# An Experimental study on partial replacement of Clay bricks with M-sand Residue

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**Abstract**—Due to increasing population the building materials used in conventional period is depleting, so the civil engineers are 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 m-sand residues of percentage 5-50% effectively. Bricks are moulded with hand and dry it in open atmosphere for 10 days and burnt the bricks about 1100°C to find the mechanical and physical properties. For each combination 10 samples of bricks were casted for accuracy in result. Compression test, Density test, Thermal-effect test and water absorption test were conducted and the results are reviewed with conventional property of brick. In this research, the m-sand residues with 30% m-sand residues gives optimum result with lower water absorption capacity

Index Terms—M-sand residue – clay bricks – Test on bricks - Compressive strength.

## 1 INTRODUCTION

Demand for the construction materials is increasing day today 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.

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

### 1.2 M-sand Residue

The M-sand residues 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 M-sand residues 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 M-sand residues are found by IS 2386 Part III (1963).

### OBJECTIVE

The main objective of this project is to make use of the waste residue from m-sand manufacturing and to make economical and cost effective.

## 2. MATERIALS AND THEIR PROPERTIES

### *2.1 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.

**Table 1: Properties of clay**

| S.NO | DESCRIPTION | RESULT |
|---|---|---|
| 1 | Specific gravity | 2.6 |
| 2 | Sieve analysis | IS 4.75mm |

### *2.2 Water*

Water is one of the important materials for the pervious concrete Potable water with pH value 6.5-8.5 is used for mixing and curing throughout the experiment.

### *2.3 Moulds*

The standard size moulds are used 230X100X80mm

### *2.4 M-sand residue*

The M-sand residues 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.The physical properties of m-sand residue are tabulated.

**Table 2: Physical Properties of M-sand residue**

| S.NO. | DESIGNATION | PROPERTIES |
|---|---|---|
| *1* | *Sieve analysis* | IS 4.75mm |
| *2* | *Specific Gravity* | *2.62* |

## 3 MIX PROPORTIONS

**Table 3: Mix Proportion**

| Samples | Clay(%) | M-sand Residue(%) |
|---|---|---|
| 0 | 100 | 0 |
| 1 | 95 | 5 |
| 2 | 90 | 10 |
| 3 | 85 | 15 |
| 4 | 80 | 20 |
| 5 | 75 | 25 |
| 6 | 70 | 30 |
| 7 | 65 | 35 |
| 8 | 60 | 40 |
| 9 | 55 | 45 |
| 10 | 50 | 50 |

## 4 PREPARATIONS OF BRICKS

### *4.1 Moulding*

The Clay and M-sand Residue is mixed and moulded with size of 230 x 100 x 80 mm.

**Fig 4.1 moulding of samples**

### *4.2 Drying of Bricks*

The brick samples are drying in the open atmosphere for 7days

**Fig 4.2 Drying**

### *4.3 Burning of bricks*

The burning process is carried out by kiln method.

**Fig 4.3 Burning of Bricks**

## 5 TESTING PROCEDURE

### *5.1 Compressive strength*

In a compression test a cloth experiences opposing forces that push inward upon the Bricks from opposite sides or is otherwise compressed, squashed, crushed, or flattened. The test sample is usually placed in between two plates that distribute the applied load across the whole area of two opposite faces of the test sample and then the plates are pushed together by a universal testing machine causing the sample to flatten. A compressed sample is typically shortened with in the direction of the applied forces and expands with in the direction perpendicular to the force. The compressive strength of bricks calculated and tabulated in table 6.

**Table 4: Compressive strength of the Bricks**

| Samples | Compressive strength of Brick (N/mm²) | | | Mean (N/mm²) |
|---|---|---|---|---|
| | T1 | T2 | T3 | |
| 0 | 5.71 | 4.50 | 5.60 | 5.27 |
| 1 | 6.00 | 7.70 | 5.50 | 6.40 |
| 2 | 6.00 | 6.50 | 7.20 | 6.56 |
| 3 | 4.70 | 6.30 | 6.50 | 5.83 |
| 4 | 4.20 | 5.30 | 4.22 | 4.57 |
| 5 | 5.10 | 7.20 | 8.04 | 5.77 |

| | | | | |
|---|---|---|---|---|
| 6 | 6.00 | 5.73 | 5.60 | 6.78 |
| 7 | 4.00 | 3.52 | 3.80 | 3.77 |
| 8 | 4.47 | 3.53 | 4.30 | 4.09 |
| 9 | 3.70 | 3.30 | 3.10 | 3.36 |
| 10 | 3.43 | 3.64 | 3.86 | 3.64 |

*5.2Water Absorption Test*

The specimens were immersed in water for 24 hours and weighed (W1) then they kept in a ventilated oven for one hour and weighed (W2).

Percentage of water absorption = W1 - W2/ W2 x 100.

**Table5: Water Absorption Test**

| Samples | weight (w1) | weight(w2) | water absorption value |
|---|---|---|---|
| 0 | 3.37 | 3.14 | 7.12% |
| 1 | 3.63 | 3.42 | 6.13% |
| 2 | 3.63 | 3.38 | 7.44% |
| 3 | 3.74 | 3.51 | 6.36% |
| 4 | 3.81 | 3.62 | 5.30% |
| 5 | 3.75 | 3.56 | 5.33% |
| 6 | 3.81 | 3.57 | 6.83% |
| 7 | 3.86 | 3.58 | 7.80% |
| 8 | 3.86 | 3.63 | 6.55% |
| 9 | 3.95 | 3.73 | 5.77% |
| 10 | 4.00 | 3.78 | 5.81% |

*5.3 Density Test*

The specimens were kept in oven at 100°C for 60 minutes and then weighed. The result is tabulated.

**Table 6: Density Test**

| Sample | Weight (kg) | Volume ($m^3$) | Density ($kg/m^3$) |
|---|---|---|---|
| 0 | 2.968 | $1.54x10^{-3}$ | 1927.27 |
| 1 | 3.315 | $1.68x10^{-3}$ | 1973.21 |
| 2 | 3.310 | $1.68x10^{-3}$ | 1960.90 |
| 3 | 3.265 | $1.68x10^{-3}$ | 1934.24 |
| 4 | 3.252 | $1.68x10^{-3}$ | 1926.54 |
| 5 | 3.252 | $1.68x10^{-3}$ | 1926.54 |
| 6 | 3.442 | $1.80x10^{-3}$ | 1912.22 |
| 7 | 3.486 | $1.80x10^{-3}$ | 1936.66 |
| 8 | 3.452 | $1.70x10^{-3}$ | 2030.58 |
| 9 | 3.500 | $1.70x10^{-3}$ | 2058.82 |
| 10 | 3.556 | $1.70x10^{-3}$ | 2091.76 |

*5.3 Thermo-effect Test*

The strength of brick gets affected due to the increase in temperature. To find the change in strength, the burned bricks were kept at 100°c in an oven for 24 hours. Then it is immediately tested in compression. The compressive strength of specimen was calculated.

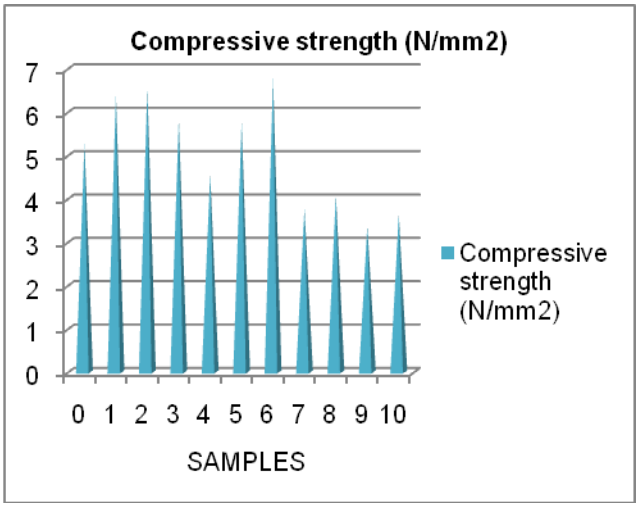
| Samples | Compressive strength ($N/mm^{2)}$ |
|---|---|
| 0 | 5.20 |
| 1 | 8.40 |
| 2 | 8.60 |
| 3 | 7.40 |
| 4 | 7.40 |
| 5 | 10.00 |
| 6 | 7.20 |
| 7 | 4.80 |
| 8 | 4.70 |
| 9 | 4.60 |
| 10 | 5.00 |

## 6 Result And Discussion

*6.1 Compressive Strength Test*

The compressive strength of brick is increased while adding M-Sand Residue at 30%.

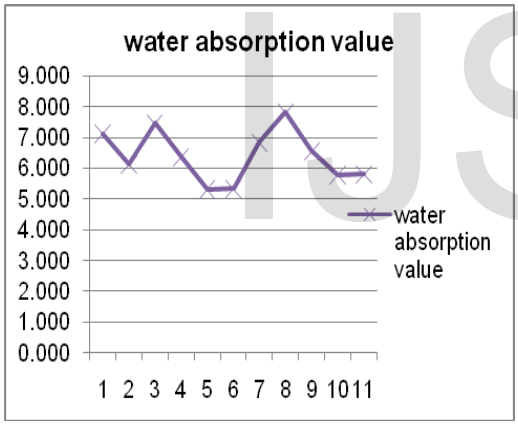
**Fig 6.1 Compressive strength test**




*6.2 Water Absorption Test*

From the Table 8, it is observed the maximum amount of water absorption allowed should be 20% of the weight of bricks. In this research when the M-sand residue increased, the water absorbing capacity of the brick is reduced.

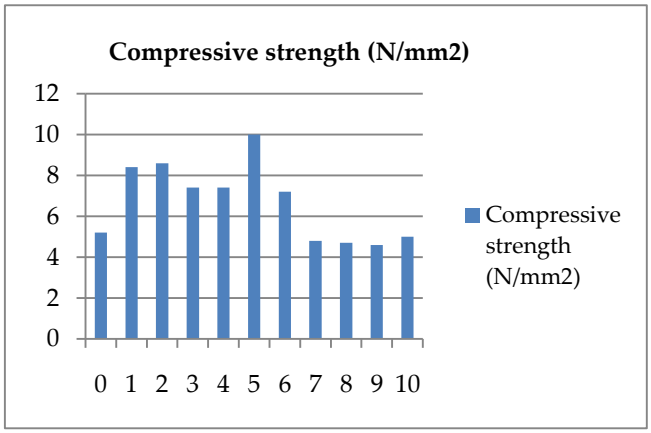
**Fig 6.2 *Water Absorption* test**




*6.3 Thermal –effect Test*

From the Table 6, it is observed that the bricks are withstand up to 30%

**Fig 6.3 *Thermal-effect* test**




*6.4 Density Test*

From the Table 6, it is observed the density of bricks is around 2000 Kg/m$^3$.

## 7 Conclusion

Based on the test results:

1. The compressive strength of brick is increased while adding M-sand residue at 30% and further increase in M-sand residue reduce the compressive strength.
2. Water absorption is decreased when M-sand residue % increased; this indicates that the water absorbing capacity of M-sand residue is less.

At 35% of M-sand residue decreases the strength. So that the possible usage of 30% replacement of M-sand residue gives better results in strength, water absorption and compression strength.

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