

# Production of Quality Bricks with Granite Waste Addition in Unsuitable Soil

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**Abstract—** Brick is building material used to build walls, paving materials and other components in masonry construction. In this study, Production of Quality Bricks with Granite Waste Additions in Unsuitable Brick soil is prepared with different proportions of Granite Waste addition in Unsuitable soil sample. The ingredients used in the preparation of bricks are unsuitable soil and Granite waste powder. The different proportions of granite waste addition in unsuitable brick soils are 0%, 10%, 20%, 30%, 40% & 50%. Using Granite waste in Unsuitable soil, bricks are casted, fired in high temperature and cured in the chamber. In this study, primarily the tests are done as per the Indian standards are Compressive strength, Water Absorption test, Efflorescence of bricks, Hardness test, Bulk Density, Size, Shape and color, Soundness and Structure test. This thesis presents a detailed experimental study on Compressive strength, Water absorption and efflorescence of bricks. Hardness, Bulk density, Size, Shape & Color, Soundness and Structure is also studied and reported in detail. The values are determined and compared with different proportions of Granite waste additions in unsuitable soil.

**Keywords—** Granite Waste, Unsuitable Soil, Clay.

## INTRODUCTION

Brick is building material used to build walls, paving materials and other components in masonry construction. Traditionally, the term brick refers to as a unit of clay sample fired in large temperature by making into rectangular blocks. The most used raw materials in the traditional brick industries can be basically divided into three categories, plastic components (clays), fluxing components (feldspar), and inert components (quartz and sand). A good quality bricks is one which gives good compressive strength and less water absorption, without any defects or cracks formed in the bricks. The following parameters viz., compressive strength, water absorption, efflorescence, bulk density, hardness, size, shape, color, soundness and structure were used to assess the quality of brick for construction

based on Indian Standards given. Many researchers in the past decades found experimentally that the addition of granite waste powder in the clay sample improves the durability of the brick. The addition of granite waste powder in unsuitable brick soil is not only economical and also eco-friendly. Normally bricks are made up of clay sample only and in some of the best research papers it is observe that bricks are made by mixing clay sample and different proportions of granite waste powder. In this subject field, the different proportions of granite waste powder are mixed with unsuitable brick soil to examine the effects on index properties and mechanical properties. The different proportions considered are 0%, 10%, 20%, 30%, 40%, & 50%. A brick is a block made of clay, burnt in a kiln. Granite waste powder is collected from Murakambattu village in Chittoor town, Andhra Pradesh Chittoor district. Soil sample is collected in RVS Nagar, Muthirevula village, Chittoor town, Andhra Pradesh Chittoor district.

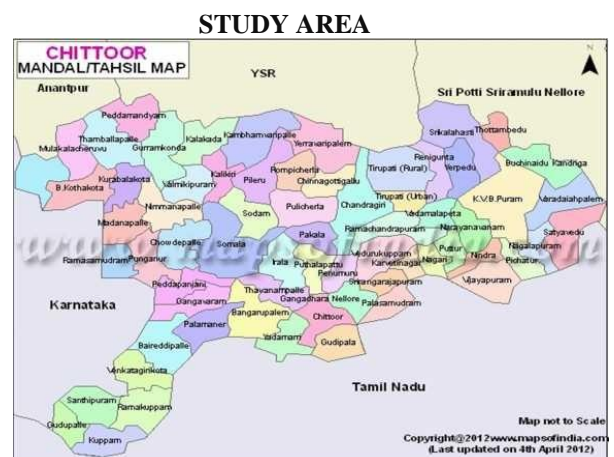


Figure- 1: study areas of the collected soil sample and granite sample

**MATERIALS AND METHODS**

Granite waste powder is collected from Murakambattu village in Chittoor town, Andhra Pradesh Chittoor district. Soil sample is collected in RVS Nagar, Muthirevula village, Chittoor town, Andhra Pradesh Chittoor district. Locally available soil is used in the present study. The most common constitute of sand is silica, normally in the form of quartz which is chemically inert and heavy. Normally clay sample is to be used for the casting of bricks. In this study, instead of using clay sample, soil is to be selected for casting the bricks. Soil is collected near the hilly region where there is the maximum quantity of sand particles and less quantity of clay particles. The parameters considered in this study are Wet Sieve Analysis, Specific Gravity, Density, and Compressive Strength for Bricks, Water Absorption Test, Efflorescence, Hardness Test, Bulk Density, Size, Shape and Color, Soundness and Structure

**RESULTS AND DISCUSSIONS**

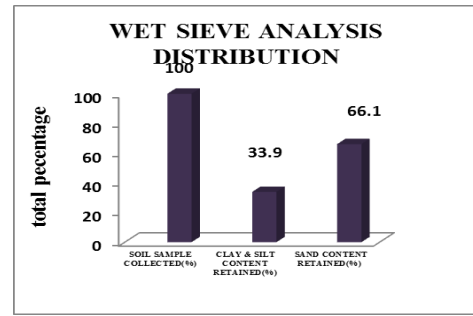
In this chapter, the outcomes of this investigation are due to the effect of firing the bricks with a high temperature and on the result of curing conditions on the engineering properties such as of brick mixes made with sand replacement material such as granite waste powder. The solutions received are used to analyze the effect of these additions of granite waste powder on the engineering attributes. Based on the various tests conducted in the laboratory is to analyze whether the preparation of brick using granite waste powder additions in unsuitable soil is good quality brick used for common building construction. To give the positive results and improvement of this investigation, experimental works are carried out and presented in a tabular form and graphically form in order to facilitate the analysis. This reading of the results is based on the availability of the literature review as good as on the outcomes received. The implication of the outcomes is evaluated with reference to the criteria set by the relevant IS codes.

**Results of Wet Sieve Analysis:**

Wet sieve analysis is performed to see the portion of clay content, silt content and sand content present in the soil sample collected. From the Table 1 it is observed that the collected soil sample is unsuitable for the casting of bricks as per the Indian Standards 2117-1991<sup>[1]</sup>

**Table 1: Wet Sieve Analysis Distribution**

Soil Sample Collected (gm)	Clay & Silt Content Retained(gm)	Sand Content Retained(gm)
1000	339	661

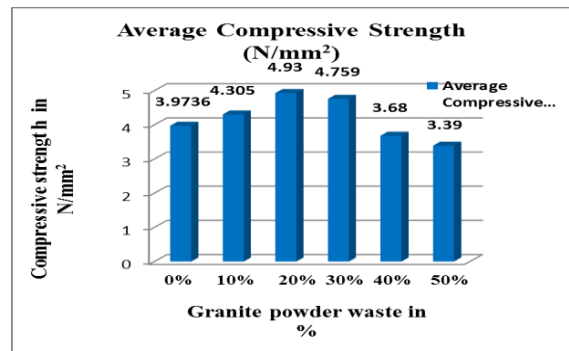


**Figure: 2 Wet Sieve analysis for Collected Soil Sample**

**Compressive Strength of Bricks:** The compressive strength is tested for 5 number of nominal bricks by curing the brick sample. The test is carried out based on the IS 3495-1992 part-1<sup>[2]</sup> to obtain the compressive strength of bricks. First the bricks are tested for six different mix proportions of granite waste powder additions in unsuitable brick soils using a Compressive Testing Machine and the values are given below in table 2

**Table 2: Compressive Strength of Bricks**

Granite Waste Powder (%)	0	10	20	30	40	50
Average Compressive Strength (N/mm <sup>2</sup> )	3.974	4.305	4.93	4.759	3.68	3.39



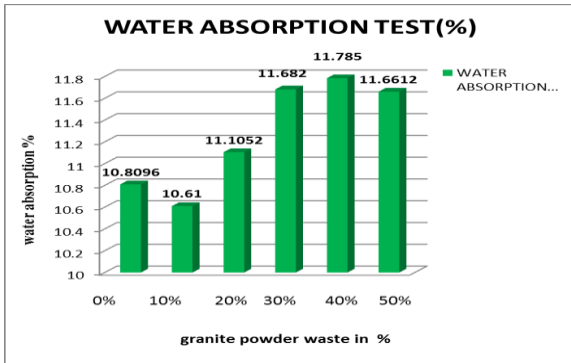
**Figure 3: Compressive Strength of Bricks**

**Water Absorption Test for Bricks:**

Water absorption test were carried out for bricks as per the IS code 3495-1992 part-2<sup>[3]</sup>. The specimens were weighed before drying. The drying was carried out in the hot air oven at a temperature of 1050<sup>0</sup>C. The dried specimens were cooled at room temperature and immersed in water. The specimens were taken out at regular interval of time, surface dried using a cloth and weighed. The water absorption percentage is reduced when there is a less percentage of granite waste addition of 10% and 20%, whereas waster absorption gets increased for the proportions of 30%, 40% and 50% of the granite waste additions. Normally there should be less water absorption for the bricks as per the Indian Standards.

**Table 3: Water absorption Test values**

Granite waste	0	10	20	30	40	50
Water absorption test (%)	10.81	10.61	11.11	11.68	11.79	11.66



**Figure 4: Water absorption Test**

**Efflorescence of Bricks:**

Efflorescence of bricks is determined to find the deposits of salt content present on the top layer of the brick or not. This examination is performed as per the process given in the IS code 3495-1992 part-3<sup>[4]</sup> and the outcomes are taken down in the table 4

**Table 4 Efflorescence Conditions of Bricks**

S.No	Granite Waste Addition In %	Efflorescence Condition
1	0%	Nil
2	10%	Nil
3	20%	Nil
4	30%	Nil
5	40%	Slight
6	50%	Slight

**Hardness Test for Bricks**

Hardness for the bricks is one of the parameter considered to know whether the brick is in good quality or not. To recognize the brick has a respectable character, hardness box is used for the bricks to know the severity of the bricks. Hardness range is determined for different proportions of granite waste addition in unsuitable brick soil. The following results are given in the table 5. Hardness value ranges are changing for the proportions of the bricks preparation. Hardness values increased for the proportions of 30%, 40% and 50% additions of granite waste with unsuitable brick soil.

**Table 5: Hardness Number Range for Bricks**

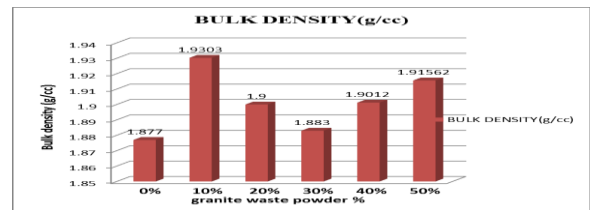
S.No	Granite waste addition in %	Hardness range
1	0%	3 to 4
2	10%	3 to 4
3	20%	4 to 5
4	30%	4 to 5
5	40%	4 to 5
6	50%	4 to 5

**Bulk Density for Bricks**

Bulk density of the sample is determined and the values are noted down in the table 6.

**Table 6: Bulk Density for Bricks**

Granite waste addition (%)	0	10	20	30	40	50
Bulk density	1.878	1.93	1.897	1.883	1.901	1.916



**Figure 5: Bulk Density for Bricks**

**Size, Shape and Color Test**

Size, shape and color for the 0% addition of granite waste powder are good in aspects. When size is considered, it is good at length wise, width wise and height wise while the shape is considered the bricks have the perfect shape for this proportion and color is red in color. Size, shape and color for the 10% and 20% additions of granite waste powder are good in aspects. When size is considered, it is good at length wise, width wise and height wise while the shape is considered the bricks have the perfect shape for this proportion and color is red. When the size, shape and color is considered for 30% it doesn't have good size and shape of the brick, but the color of the bricks are red in color. Size, shape and color for the 40% & 50% addition of granite waste powder are not safe in any aspects. When size is considered, it is not good at length wise, width wise and height wise while the shape considered for the bricks is irregular for this proportion and color is red in color.

**Soundness Test**

In this test, two bricks are taken with both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break, then those are good quality bricks. In this test, the bricks of 0%, 10%, 20%, & 30% of the bricks are giving clear metallic ringing sound and don't break. Thus the bricks of this proportion are good at soundness test. The remaining proportions of the bricks are not good at soundness, because it doesn't give clear ringing sound.

#### **Structure Test**

In this trial, a brick is broken or a broken brick is collected and closely watched. If there are any flaws, cracks or holes present on that broken face, then that isn't good quality brick. The structure of the 0% proportion of the granite waste addition is not good because it has flaws, cracks and holes present in the bricks. For 10% and 20% proportion of the granite waste addition in unsuitable soil has no flaws, cracks and holes in the bricks. So it is considered to be a good quality bricks. For 30%, 40% and 50% proportion of the granite waste addition in unsuitable soil has cracks and holes in the bricks. So it is not considered to be a good quality bricks.

#### **CONCLUSIONS**

In the present thesis, **Compressive Strength** of bricks increases gradually with increasing in percentage of granite waste powder additions in unsuitable soils up to 20% and gets reduced from 30% to 50% of granite waste addition. It was found that for 20% of granite waste powder additions in the unsuitable brick, soil gives the maximum intensity level for the bricks whereas the remaining percentage of proportions gives less strength as per IS 1077-1992 class designation.

By considering **water absorption test** for bricks, it is found that the waste absorption percentage is less for the bricks when the percentage of granite waste addition is from 0% to 20%. Usually the water absorption value shouldn't be more than 15% to 20% as per the IS 3495-1992 part -2. In this study, the water absorption doesn't increase more than 15%.

**Efflorescence** is one of the important parameters to be considered to cover whether the deposits of salts are available in the prepared bricks. In the present scenario, the efflorescence for bricks are nil for the proportions 0%, 10%, 20%, and 30%, i.e., the deposits of salts are not present in this percentage additions whereas for the 40% and 50% the efflorescence for bricks is slight some percentage of residues are present in the bricks.

**Hardness** range for the first proportions 0% and 10% are 3 to 4 and hardness range for the proportions 20%, 30%, 40% and 50% are 4 to 5. When there is an increase in granite waste powder there is an increase in hardness value. By considering the bulk density for the bricks, it is found that bulk density is more for 10% granite waste additions in unsuitable soil and less for the 0% and 20% additions of

granite waste in unsuitable brick soil. As per the IS 1077-1991.

**Size, Shape and Color** are good for the 0%, 10% & 20% additions of granite waste powder in unsuitable soil. When the size, shape and color is considered for 30% it doesn't have good size and shape of the brick, but the color of the bricks are red in color. Size, shape and color for the 40% & 50% addition of granite waste powder are not good in any aspects. It was found that soundness test for the bricks of 0%, 10%, 20%, & 30% of the bricks are giving clear metallic ringing sound and don't break whereas for the remaining proportions soundness is not clear and breaks.

**Structure** is one of the important parameters considered, in this test the structure of the 0% proportion of the granite waste addition is not good because it has flaws, cracks and holes present in the bricks. For 10% and 20% proportion of the granite waste addition in unsuitable soil has no flaws, cracks and holes in the bricks. So it is considered to be a good quality bricks. For 30%, 40% and 50% proportion of the granite waste addition in unsuitable soil has cracks and holes in the bricks. And then it is not believed to be a good quality bricks. By considering the above parameter results, it is found that compressive strength for brick is found to be more for 20% addition of granite waste in unsuitable soil, whereas for the other parameters considered, it is found that for 0%, 10% and 20% additions of granite waste in unsuitable soil is good in all aspects.

So, It is recommended that the preparation of Quality bricks can be done with 20% of granite waste addition in unsuitable brick soil as per the class designation given in IS code 1077-1992 and can be used for common building constructions. The present investigation comes under the class designation 3.5 to 5 where the average compressive strength of the bricks is 3.5 N/mm<sup>2</sup> to 5 N/mm<sup>2</sup>.

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