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Brick masonry and hollow concrete block masonry a comparative study

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Abstract:

The fundamental necessities of any architectural framework encompass economic viability and stability. An exemplary designer is one who formulates a design yielding a stable and cost-effective structure. This paper delves into an examination of hollow concrete block masonry, conducting a comparative analysis in relation to brick masonry construction. Parameters such as strength, economic efficiency, lightweight attributes, and insulation properties are thoroughly investigated and juxtaposed. While the strength of a hollow concrete block masonry wall may be inferior to that of a brick masonry wall, the construction cost of the former is significantly lower

Keywords:

Masonry with Bricks, Compressive Strength, Economic Efficiency, Hollow Concrete Blocks, Insulation Properties.

1. Introduction:

The fundamental human need for survival in the world is encapsulated in the concept of shelter. As human civilization evolved, the imperative for shelter, primarily for safety, became evident. In ancient times, shelter often took the form of caves or structures excavated below ground or under overhanging mountain cliffs, offering protection from environmental extremes. During this period, structural considerations of stability and safety were secondary concerns. However, as human intellect developed, there was a shift towards modifying the structural composition of shelters to meet the growing needs and amenities associated with an optimal design.

Having initially utilized readily available materials like mud for constructing walls and later employing burnt clay brick masonry as a structural element, there remained a quest for the best possible structural material ensuring stability and safety of shelter constructions while also being economically viable. The exploration for a secure and stable structural material, considering the overall economy of the structure, led to the adoption of hollow concrete blocks in masonry, primarily due to the following advantages:

1. **Thermal Insulation:** Possesses a dual characteristic of maintaining a cool environment in summer and warmth in winter.
2. **Sound Insulation:** Effectively reduces external noise disturbances.
3. **Adequate Strength and Structural Stability:** Provides the necessary strength and stability for structural integrity.
4. **Highly Durable:** Exhibits long-lasting durability.
5. **Fire Resistant:** Offers resistance to fire.
6. **Economy:** Economical in terms of construction cost.
7. **Low Maintenance:** Free from efflorescence-related issues.
8. **Environmentally Eco-Friendly:** Constituents can be substituted with waste products like fly ash, promoting environmental sustainability.
9. **Reduction in Mortar Consumption:** Efficient use of mortar.
10. **Fast and Easier Construction System:** Facilitates quicker and more straightforward construction processes.
11. **Better Architectural Features:** Enhances the architectural aspects of the structure.

The hollow concrete block emerges as a valuable addition to the array of masonry units

available to Designers and engineers. Its increasing use in masonry construction can be attributed to the multitude of advantages outlined above. Despite this, a lack of awareness regarding the utilization of hollow concrete blocks persists. This research aims to bridge this gap, empowering engineers and builders to embrace hollow concrete block masonry construction on a large scale wherever it proves to be economically viable.

2. Materials used:

1. Cement Throughout the project, Ordinary Portland cement, graded at 43, in compliance with IS 8112:1989, was utilized.
2. Sand The project exclusively utilized plain river sand, with a maximum particle size of 4.75mm, adhering to zone II specifications as per IS 383-1970. The sand exhibited a specific gravity of 2.6.
3. Hollow Concrete Blocks Walls were constructed using hollow concrete blocks, available in two sizes: (16x8x8) inches and (8x8x8) inches. Refer for an illustration of the hollow concrete block units.
4. Bricks Class B Bricks, in a modular size of (22.5x10x7.5) cm, were employed in the construction process.

Mortar For wall masonry, a cement-sand mortar mixture with a ratio of 1:4 was prepared following the standard procedures outlined in IS: 3535-1986.

3. Experimental investigation:

1. Testing of Individual Hollow Concrete Block and Brick Units Individual hollow concrete blocks, conforming to IS : 2185-1984 (Part 3) [5], and Class B brick units, meeting IS : 1077-1986[6], IS : 2180-1985[7], and IS : 2222-1979[8], underwent compression testing using a compressive testing machine.
2. Testing of Mortar Mortar blocks of size (15x15) cm were cast and tested after 28 days, adhering to IS: 4031 (Part 1)[9].
3. Procedure for Construction of Walls Girders were positioned side by side with their flanges serving as the base for the walls. Mortar was applied on the girders to create a uniform and level base. Walls were constructed per IS code recommendations using 1 cm

thick mortar, resulting in four hollow concrete block masonry walls and four brick masonry walls.

4. **Testing of Walls after 7 days of curing**, testing was conducted after 28 days. The testing setup involved a rail section covering the top of the wall, a centrally placed jack, and a proving ring for load measurement. The mode of failure was observed by gradually increasing the load.
5. **Factor of Safety** The factor of safety for each wall was calculated as the observed load divided by the permissible load.
6. **Lightweight Character** The average dry weight of hollow concrete block units was compared with that of brick units in the same volume, and the difference in weights was measured.

4. Results and discussion:

1. **Testing of Individual Hollow Concrete Block and Brick Units** Individual units were compression- tested, resulting in average compressive strengths of 34.99 Kg/cm² and 28.05 Kg/cm² for hollow concrete blocks of sizes (16"x8x8") and (8"x8x8"), respectively. The average compressive strength of individual brick units was 113.33 Kg/cm².
2. **Testing of Mortar** Mortar blocks exhibited a compressive strength of 28 days conforming to IS 4031 (Part I)[12].
3. **Testing of Walls** After construction, curing, and 28 days, four hollow concrete block masonry walls and four brick masonry walls were tested for compression. Strength values and geometrical parameters are detailed in Table 3.
4. **Factor of Safety** The factor of safety for each wall sample was determined. Hollow block walls demonstrated the highest factor of safety, while brick walls with Flemish bond exhibited the lowest.
5. **Lightweight Character** Hollow concrete block masonry was found to be heavier than brick masonry **Economy** The cost of block walls per cubic meter of hollow concrete masonry was 17.78% less than that of brick walls, indicating the economic superiority of block masonry over brick masonry.

5. Conclusion:

Based on the obtained results, the following conclusions can be drawn:

The compressive strength of brick units and brick masonry walls surpassed that of hollow concrete block units and hollow concrete wall masonry.

Hollow concrete masonry exhibits superior sound insulation properties compared to brick masonry.

The thermal insulation property of hollow concrete masonry is higher than that of brick masonry, attributed to the presence of air in hollow concrete units.

The cost of block walls per cubic meter of masonry is 17.78% less than that of brick walls, establishing block masonry as more economical.

Maintenance costs of hollow concrete block masonry are lower than brick masonry due to efflorescence in brick masonry walls.

Hollow concrete block masonry is environmentally eco-friendly, as constituents in hollow concrete block units can be substituted with waste products like fly ash.

Hollow concrete block masonry presents a more aesthetically pleasing architectural view compared to brick masonry.

Hollow concrete masonry construction offers a faster construction system than brick masonry construction.

Hollow concrete block masonry consumes less mortar than brick masonry, as the volume of joints is lower.

In brick masonry wall failures, cracks typically form along one side face throughout the height of the wall. In hollow block masonry, failure occurs by the crushing of the top layer only.

The factor of safety for hollow concrete block masonry is higher than that for brick masonry.

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