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MANUFACTURING OF INTERLOCKING BRICKS USING FLY ASH

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Abstract - *The use of interlocking bricks masonry has gained rapid popularity in many foreign countries as an alternative to conventional brick. It has been challenging always for researchers to make interlocking brick light weight, low cost and improve the performance against aggressive environment. An experimental effort has been made in this concern. This project gives the results of an experimental investigation in which the compressive strength, water absorption and density were investigated by using varying percentage of fly ash.* The need of the hour is to find wealth from wastage and eco-friendly technologies for our progress and prosperity. With the rise in population and increase in constructional activities considering the improvement in the standard of living the demand for building bricks is increasing day by day.

1.INTRODUCTION

The present of interlocking mortarless brick work has prompted a huge increment in field profitability and effectiveness, and also a diminishment in the prerequisites for very particular work teams. Besides, the utilization of interlocking blocks work has increased fast prevalence in numerous outside nations as a contrasting option to traditional blocks for supportable and sustainable buildings. Interlocking blocks are unique in relation to conventional blocks since the absence of the mortar to be filled between the blocks layers during the construction process.

1.1 Problem statement

Coal is the main source of energy in thermal power station, the ash is produced when the coal is burnt is been collected in the electrostatic precipitator as fly ash. fly ash basically contain toxic substances in traces, which will leads to negative impacts on the human health, plant life, environment and even on the land where fly ash will be disposed. Fly ash are industrial waste.The disposal of this waste creates environmental problems and health hazards. It is necessary to use these wastes into useful manner, attempt is made to utilise these industrial waste into alternative building brick.

1.2 Demand

The Indian housing sector at present faces a shortage of 20million dwelling units for its lower middle and low income groups which will witness a spurt of about 22.5million dwelling units by the end of Tenth plan period. There is ample scope for fly ash brick and block units. In Chennai alone 1 crore bricks are required for constructional activities in every day. But good quality of bricks as well as required quantity are not available moreover during the rainey seasons supply of clay bricks are very difficult. Therefore, in order to fulfill the required demand there will be a great chance to start more units in the field of fly ash bricks.

1.3. Source of fly ash

72% of India's power plants are coal based. These power stations generate nearly 40 million tones of fly ash annually. Fly ash contains Co2 emitted from Thermal power plants, industries using coal as a fuel emits unwanted ash and smoke from which fly ash is produced. In all the power plants and industries, they separate the fly ash by using the cyclone converter. This fly ash is then used as a raw material for manufacture of bricks.

1.4. Market

here are around 25 FAL-G bricks manufacturing units functioning in the state of Orissa and many more prospective entrepreneurs are going for the said project. As the production of building bricks in the state and country, as well falls far below the market demand due to increase in constructional activities and standard of living of the countrymen, the shortfall is likely to increase in manifold. Considering the gravity of the situation of disposal of fly ash, which is hazardous, both the central and State Governments and R&D organizations have been constantly finding out appropriate means for best utilization of fly ash. Fal-G bricks is the outcome of the developmental works done by Institute of Solid Waste Research & Ecological Balance (INSWAREB), Visakhapatnam. The need of the hour is to find wealth from wastage and eco-friendly technologies for our progress and prosperity. With the rise in population and increase in constructional activities considering the improvement in the standard of living the demand for building bricks is increasing day by day.

2. Literature review

Swapnil H Patil (2016), had studied on interlocking stabilized soil bricks. Materials used were Red soil, Cement, Water, Sand and Fly ash. Method used for casting the Interlocking Soil Bricks: Manual casting & Casting by Hydraulic Press Machines,Size of brick were (230mm x100mm x100mm) (230mm x 150mm x 100mm) Tests conducted were Water absorption and Compression strength on stabilized bricks. Authors conclude that if brick are prepared of ISSB bricks on site then it reduces the transportation cost and time. Maximum compressive strength for 10% cement & soil 2.65kg with compressive strength as 2.42 N/mm^2 and water absorption as 21.70%.

R. K. Watile et.al (2016) had studied the use of interlocking bricks masonry has gained rapid popularity as an alternative to conventional bricks for sustainable housing. R. K. Watile et.al had carried out an experimental investigation in which the compressive strength, water absorption and density were investigated by using varying percentage of fly ash, stone dust, and sand with different mix proportion. A manmade fibre, glass fibre reinforce polymer (GFRP) utilize as reinforcing material to produce the interlocking blocks which gives appreciable results were studied. There experimental results compared with that ordinary brunt clay brick and interlocking brick found durable in aggressive environments and have sufficient strength for their use in sustainable building construction.

S. Pareek. —Gainful Utilization of Marble Waste (2007) have carried the experimental work by using, laterite soil, plastic (PET) and bitumen as a raw material for the brick i.e. poly ethylene terephthalate as a plastic, size of the brick was 20x10x10cm,and weight of brick as 3kg, they have carried test on the index properties of the soil, and they have also carried test for bitumen, they have replaced the soil up to 80% by the plastic and bitumen by keeping the bitumen content constant (2%), and varied the proportion of plastic content by the increment of 8%,they concluded that maximum compressive strength as 7.20 MPa , water absorption as 1.824% and for second brick they have varying the bitumen content, and keeping plastic constant in soil, with bitumen up to 10%, interval of 2% and 70% as optimum plastic content by the weight of the soil,

R.K. Watile, S.K. Deshmukh, H.C. Muley (2014) et.al. have carried the experimental work, by using rice husk ash and clay as a raw material for the brick and the size of brick was 190x90x90 mm, with 3 kg weight of the brick. They have casted two different types of bricks ,first brick with rice husk ash and clay as a raw material for the brick , they have added rice husk ash up to 80% with interval of 10%, clay up to 40% by interval of 10% and for second brick, they have casted with rice husk ash, lime and gypsum as raw material for the brick.

3. Methodology

Flow chart shown below is the sequences of methodologywhich were adopted during our research work

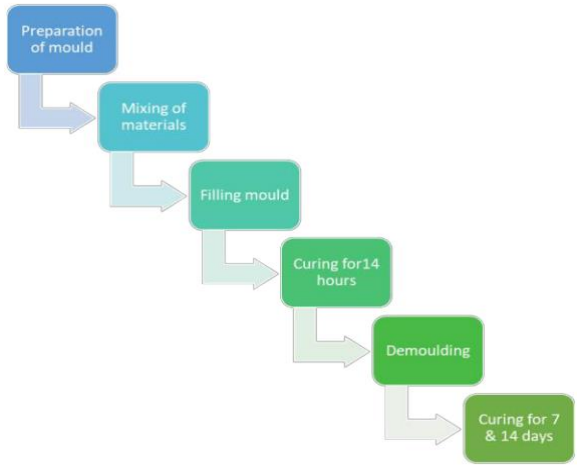

Chart .1 Methodology

3.1 preparation of mould

- Special Mould must be prepared for making Interlocking Bricks
- Two types of mould must be required, as to fill the gap with single brick while making a wall.

3.2 Mixing of materials

- Materials must be mixed in proper composition.
- If the composition is wrong, then the weight of the brick either increases or decreases which effect the strength of the Bricks.

3.3 Composition of bricks

1:6 Where,
1= Cement 6= Fly Ash
Water% = 10% = 700ml

3.4 Filing of mould

- Mould must be filled with proper proportion.
- Proper amount of material must be filled.
- Mould should be in proper manner, if there is any kind of damage to the mould, it results in improper size of the brick.

3.5 Curing for 14 hours

- Curing for 14 hours is required after filling the mould.
- These results in the Better strength of bricks.
- After curing, the bricks must be demoulded.
- Curing for 14 hours are needed after the demoulding process is done, so that the brick should not get disturbed.

3.6 Demoulding of brick

- Brick must be demoulded after proper curing of 14 hours.
- While demoulding, proper care must be taken such that the bricks do not tear apart or broken.
- After demoulding the bricks, it is necessary to do the curing again.

3.7 Curing for 7 & 14 days

- Curing is required to bring the good strength among the bricks.
- After the bricks get demoulded, it is necessary to keep the brick for Curing.
- It results in the consistency of bricks which helps in building the proper walls.

4. Testing

4.1 Test to be performed

- Specific gravity test
- Compression test
- Water absorption test
- Soundness test
- Impact test

4.1.2 Specific gravity test

Specific gravity is an important property of cement being related to its density and viscosity. It is one of the factor to determine density of cement. If the specific gravity of cement is more than 3.19 then it has more moisture content, which will affect the mix and bonding.

Specific gravity formula : = Wd / Ww

=(W2-W1)/(W4-W1)-(W3-W2)

CEMENT-

W1-0.662 Kg (weight of cyclometer)

W2-1.110 Kg (weight of cyclometer + cement)

W3-1.810 Kg (weight of cyclometer + cement+ water)

W4-1.526 Kg (weight of cyclometer +water)

Sr.no	W1(Kg)	W2(Kg)	W3(Kg)	W4(Kg)
1.	0.662	1.110	1.810	1.526

Table 1 Specific gravity cement

FLYASH-

W1-0.662 Kg (weight of cyclometer)

W2-1.110 Kg (weight of cyclometer + fly ash)

W3-1.810 Kg (weight of cyclometer + fly ash+ water)

W4-1.526 Kg (weight of cyclometer +water

Sr.no	W1(Kg)	W2(Kg)	W3(Kg)	W4(Kg)
1.	0.662	1.097	1.751	1.526

TABLE 2 SPECIFIC GRAVITY

Fig1-Performing Specific gravity

4.1.2 COMPRESSION TEST

These specimens are tested by compression testing machine after 7 days curing or 21 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

Compression test formula :

Compressive strength in N/mm^2 (kgf/cm^2) = Maximum load a failure in N (kgf)/Average area of the bed faces in mm^2(cm^2).

Compression strength test for 7 days curing

Sr.No.	Load (KN)	Surface Area (mm^2)	Compression strength(N/mm^2)	Average strength (N/mm^2)
1	49	22500	2.17	
2	51	22500	2.26	2.08
3	42	22500	1.86	

TABLE 3 COMPRESSION TEST

Compression strength test for 14 days curing

Sr.No.	Load (KN)	Surface Area (mm^2)	Compression strength(N/mm^2)	Average strength (N/mm^2)
1	98	22500	4.36	
2	88	22500	3.91	4.10
3	91	22500	4.04	

TABLE 4 COMPRESSION TEST

Compression strength test for 28 days curing

Sr.No.	Load (KN)	Surface Area (mm^2)	Compression strength(N/mm^2)	Average strength (N/mm^2)
1	156	22500	6.93	
2	145	22500	6.44	6.71
3	152	22500	6.76	

TABLE 5 COMPRESSION TEST

Fig 2 – Compressive strength test

4.1.3 Water absorption test

A brick is dried is weighted. It is then immersed in water for a period of 24 hours. It is weighed again and the difference in weight indicates the amount of water absorbed by the brick. It should not, in any case, exceed **20%** of the weight of dry brick for first class.

Formula:
Water absorption (%) = [(W2-W1) / W1] x 100 Where,

W1 = Dry Brick Weight (oven Dry Condition after 24 hours at temperature 110 to 150 °C)

W2 = Wet Brick Weight (After Immersion for 24 Hour)

Water absorption value (%)

SR.NO	W1(KG)	W2	(W2-W1)/W1	(W2W1)/W1*100 (%)
1.	3.75	4.34	0.157	15.7
2.	3.69	4.29	0.162	16.2
3.	3.73	4.36	0.168	16.8

TABLE *6* WATER ABSORPTION

5. COST CALCULATION

Rate of 1 kg fly ash - 2 Rs

Rate of 50 kg cement bag - 350 Rs

1kg cement - Rs

Mix proportion

1:3

Where 1= Cement

3= fly ash

Mortor required for 1 block of interlocking brick is 6 kg

So,

Fly Ash required is 4.5 kg

Cement required is 1.5 kg

Cost for fly Ash is 4.5 × 2 = 9 Rs .

Cost for cement is 1.5 × 7 = 10.5 Rs.

Cost for 1 block is =19.5 Rs.

6. Advantages

- They are light in weight and hence are very suitable for multi-floored buildings. This is because as the height of the buildings increase, the stress and tension on the foundation and structure increase too. With light bricks, this stress and tension are reduced manifold.

- Fly ash bricks absorb less heat and considering the Indian climate, it makes it better when compared to clay bricks.

- From the cost front, it requires less mortar during construction. Further, the machine that we provide requires less labor too. Our machines are made keeping in mind the costs associated with water wastage and raw material wastage too. You hence save in the breakage front (15%), the plaster and jointing front (15%) and curing and labor front (7%). So Q Green fly ash brick machines reduce the overall costs.

- The compressive strength is very high and they are less porous. They absorb less water and saves cost there, as well.
- It is environmentally friendly and hence allows your business to take a step towards sustainable development. Q-Green machines are green machines too, that promote environmental protection and conservation. Production of fly ash bricks requires no fossil fuel and hence does not lead to the emission of green house gases.
- Production of clay bricks damages the top-soil and this is prevented in the manufacturing process of fly ash bricks. There is no pollution or environmental damage, as a result of which it has been put into the white category of products.
- Fly ash bricks are stronger, more uniform and denser as compared to clay bricks. While their mortar consumption is low, their wastage is only about 1% as against that of clay bricks which are about 10%.
- These bricks are generally available closer to the thermal power plants. However, finding dealers in all major cities and towns wouldn't be a problem.
- Increasing the life of concrete roads and structures by improving concrete durability,
- Net reduction in energy use and greenhouse gas and other adverse air emissions when fly ash is used to replace or displace manufactured cement,
- Reduction in amount of coal combustion products that must be disposed in landfills, and conservation of other natural resources and materials.

7. Conclusion

- The results of an analysis of interlocking brick costs have addressed the problems faced by industry that interlocked brick products can be differentiated into two quality classifications based on their compressive strength test.
- In conclusion, the interlocking brick development is presented in this study and confirmed that this system is utilized in masonry structures.
- Accordingly, the concept of interlocking system has been widely used as a replacement of the conventional system.
- Also, it verified that interlocking brick can be utilized either as load bearing wall or non-load bearing system.
- Interlocking brick that functions as a wall construction that holds the load classified to quality I and it cost per piece is greater than the interlocked brick that functions as a non-structural wall.
- This research is an initial analysis in obtaining the quality of interlocking brick material.
- This research needs to be developed further by using other types of material in the mix design so that an effective and efficient mixture is obtained.
- The manufacturing of bricks using fly ash is environment friendly.
- The fly ash 70 to 80% used in manufacturing bricks is beneficial to increase in compressive strength.

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