Comparative Analysis of R.C.C. Structure using CLC Blocks with Burnt Clay Bricks

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Abstract— A building can be defined as an enclosed structure intended for human occupancy. Constructions work can be seen in almost all the developing countries. With the increases in material cost in the construction work, there is a need to find more cost saving alternatives so as to maintain the cost of construction houses , multi storey etc, which can be affordable to people. In the manufacturing of burnt clay bricks, smoke evolved at a great extent and also some toxic gases which can harm an environment. So as to overcome with all these problem, Cellular lightweight concrete blocks are used which is more economical and eco-friendly. So as to overcome with all these problem cellular lightweight concrete blocks are used which is more economical and eco-friendly because the energy required for the production of cellular light weight concrete blocks is only a fraction as compared to the production of burnt clay bricks and emits no pollutants and creates no toxic products. Cellular light weight concrete blocks are light in weight which contain mixture of cement, potable water, Fly ash, and foaming agent. This project presents analysis and comparison of building for G+12 residential building by using Cellular lightweight concrete blocks at the replacement of burnt clay bricks. Analysis has been carried out by using burnt clay bricks and Cellular lightweight concrete blocks for different densities. Overall modelling and analysis is done by using STAAD- Pro software. By using cellular lightweight concrete blocks the overall cost of construction is reduce and it will be safe and economical in earthquake forces also.

Keywords: Cellular Lightweight Blocks (CLC Blocks), Burnt Clay Bricks, Autoclaved Aerated Concrete Blocks (AAC), Construction Cost, Eco-Friendly

I. INTRODUCTION

A building can be defined as an enclosed structure intended for human occupancy. Among the building materials brick plays an important role in the building. Bricks can be of different types such as burnt clay bricks, cellular light weight concrete blocks, autoclave aerated concrete blocks etc. In the manufacturing of burnt clay bricks, smoke evolved at a great extent and also some toxic gases which can harm an environment. Therefore brick which is used in this project is cellular light weight concrete blocks (CLC blocks) of different densities and the main focus is on Grade B density i.e. 800kg/m^3. The cellular lightweight concrete block is a certified green building material, which can be used for commercial, industrial and residential construction. The density of cellular light weight concrete blocks are less as compared to conventional burnt clay bricks and it is porous, non-toxic, reusable, renewable and recycled. Therefore cellular lightweight concrete blocks are used in the high rise residential building at the replacement of the conventional burnt clay bricks. And the comparison has been made between cellular light weight concrete blocks building and the conventional burnt clay bricks building. Due to lightweight of these blocks dead load will act on the structure is less, therefore the structure became lighter. If the structure will be lighter than there will be reduction in the reinforcement, reduction in the size of the member and also by using these blocks there will be no use of coarse sand for the plastering purpose. And the building should be constructed in a most economical way. In this system will compare R.C.C. structure and light weight R.C.C. structure by using alternative building materials such as burnt clay bricks and cellular lightweight concrete blocks of different grades. Detailed analysis and design of a building has been done by computer aided analysis software i.e.(STAAD-pro) where cost estimating will be carried out using MS-Excel programming.

II. CELLULAR LIGHTWEIGHT CONCRETE BLOCKS

Cellular lightweight concrete blocks are produced by initially making slurry of cement + fly ash + water which is further mixed with a foaming agent in an ordinary concrete. By using cellular lightweight concrete blocks the dead load of the building or structure has reduce, therefore the reinforcement in the building is reduced to a great extent. Based on the trial mixes, it is found that compressive strength of CLC blocks is more than the compressive strength of conventional clay bricks.

The addition of foam to the concrete mixture creates millions of tiny voids or cells in the material, hence the name Cellular concrete. Cellular lightweight concrete blocks are using in the structure than there will be no need of coarse sand plastering on the walls of the building. And it require less time and less manpower in the construction, therefore the construction of the building can be done in a more economical way as compare to the conventional red bricks.

A. Classifications

The cellular lightweight concrete blocks can be classified in several different ways. These are following:

1) Grade A:
These grade of blocks are used for load bearing units and have a block density in the range of 1200 kg/m3 to 1800kg/m3.

2) Grade B:
These grade of blocks are used for non-load bearing units and have a block density in the range of 800kg/m3 to 1000kg/m3.

3) Grade C:
These grade of blocks are used for providing thermal insulation and have a block density in the range of 400kg/m3 to 600kg/m3.

B. Physical Properties

- Light weight: The blocks which are used having a density of 800kg/m3 as compared to conventional red bricks

having density of 1900 kg/m3. Therefore having light weight.

- Earthquake Resistant: The blocks are lighter than burnt clay bricks so the lightness of its material increases resistance against earthquake as well as less damage.
- Water absorption: Blocks products are closed cellular structure and hence have lower water absorption as compare to burnt clay bricks.
- Workability: Due to its lightweight it can be easily handle.
- Environment friendly: Blocks products are manufactured with fly ash 100 % recycled resources therefore it is eco-friendly.

C. Material & Block Dimension

1) Cement:

The cement used in all mixtures is commercially available Portland cement of 53 grade confirming to IS12269:1987 is used. The specific gravity of cement is 3.15.

2) Water:

The water used in the manufacture of CLC blocks is potable water whose pH value lies from 6.5 to 8.5.

3) Fly Ash:

Fly ash, the bye product in thermal power plants is used. Fly ash conforming to IS3812 (part-1) is used and uniform blending of fly ash with cement is ensured.

The nominal dimensions of the CLC blocks are as follows:-

4) Length:

400,500 or 600 mm

5) Height:

200, 250 or 300 mm Width: 100, 150, 200 or 250 mm

6) Foaming Agent:

The suppressions holding foaming agent must be kept air tight and under the temperatures not exceeding 25 degree centigrade. There are several foaming agents such as Neopor, Profo etc.

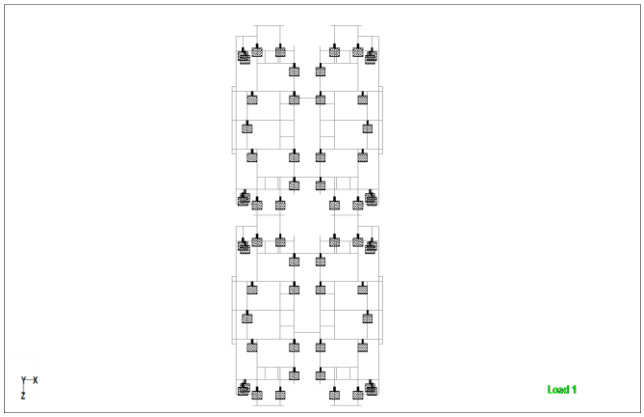
Comparison between the properties of CLC blocks of Grade B and burnt clay bricks

S.No.	Parameters	Burnt Clay Bricks	CLC Bricks
1.	Basic Raw Material	Agricultural soil, coal	Cement, Fly ash, Foaming agent
2.	Density (kg/m3)	1900-2100	800
3.	Compressive strength(kg/cm2)	30	35
4.	Thermal Conductivity	Better	Very good
5.	Water absorption (%)	20 %	12.5 % for 800 kg/m3 density
6.	Aging	NO	Gains strength with age
7.	Labor requirement	100 %	50 % of normal brick
8.	Ease in working	Normal	Very easy
9.	Weight of bricks(kg)	12 (for three bricks)	9.6 (for single block)
10.	Eco-Friendliness	-Process creates smoke, - Uses high energy for firing, -Agricultural soil is wasted	Pollution free Least energy requirement - Consume fly ash which is waste from thermal power plant - Uses no agricultural soil

III. MODELLING OF A BUILDING

A G+12 residential building is analysis by using STAAD.PRO software for different types of loading such as dead load, live load, earthquake load, wind load , combinations of load etc.

Model of a G+12 residential building with structural plan and elevation



IV. RESULTS AND DISCUSSION

The pre-existing building G+12 has been analyses and design by different types of bricks, such as Cellular lightweight concrete blocks with different grades and burnt clay bricks. After the analyses and design, the observation has been made seen that as the density of bricks changes there will be changes in the area of reinforcement of column, beam, footing. Therefore the area of reinforcement id directly proportional to the density of bricks

A. Comparison of Reinforcement in Column

The given below is the bar chart between the total weight of reinforcement of whole column of the building with respect to the different types of bricks. The chart shows that the when burnt clay bricks are using in the structure than the design of the building is heavy as compared to the cellular light weight concrete blocks of different grade.

So to make building in a more economical way, the cellular light weight concrete blocks of Grade B with density of 800 kg/m3 can be use at the replacement of burnt clay bricks. By using these grade of block in the structure approximately 25660 kg of reinforcement can be save in column.

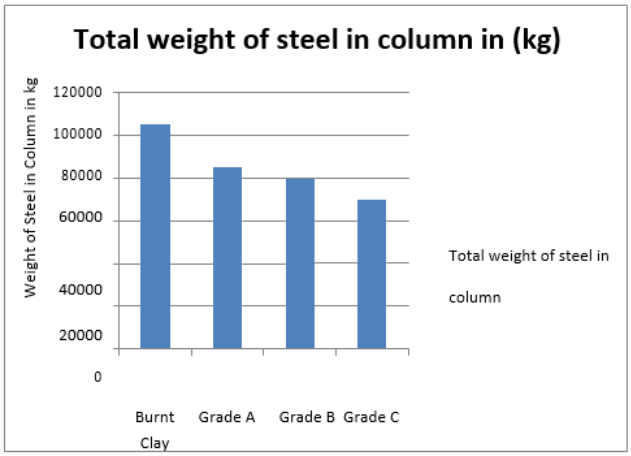


Fig. 5.1: Bar chart shows the total weight of reinforcement in column in (Kg)

B. Comparison of Reinforcement in Beam

The comparison has been made for the total weight of reinforcement in the beam with respect to the cellular light weight concrete blocks of different grade of blocks. Similarly, by using cellular lightweight concrete blocks of Grade B density of 800kg/m^3 on the replacement of burnt clay bricks approximately 10620 kg of reinforcement can be save in the beam. Hence, given below is the bar chart shows the comparison.

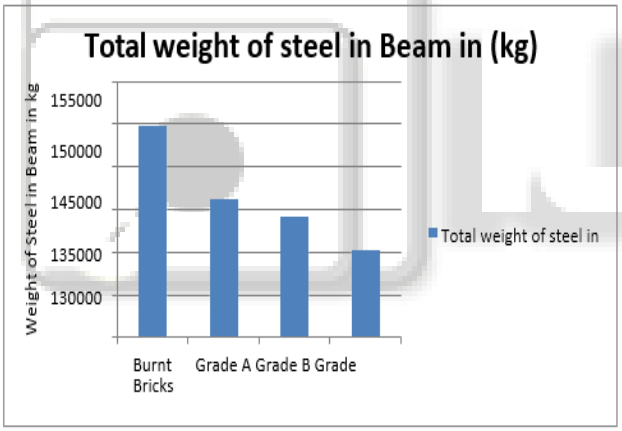


Fig. 5.2: Bar chart shows the total weight of reinforcement in Beam in (Kg)

C. Comparison of Total Reinforcement

The reinforcement in the beam and column which is save on the project by using Cellular light weight concrete blocks of Grade B density i.e. 800kg/m^3 is 36280 kg. Also in the raft foundation the total reinforcement has been save by using cellular light weight bricks is 9000 kg. So the total reinforcement which is save in the project is 45280 kg. By this the building can be built in an economical way as compared to the existing structure.

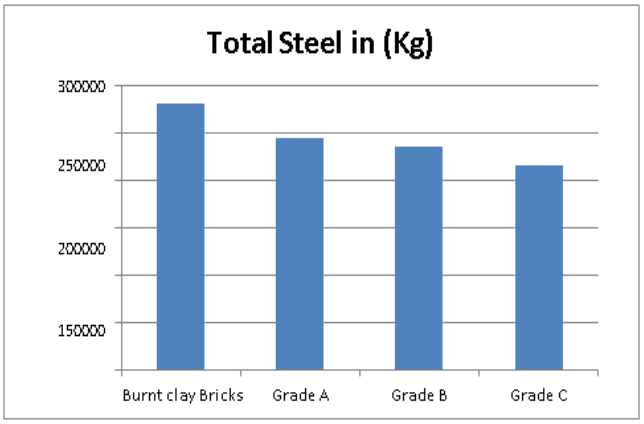


Fig. 5.3: Bar chart shows the total weight reinforcement in (Kg)

From the above graph we will observed that the overall steel for a building by using burnt clay bricks is greater as compare to the cellular lightweight concrete block of density grade B . In Cellular lightweight concrete blocks there will be an approximately 16% overall steel is reduced as compare to burnt clay bricks.

D. Comparison of Coarse Sand and Concrete

When CLC blocks of Grade B are using in the structure at the replacement of burnt clay bricks then there will be no need of coarse sand for the purpose of plaster. Therefore by this approximately 2730 m^3 of coarse sand can be save. And this is shown below by the help of bar chart (Fig.).

The size of the member also reduced to a great extent due to the lightweight concrete blocks. Therefore the quantity of concrete is reduced approximately 358 m^3. Also 175 m^3 of concrete has been saved in the raft foundation. So the overall concrete has been save in the project is 533 m^3. And this can be shown below by the help of bar chart (Fig.).

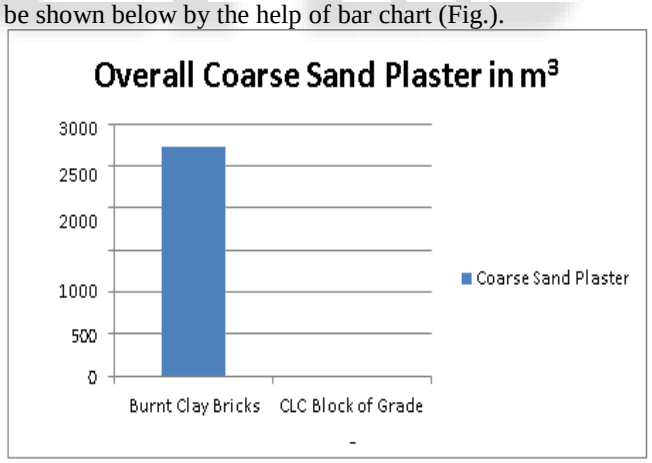


Fig. 5.4: Bar chart shows the total coarse sand (m^3)

From the above graph we will observed that the overall coarse sand for a building by using burnt clay bricks is greater as compare to the cellular lightweight concrete block of density grade B . In Cellular lightweight concrete blocks there will be a 0% coarse sand or can say there is no need of coarse sand as compared to burnt clay bricks.

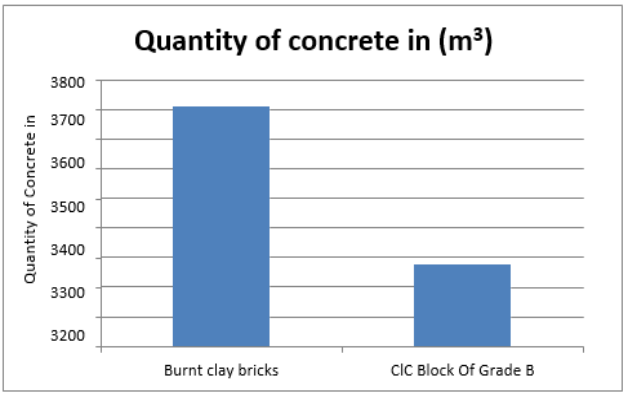


Fig. 5.5: Bar chart shows the total quantity of concrete in (m^3)

From the above graph we will observed that the overall Concrete for a building by using burnt clay bricks is greater as compare to the cellular lightweight concrete block of density Grade B .

In Cellular lightweight concrete blocks there will be an approximately 14.3 % overall concrete is reduced as compare to burnt clay bricks.

E. Comparison of Cement due to Coarse Sand Plaster

When CLC blocks of Grade B are using in the structure at the replacement of burnt clay bricks then there will be no need of coarse sand for the purpose of plaster. Therefore by this approximately 2730 m^3 of coarse sand can be save. When there is no need of coarse sand in cellular lightweight concrete block for plaster than approximately 16380 cements of bag can be save in the entire projects.

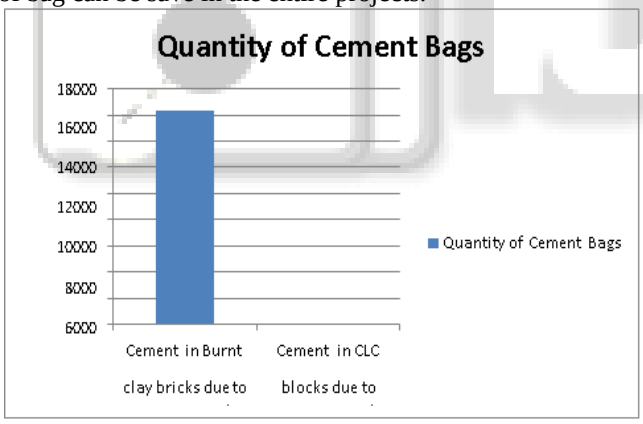


Fig. 5.6: Bar chart shows the total quantity of cement of bags

From the above graph we will observed that the overall Cement , when there is no use of coarse sand , for a building by using burnt clay bricks is greater as compare to the cellular lightweight concrete block of density Grade B . In Cellular lightweight concrete blocks there will be an approximately 16380 cement of bags is reduced as compare to burnt clay bricks

F. Total Cost Comparison of the Structure

The total cost of the superstructure when using burnt clay bricks is Rs.71248250 or approximately Rs. 71250000/- and the total cost of the superstructure by using cellular light weight concrete blocks is Rs.59062540 or approximately Rs.59100000/-.

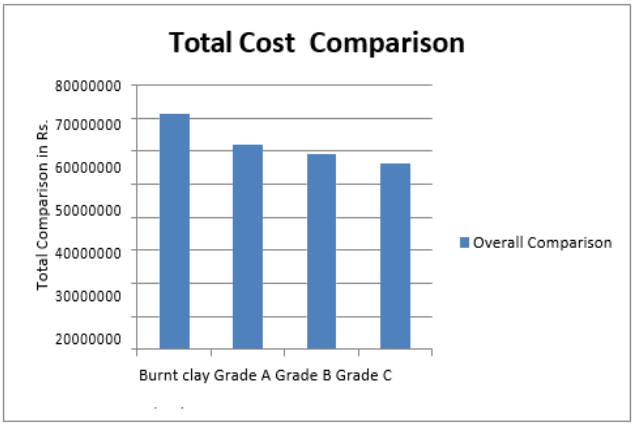


Fig. 5.7: Bar chart shows the total cost comparison in (Rs.)

From the above graph following observations has been seen that the overall cost for a building by using burnt clay bricks is greater as compare to the Cellular light weight concrete blocks. In Cellular light weight concrete block there will be a 17.15% overall cost is reduced as compare to burnt clay bricks in present.

Hence by using Cellular light weight concrete block there will be a less carbon emission in the environment and also by using light weight block in a construction is economical and time saving.

V. CONCLUSIONS

- The surface of the cellular light weight concrete blocks is well finished so there will be no use of coarse sand for plaster. Hence the coarse sand is not applying on the wall for the plastering so there will be saving of cement approx.16380 cement of bags in present.
- The size of the members of the structure has been reduces due to use of cellular light weight concrete blocks in comparison of burnt clay bricks.
- As the sizes of the members reduces therefore the quantity of concrete is reduces approx. 14.3% of the overall concrete.
- As per the observation the reinforcement in the structure is reduce an approximately 16 % of the overall reinforcement in present.
- Total cost of the superstructure loaded with burnt clay bricks is Rs.71250000 and for cellular light weight concrete blocks is Rs.59100000 which is less as compare to the burnt clay bricks. In Cellular light weight concrete block there will be a 17.15% overall cost is reduced as compare to burnt clay bricks in present.
- Hence Cellular light weight concrete blocks masonry was found to be economical as compared to conventional burnt clay bricks.
- Due to reduction of concrete consumption and steel consumption carbon foot prints are reduced.

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