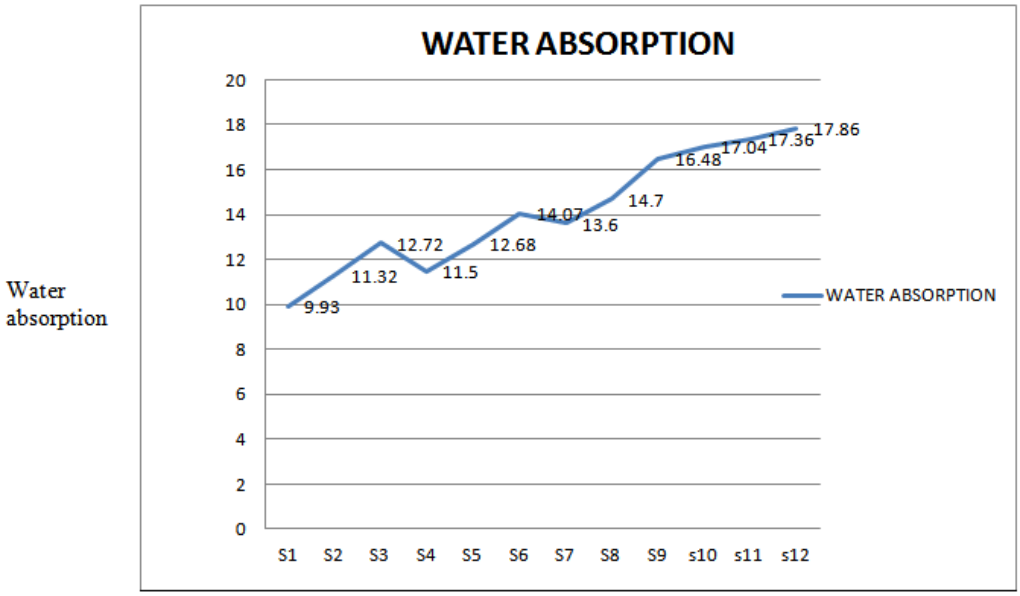
TABLE2.1 shows the amount of water absorbed corresponding to different Rice Husk Ash and Hypo-Sludge composition. The water absorption values of Rice Husk Ash and Hypo-Sludge composites lies in the range of 9.93% to 16.48%. It can be seen that

all the composition met the absorption criteria set by IS code specification. IS code permits the maximum of 20 % water absorption when compacts are immersed for 24 hours.

Graph.2.1 shows a relation between the amount of water absorbed and density of dry composite with respect to Rice Husk Ash and Hypo-Sludge composition. It is evident from the graph that the water absorption increases with increase in Rice Husk Ash and Hypo-Sludge content; 90%. Rice Husk Ash and 50% Hypo-Sludge bricks combination absorb water to a maximum of 16.48%. This indicates that the entire combination can use for construction work and as the percentage of Rice Husk Ash and hypo sludge increases the water absorption also increase.

Mix Composition (Wt. %)	Weight (gm.)		Water Absorption (%)	Average Water Absorption Value (%)
	Dry	Wet		
S1	2.315	2.543	9.84	9.93
	2.312	2.544	10.03	
S2	2.299	2.555	11.13	11.32
	2.295	2.559	11.50	
S3	2.290	2.580	12.66	12.72
	2.291	2.584	12.78	
S4	2.286	2.552	11.63	11.50
	2.283	2.543	11.38	
S5	2.275	2.565	12.74	12.68
	2.274	2.561	12.62	
S6	2.270	2.591	14.14	14.07
	2.270	2.588	14.00	
S7	2.265	2.572	13.55	13.60
	2.261	2.570	13.66	
S8	2.251	2.580	14.62	14.70
	2.254	2.587	14.77	
S9	2.244	2.609	16.26	16.48
	2.238	2.612	16.71	
S10	2.230	2.401	16.92	17.04
	2.229	2.300	17.23	
S11	2.220	2.337	17.26	17.36
	2.190	2.292	17.56	
S12	2.117	2.220	17.73	17.86
	2.223	2.340	18.05	

TABLE2.1 PERCENTAGE (%) WATER ABSORBED BY VARIOUS RHA AND HS COMPACTS



GRAPH-2.2 WATER ABSORPTION TEST FOR DIFFERENT MIXED

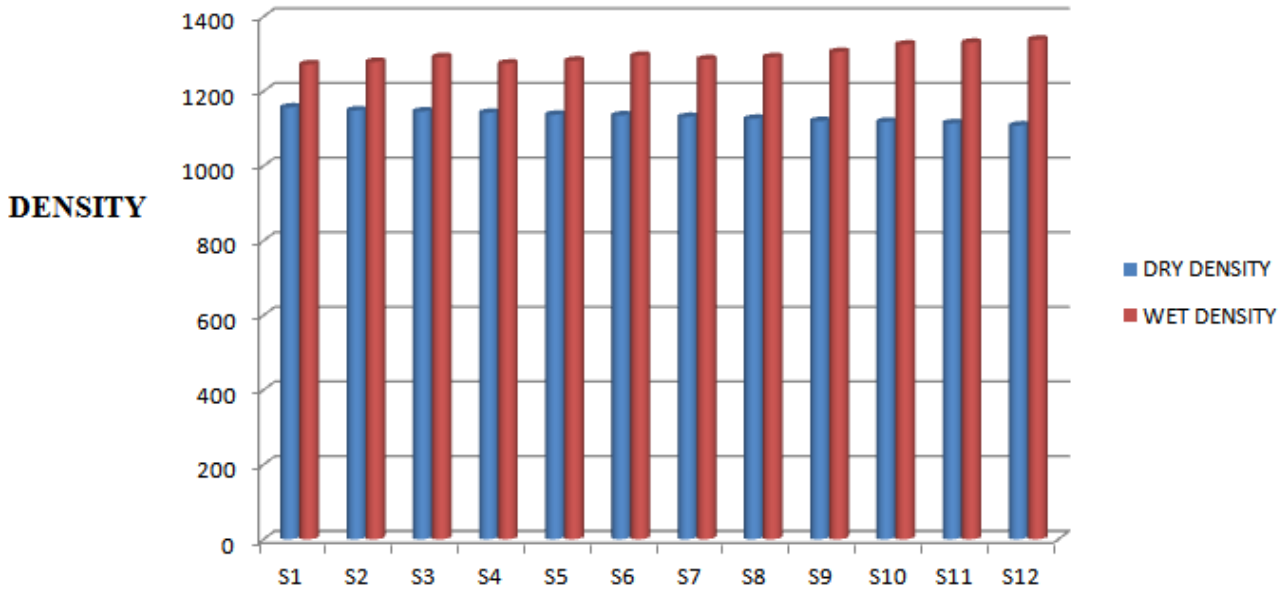
2.4. Density Measurement Result

The density of the samples was calculated before and after water treatment. From FIG.4.2 we can say that density of dry compacts decreases with increase in weight percentage of Rice Husk Ash and Hypo-Sludge because the specific gravity of Rice Husk Ash and Hypo sludge is lower than other bricks material. As the dry compacts are immersed in water at 110°C -180°C, then through capillary action voids are filled and it becomes hard and the porosity is eliminated. As a result of which the compacts become dense and finally the density increases with increase in Rice Husk Ash and Hypo-Sludge content.

TABLE2.3 DENSITY VALUE OF DRY AND WET RHA POLYMER COMPACTS

Sample	Volume	Weight (kg)		Density	
		Dry	Wet	Dry	Wet
S1	2 x 10^{-3} m^3	2.313	2.544	1156.5	1272
S2	2 x 10^{-3} m^3	2.297	2.557	1148.5	1278.5
S3	2 x 10^{-3} m^3	2.291	2.582	1145.5	1291
S4	2 x 10^{-3} m^3	2.284	2.548	1142	1274
S5	2 x 10^{-3} m^3	2.274	2.563	1137	1281.5
S6	2 x 10^{-3} m^3	2.270	2.590	1135	1295
S7	2 x 10^{-3} m^3	2.263	2.571	1131	1285.5
S8	2 x 10^{-3} m^3	2.252	2.584	1126	1291
S9	2 x 10^{-3} m^3	2.241	2.610	1120	1305
S10	2 x 10^{-3} m^3	2.274	2.563	1138	1287
S11	2 x 10^{-3} m^3	2.270	2.590	1134	1295
S12	2 x 10^{-3} m^3	2.263	2.571	1136.	1288

FIG.-2.3 DENSITY VS DIFFERENT MIXED COMPOSITION



2.5. Hardness Measurement Result

Hardness test for all the Rice Husk Ash and Hypo-Sludge bricks should be done with the help of steel knife. The result is collected by the observation only.

S. No	Samples	Observations
1.	S1	No Impression on surface
2.	S2	Little Impression on surface
3.	S3	Little Impression on surface
4.	S4	No Impression on surface
5.	S5	Little Impression on surface
6.	S6	Little Impression on surface
7.	S7	No Impression on surface
8.	S8	Little Impression on surface
9.	S9	Little Impression on surface
10	S10	Little Impression on surface
11	S11	Little Impression on surface
12	S12	Little Impression on surface

TABLE2.4 HARDNESS VALUES OF VARIOUS RHA AND HS MIX COMPACTS

2.6. Determination of Compressive Strength Result

The compressive strength measurement of the bricks samples was done as per standard practiced. The test was conducted on the three samples of each composition and the average value of all is evaluated as the result compressive strength. TABLE2.6 shows the strength values of different compositions of Rice Husk Ash and Hypo-Sludge, both in the dry and wet state. For dry composites, the Compressive strength value (28 days) lies in the range of 8.01to 12.57 MPa. 70% to 90% weight of Rice Husk Ash with a variation of Hypo-Sludge compositions 40% to 45% by weight. We have got the highest strength value 12.57 MPa while the lowest strength value of 8.01 MPa was gained.

TABLE 2.5 COMPRESSIVE STRENGTH VALUES OF DIFFERENT RHA HYPO SLUDGE MIX FOR 7 DAYS SAMPLE

S. No	Sample	Compressive strength (MPa) 7 days	Average Compressive Strength (MPa) (7 days sample)
1.	S1	2.35	2.23
		2.35	
		2.30	
2.	S2	2.00	2.00
		2.00	
		2.00	
3.	S3	1.95	1.95
		2.00	
		1.90	
4.	S4	2.45	2.43
		2.40	
		2.45	
5.	S5	2.15	2.07
		2.05	
		2.00	
6.	S6	2.00	1.95
		1.95	
		1.90	
7.	S7	2.00	1.97
		1.95	
		1.95	
8.	S8	1.85	1.83
		1.80	
		1.85	
9.	S9	1.70	1.68
		1.70	
		1.65	
10.	S10	1.62	1.60
		1.60	
		1.59	
11.	S11	1.56	1.54
		1.55	
		1.53	
12.	S12	1.51	1.49
		1.50	
		1.48	

TABLE 2.6 COMPRESSIVE STRENGTH VALUES OF DIFFERENT RHA HYPO SLUDGE MIX FOR 14 DAYS SAMPLE

S. No	Sample	Compressive strength (MPa) 14 days	Average Compressive Strength (MPa)(14 days sample)
1.	S1	6.90	6.92
		6.95	
		6.90	
2.	S2	6.50	6.53
		6.55	
		6.55	
3.	S3	6.05	6.02
		6.00	
		6.00	
4.	S4	6.95	7.00
		7.00	
		7.05	
5.	S5	6.50	6.47
		6.40	
		6.50	
6.	S6	6.00	6.01
		6.00	
		6.05	
7.	S7	6.30	6.26
		6.25	
		6.25	

8.	S8	5.90	5.97
		6.00	
		6.00	
9.	S9	5.80	5.87
		5.90	
		5.90	
10	S10	5.90	5.85
		5.88	
		5.82	
11	S11	5.82	5.79
		5.80	
		5.77	
12	S12	5.77	5.65
		5.70	
		5.60	

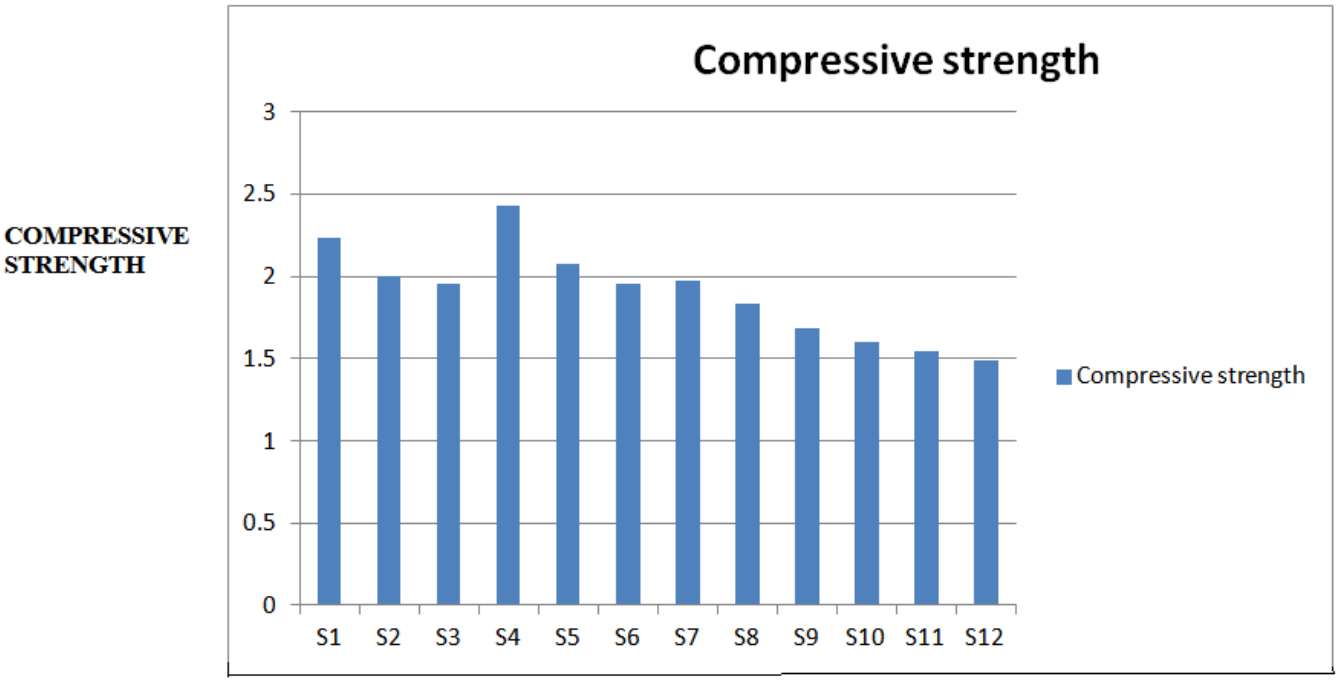


FIG.-2.4 7 DAYS COMPRESSIVE STRENGTH

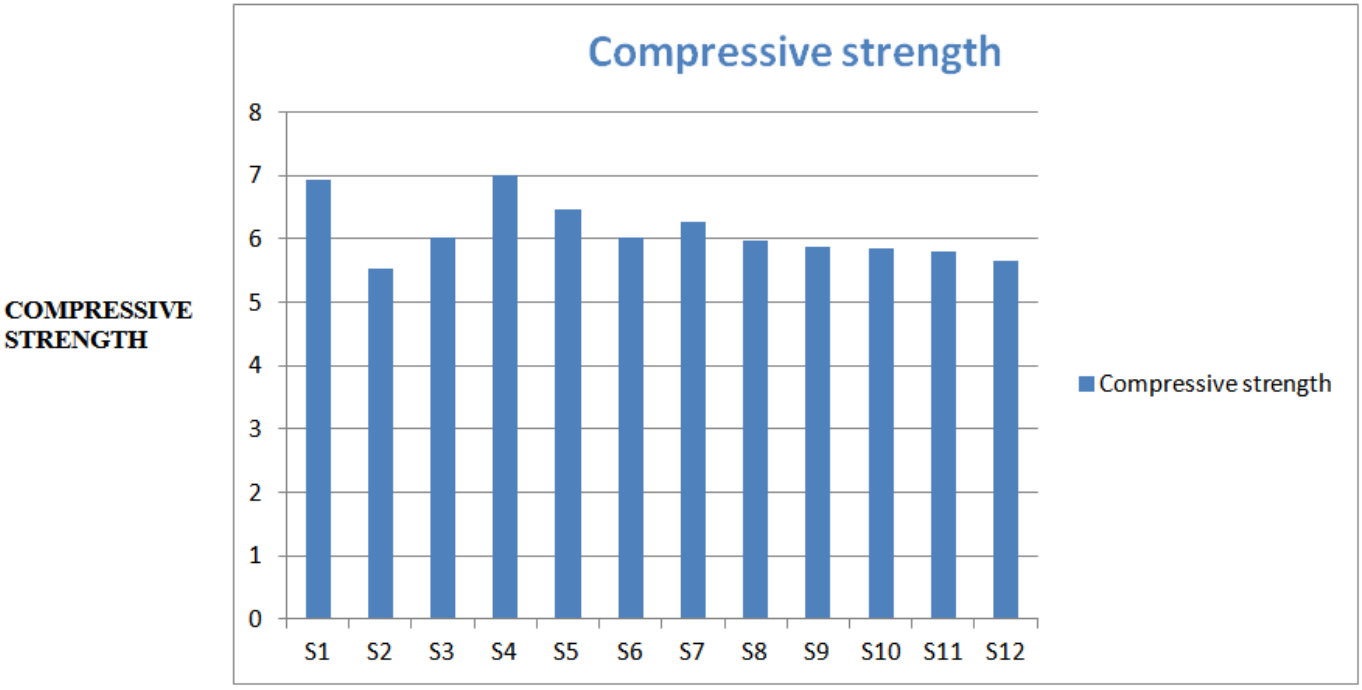


FIG- 2.5 14 DAYS COMPRESSIVE STRENGTH

TABLE 2.7 COMPRESSIVE STRENGTH VALUES OF DIFFERENT RHA HYPO SLUDGE MIX FOR 28 DAYS SAMPLE

S. No	Sample	Compressive strength (MPa) 28 days	Average Compressive Strength (MPa) (28 days sample)
1.	S1	11.05	11.97
		11.90	
		11.95	
2.	S2	10.80	10.72
		10.65	
		10.70	
3.	S3	9.75	9.70
		9.65	
		9.70	
4.	S4	12.50	12.57
		12.80	
		12.40	
5.	S5	11.70	11.60
		11.50	
		11.60	
6.	S6	9.10	9.03
		9.00	
		9.00	
7.	S7	10.75	10.63
		10.60	
		10.55	
8.	S8	9.15	9.07
		9.05	
		9.00	
9.	S9	8.05	8.01
		8.00	
		8.00	
10.	S10	7.98	7.82
		7.75	
		7.62	
11.	S11	7.50	7.46
		7.48	
		7.32	
12.	S12	7.30	7.29
		7.28	

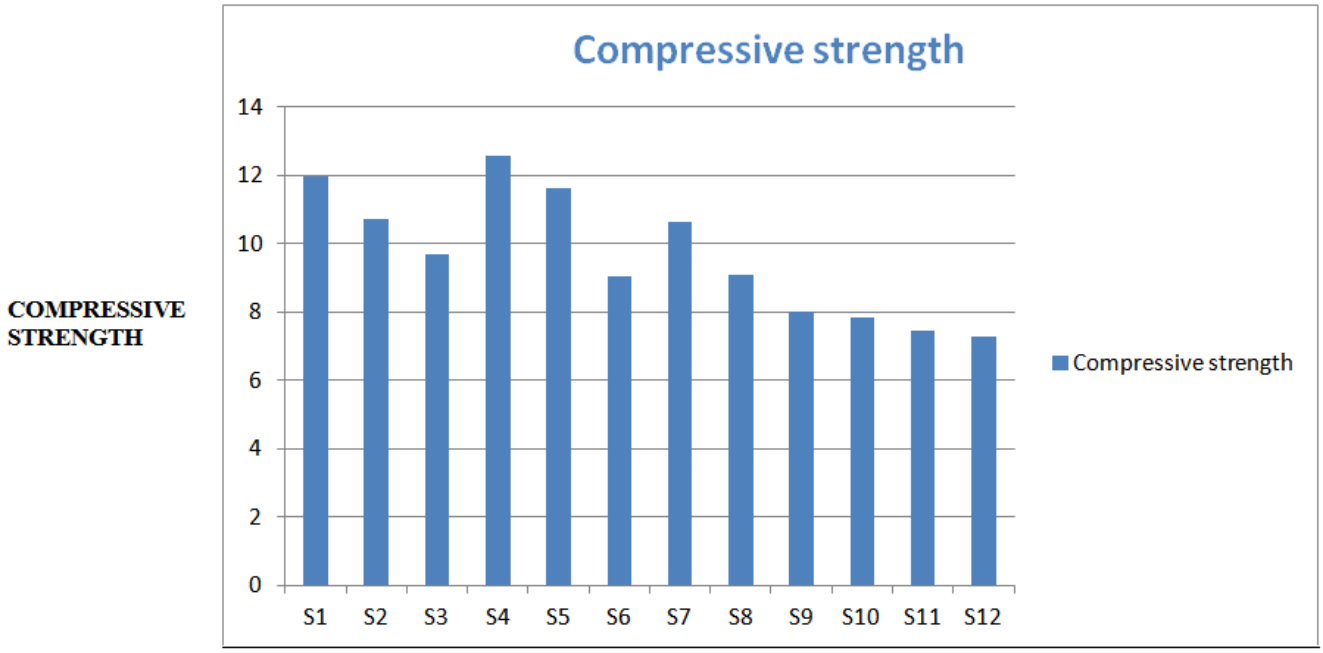


FIG.-2.6 28 DAYS COMPRESSIVE STRENGTH

It can be seen from graph-6 that the composition of (Rice Husk Ash) ---%+ (Hypo-sludge) ---% has higher compressive strength than other compositions. It is found that with a decrease in the resin percent of Rice husk ash mix has increased the compressive strength. As it is evident from SEM graphs that ---t. % RHA mix composite possesses cracks which lead to decrement in compressive strength. As the percentage of RHA is increased there is a good bonding between the interfaces which leads to improvement in strength of the compacts.

2.7. EFFLORESCENCE TEST RESULTS

Percentage of efflorescence was calculated by using butter and graph paper. The liability efflorescence of all tested sample with different parameters is reported as slight Approximately 10% of the exposed area of the brick was enclosed with a lean deposit of salts. Low deposition of salt is attributed to the fact that Rice husk ash and cement used were having very less salt content in their composition. Only hypo-sludge that was used for research contains little salt. But Rice husk ash and cement form the bulk of brick. Hence only a little efflorescence is observed in the bricks that too because of lime content.

S.No.	Specimen	Observations
1.	S1	Slight
2.	S2	Slight
3.	S3	Slight
4.	S4	Slight
5.	S5	Slight
6.	S6	Slight
7.	S7	Slight
8.	S8	Slight
9.	S9	Slight
10.	S10	Slight
11.	S11	Slight
12.	S12	Slight

TABLENO. 2.8- RESULTS OF EFFLORESCENCE TEST

2.8. SOUNDNESS TEST RESULTS

Samples S1, S2, S4, S5, S7, and S8 showed good metallic ringing sound without breaking as they must have a high percentage of cement in them. All of them have good hardness and strength. They have comparatively more dense and compact texture. While sample S3, S6, and S9 has large amount of RHA due to which availability of unbound material happened in S3, S6 and S9 that's why it did not provide a satisfactory result and sample S1, S2, S4, S5, S7, and S8 have a high amount of cement which are likely to be the main factor responsible for producing a good metallic sound after striking RHA Hypo-Sludge bricks with each other.

TABLENO. 2.9- RESULTS OF SOUNDNESS TEST

S. No.	Specimen	Observations
1.	S1	Good Metallic Sound without Breaking
2.	S2	Good Metallic Sound without Breaking
3.	S3	Slightly Metallic Sound without Breaking
4.	S4	Good Metallic Sound without Breaking
5.	S5	Good Metallic Sound without Breaking
6.	S6	Slightly Metallic Sound without Breaking
7.	S7	Good Metallic Sound without Breaking
8.	S8	Good Metallic Sound without Breaking
9.	S9	Slightly Metallic Sound without Breaking
10.	S10	Slightly Metallic Sound without Breaking
11.	S11	Slightly Metallic Sound without Breaking
12.	S12	Slightly Metallic Sound without Breaking

TABLENO. 2.10 COMPRESSIVE STRENGTH OF HYPO SLUDGE+RHA BRICKS

Proportions	7 days (N/mm^2)	14days (N/mm^2)	28days (N/mm^2)
S1	2.23	6.92	11.97
S2	2.00	6.53	10.72
S3	1.95	6.02	9.70
S4	2.43	7.00	12.57
S5	2.07	6.47	11.60
S6	1.95	6.01	9.03
S7	1.97	6.26	10.63
S8	1.83	5.97	9.07
S9	1.68	5.87	8.01
S10	1.60	5.85	7.82
S11	1.54	5.79	7.42
S12	1.49	5.65	7.29

2.9. COMPRESSIVE STRENGTH COMPARISON

TABLENO. 2.11 COMPRESSIVE STRENGTH OF DIFFERENT BRICKS

Proportions	Hypo Sludge-Rice Husk Ash Bricks 28 days (N/mm²)	Conventional Clay Bricks	Fly ash with Quarry Dust	IS Code values for different brick classes (MPa)		
				1st	2nd	3rd
SAMPLE 1	12.57	10.85	5.95	>10.5	7-10.5	3.5-7
SAMPLE 2	10.72	10.35	6.35	>10.5	7-10.5	3.5-7
SAMPLE 3	8.01	10.05	6.00	>10.5	7-10.5	3.5-7

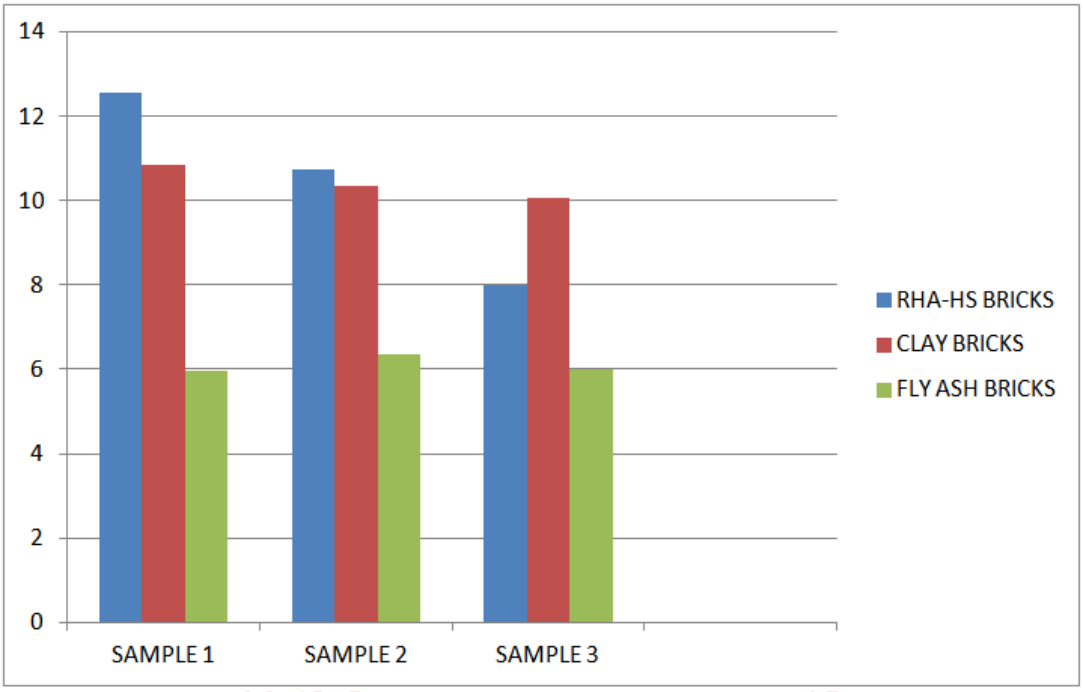


FIG.2.7 COMPRESSIVE STRENGTH OF DIFFERENT BRICKS

Compressive Strength Test is performed on all 12 samples and as per result obtained, the bricks can be used for 1st and 2nd class construction work.

The samples which can be used for 1st class construction work are S1,S2,S4,S5,S7 and those which can be used for 2nd class construction are S3,S6,S8,S9,S10,S11,S12.

3. WATER ABSORPTION COMPARISON CHART

TABLENO 2.12 WATER ABSORPTION OF DIFFERENT BRICKS

Proportions	Hypo Sludge-Rice Husk Ash Bricks	Conventional Clay Bricks	Fly ash with Quarry Dust	Permitted max. water absorption for classes		
				1st	2nd	3rd
SAMPLE 1	9.93%	11.25%	14.06%	20%	22%	24%
SAMPLE 2	12.68%	12.06%	14.12%	20%	22%	24%
SAMPLE 3	14.70%	12.35%	14.35%	20%	22%	24%

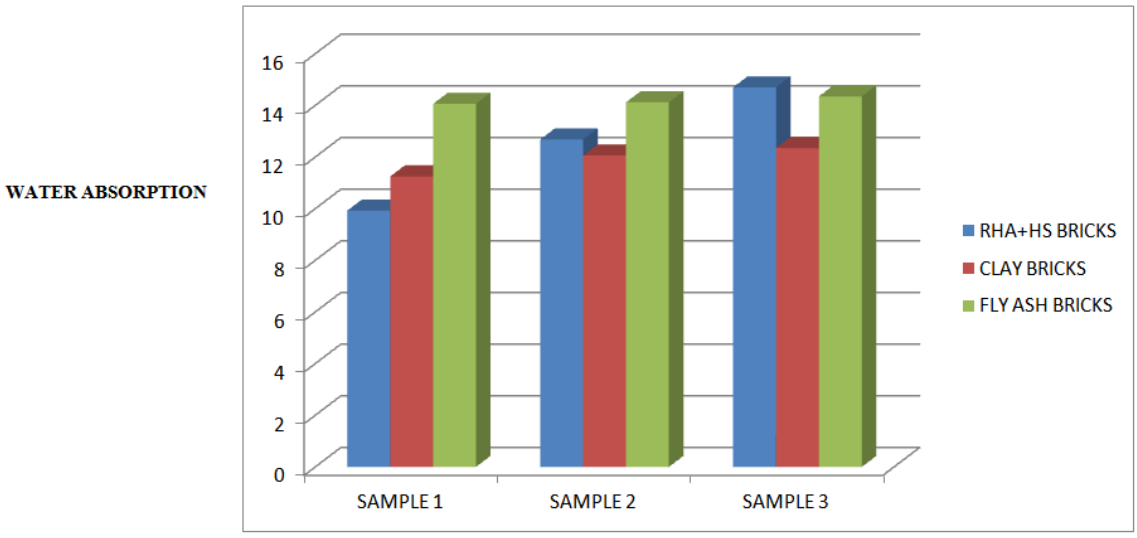


FIG.2.8 WATER ABSORPTION OF DIFFERENT BRICKS

TABLENo. 2.13 EFFLORESCENCE TEST RESULT COMPARISON CHART

SPECIMEN	AREA COVERED BY SALT DEPOSIT	CLASSIFICATION AS PER IS CODE
S1	<10%(Slight)	Slight
S2	<10%(Slight)	Slight
S3	<10%(Slight)	Slight
S4	<10%(Slight)	Slight
S5	<10%(Slight)	Slight
S6	<10%(Slight)	Slight
S7	<10%(Slight)	Slight
S8	<10%(Slight)	Slight
S9	<10%(Slight)	Slight
S10	<10%(Slight)	Slight
S11	<10%(Slight)	Slight
S12	<10%(Slight)	Slight

2.10. Structure Analysis result

TABLENo. 2.14 Moment with different type of Bricks

MOMENT IN KN-M			
STOREY	STRUCTURE WITH HYPO SLUGE	Structure With Clay Bricks	STRUCTURE WITH FLY ASH BRICKS
1	566.81	734.17	658.65
2	553.84	705.63	645.21
3	540.87	677.09	610.54
4	527.9	648.55	593.10
5	514.93	620.01	582.65
6	501.96	591.47	563.47
7	488.99	562.93	548.95
8	476.02	534.39	510.36
9	463.05	505.85	473.63
10	450.08	477.31	454.58
11	437.11	468.25	446.93
12	424.14	461.05	431.21

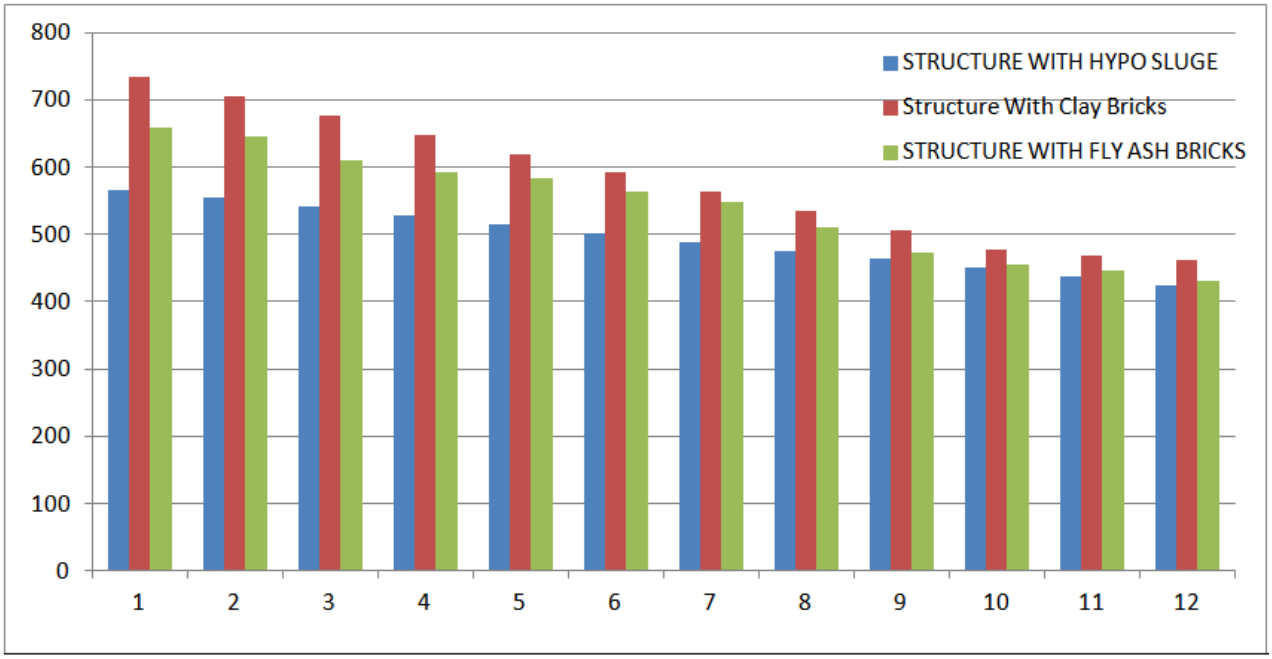


Fig2.9 Moment with different type of Bricks

2.11. Max. Shear force kN

TABLE2.15 Max Shear force with different Bricks

SHEAR FORCE IN KN			
STOREY	STRUCTURE WITH HYPO SLUGE	Structure With Clay Bricks	STRUCTURE WITH FLY ASH BRICKS
1	840.43	941.85	859.97
2	813.87	923.25	796.84
3	787.31	904.65	770.45
4	760.75	886.05	748.69
5	734.19	867.45	724.65

6	707.63	848.85	707.59
7	681.07	830.25	667.25
8	654.51	811.65	634.56
9	627.95	793.05	620.42
10	601.39	774.45	610.36
11	574.83	755.85	597.87
12	548.27	737.25	570.95

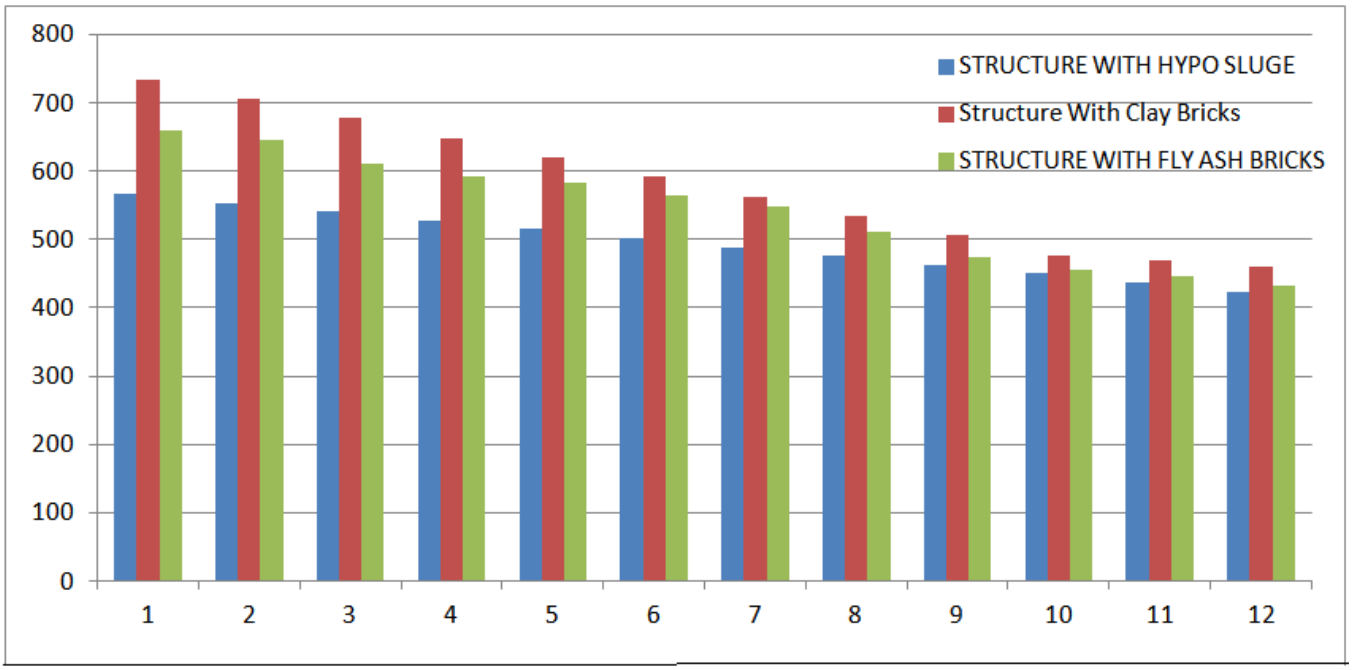


Fig2.10 Max Shear force

2.12. Cost Analysis

TABLE2.5 Cost analysis

S. No.	STRUCTURE Type	Concrete cu. m	Rate of concrete (m^3) as per S.O.R.	Cost of concrete in INR (Rupees)
1	Structure with clay Brick	110.98	5757	6,38,911.86
2	Structure with fly ash Brick	101.67	5757	585314.19
3	Structure with hypo sluge Brick	92.78	5757	5,02,313.86

TABLE2.16 Cost analysis

S. No.	STRUCTURE Type	Reinforcement in kg	Rate of Rebar kg as per S.O.R.	Cost of Rebar in INR (Rupees)
1	Structure with clay Brick	9454.23	72.75	6,87,795.23
2	Structure with fly ash Brick	8766.78	72.75	637783.245
3	Structure with hypo sluge Brick	8142.87	72.75	592393.79

3. CONCLUSIONS AND FUTURE SCOPE OF WORK

CONCLUSIONS

Following conclusions were identifying from the work.

1. The use of rice husk ash shows a perfect replacement of fly ash in cement-fly ash brick similarly hypo-sludge can use as a partial replacement of cement.
2. The gradual increase in rice husk ash was seen in the compressive strength of bricks with 70% to 90% will decrease but still, the strength of bricks is in the range of as per IS standers.
3. The gradual increase was seen in the compressive strength of bricks blended with 40% to 45% hypo sludge for all curing ages. But beyond that for 50% of hypo sludge, there is a significant reduction in compressive strength because at a higher dosage of non-cementing material in hypo-sludge becomes unbounded and unreacted which tend to decrease the strength.
4. The addition of both hypo sludge and rice husk ash increases the strength of bricks for all curing ages up to certain point. After that, there is an abrupt reduction in strength of the bricks because, at ahigher dosage, brick's cement loses its ability to make a proper bond with other material.
5. Both the material rice husk ash and hypo sludge having high water absorption properties that's why super latex is used as 0.1% to reduce the amount of water absorption in bricks and it help to control both initial rate of absorption as well as water absorption in all bricks.
6. As per the results obtained from soundness test RHA-HS Bricks shows good metallic ringing sound without breaking and from the result of hardness test it is clear that hard bricks are obtained, as when RHA-HS Bricks are scratched with steel knife no or little impressions are observed.

7. The weight of a RHA-HS Brick is approximately 2.6 to 2.7 kg while clay brick weights approximately 3.0 kg, it causes approximately 13.33% reduction in dead load of structure due to partition walls which on the other hand causes reduction in percentage of steel used in all related load carrying structure section like Beams, Columns, and Footing.
8. Results obtained by testing the bricks show that with the increasing the percentage of hypo-sludge and rice husk ash the amount of water absorption also increases but remains within the permissible limit.
9. Also with the increase of rice husk ash and hypo-sludge, the soundness of bricks also decreases.
10. 50% hypo sludge and 60% rice husk ash combination show minimum hardness where 40% hypo sludge and 50% of rice husk ash gave maximum hardness.
11. Combine analysis with conventional clay bricks and fly ash bricks, hypo-sludge rice husk bricks full fill all requirements.
12. From the analysis by etabs conclusion can be made that bending moments and shear forces are less in structure made up of hypo sludge bricks as compare to conventional structures (structure those are made up of either clay bricks or fly ash bricks) on every storey of building structure

FUTURE SCOPE OF WORK

1. Further study can be done by using different pozzolonic material in bricks (sewage sludge , industrial waste)
2. The analysis of can be done by other advance software like Staad pro. Revit structure etc.
3. Different pozzolonic materials or industrial waste can be used in clay bricks also to improve the quality of convention clay bricks.

References

[1] Dr. SantoshAhirwar, Dr. Rajeev Chandak, Effective use of Paper Sludge (Hypo Sludge) in Concrete(IJEDR 2019 | Volume 6, Issue 2 | ISSN: 2321-9939)

[2] Prof.S.S.Razvi, "Partially Replacement of Clay by S.T.P. Sludge in Brick Manufacturing," Int. J. Innov. Res. Adv. Eng., vol. 3, no. May, pp. 41–47, 2018.

[3] R.K. Arya and R. Kansal, "Utilization of Waste Papers to Produce Eco-friendly Bricks," vol. 5, Issue 8, pp. 92-96, 2016

[4] NishantKad and M. Vinod "Review Research Paper on Influence of Rice Husk Ash on the Properties of Concrete" International Journal of Research May 2015.

[5] Chukwudebelu J.A."Prospects of using whole Rice Husk for the Production of Dence and Hollow Bricks" African Journal of EnviromentalScince and Technology, 2015

[6] Naveen, SumitBansal "Effect of Rice Husk on Compressive Strength of Concrete"0975-8364International Journal on Emerging Technologies 6(1): 144-150(2015)

[7] Md. KhurshedAlam"Quality Study of Rice Husk Ash (RHA) Brick Using Neutron Radiography Technique" Journal of Building Construction and Planning Research, 2015.

[8] Surender Malik and Bhavana Arora, "Effect of Fly Ash and Rice Husk Ash on the Properties of Burnt Clay Bricks" (IJIRCST)ISSN: 2347-5552, Volume-3, Issue-4, July-2015

[9] Sidhath Talsania, "Effect of Rice Husk Ash on Properties of Pervious Concrete" International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974

[10] Chintan Khatri and Jenish M. Mistry, "An experimental study on rice husk ash and glass fiber reinforced concrete" International Journal of Advance Engineering and Research Development Volume 2,Issue 12,December -2015.

[11] R. Kumar, V. Patyal, B. Lallotra, D. Kumar, and C. Brick, "Open Access Study of Properties of Light Weight Fly Ash," no. March, pp. 49–53, 2014.

[12] S. Yadav, S. Agnihotri, S. Gupta, R. Kumar Tripathi, and A. Professor, "Incorporation of STP Sludge and Fly ash in Brick Manufacturing: An attempt to save the Environment," Int. J. Adv. Res. Technol., vol. 3, no. 5, pp. 138–144, 2014.

[13] [16] M. Scinduja, S. Nathiya, C. V Shudesamithronn, M. H. Balaji, T. Sarathivelan, and S. Jaya, "Innovative Brick Material," no. 1, pp. 49–61, 2014.

[14] G. K. R. R and S. G. Patil, "Structural Performance of Concrete by Partial Replacement of Cement with Hypo Sludge (paper waste)," vol. 1, no. 7, pp. 175–181, 2014

[15] S. F. Seyyedalipour, D. Y. Kebria, N. RMalidarreh and G. Norouzneja, "Study of Utilization of Pulp and Paper Industry Wastes in Production of Concrete," International Journal of Engineering Research and Applications, vol. 4, pp. 115-122, 2014.

[16] Mr. R. Balamurugan and Mr. R. Karthickraja, "An Experimental Investigation of Partial replacement of Cement by Industrial Waste (Hypo Sludge)," International Journal of Engineering Research and Applications, vol. 4, no. 1, April 2014, pp. 430-435.

[17] R. Srinivasan and M. Palanisamy, "Experimental Investigation In developing Low Cost Concrete From Paper Industry Waste," M. Engg. Thesis report, Department of Civil Engineering, Tamilnadu College of Engineering, Karumatham patti, Coimbatore-641659, Tamilnadu, India

[18] A. Kulkarni, S. Raje, and M. Rajgor, "Bagasse Ash as an Effective Replacement in Flyash Bricks," Int. J. Eng. Trends Technol., vol. 4, no. 10, pp. 4484–4489, 2013.

[19] Rahul Amin and Latiful Khabir "Energy Saving Brick from Rice Husk Ash "Journal of Engineering (JOE) ISSN: 2325-0224 77 Vol. 2, No. 1, 2013,

[20] Deepa G Nair, K Sivaraman "Mechanical Properties of Rice Husk Ash (RHA) - High strength Concrete" American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 2013

[21] S. S. Jahagirdar, S. Shrihari, and B. Manu, "Utilization of Textile Mill Sludge in Burnt Clay Bricks," vol. 3, no. 1, pp. 6–13, 2013.

[22] J. pitroda, L. B. Zala and F. S. Umrigar, "Innovative Use of Paper Industry Waste (Hypo sludge) in design mix concrete." International Journal of Advanced Engineering Technology, vol. 4, no. 1, Jan-March 2013

[23] J. V. Solanki and J. Pitroda, "Study of Modulus of Elasticity of concrete with Partial Replacement of Cement by Hypo Sludge Waste from Paper industry," Global Researc Analysis, vol. 2, no. 1, Jan. 2013.

[24] J. R. Pitroda, F. S. Umrigar, "Evaluation of Modulus of Elasticity of Concrete with Partial Replacement of Cement by Thermal Industry Waste (Fly Ash) and Paper Industry Waste (Hypo Sludge)," International Journal of Engineering Science and Innovative Technology, vol. 2, no. 1, Jan. 2013.

[25] J. Pitroda, L.B. Zala, F. S. Umrigar, "Durability of concrete with Partial Replacement of Cement by Paper Industry Waste (Hypo Sludge)," International Journal of Innovative Technology and Exploring Engineering, vol. 2, no. 3, Feb. 2013.

[26] Indian Standard Code of Practice for plain and reinforced concrete (fourth edition), IS 456:2000, Bureau of Indian Standard, New Delhi.

[27] Indian Standard, recommended guidelines for concrete mix design, IS 10262:1982,Bureau of Indian Standard, New Delhi.

[28] Indian Standard concrete mix proportioning-Guidelines (First revision), IS 10262:2009, Bureau of Indian Standard, New Delhi, India.

[29] Indian Stander, IS 3495-1 to 4: Methods of tests of burnt clay building bricks: Part 1 Determination of compressive strength Part 2 Determination of water absorption Part 3 Determination of efflorescence, Part 4: Determination of war page.

[30] GhassanAboobHabeeb "Study on Properties of Rice Husk Ash and Its Use as Cement Replacement Material" Materials Research. 2010; 13(2): 185-190

[31] R. Garcıa, R. Vigil de la Villa, I. Vegas , M. Frıas and M. I. Sanchez de Rojas, "The pozzolanic properties of paper sludge waste," Construction Building Material , vol. 22, pp. 1484–90, 2008.

[32] M. Frias, MI. Sanchez de Rojas and J. Rivera, "Influence of calcining conditions on pozzolanic activity and reaction kinetics in paper sludge-calcium hydroxide mixes," Proceedings of the 8 CANMET/ ACI international conference on fly ash, silica fume, slag and natural pozzolans in concrete, Las Vegas, pp. 879–86, 2004