Experimental Analysis on Manufacture of Brick by Partial Replacement of Clay with Stone Dust

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Abstract- **Due to increasing population the building materials used in conventional period is depleting, so the civil engineers are in the situation to use the waste material effectively in construction works without compromising the quality of the material. This strategy will also help to reduce the effects taking in disposal of waste materials. Bricks are one of the important building material used in construction but due to its non-availability of resource and its increased self-weight in the structure hollow blocks and solid blocks replace it. In this paper, the main material clay in conventional brick is partially replaced with different proportion of stone dust of percentage 10% 20% 30% effectively. Bricks are moulded with hand and dry it in hot weather for 15 days and burnt the bricks about 1100°C to find the mechanical .and physical properties. For each combination 5 sample of bricks were casted for accuracy in result. Compression test, efflorescence test and water absorption test were conducted and the results are reviewed with conventional property of brick. In this research, the stone dust with 20% stone dust gives optimum result with lower water absorption capacity.**

Keywords: **Stone dust, replacement for clay in bricks, light weight brick, water absorption.**

I. INTRODUCTION

Demand for the construction materials is increasing day to day in housing sectors in both rural and urban areas. Brick is one of the conventional material used in centuries. In world, Asia produced around 87% of bricks. India and china are the major consumers of brick, so an alternative and eco-friendly material to overcome the problem.

Stone dust is a by-product from quarrying, it is estimated that 20% of stone dust in an issue of disposal and this creates environmental issues and landfill problems. In this project, the properties and characteristics of stone dust are studied.

II. LITERATURE REVIEW

Ismail (2007) investigated the potential utilization of organic residues in clay bricks as sawdust, tobacco residues and grass were mixed with clay at (0, 2.5, 5, and 10) percent by weight. Effects on shaping, plasticity, density, and mechanical properties were investigated. It was observed that the fibrous nature of the residues did not create extrusion problems. However, higher residue addition required a higher water content to ensure the right plasticity. The organic residue can be utilized in an environmentally safe way as organic pore-forming agents in brick clay.

Pitroda et al., (2013) analysed that, as the percentage of the glass fibre in brick increased the compressive strength of the brick is also increased. In this experimental work 1% fibre addition gives the maximum strength 5.86 N/mm^2 and water absorption 12.32%. He also recommend that use of glass fibre increase the strength but at same time the cost is also increased

Madurwar et al., (2014) studied the application of bio fuel by-product sugarcane bagasse ash (SBA) as a principal raw material for the manufacturing of bricks was studied. The bricks were developed using the quarry dust (QD) as a replacement to natural river sand and lime (L) as a binder. The bricks with 20% addition of lime to SBA and quarry dust exhibited a compressive strength of up to 6.59 MPa, which is almost double that of the conventional clay bricks (3.5 MPa). The optimum composition of SBA–QD–L brick is 15% and 25% lighter than the commercially available burnt clay and fly ash– cement bricks respectively.

Niklesh et al (2017) studied that the commercial production of bricks from waste materials is still very limited sot the possible reasons are related to the methods for producing bricks from waste materials, the potential contamination from the waste materials used, absence of relevant standards, improper guidance, lack of awareness, and the slow acceptance of waste materials-based bricks by industry and public. For wide production and application of bricks from waste materials, further research and development is needed, not only on the technical, economic and environmental aspects but also on standardization, government policy and public education related to waste recycling and sustainable development.

III. MATERIALS USED

3.1 Clay

Clay soils are compounds of silica and alumina. The silica in the clay, when fired at 900-1200 degrees C, will turn to a glassy phase. This process, called vitrification. However,

the vitrification does occur enough to give sufficient strength to the brick. It takes approximately 3 m^3 of clay soil to make 1000 bricks.

3.2 Stone dust

The stone dust is the by-product which is formed in the processing of the bigger stones which broken downs into the coarse aggregates of different sizes and the use of this replacement material offer cost reduction. They indicated that the liquid limit, plastic limit, plasticity index and optimum moisture content decrease by adding stone dust which in turn increases usefulness of soil as highway sub-grade material. Therefore, it is used as a good binding material when it is used as an additive. Physical properties of the stone dust is found by IS 2386 Part III (1963) and the chemical properties are found by IS 4032-1968 and the values are tabulated.

Table I
Physical Properties of stone dust and clay

Property	Stone dust	Clay
Specific gravity	2.60	2.63
Bulk density (kg/m^3)	1720	1750
Absorption (%)	1.58	1.62
Moisture content (%)	Nil	1.50
Fine particles less than 0.075mm (%)	15	20
Sieve analysis	Zone II	Zone II

The above table shows that stone dust and clay possess similar physical properties, which can be taken as an indicator that stone dust can be replaced for clay.

Table II
Chemical Properties of stone dust

S.No	Constituents	Stone dust
1	Al_2O_3	18.72
2	Fe_2O_3	6.54
3	CaO	4.83
4	MgO	2.56
5	Na_2O	Nil
6	K_2O	3.18
7	TiO_2	1.21
8	Loss of ignition	0.48

IV. MANUFACTURE OF BRICKS

Four steps in manufacture of bricks are preparation of clay, moulding, drying and burning. The clay is unsoiled and cleaned so that the lumps and other vegetable matters are removed and screened. Weathering, blending and tempering of clay is done. In this research, the moulding bricks is done by hand and the bricks are laid in stacks to remove the moisture and the bricks are burned in clamps.

Fig 1 Moulding of bricks

Fig 2 Burning of bricks

V. TEST ON BRICKS

The bricks are tested for compression, water absorption and efflorescence various mix proportions of stone dust 10%, 20% and 30% of brick size 230x110x70mm of area 253mm^2 are chosen for research. Under each proportions 5 samples of bricks are taken for testing and the average are shown above

Table 3
Compressive strength Test

Mix	Compressive strength (N/mm^2)
Conventional brick (B0)	5.12
90% clay 10% stone dust (B1)	5.83
80% clay 20% stone dust (B2)	6.65
70% clay 30% stone dust (B3)	5.40

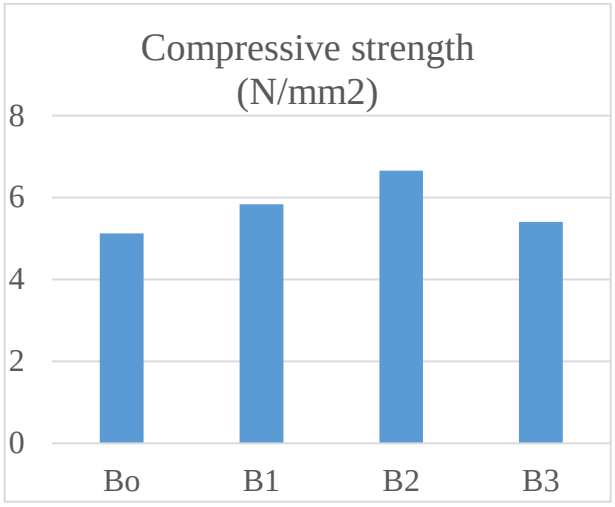

Fig 3 Compressive strength on bricks

From the graph, 20 % replacement of stone dust shows a higher compressive strength

Table 4
Test on water absorption and efflorescence

Mix	Water absorption (%)	Efflorescence
Conventional brick (B0)	11.43	Nil
90% clay 10% stone dust (B1)	10.60	Slight
80% clay 20% stone dust (B2)	10.12	Slight
70% clay 30% stone dust (B3)	9.53	Moderate

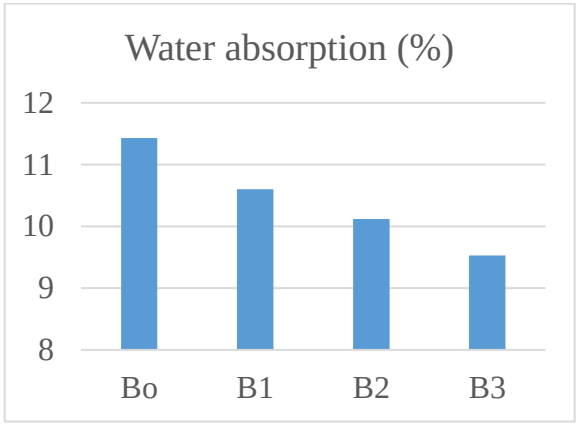

Fig 4 Water absorption

The maximum amount of water absorption allowed should be 20% of the weight of bricks. In this research when the stone dust increased, the water absorbing capacity of the brick is reduced. Efflorescence is the crystalline salt on the surface of brick as the stone dust contain calcium, magnesium and potassium there will be a slight observation of efflorescence in those stone dust replacement bricks.

VI. RESULTS AND CONCLUSIONS

Based on the test results:

1. The compressive strength of brick is increased while adding stone dust at 20% and further increase in stone dust reduce the compressive strength.
2. Water absorption is decreased when the stone dust % increased, this indicates that the water absorbing capacity of stone dust is less.
3. Due to crystalline salts in stone dust there will be a slight observation that is 10% of the area of brick is covered with thin salt deposit. This is acceptable limit 20% of replacement gives good result

At 30% of stone dust decreases the strength as well as efflorescence is moderate so that the possible usage of 20% replacement of stone dust gives better results in strength, water absorption and efflorescence.

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