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Manufacturing of Stabilized Soil Bricks

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Abstract: *The main purpose of this paper is the development of low cost housing structures, in rural as well as in urban areas. In present scenario, the cost of construction of houses is going to be high, so it is difficult to make their homes at low cost especially for rural population. The clay bricks are generally high in cost and create pollution during burning process in kiln. So, in this paper, the reuse of fly ash and foundry sand is done as replacement of major amount of clay which will reduce the cost as well as pollution. No burning is required while making of this brick. For economic construction, we tried to replace the class A clay brick at very low cost by this brick. In this, we replace the major amount of clay by the fly ash and foundry sand with the cement and plasticizer. The strength of brick is comparatively more than class A brick at low cost by the composition of 33.33% of foundry sand, 40% of fly ash, 15% of cement and 5gm of plasticizer. Compressive strength of brick sample is tested at 5 days after removing the sample from mould.*

Keywords: *Fly ash, foundry sand, strength, cement, low cost, brick.*

I. Introduction

In India, the use of clay brick is very common. But with the use of clay bricks, the fertility of land is getting affected because during excavation process the top layer of minerals gets excavated. The huge land required for manufacturing of clay bricks and also during burning process, the problem of pollution is generated. On the other hand, the production of foundry sand and fly ash is also huge so the waste management is becoming a serious issue in now days. With the use of these two wastes in bricks, reduces the cost of bricks and also reduce the disposing cost of the wastes, so the overall cost of construction could get low and the amount of clay could be reduced.

Amit Kumar D. Raval, Arti Pamnani, Alefiya I. Kachwala [1] studied partial replacement of fine aggregate with foundry sand. They analysed the compressive strength of concrete block by 0%, 10%, 20%, 30%, 40%, 50% at different curing periods (7 days, 14 days and 28 days). The compressive strength of concrete increased along with the foundry sand replacement up to 30%. At 30% replacement of fine aggregate with foundry sand, maximum strength was 33.65 MPa.

The idea "use of foundry sand in bricks" was generated from there because foundry sand is high silica sand and the due to presence of high silica content the strength is also good enough.

II. Material used

1. OPC: The ordinary Portland cement of grade 43, used in this brick for binding and strength purposes.
2. Foundry sand: It is the by-product of metal and non-metal casting industries. The sand produced after the several operations of moulding. In this silica content is in high amount which imparts the strength.
3. Clayey soil: Clayey soil is very fine material having clay content. And the size of clay particle is less than 0.002 mm
4. Plasticizer: Plasticizer is that material which imparts the plasticity as well as strength. In this we use silicon pc plasticizer.
5. Fly ash: It is by-product or waste generated from thermal power plants after the coal combustion.

III. Methodology

The preparation of brick mix done by following:

1. First, we collect the materials and weigh it.
2. We mix the material properly in dry state and then add sufficient amount of water in dry mix and mixed both properly.
3. The prepared mix is then poured into brick mould of size 26*13.4*7.3cm. During pouring, we tamped it time to time to prevent the formation of void and then finally, we placed the mould onto the vibrating machine.
4. After vibrating process, we left the sample for a day in exposed environment for sun drying. And then remove the brick sample from the mould.
5. After this we placed the brick sample into the oven for 10-12 hrs at 108-110 c to remove the excess moisture content.

6. Then for 5 days, we cured the sample and then perform the compressive strength test on it.
7. The size of brick sample is 23.4*11.2*6.3cm.

IV. Result and Discussion

4.1. Test results of foundry sand

Table 1: Properties of Foundry sand

S. No.	Name of experiment	Observed value			
		Sample 1	Sample 2	Sample 3	Average
1.	Specific gravity	2.44	2.51	2.46	2.47

4.1.1. Grain size test of foundry sand:

Table 2: Grain size test of foundry sand

Sizeof grain	Weight of grain retained (gm)	Weight retained, in %	Cumulative weight retained(gm)	Cumulative Weight retained, in%	% finer
1mm	16	3.85	16	3.85	96.15
600µ	9	2.16	25	6.01	93.99
450µ	89	21.394	114	27.404	72.596
300µ	133	31.97	247	59.019	40.981
150µ	144	34.615	391	93.634	6.366
75µ	6	1.442	397	95.076	4.924
Pan	19	4.567	416	99.643	0.357

$\mathbf{D_{60}}$= 300+((450-300)*(60-40.981)/(72.596-40.981) = 390.23 micron
Similarly,$\mathbf{d_{10}}$= 165.747 micron
$\mathbf{d_{30}}$ = 252.415 micron
Coefficient of uniformity, $\mathbf{c_u = d_{60}/d_{10}}$ = 2.352
Coefficient of curvature, $\mathbf{c_c = d_{30}^2/ (d_{60}*d_{10})}$ = 0.9850
The sand is poorly graded or uniform.

4.2. Test results of clayey soil

Table 3: Test results of clayey soil

S. No.	Name of experiment	Observed value			
		Sample 1	Sample 2	Sample 3	Average
1.	Specific gravity	2.43	2.44	2.42	2.44

4.3. Tests result on cement

Table 4: Test results of clayey soil

S. No.	Name of experiment	Observed value			
		Sample 1	Sample 2	Sample 3	Average
1.	Initial setting time	98	102	100	100
2.	Final setting time	218	222	220	220
3.	Consistency	39	41	40	40
4.	Soundness	1.1	1.3	1.2	1.2
5.	Fineness	2.7	3.3	3.0	3.0
6.	Specific gravity	3.14	3.1	3.16	3.13
7.	Compressive Strength: 1. 3 Days 2. 7 Days 3. 28 Days	 24.08 36.4 45.8	 22.7 35.8 44.3	 24.43 37.25 46.32	 23.736 36.483 45.473

4.4. Tests on fly ash

Table 5: Test results of clayey soil

S. No.	Name of experiment	Observed value			
		Sample 1	Sample 2	Sample 3	Average
1.	Consistency	45	44.5	45.5	45
2.	Fineness	24.2	25.2	25.6	25

4.5. Compressive strength test results of brick sample

4.5.1. Casting of specimen 1:

Table 6: Compressive strength of specimen 1

Foundry sand	Clayey soil	Cement	Water	Compressive load, inTon	Strength in N/mm^2
25%	50%	25%	1000ml	22.5	9.81
1kg	2kg	1kg			

4.5.2. Casting of specimen 2:

Table 7: Compressive strength of specimen 2

Foundry sand	Clayey soil	Cement	Water	Compressive load, In Ton	Strength in N/mm^2
25%	50%	25%	1000ml	36	12.5
1kg	2kg	1kg			

4.5.3. Casting of specimen 3:

Table 8: Compressive strength of specimen 3

Foundry sand	Clayey soil	Cement+ lime	Water	Flyash	Compressive strength, inTon	Strength in N/mm^2
25%	50%	12.5%	1370ml	12.5%	-	-
1.25kg	2.5kg	0.525kg +100gm lime		0.625kg		

Result of specimen 3 = during extracting of brick from mould the brick was broken due to high moisture content and improper binding.

4.5.4. Casting of specimen 4:

Table 9: Compressive strength of specimen 4

Foundry sand	Clayey soil	Cement	Water	Flyash	Compressive strength, in ton	Strength in N/mm^2
12%	50%	13%	1200ml	12%	-	-
.42kg	1.8kg	.455kg		0.42kg		

Result: During extracting of brick from mould the brick was broken due to excessive drying.

4.5.5. Casting of specimen 5:

Table 10: Compressive strength of specimen 5

Foundry sand	Clay soil	Cement	Water	Flyash	Plasticizer	Compressive strength, in ton	Strength in N/mm^2
30%	45%	15%	1200 ml	10%	0.005Kg	16.5	6.295
1.05kg	1.575kg	0.525kg		0.15kg			

4.5.6. Casting of specimen 6:

Table 11: Compressive strength of specimen 6

Foundry sand	Clay soil	Cement	Water	Fly ash	Plasticizer	Compressive strength in ton	Strength in N/mm^2
33.33%	11.67%	15%	1200 Ml	40%	0.005Kg	290	11.065
1kg	0.350 kg	0.45kg		1.2kg			

Figure 1: Compressive strength reading of specimen 6

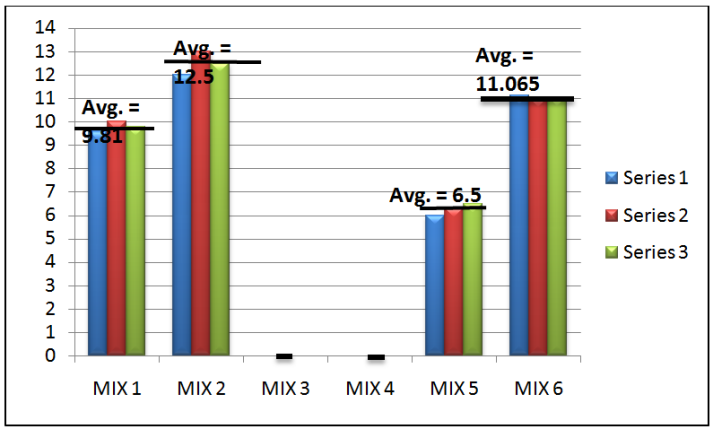

Figure 2: Compressive strength of brick samples at 5 days

V. Conclusion

1. Conclusions

The addition of foundry sand and cement to the brick mix gives a comparable value of compressive strength at 5 days testing, after casting when compared with the strength of class A brick. On the addition of 33.33% foundry sand and 15% of cement to the brick mix the strength obtained was 11.065 N/mm^2 viz. 110.65% greater than the conventional brick of class A which shows strength up to 10 N/mm^2.

It is observed from experiment result that as decrease in cement amount and clayey soil at the certain value (15% of cement and 11.67% of clay),with increasing in amount of fly ash and foundry sand, the compressive strength of brick sample increases.

Thus, from the experimental results we can conclude that:

- As the clay content reduces and foundry sand increases, compressive strength of specimen increases.
- The maximum compressive strength attained is at 40% of fly ash and 33.33% of foundry sand.
- Cost of the brick is reduced to Rs.4.5 in comparison of standard brick of Rs.8.

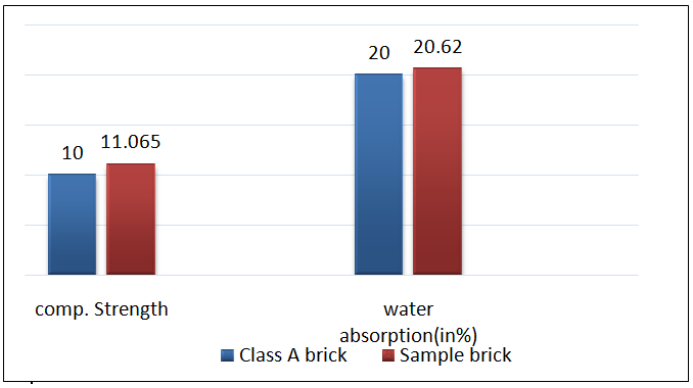

Figure 25: Comparison of strength and water absorption of brick sample with standard sample

2. Cost analysis:

1. Cement: Rs. 7 /kg
2. Flyash: Rs. 0.5 /kg
3. Admixture: Rs. 140 /litre
4. Foundry sand: Rs. 0
5. Clayey soil: Rs. 1600/ 2440 kg

- **Cost of standard sample (class A brick):**
  Cost= Rs. 8/ brick

- **Cost of brick with foundry sand, fly ash and cement:**
  Cost = Rs. 4.5 / brick

Cost of saving = Rs. 3.5/ brick

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Authors' profile

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