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PERFORMANCE EVALUATION OF INTERLOCKING BRICKS USING GRANITE WASTE POWDER

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Abstract— This paper mainly focus on utilisation of industrial wastes in making interlocking building brick, Flyash and Granite industry generate large amount of solid waste, the disposal of this waste creates environmental problems and health hazards. The study involves the experimental investigation of effect of varying proportion of granite waste powder and lime in the fly-ash in making flyash based interlocking brick and to analyses the properties of interlocking bricks such as compressive strength and water absorption. Three different types mix proportion were prepared, for first mix proportion with fly-ash with (85 to 65)% ,granite waste powder (5 to 25)% and lime 10% were used as raw materials for production of interlocking bricks, for second mix proportion with fly-ash with (73 to 65)% ,granite waste powder 25% and lime (2 to 10)% were used as raw materials, for third mix proportion with fly-ash with 60% ,granite waste powder (10 to 30)% and lime (30 to 10)% were used as raw materials, after casting the fly ash based interlocking bricks for varying different proportions, these interlocking bricks were sun dried and then tests was carried out on the interlocking bricks, for 7 and 21 days compressive strength and percentage of water absorption was determined.

Keywords—Fly ash, Granite Waste Powder, Interlocking bricks

I. INTRODUCTION

Bricks are most widely used as infill material in India, due to its structural strength, durability, resistance to the climatic condition, sound insulation and flexibility. Bricks are used for load bearing and non load bearing wall, partition wall, for foundations, load bearing columns and piers. for next up coming years the India could require the large quantity of building material. It has been estimated that during the period 2005-2030 in India, there will be increase in the demand for the bricks which could be approximately 500 billion bricks. The growth rate of urbanization in India was 31.3% during the period (1991-2001) and 31.8% during (2001-2011), 217.7 million was the population of the urban during 1991, and

population was 377.10 million during 2011. As there is increase in the urban population, number of cities and also towns were also been increased from 3768 to 7951 in during (1991-2001), due to growth of urbanization which lead to increase in the demand in construction sector and industrial sector.[1]

India Construction sector contributes about 10 % of the GDP (gross domestic progress) with annual growth rate of 9% As construction sector is growing rapidly, the demand of construction materials is also increasing. Presently China is the largest bricks producer in Asia and India is second on the production of bricks. During 9th five year plan (1997-2002), it was estimated that US \$4.5 billion as revenues can be generated from 170 million brick (annual demand) produced. During the 11th five year plan (2007-2012) it was estimated that about US\$ 5.3 billion as generation of revenues from 220 million bricks.[2]

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 and Granite waste powder are industrial waste. Granite stone are shaped by cutting and polishing, during this process certain percentage of granite powder generated as waste. Granite industry generate large amount of solid and powder 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 Objectives of the research work

- To utilise fly-ash, granite waste powder for preparation of interlocking bricks.
- To determine the optimum mix proportion for interlocking brick.

- To study the effect of fly-ash and granite waste powder on the properties of interlocking bricks like compressive strength and water absorption.
- To study cost analysis of interlocking bricks.

II. LITERATURE SURVEY

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/mm² and water absorption as 21.70%[1]

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 burnt clay brick and interlocking brick found durable in aggressive environments and have sufficient strength for their use in sustainable building construction.[8]

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, [11]

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 upto 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. They have added rice husk ash upto 80% with interval of 10%, lime upto 40% with interval of 10%, gypsum upto 20% with interval of 10%, they have found, the maximum compressive strength and water absorption at 30% rice husk ash and 70% clay with 40 kg/cm² and 16.30% respectively for the first brick. And for second brick at 50% rice husk ash, 30% lime, 20% gypsum, maximum compressive strength for 7 day as 34 kg/cm², for 21 day as 41 kg/cm² and water absorption as 17.6% 3.1.1[8]

III. MATERIALS & METHODOLOGY

The materials used in preparation of interlocking were

3.1 Fly ash

3.2 Granite waste powder

3.3 Lime

3.1 Fly Ash

Fly ash also known as 'Pulverized fuel' is a combustion product composed of fine particles that are driven out of the boiler with the flue gases, class F flyash was used in making interlocking brick which was procured from raichur ash having Bulk density – 1.3 gm/cc, Specific gravity-2.2



Fig.1.Fly Ash

3.2 Granite Waste Powder

Granite waste powder are industrial waste, procured from Ilakal quarry in Hubli, The specific gravity of Granite waste powder obtained was 2.43 physical and chemical tests were conducted on procured Granite Waste powder details are given



Fig. 2. Granite Waste Powder

Table 1: Chemical tests analysis of Granite Waste Powder

Sl.No	Parameter	Observed value(%)
1	Total Ash	90.82
2	moisture	6.50
3	Loss of ignition	9.18
4	CaO	1.82
5	MgO	0.74
6	SiO ₂	70.26
7	Al ₂ O ₃	13.48
8	FeO ₃	01.04

3.3 Lime

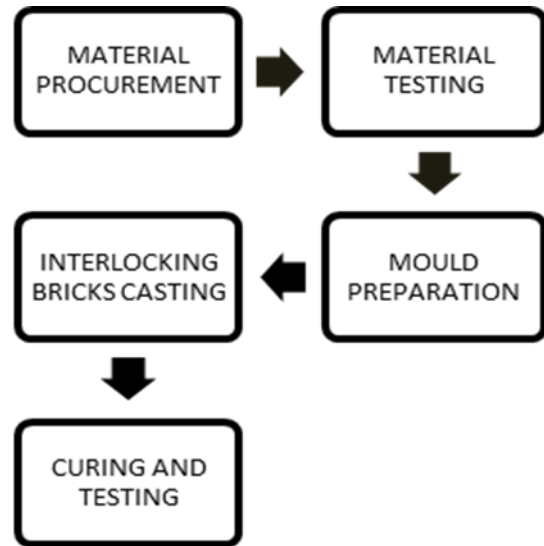
Locally available lime was used in making interlocking brick having the specific gravity of lime is 2.32.



Fig. 3. Lime sample

3.4 Methodology flow chart:

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



Flow chart .1. Methodology of our work

- Material were identified which are required for our research work and they were procured.
- Test on materials were done
- Wooden Mould were prepared. Interlocking bricks were casted, cured and tested for Compressive strength, Water absorption

3.5 Mould preparation

Wooden brick mould were used for casting of interlocking brick with the Size - 210 mm x 150 mm x 60 mm



Fig. 4. Wooden Brick Mould

3.5 Proposed mix proportion:

Table 2,3 and 4 shows the various mix proportion used for research work

Table 2: Mix proportion 1 (Lime % is fixed other two parameters were varied)

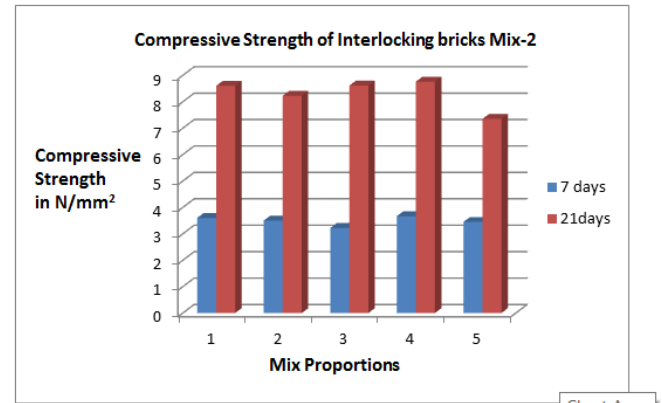
Sl. No	Fly ash (%)	Granite Waste powder (%)	Lime (%)	Total No Bricks Casted
1	70	20	10	15
2	72	18	10	
3	74	16	10	
4	76	14	10	
5	78	12	10	

Table 3: Mix proportion 2 (Fly ash % is fixed other two parameters were varied)

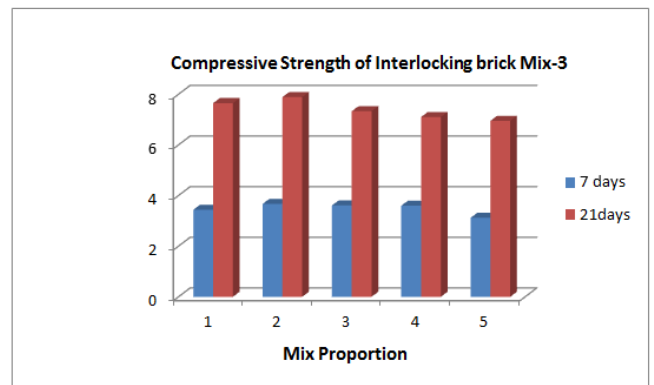
Sl. No	Fly ash (%)	Granite powder (%)	Lime (%)	Total No Bricks Casted
1	72	24	4	15
2	72	22	6	
3	72	20	8	
4	72	18	10	
5	72	16	12	

Table 4: Mix proportion 3 (Granite waste powder % is fixed other two parameters were varied)

Sl. No	Fly ash (%)	Granite Waste powder (%)	Lime (%)	Total No Bricks Casted
1	70	18	12	15
2	72	18	10	
3	74	18	8	
4	76	18	6	
5	78	18	4	



Graph 2 – Compressive strength for Mix Proportion 2

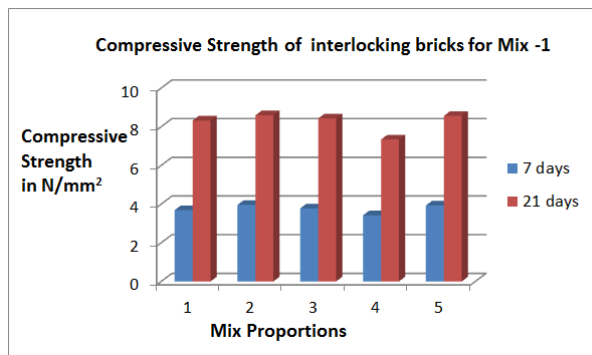


Graph 3 – Compressive strength for Mix Proportion 3

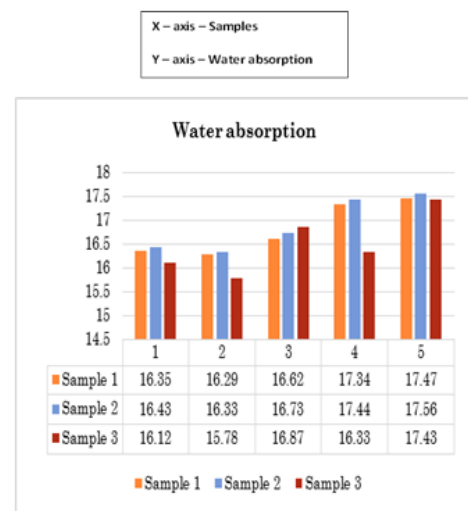
IV. RESULTS AND DISCUSSION

The tests conducted were:

- Compressive strength
- Water absorption



Graph 1: - Compressive strength for Mix Proportion 1



Graph 4 – Water Absorption for optimum mix proportion



V. COST ANALYSIS

Table 5: Cost of each interlocking is given below:

Materials	Cost	Additional	Profit	Cost of each brick
Lime	₹5.0 /unit	₹0.80	1	₹5.80
Granite powder	Free			
Fly Ash	Free			

The cost of each brick inclusive of all charges is **₹5.80**

For 1m³ no of bricks – 320 units for size of 210 mm X 150 mm X 60 mm
 Rate per 1m³ - 320 x 5.80 =Rs 1856/-

VI. RESULTS

- The optimum percentage of fly ash, granite powder and lime for Mix proportion 1, is found out to be 72% Fly ash, 18% Granite powder and 10% Lime. Compressive strength was found to be 3.96 N/mm² for 7 days and 8.59 for 21 days.
- The optimum percentage of fly ash, granite powder and lime for Mix proportion 2 is found out to be 72% Fly ash, 16% Granite powder and 6% Lime. Compressive strength for this mix proportion was found out to be 3.98 N/mm² for 7 days and 8.96 for 21 days.
- The optimum percentage of fly ash, granite powder and lime for Mix proportion 3 is found out to be 72% Fly ash, 18% Granite waste powder, 10% Lime, compressive strength for this mix proportion was found out to be 3.78 N/mm² for 7 days and 8.32 for 21 days.
- The Water Absorption found out from all the 3-mix proportion was 15.20%, 16.10%, 16.50 %.
- Cost of each inter locking brick is ₹5.80

VII. CONCLUSION

- Industrial wastes such as granite waste powder with certain percentage can be added to fly ash based interlocking brick.
- Interlocking brick require less mortar then compared with burnt brick clay.
- Faster is the construction of masonry units when we use interlocking brick then burnt clay bricks.

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