COST EFFECTIVENESS OF USING AAC BLOCKS FOR BUILDING CONSTRUCTION IN RESIDENTIAL BUILDING AND PUBLIC BUILDINGS

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Abstract

Red bricks are one of the most pre-eminant construction material used for construction. The carbon dioxide emissions in the brick manufacturing process has been certified as a relevant factor to global warming. Therefore, it becomes necessary to focus more on pursuing environmental solutions for greener environment. To fulfill this objective, new construction materials can be used for construction. One such material i.e., AAC blocks can be used as an alternative material for construction. This paper highlights the comparative statistical analysis of cost effectiveness of using AAC blocks instead of traditional red bricks. The use of AAC blocks gives an eventual solution to the construction industry about the environmental related issues. In this study, an attempt has been made to replace the burnt clay red bricks with the autoclave aerated concrete blocks. The different types of tests were performed to determine various properties of AAC blocks as compared to others. The 6" and 9" thick wall building were designed using Staad pro software and the cost calculation for different component parts of the building were carried out. From the experimental results, it is observed that the compressive strength of AAC block is comparatively more than traditional bricks and the density of AAC block is comparatively less which helps in reducing the dead load of structure. It is found that upto 15 to 20% , the cost of construction can be reduced by using AAC blocks.

Keywords: *Brick, AAC Blocks, Brick, Cost-Effectiveness, Material,* XTRALITE

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1. INTRODUCTION

Bricks are one of the most important building materials used for the construction. Brick is a building material which is used to make walls, pavements and other elements in construction. The continuation use of clay bricks In construction industry is leading to the extensive loss of fertile top soil which could be a devastating environmental hazard. It is causing a number of environmental and health problems. Within the reach of a brick kiln, environmental pollution from brick-making operations is injurious to human health, animals and plant life. Environmental pollution from brick manufacturing process contributes to the global warming and climatic change. The weather may cause degradation of the brick surface due to frost damage is leading to global warming which is now a global concern. To reduce environmental pollution and global warming problems, various types of blocks can be used as an alternative to the red bricks. AAC blocks may be one of the solutions as a replacement to clay bricks. AAC blocks are a relatively new phenomenon in Indian construction industry. In spite of drastic growth in manufacturing of AAC, the real fact is that market share of AAC is very small as compared to the red bricks. Autoclaved Aerated Concrete (AAC) blocks are made of fly ash, aluminium powder and water. The manufacturing process of AAC blocks does not cause any environmental problems. Autoclaved Aerated Concrete (AAC) blocks are smooth and almost eight times bigger than the red bricks and are lighter than the normal red clay bricks. The bricks are of typical size. They do not have much strength as compared to aerated concrete blocks. the larger size of AAC blocks leads to faster masonry works and reduces the cost of the project. AAC has an excellent property which makes it an excellent insulator i.e. the interior environment is easier to maintain. Autoclaved Aerated Concrete (AAC) blocks have light weight, high strength, good durability, heat preservation, sound insulation, fire proofing, impervious, good anchoring properties. Autoclaved Aerated Concrete (AAC) is a certified green building materials, which is porous, non-toxic, reusable, renewable and recyclable can be used for commercial, industrial and residential construction.

2. MATERIALS AND METHODOLOGY

For this study, XTRALITE AAC block for various tests were used. It is a lightweight aerated autoclaved concrete (AAC) block. It is ideal for huge construction. As it is lighter in weight than standard size red clay bricks, it is suitable for the construction of multistoried structures. It is a very thin jointing material used for laying AAC blocks, fly ash bicks etc. During the process of manufacturing AAC blocks, there is a reaction of aluminum on a proportionate blend of lime, cement and fly ash. During this process, the

hydrogen gas that escapes creates millions of tiny air cells, which makes it a strong cellular structure which is then strengthened by a high pressure steam curing in autoclaves. The product thus formed is not only lightweight but also has higher compressive strength. These blocks are available in many varieties of sizes such as 600mm x 200mm x 75 to 300mm i.e. from 3" to 12." Using this material, various studies and tests was carried out. As a case study for this research work, typical building plan of institutional building is considered. To precede the study following work was carried out in sequence. AAC blocks, traditional bricks and other required materials were procured from market. Various engineering properties of traditional bricks and AAC blocks were tested in laboratory. Then, comparative study of AAC block masonry with traditional brick masonry was carried out in which various aspects such as size, weight, density, workability, water absorption, moisture content, curing behaviors, mortar requirement, quantity requirement, plaster requirement, time require for construction, finishing alternatives, structural behavior, strength and stability, etc were compared. For such comparison, building plans were selected and structural design of the building using Staad pro software was carried out in which traditional bricks were used. Again for same building, Structural Design of the building using Staad pro software was carried out in which AAC block was used. For quantity and cost comparison, detailed estimate was prepared for both above design. From the data prepared in structural design and estimate, cost effectiveness of different items of work was compared.

3. ANALYTICAL STUDY

The comparative study of AAC block masonry, RCC frame structure systematic analytical study was carried out. For this, different types of buildings such as 1BHK, 2BHK, 3BHK, hospital, market, school, industrial – shed were undertaken. For the building, double line plan was prepared considering traditional 9" wall thick wall. For comparative study same building plan was used considering AAC block for wall having 6" wall thickness. Developed plan and centre line plan of 9 inch thick wall and 6 inch thick wall for both building was prepared in AutoCAD 2008 software. From developed plan of 9 inch thick wall and 6 inch thick wall, carpet area was calculated. Centre line plan of 9 inch thick wall and 6 inch thick wall thick wall building was used in STAAD Pro v 8.1 for making structural analysis of building. Same procedure was carried out for structural analysis of both the building. Fixed support was given to all columns after that member property was given to beam and column and then loading was given to complete building from Indian standard code.

4. RESULT AND DISCUSSION

The cost of savings of AAC with respect to bricks for buildings such as 1BHK, 2BHK, 3BHK are shown in chart -1

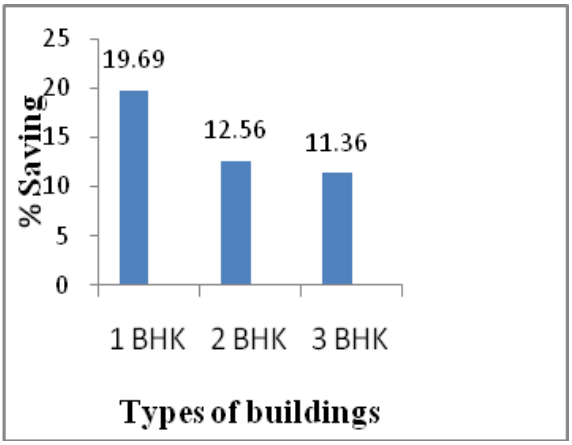

Chart -1 Comparison of cost of AAC Block

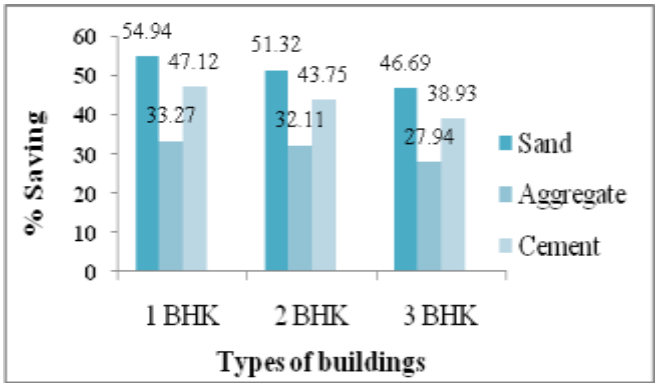

Chart -2 Comparison of cost of sand, aggregate and cement

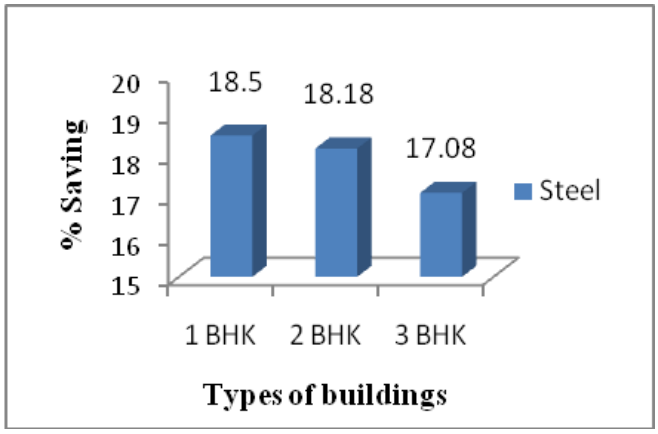

Chart -3 Comparison of cost of steel

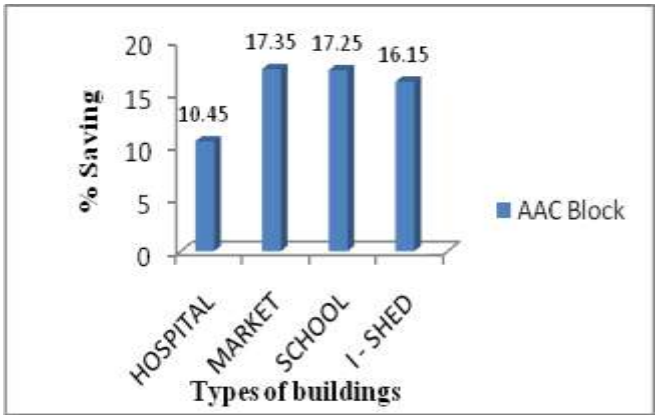

Chart -4 Comparison of cost of AAC Block

From above graph it is seen that as number of room increases built-up area of residential building also increases in such case the cost of saving in AAC decreases which is minimum about 14.5%.

The cost of savings of sand, aggregate, cement for buildings such as 1BHK, 2BHK, 3BHK are shown in chart -2
From above graph it is seen that as the built-up area increases, the cost of saving in sand decreases. Average saving in cost of sand is 50.98%. Also it is seen that as built up area is increasing cost of consumption of aggregate is almost constant for residential buildings. Average saving in cost of aggregate is about 31.11%. Similarly, the cost of saving in cement decreases with increase in built up area, which is about 43.27%. Thus The average saving in total cost of materials for residential building is about 41.8%. The cost of savings in steel for buildings such as 1BHK, 2BHK, 3BHK are shown in chart -3 above. From this graph it is seen that as the built-up area increases, there is reduction in cost of steel where average % saving in cost of steel is about 17.9%. The cost of savings of AAC with respect to bricks for buildings such as hospital, market, school and industrial shed are shown in chart -4. From the above graph it is seen that for public building such as hospital, shopping complex, school building and industrial shed, the average cost saving for AAC block is about 15.3%. The cost of savings of cement, aggregate and cement for buildings such as hospital, market, school and industrial shed are shown in chart -5. For public building, the average cost saving for sand is about 55.66%. The average cost saving for aggregate is about 36.27% and the average cost saving for cement is about 47.21%. It show that when AAC block is used instead of traditional bricks there is total cost saving in material for public building is about 46.3%. It proves that building structures designed using AAC blocks are more cost effective as compared with building structure designed with traditional brick.

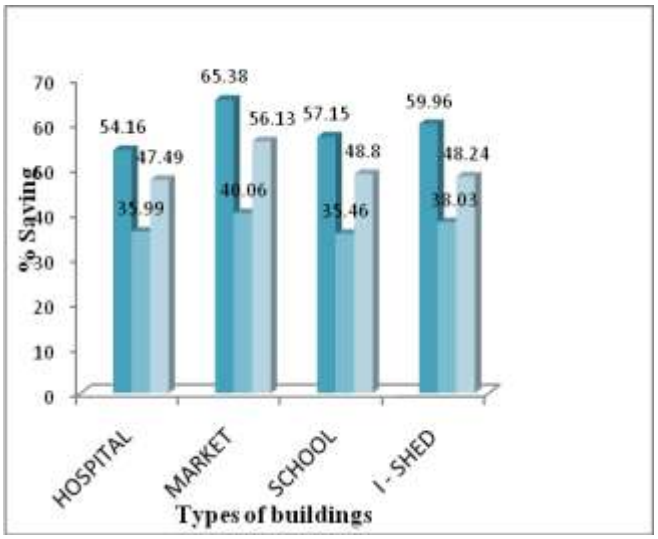

Chart -5 Comparison of cost of sand, aggregate and cement

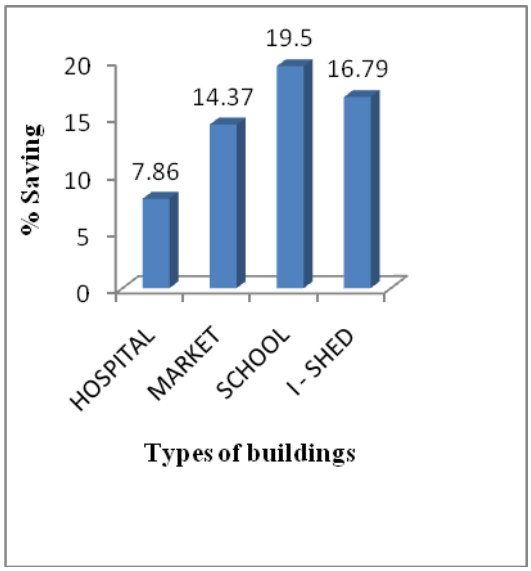

Chart -6 Comparison of cost of steel

The cost of savings of cement, aggregate and cement for buildings such as hospital, market, school and industrial shed are shown in chart -6. From above graph is it seen that for public building such as hospital, shopping complex, school building and industrial shed, the average cost saving for steel is about 14.63% which is less than saving in residential building, it is because, in public building, room sizes are more and beam span are larger which optimizes the requirement of steel for various RCC elements.

6. CONCLUSIONS

From above results and discussion, following conclusions are drawn regarding cost effectiveness of using AAC block for building construction

i) For residential building, as number of room increases, built-up area also increases and the cost of saving in AAC decreases which is minimum about 14.5%. Similarly, the cost of saving in cement decreases with increase in built up area, which is about 43.27%.
ii) For residential building, as the built-up area increases, there is reduction in cost of steel where average % saving in cost of steel is about 17.9%.
iii) For public building the average cost saving for steel is about 14.63% which is less than saving in residential building, it is because of in public building room sizes are more and beam span are larger which optimizes the requirement of steel for various RCC elements.
iv) The savings in cost of AAC blocks for different types of buildings is 14.78%.
v) The savings in cost of materials such as sand, aggregate and cement for different types of buildings is 41.7%.
vi) The savings in cost of steel for different types of buildings is 17.2% as reduction of dead load of wall on beam makes comparatively lighter members.
vii) The overall saving in cost of construction for different types of buildings is 20.99%.
viii) The savings per sq m in built-up area for residential building is about 0.11%, for public building is about 0.04% .

ix) The increase in carpet area for various types of buildings is 4.3% when the width of wall is 6 inch thick as compared to 9 inch thick wall.
x) Cost of construction reduces by maximum up to 20 % as reduction of dead load of wall on beam makes comparatively lighter members.

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