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EXPERIMENTAL INVESTIGATION OF SOLID BLOCKS BY ADDING GRANITE WASTE STEEL POWDER AND COAL POWDER.

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Abstract: A concrete block primarily used as a building material in the construction of walls is sometimes called a concrete masonry unit (CMU). A concrete block is one of the several precast concrete products used in construction. In use, concrete blocks are stacked one at a time and held together with fresh concrete mortar to form the desired length and height of the wall. The raw material of blocks commonly used to make concrete blocks is a mixture of powdered Portland cement, water, sand and gravel. The weight of a typical concrete block partially can be reduced by replacing its raw materials by waste products. This may decrease the cost and also reduce environmental pollution. Indonesia coal, waste iron dust and granite waste are used for replacing the cement. Coal is used for partial replacement of cement, granite waste is fully replaced by gravel and cement is replaced by superfast cement. In that combination, mix is automatically adjusted to compensate, the temperature, pressure and cycle times are all controlled and recorded manually to ensure that the blocks are cured properly in order to achieve their required strength.

Keywords: Powdered Portland cement, raw materials compressive strength, concrete block

1. INTRODUCTION

Precast Cement Concrete Block is a factory made product. It is possible to prepare well-made pre-cast products by keeping a high standard of finishing. Due to problem of pollution control and shortage of land for brick manufacturing, the precast concrete block construction is becoming very advantageous for building construction nowadays. Construction of concrete block will continue to evolve as architects and block manufactures develop new shapes and sizes. In this paper we have proposed an approach in which cement, sand, coarse aggregate and waste materials like caste iron waste, granite waste coal are used extensively as a partial replacement of cement. It increases the strength of the concrete. Cast iron dust is very well known to increase the strength of block. Granite waste is a by product from sizing process during granite activities.

1.1 Definition of Concrete Block

Concrete block which is also known as concrete masonry unit have advantages over brick and stone masonry. Concrete blocks are manufactured in required shape and size and these may be solid or hollow blocks. The common size of concrete blocks is 39cm×19cm×10cm. Cement, aggregate, water are used to prepare concrete blocks. The cement aggregate ratio in concrete blocks is 1:6. Aggregate used is of 60% fine aggregate and 40% coarse aggregate. Their minimum strength is about 3N/mm^2.

1.2 Types of concrete blocks

Depending upon the structure, shape, size, and manufacturing processes concrete blocks are mainly classified into two types:

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- Solid concrete blocks
- Hollow concrete blocks

These types of blocks are majorly used in construction and different varieties of blocks are prepared by using different materials. Each and every block is different from each other by the sizes.

1.3 Solid Concrete Blocks

Solid concrete blocks are commonly used, which are heavy in weight and manufactured from dense aggregate. They are very strong and provide good stability to the structures. Therefore, for load bearing walls these solid blocks are preferable. They are available in large sizes compared to bricks. So, it takes less time to construct concrete masonry than brick masonry.

1.4 Hollow Concrete Blocks

Hollow concrete blocks contain void area greater than 25% of gross area. Solid area of hollow bricks should be more than 50%.

2. METHODOLOGY

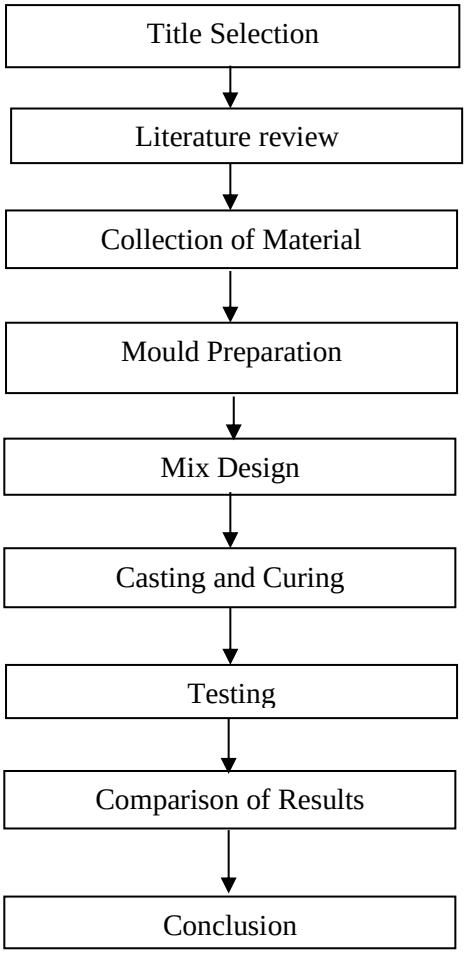

Figure 1. Flow of Methodology

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2.1 Material Investigation

In this approach waste materials were utilized to produce building blocks. The following materials were used in this investigation.

2.2 Mix Proportions

After all the ingredients were ready the mix is prepared in these investigation mixing done manually and also three mix proportion were used to find the suitable proportion. Table 1 gives the mix proportion of the components.

Table 1. Mix proportion of the components

Components	Components weight in one block
Cement	3 Kg
Coal powder	1.875 Kg
Aggregate chips	3.37 kg
Granite chips	3.5 kg
M-sand	2.08 kg
Iron dust	1.05 kg
Total weight(M3 BLOCK)	14.875kg

Mix Proportions for CGI Block

Table 2. Mix proportion for CGI block

Mix	Cement	Coal powder	M-sand	Iron dust	Aggregate chips	Granite chips
M1	2	1 .23	3	1.3	4	1.8
M2	2	1 .24	3	1.4	4	1.9
M1	2	1 .25	3	1.5	4	2

Mix Proportions for Block

Table 3. Mix proportion for block

Mix	Cement	Aggregate chip	M-sand
M1	4	8	3
M2	4	8	3
M3	4	8	3

3. STUDY OF UNIVERSAL TESTING MACHINE (UTM)

The universal testing machine is so named at it can test almost all the tests in the strength of materials laboratory except impact test on metals. The tests conducted in UTM are:

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1) Tension test
2) Bending and deflection test
3) Compression test
4) Shear test and
5) Hardness test

The UTM is available in different capacities viz., 100kN, 200kN, 400kN, 600kN, 1000kN, 2000kN, and 3000 kN

3.1 Compression Test on Concrete Blocks

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time.

Table 4. compressive load observation

Mix of Specimen	Compressive Load of Blocks In (Kn)			Compressive Strength in N/mm^2		
	7 days	14 days	28 days	7days	14 days	28 days
M1	182	231	263	6.1	7.4	8.5
M2	195	243	277	6.2	7.8	8.9
M3	206	258	301	6.6	8.3	9.7

Model Calculation:

Area of specimen =30967.68mm
Maximum compressive load of specimen =182
Compressive strength in N/mm^2 = load/area
$=231\times10^3/30967.68$
$=6.1$N/mm^2

Result

Maximum compressive strength of CGI blocks = 9.7 N/mm^2

3.2 Weight Test of Concrete Blocks:

Table 5. weight test observation

ORDINARY FIRST CLASS BRICK WEIGHT(kg)	CONCRETE BLOCK WEIGHT (kg)
3-3.5	14.01
3-3.5	14.6
3-3.5	14.87

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Result:
Average weight of blocks in compare then all bricks= 14.87kg.

Analysis of Test Results

After casting the concrete blocks, they were analyzed for using as a blocks. Various tests were carried out to check the properties of the blocks. The results of that test were analyzed with the existing and standard results. The following tests were carried out to check the concrete blocks.

3.3 Compression Test

This test was carried out by a universal testing machine (UTM). This test was carried out for the 7, 14 and 28 days from the date of casting. While testing the concrete blocks, great care must be taken, because concrete blocks never failed catastrophically, it just compressed like squeezing rubber. So load was applied up to full compression. When concrete blocks failed at the higher load, the structure was not fully collapsed.

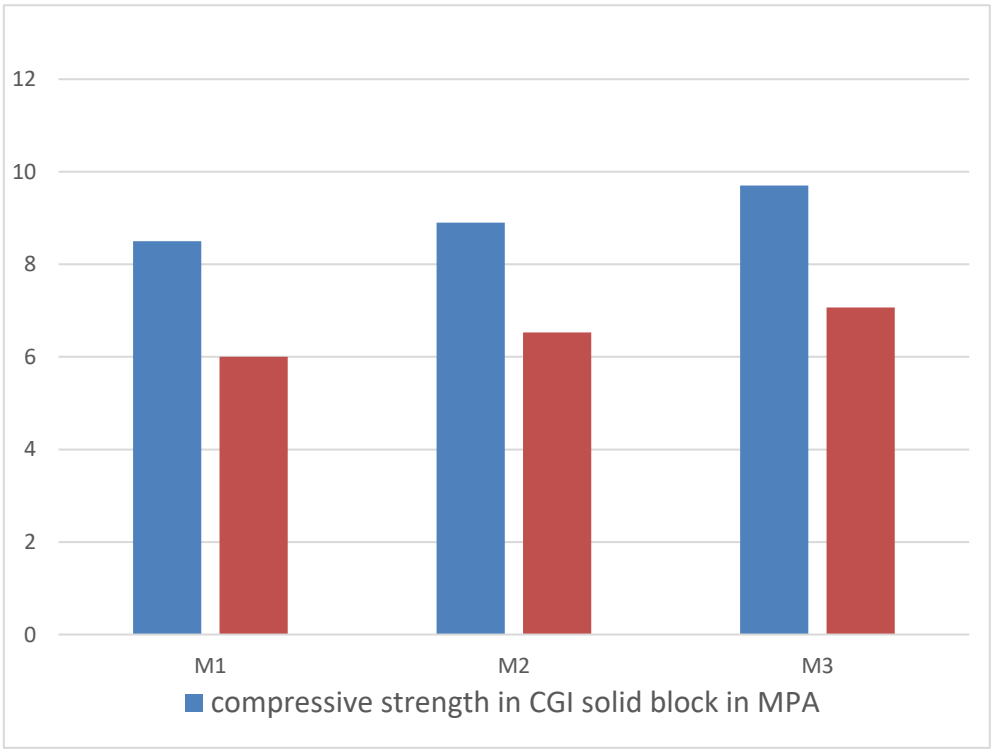

Figure 2. compression strength chart

3.4 Water Absorption Test

Water absorption test is used to find out the water absorption ratio. Because the blocks which are absorbing more water cannot be used in water logging area or exterior walls which is open to sky. The blocks from all the proportion were tested.

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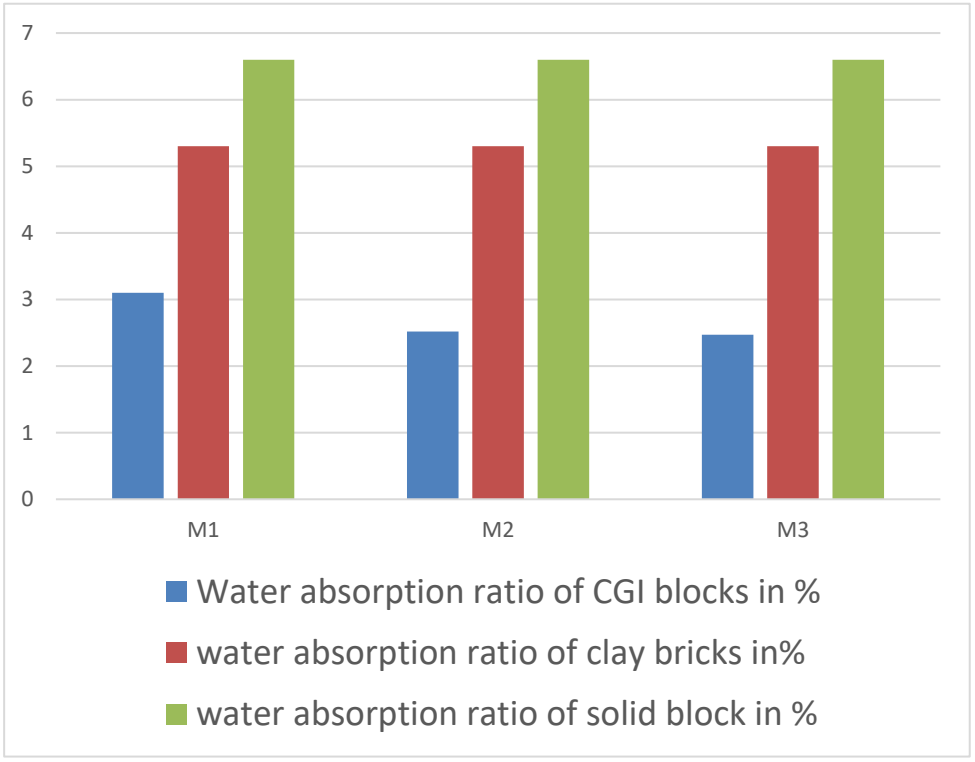

Figure 3. Water absorption ratio in %

3.5 Weight Test Of Concrete Blocks

Light weight blocks are also the important objectives of this project. So, all the blocks were tested whether they are having less weight or not. All the blocks were weighed in a well- conditioned electronic weighing machine.

Figure 4. weight test chart

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The ordinary convention blocks weight varies from 3 to 3.5 kg. but the concrete blocks weight varies from 8 to 9 kg and the maximum weight is less than 8kg only. In this above proportion concrete blocks based blocks are having 1/3 rd of the conventional blocks weight only. So these blocks are light weight and it will also reduce total cost of construction due to the reduction in dead load.

3.6 Cost Analysis

In this approach cost was calculated for all proportions. The cost of blocks is calculated by using the cost of materials. In this cost calculation we must consider the purchasing cost of the raw materials.

Details of purchasing cost

- Ramco cement - Rs.380/ bag-(Rs.7.60/kg)
- Coal ash - Rs.25/kg
- Aggregate chips - Rs.24/kg
- Granite chips - Rs. 7.50 /kg
- M-sand - Rs.5/kg
- Cast iron waste - Rs.8/kg

Table 6. Cost analysis of the purchased materials

Mix	Cement (Rs)	Coal Powder (Rs)	Aggregate Chips (Rs)	Granite Wastages (Rs)	M sand (Rs)	Cast iron Powder (Rs)	Cost of One block (Rs)
M1	1.2	2.4	3.67	0.8	5.6	1.33	15
M2	1.2	2.4	3.67	0.8	5.6	1.33	15
M3	1.2	2.4	3.67	0.8	5.6	1.33	15

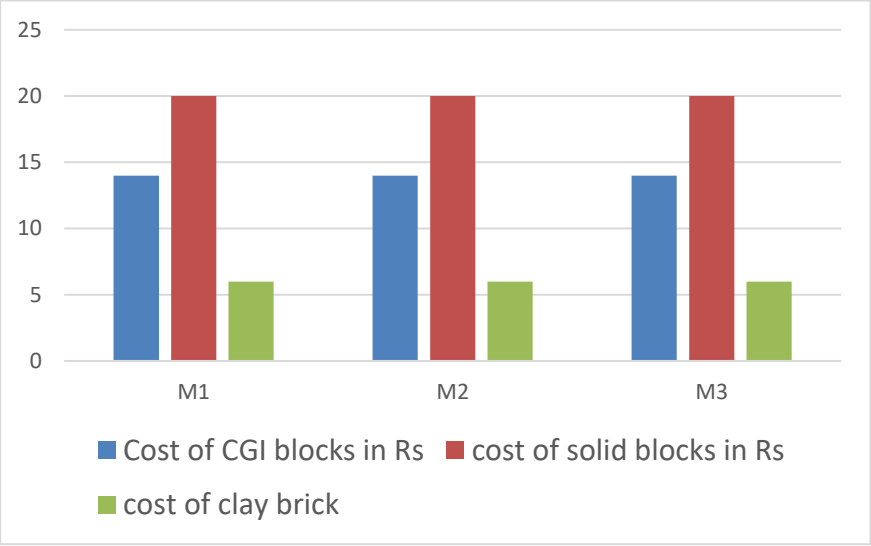

Figure 5. Cost analysis chart

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The cost of this concrete blocks is decided by the mix of materials on in the specimen. The volume of each material is converted in to kilogram and the cost analysis is derived by the purchasing cost of each raw material and the block design in volume analysis based in design of every mix proportions.

In this cost analysis M1 blocks costs only **Rs.15** for 1 block. But the rate of normal conventional block varies from **Rs.15** - **Rs.20**. So the rate of concrete block varies from 25% to 30% of conventional block. So, the total cost of the building will be reduced. M2 and M3 proportions are slightly high cost due to sand.

4. CONCLUSION

In the experimental investigation compare the block with super-fast cement, Granite waste, iron dust and coal are the replacement of cement, sand, Gravel gives better result than the normal block which increases compressive strength. Coal is the product to obtain durability and environmental benefits. CGI blocks are considered to be the economy in material and the consumption of by-product and waste material such as granite waste and cast iron waste. Compressive strength of CGI blocks comparatively more than the traditional clay brick. Among the papers that we studied half of them were light weight and other half were interlocking. Most of the people used glue instead of using mortar. EPS beads and fly ash are easily available so they can be used as lightweight material. Interlocking is not only effective in modern terms but in traditional way also. Use of interlocking concrete blocks the cost of labor is also negligible. With interlocking of concrete blocks we can improve the aesthetic view of building and also the failure at joint is reduced.

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