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Load Carrying Capacity of Hollow Concrete Block Masonry Column

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Abstract—*Stability plays an important role but Economy of structure is one of the basic aspect upon which any design is based however, best designer is one who comes out with a design which gives the stable and economic structure .the development of construction technology is closely related to the development of adequate mechanization and handling technology. Hollow concrete block is an important addition to the types of masonry units available to the builder and its use for masonry is a constantly increases. This project is a study of construction of hollow concrete block masonry, Columns constructed with hollow concrete blocks, and to the load carrying capacity of the hollow concrete block individually and when used in the masonry work, by comparing the work with brick masonry this will help builders to appreciate the essential constructional details and adopt hollow concrete block masonry in a large scale wherever it is economical.*

Key words—*masonry, hollow concrete block, strength of masonry*

I. INTRODUCTION

Shelter is one of the three basic requirements of human being. Initially ancient man started living in caves excavated below ground level on near the hill ends .thereafter, they started constructing walls from mud, and in due course of time, the developed the techniques of burnt clay brick masonry to form the structural part of the shelter.

The desire for search of new structural materials paved the way for hollow concrete blocks due to following advantages

1. Adequate strength and structural stability.
2. Superior thermal insulation and acoustic characteristics.
3. Sound control.
4. Resistance to fire.
5. Light weight.
6. Speedy work.
7. Economy

Building construction is a multi disciplined technology. It involves an exchange of thoughts, experience and ideas among those engaged in the various disciplined of the construction activity in order to achieve overall economy and proper serviceability of the construction project at hand. It should also make use of innovative methods in the field of material technology by the use of improved materials resulting in the production of economical, aesthetically acceptable and durable structure.

The resistance to any change comes not only from the artisans and makers but even from engineers, contractors, owners and public in general. It is a human attitude of unwillingness to come out of a well established route.

The modern recommended practice is to dispense with several ‘on the spot’ operations and replace them with the manufactured materials. That site operation are often left to workers who do not have the skills to the desirable extent and cannot be adequately supervised, resulting in such work often being sheddy and expensive. Economical and efficient construction techniques demand excellent micro-planning, determining as to which of the building materials should be manufactured on a mass scale, setting out and promoting such manufacturing facilities and popularizing their use.

The development of construction technology is closely related to the development of adequate mechanization and handling technology, the latter involves both the provisions of equipment as well as the handling dexterity.

Hollow concrete block is an important addition to the types of masonry units available to the builders and its use for masonry a constant increases, some of the advantages of hollow concrete block construction are

reduced mortar consumption, light weight and greater speed of masonry work. Work compared with brick masonry. Since may builders are yet to become familiar with the use of hollow concrete blocks, this will help them to appreciate the essential constructional details and adopt hollow concrete block masonry in a large scale wherever it is economical.

II. EXPERIMENTAL PROGRAM

This project is a study of construction of hollow concrete block masonry. The emphasis in the present study is given to study the crack patterns developed in the structural elements like columns constructed with hollow concrete blocks, and to the load carrying capacity of the hollow concrete block individually and when used in the masonry work.

There different columns of size of cross sectional area 400 x 400 mm and 1.8 meter height were also tested in the compression testing machine. All the three columns were constructed by joining the blocks with mortar 1:3. One column was kept hollow inside, one was made solid by filling mortar of 1:3 proportion cement concrete.

It was noted that the strength of the hollow column is increased significantly when it was made solid by filling the hollow portion by cement-sand, mortar. But putting mortar inside the hollow portion by soil, which is easily available and is not a cost influencing factor, the strength of the hollow columns can be increased by them solid, thus making them economical also.

The hollow concrete blocks are tested in compression testing machine. The bearing surfaces of the compression testing machine are wiped clean and any dry loose or other materials are removed. The hollow concrete blocks taken out from the curing and are allowed to dry for 24 hours in open air. The dimensions of the hollow blocks are measured to the nearest 0.2 mm and their weighs are noted before testing.

The two surfaces of each block that would normally be placed horizontally in the wall are termed as faces. The load is applied in these bed faces. The axis of the bed face is carefully aligned with the centre of spherically seated plate. No packing is used between the faces of the test specimen and the steel plate of the testing machine. As the spherically seated block is brought to bear on the specimen, the movable portion is rotated gently by hand so that uniform seating may be obtained. The load is applied without shock and increased continuously at a rate of approximately 140 kg/sq.cm/min until the resistance of hollow concrete blocks to the increasing load breaks down and greater load can be sustained. The load applied to block and any unusual features in the type and failure are noted. The maximum load in kilograms supported by the block before failure on square centimeter will be taken as the compressive strength of the block. The mean of the compressive strength of the three blocks will be taken as the compressive strength of batch compressive strength less than 75% of the mean value so obtained.

Mortar should be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of one centimeter thickness. Normally full mortar bedding should be adopted as it enables fuller utilization of the load carrying capacity of the blocks. But where the walls carry right loads such as panel walls in framed structure face shell bedding may be used. In this type of bedding the mortar is spread only over the front and rear shells and not the web which helps to arrest the seepage of water through the joints penetrating to the interior surface of the walls

For vertical joints the mortar should be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or to the next unit to be laid along with to be laid alongside of it. But it will more convenient to apply mortar in the edges of the succeeding unit when it is standing vertically and then placing it horizontally well pressed against the previously laid unit however whatever the method used for applying mortar care must be taken to produced well compacted vertical joints. In the case of two cell blocks there is a slight depression on their vertical sides which may also be filled up with mortar where it is considered necessary to secure greater lateral rigidity.

Mortar should not be spread so much a head of the actual laying of the units that it tends to stiffen and lose its plasticity thereby resulting in poor bond. For most of the work the joints both horizontal and vertical should be one centimeter thick. Expect in the case of extruded joint construction the mortar should be raked out from the joint with a trowel to a depth of about one centimeter as each course is laid so as to ensure good bond for the plaster.

When the mortar has stiffened somewhat it should be firmly compacted with a jointing tool. This compaction is important since mortar while hardening has a tendency to shrink slightly and thus pull away from the edges of the blocks.

III. RESULTS AND DISCUSSION

The basic objective of present study is to know the load bearing capacity of the hollow concrete blocks when used in the construction of columns and other such elements in any construction project. Beside this, the crack pattern at initial and final failure is also of importance. So in the present study, to have an idea of the load

carrying capacity and cracks pattern the hollow concrete blocks manufactured already at site were used for the construction of structure.

The hollow concrete blocks were tested in the compression testing machine. A number of blocks were tested and then by knowing the load carrying of capacity of a single unit **(Table 1.0)** we constructed different types of columns. While constructing the column special care was taken to see that the concrete block unit used in a particular structure is of consistent strength. Because in the hand operating machines this is one of measure disadvantage than we don't get the hollow concrete blocks of consistent strength. Before starting the actual construction the question arose that where and how could we apply the compressive force to the structure that we test for present study. Because the height of the structure that we wanted to test was 1.8 m and it was really a puzzling task to construct the structure at a place in the laboratory then to shift it to the compression testing machine without giving any jerk or vibration to the structure.

TABLE:1.0 COMRESSIVE STRENGTH OF HOLLOW BLOCK

Sr no.	Size of hollow concrete block	Average compressive load of 10 reading	Stress in N/mm^2 on net area
1.	400 X 200 X 200	9.0	2.2
2.	200 X 200 X 200	10.0	8.8

For the column of the size 0.4 x 0.4 x 1.8 m the concrete plate casted was of dimension 0.6 x 0.6 x 0.1 m.

The plates were casted simultaneously and then allowed to cure for 28 days so as to get the enough strength of plates. After the plates got cured the structures were constructed on it.

One column of dimension 0.4 x 0.4 x 1.8 m kept complete hollow inside and mortar proportion of cement and sand was 1:3. One column of dimension 0.4 x 0.4 x 1.8 m was filled inside by the mortar proportion 1:3 i. e. cement & fine aggregate proportion. The mortar for joining the different block units was also 1:3 ratios. The last column was filled with reinforced cement concrete. The steel placed inside was 8 mm – 4 no. of the bars. The four bars were bounded by putting stirrups in each layer of the block unit. For the concreting inside, the grit of size taken was less than 20 mm.

While concreting the structures columns special care were taken to ensure that the erection of those structures are completely vertical and aligned. The horizontal alignment was checked by the spirit level while the vertical alignment was ensured with the help of plumb bob. For joining each unit properly with the other the mortar is placed in between then in proper quantity. For joining each layer with the other layer of blocks the mortar placed in between the layers was kept in proper quantity. Usually a mortar layer of 10 mm is placed in between the two layers to ensure the proper bonding between the layers. The blocks were placed so as to get the staggered joint. For this in each alternate layer the outer block placed were a single hollow block of size 20 x20 x 20 cm in the wall. While no such concrete block was needed for the column. In the column in each alternate layer two concrete hollow blocks were placed perpendicular to the previous layer thus forming the staggered joint instead of one complete vertical joint.

After constructing the structure the outer face of the joint were filled by the mortar so as to get the smooth flatter face of the structure. By this way joint strength is also increased by achieving compacted joints. After the complete construction is finished the structure is cured for 14 days. For curing the structure is always kept in wet condition. After the structure is cured and achieved enough strength those were tested on the compression testing machine.

Fig.1.0 experimental set up for column testing

IV. CONCLUSION:-

The hollow concrete blocks of sizes 400 x 200 x 200 mm made with the concrete grade 1:3:6 proportion gives the average compressive strength of 11.25 kg/cm2 considering the gross area. Considering the net cross sectional area the hollow concrete blocks of size 400 x 200 x 200 mm made with the concrete grade 1:3:6 proportion gives the average compressive strength of 22kg/cm2. The hollow concrete blocks of size 200 x 200 x 200 mm made with the concrete grade 1:3:6 proportion gives the average compressive strength of 45 kg/cm2 considering the gross area and 87.8 kg/cm2 considering the net cross sectional area.

The cost of hollow concrete block size 400 x 200 x 200 mm made with concrete grade 1:3:6 proportions is Rs. 9/-. When the admixture is mixes, the cost increases by 2% approximately. The cost of hollow concrete block of size 400 x 200 x 200mm made with concrete grade 1:2:4 proportions and 1:4:8 proportions are respectively Rs. 10.80/- and Rs. 8.10/-.

Hollow column of size 400 x 400 mm and 1.8 meter height made with mortar 1:3 proportion gives the compressive stress of 10.3kg/cm2 at initial cracks and 10.6kg/cm2 at ultimate failure or final cracks considering the gross cross sectional area. Considering the net cross sectional are these values are 20.1 kg/cm2 and 20.7 kg/cm2 respectively.

Solid column of size 400 x 400mm and 1.8 meter height made with 1:3 mortar proportion and filled inside with the 1:3 mortar gives the compressive and filled cracks and final cracks 2 kg/cm2 and 33 kg/cm2 respectively.

Solid column of size 400 x 400mm and 1.7 meter height made with 1:3 mortar proportion and filled inside by reinforced cement concrete gives the compressive stress of 35.9 kg/cm2 and 36.9kg/cm2 respectively at initial cracks and ultimate or final cracks.

It is seen that in the strength of the wall the mortar used in wall construction does not play vital role as strength in all the three sets of walls are nearly same or these values are not varying in a significant values. Also introduction of steel in the column does not affect the strength of the column and solid column made with mortar are almost or nearly same.

The cost of the hollow concrete block of size 400 x 200 x200 made with concrete grade 1:3:6 proportions come to Rs. 9/- when calculated theoretically. This value comes to Rs.10.00/- when calculated practically. Means the way the manufacture calculates it comes to Rs. 10.00/-

Though the strength of column constructed with hollow concrete blocks give the less strength as compared to brick masonry. But the cost of wall constructed with hollow concrete blocks is very much less than that of brick masonry. As the cost of brick wall of width 0.23 meter per square meter without plaster is equal to Rs. 143/-. With plaster the cost of this wall per squares meter is Rs. 221/-. The cost of hollow concrete wall of width 0.2 meter per square meter without plaster is equal to Rs. 135.5/-. With plaster the cost of this wall per square meter is Rs. 179.5/-. Hence the hollow concrete wall is more economical and speedy.

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