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# A Review Study on Different Properties ofHollow Concrete Blocks

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***Abstract*- These days concrete hollow blocks are very popular in the construction of various load bearing non-load bearing structures. In this paper, we discuss about the compressive strength of hollow blocks made in different mix proportions with different replacements. The main motive of this paper is to investigate the different properties of different hollow blocks made in different sizes, materials, proportions in the mix. In this study the result giving the difference in compressive strength with the replacement of fine and coarse-aggregate with waste materials like vermiculite, cement kiln dust, quarry dustetc.**

## INTRODUCTION

The basic requirement of human being is shelter. In ancient time human starts living in caves below ground level, after that they started constructing walls from mud, they developed the techniques of burnt clay brick masonry for making the structure part of the shelter.

Now days, hollow concrete blocks are being very popular in construction. These blocks are being mostly used in the construction of multi- storied buildings, factories and residential buildings. These concrete hollow blocks are commonly used in compound walls because of cheapness. These concrete hollow blocks are more useful due to its lightweight and the most important feature is ease of ventilation. The concrete hollow blocks are made out of mixture of cement, sand and stone chips. It reduces cement in masonry work and reduced the cost of construction.

The hollow concrete blocks found out due to different advantages-

1. Sound control
2. Small dead load
3. Resistance to fire
4. Adequatestrength
5. Superior thermal insulation
6. Economy
7. Highlydurable
8. Environmentally Ecofriendly
9. Reduction in mortarconsumption
10. Fast and Easier constructionsystem
11. Better Architecturalfeatures

The first Concrete block as a replacement for stone and wood in the building was used in the United States. The first concrete block house built up in 1837 on Staten Island in NewYork.

Harmon S. Palmer, designed first hollow concrete block in 1890. Palmer patented the design of hollow block in 1900 after 10 years of experimental research. Palmer's blocks were 8-inch(20.3cm)×10-inch(25.4cm)×30-inch(76.2cm) and they

were heavy in weight. These early hollow blocks were cast by hand and average output was about 10 blocks per hour. Now concrete blocks are manufacturing by automated process that can make up to 2000 blocks perhour.

The Compressive strength of masonry is one of the most important property in the design of masonry structure. This strength depends upon several factors such as unit strength, mortar strength, grouting, grout strength, geometry of the blocks, bedding mortar, and the type of bonding and bedding arrangements adopted. In extreme hot or cold climate countries these concrete blocks possessing low thermal conductivity and also serve as a thermal insulation material which minimize the energy consumption by minimizing the dependence on electricity for air conditioning or heating. In all countries, the different conventional materials are replacing to the concrete hollow blocks because most conventional materials cost is increasing. In the review study we found that hollow blocks of double- H shape gives more strength with semi-grouted masonry and low strength with fully groutedmasonry.

## I. LITERATURE REVIEW

H. S. Sureshchandra, G. Sarangapani, and B. G. Naresh Kumar(2014)[1] find out the compressive strength of hollow blocks with partial and full replacement of sand by quarry dust. After replacement he found that 50% replacement of sand gave high strength and 100% replacement of sand gave low strength.

Ernesto S. Fortes, Guilherme A. Parsekian, and Fernando S. Fonseca, A.M.(2014)[2] studied the compressive strength of un-grouted, grouted masonry and masonry units. This research work indicate an increase in the compressive strength of the masonry with increasing compressive strength of the units.

Liang Huang, Lejia Liao, Libo Yan, S.M. and Hongwei Yi(2014)[3] studied the compressive strength of double H concrete block masonry prisms under uni-axial compression. He discussed the effects of mortar strength, grouting and grout strength effect on compressive strength of the prism. The test result shows that the compressive strength of H block prism decreased with an increase of grouting and the ultimate load of the prisms increasedgreatly.

K. S. Al-Jabri, A. W. Hago,R.Taha, A. S. Alnuaimi and A. H. Al-Saidy(2009)[4] makes the block with waste materials: vermiculite and polystyrene which were used as light weight aggregates and cement kiln dust (CKD) which was the partial replacement for cement. The result shows that the light weight concrete blocks manufactured from polystyrenehad

low thermal conductivity than vermiculite and ordinary concrete blocks and the addition of up to 15% CKD as cement replacement gives a negligible effect on the strength. Denise S. Sanchez and Lisa R. Feldman(2014)[5] determined that calculated tensile resistance of the reinforcement was greater for bars that were in contact and furthermore is in sensitive to the magnitude of the transverse spacing provided in the case of noncontact lapsplices.

Thaniya Kaosol (2010)[6] has made study on the reuse of concrete waste as crushed stone for hollow concrete masonry units. The main objective was to increase the value of the concrete waste, to make a sustainable and profitable disposal alternative for the concrete waste. Attempts were made to utilize the concrete waste as crushed stones in the concrete mix to make hollow concrete blocks. Various percentages of crusted stones have been tried the amount (i.e. 0%, 10%, 20%, 50% and 100%). From the results they found concrete waste can used to produce hallow concrete block masonry units.

M.K. Maroliya(2012)[7] found that the crack patterns developed in the structural elements such as wall and the strength of wall constructed with hollow concrete block gives the less strength as compared to brick masonry but cost of construction is very less.

## II. MATERIALS

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

### *A. Cement*

Cement is the cementing material used in concrete hollow blocks. We can use ordinary Portland cement for manufacturing of concrete hollow blocks to find high strength. The primary function of cement is to bind the fine and coarse aggregate particles together. Today cement find the excess use in all types of construction works where high strength isrequired.

### *B. Coarse and Fine aggregates*

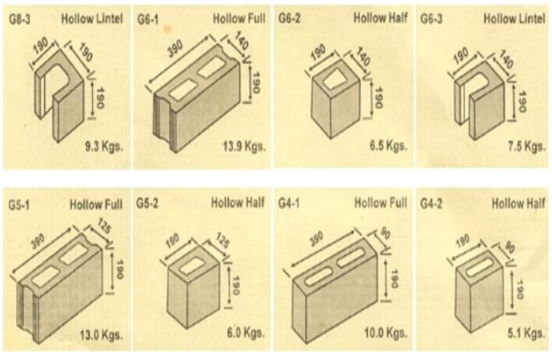
Mineral aggregates are normally divided into two types based on their particle size. Aggregate particles passing through the

4.7 mm Indian Standard sieve are known as fine aggregate and the particles retained on 4.7mm Indian Standard sieve are known as coarse aggregate. Natural sand is often used as fine aggregate in concrete mixture. Coarse aggregates are crushed stone chips made by the crushing stone boulders. Crushed stone particle sizes passing through the 4.7 mm sieve may also be used as fine aggregate. The maximum size of the coarse aggregate that may be used in concrete hollow blocks is 12.5 mm. It should be noted that the particle size must be upto 1/3 thickness of thinnest web of the hollow concrete blocks

### *C. Quarrydust*

The quarry dust is the by-product of granite stones which can produced when stones broken down into the coarse aggregates of different sizes. This dust is the partial or full replacement of sand in the manufacturing of hollow concrete blocks.

### *D.*



*Vermiculite*

Vermiculite is a natural mineral that expands with the application of heat. It is a platy structure similar to that of mica and is found in many countries like South Africa, China, Brazil and several other countries. Vermiculite can expand up to30 times of its original volume by exfoliation of thin plates when heated to temperatures of650to1000˚C.

### *E. Cement Kiln Dust(CKD)*

Cement kiln dust is a byproduct of cement produced cement kiln by the dry process. It is generated during the calcining process in the kiln and also known as cement bypass dust. When the raw materials are heated, dust particles are produced in the kiln and then carried out with the exhaust gases at the upper end of the kiln. These gases are cooled and dust particles are collected by efficient dust collectionsystem

## III. QUALITYSPECIFICATION

As per the Indian Standard specification, a hollow block is defined as the block having one or more large holes of cavities which pass through the block and having solid material between 50 and 75 percent of the total volume of block calculated from the overall dimension. All the different types of cement concrete hollow and rigid bricks are covered by Bureau of Indian Standard (BIS) specification mentioned below:

### *F. Shape andsize*

Table 1 Size and weight of different hollow blocks

| Ref No. | Description | Sizes in (cms) | Approx Weight in Kgs. |
|---|---|---|---|
| G4-1 | Hollow Full | 39 x09 x 19 | 10.0 |
| G4-2 | Hollow Half | 19 x 09 x 19 | 5.1 |
| G5-1 | Hollow Full | 39 x 12.5 x 19 | 13.0 |
| G5-2 | Hollow Half | 19 x 12.5 x 19 | 6.3 |
| G6-1 | Hollow Full | 39 x 14 x 19 | 13.9 |
| G6-2 | Hollow Half | 19 x 14 x 19 | 6.5 |
| G6-3 | Half Lintel | 19 x 14 x19 | 7.5 |
| G8-1 | Hollow Full | 39 x 19 x 19 | 16.7 |
| G8-2 | Hollow Half | 19 x 19 x19 | 8.8 |
| G8-3 | Half Lintel | 19 x19 x 19 | 9.3 |
| G8-8 | Hollow Full | 40 x 20 x 20 | 17.6 |
| G9-1 | Hollow Full | 39 x 23 x 19 | 28.4 |
| G10-1 | Floor Slab | 50x20x12.5 | 18.00 |

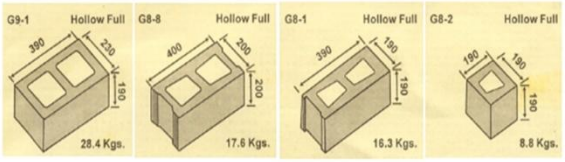



Fig. 1 Different shapes of hollow blocks

The maximum variation in the dimensions shall not be + 1.5 mm for height and breadth and + 300mm length. The size other than those mentioned above may also be used by mutual agreement between the purchaser and manufacturers/suppliers.

*G. Cavities*

The total width of the cavity in a block right angle to the face of the block as laid in wall (i.e. the bedding surface will be at right angles to the face of the block shall not exceed 65% of the total breadth of the block.

*H. ShellThickness*

The shell thickness of blocks shall not be less than 40 mm.

*I. Joints*

The end of the blocks, which form the vertical joints, may be plain rectangle and grooved or double grooved.

*J. Density*

The block density hollow concrete block shall not be more than 1600 kg/cubic meter of gross volume.

*K. Drying Shrinkage*

The drying shrinkage of average of three blocks shall not exceed 0.004 per cent.

*L. Moisturecontents*

The moisture content of the dried blocks on being immersed in water shall not exceed 0.03 %.

*M. WaterAbsorption*

*The water absorption shall not exceed 10% by weight.*

## IV. COMPRESSIVE STRENGTHTEST

Each block was first dried, weighed, and placed between the platens of a compression testing machine. Soft wood plates were placed beneath and on the top of the block separating it from the platens of the machine. The load was applied in small increments until failure, and the failure load of the block was recorded. The stress at failure was calculated using the gross area of the block normal to theload

## V. COMPARISON OFCOMPRESSIVE STRENGTH

Below table is giving the comparison of compressive strength of the hollow blocks with the size of 20cm×20cm×20cm which are constructed by different mix proportions. Some replacement also take place like vermiculite with aggregate, CKD with cement and quarry dust with sand.

Table 2 Compressive strength with different mix proportions

| Size (cm) | Mix Ratio | Material replacement | % | Strength (MPa) |
|---|---|---|---|---|
| 20×20×40 | 1:2:0.5 | | 0 | 28 |
| 20×20×40 | 1:2:0.5 | Vermiculite with aggregate | 30 | 14.1 |
| 20×20×40 | 1:2:0.5 | | 0 | 10 |
| 20×20×40 | 1:2:0.5 | CKD with cement | 5 | 15 |
| 20×20×40 | 1:2:0.5 | CKD with cement | 10 | 10.6 |
| 20×20×40 | 1:3:6 | | 0 | 2.25 |
| 20×20×40 | 1:4:0 | | 0 | 1.9 |
| 40×20×20 | 1:3:6 | | 0 | 3.69 |
| 40×20×20 | 1:3:6 | Quarry Dust with sand | 50 | 6.03 |
| 40×20×20 | 1:3:6 | Quarry Dust with sand | 100 | 5.78 |

## VI. CONCLUSION

The hollow concrete blocks of size 20×20×40 cm made with ratio 1:2:0.5 gives the best compressive strength 28 MPa the concrete hollow blocks of size 20×20×40 with vermiculite as partial replacement of aggregate gives just half compressive strength which is some time objectionable but not objectionable when use in non load bearing structures. The use of waste such as vermiculite, cement kiln dust and quarry dust makes the environment as pollution free and it reduces the cost of construction of hollow blocks which is beneficial for manufacturer and consumers. Many companies' faces more challenges in the disposal of these wastes, so the use of these waste reduces the disposal of the wastes and saving agricultural land from these wastes.

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