Comparative Study of Self Interlocking Masonry Block by Using Recycled Aggregate with Brick Masonry

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Abstract **- The Construction is one of the significant sectors of Indian economy and is an integral part of the development. Today India's urban population is the second largest in the world and its future development leads to increased demand for housing to cope with this problem India should desperately need to plan for acquisition of land and rapid creation of dwelling units. Construction is a complex process involving basically the areas of Architectural planning, Engineering and Construction. There is growing realization today that speed of construction needs to be given greater importance especially for large housing projects. This is not only essential for the faster turnover of equipment and investment leading possible to the reduction in the housing cost but also for achieving the national objective of creating a large stock to overcome shortest possible time. Fortunately, some of the advanced technologies catering to faster speed of construction are already available in the country. For e.g. Prefabrication, autoclaved blocks, tunnel formwork, aluminum formwork of construction etc.**

Index Terms **- Cost effectiveness, Time effectiveness, Quality control, Quantity parameter.**

I.INTRODUCTION

The blocks which are locked against each other without use of cement mortar to form a structurally stable wall that reduces the cost and time of construction to almost half.

At present there is a high demand for houses in India which is finding difficult to be fulfilled by builders and contractors adopting relatively slow construction practices leading to high construction cost.

Thus, there is demand for products which can reduce construction cost and also increase the speed of construction without compromising quality and safety.

Without compromising the quality and safety, the reduction in construction cost and speeding up the construction progress can be achieved by variety of ways, but we are concentrating on partitioning materials as partitioning of the space within the framed buildings is one of the major activities in the context of material requirement, speed & cost. Partitioning unit is costing around 40 to 45 % of the total construction cost. A fast & cost-effective alternative to conventional masonry used in partitioning work in buildings will be a great boon to the construction fraternity.

So, through this project we are attempting to develop a product named "Self-Interlocking Blocks". It will be used in partitioning the space in framed buildings. It will not demand mortar for construction & plastering to conventional extent. It will reduce the material & labour cost of partitioning of space and will speed up the construction.

1.1 Background

- Self-Interlocking Block technique is applicable for multistorey buildings same way as for standard masonry construction.
- SIB can be used for retaining walls, Foundation Walls, Partition Walls, compound wall and bearing walls up to certain height.

1.2 Objectives

- To study construction demolition waste and its application for making masonry blocks.
- Use of recycled concrete aggregate (RCA) for casting Self Interlocking Blocks thus reducing the cost involve in materials for making blocks.
- Casting of Self interlocking Block.
- To compare self-Interlocking Block Masonry with Conventional masonry.

- To study financial feasibility.

II. THEROTICAL CONTENT

I. Masonry

Masonry is a construction of building units bonded together with mortar. The selection of the type of material i.e. brick or stone etc. for the masonry is made keeping in view the requirement of strength, waterproofing, thermal insulation, fire resistance, durability and economy.

Masonry is basically a wall material. Masonry walls can be divided into following three categories-

1. Load bearing walls

A wall designed to carry superimposed loads from floors and roof is termed as load bearing wall. Such walls have continuous foundation to carry the entire superimposed load including their self-weight.

2. Non-Load Bearing Walls

Also known as panel wall, curtain wall or filler wall is a type of wall which carries no superimposed load. It is provided to serve as a screen for privacy and to keep out wind and weather. The load from floors and roofs in this case is borne by either brick piers or by system of RCC or steel beam and column frames.

3. Retaining Wall

This is type of wall built to resist the pressure of earth, granular material or liquid field behind it after it is built. Depending upon type of material used, masonry can be broadly divided in the following categories-

II. Brick masonry

Construction of brick units bonded together with mortar is termed as brick masonry. The strength of the brickwork primarily depends upon quality and the strength of the brick, the type of mortar and method of bonding, adopted in construction. In addition, the strength of brick wall is also dependent upon its slenderness ratio, lateral pressure due to wind and degree of soundness in construction. Mortar not only acts as a cementing material but also impart strength to the work by holding the individual brick together to act as a homogeneous mass. Mortar is usually a mixture of cement and sand or lime and sand or a mixture of three.

Bricks can be divided into two types

Traditional Bricks- Its dimension varies from 21 to 25cm in length, 10 to 13cm in width and 7.5 cm in height in different parts of the country. The commonly adopted nominal size of traditional brick is 23x11.4x7.6cm.

Modular Brick- With a view to achieve manufacture of uniform size of bricks all over the country IS institution has established a standard size for the brick such a brick known as Modular brick. The nominal size of modular brick is taken as 20x10x10cm whereas its actual dimensions are 19cmx9cmx9cm.

III. TEST ON MATERIALS

A. Tests on Cement

The following are the quality tests commonly used on cement:

Table No. 1 -Test on cement

Sr. No.	Test on cement	IS code referred
1.	Color Test	Field Test
2.	Float Test	Field Test
3.	Presence of Lumps	Field Test
4.	Fineness Test	IS: 4031-Part 1 1988
5.	Soundness Test	IS: 4031-Part 3 1988
7.	Compressive Strength	IS: 4031-Part 6 1988
8.	Initial Setting Time	IS 4031-Part 5 1988
9.	Final Setting Time	IS: 4031-Part 6 1988

B. Test on aggregates

The following testsare commonly performed on Aggregates:

Table No. 2 - Test on aggregates

Sr.No.	Test on aggregate	IS code
1.	Aggregate Crushing Value Test	IS 2386 PartIV-1963
2.	Flakiness Index and Elongation Index	IS 2386 PartI-1963
3.	Abrasion Test	IS 2386 PartIV-1963
4.	Aggregate impact test	IS 2386 PartIV-1963
5.	Specific Gravity and Water Absorption Tests	IS 2386 PartIII-1963

C. Tests on recycled aggregates

The following tests performed on Recycled Aggregates:

Table No. 3 -Test on RCA

Sr.No.	Test on recycled aggregates	IS code
1.	Specific gravity of recycled coarse aggregate	IS: 2386 part III-1963

2.	Water Absorption of recycled coarse aggregate	IS : 2386 part III-1963

IV. COST ANALYSIS OF BRICK MASONRY AND SIB FOR 1 CU.M VOLUME

A- Brick masonry

a. Summary

- Total volume – 1 cum.
- Materials – Bricks, Cement, Crush Sand
- Nominal size of brick – 0.2m x 0.1m x 0.1m = 0.002 Cum
- Standard size of brick – 0.19m x 0.09m x 0.09m = 0.001539 Cum

b. Materials quantities -

- No. of bricks for 1 Cum = 1 / 0.002 = 500 no's
- Add 5 % wastage = 5 / 100 x 500 = 25 no's
- Total no. of bricks = 525
- Mortar quantity = 1 – (Total bricks volume) = 1-(500 x 0.001539) = 0.2305 Cum
- Assume ratio of cement sand as 1:6 for mortar
- So, total cement quantity = 0.2305 / 7 = 0.0329 Cum = 30 x 0.0329 = 0.988 ≈ 1 bag
- Total quantity of crushed sand = 0.0329 x 6 / 2.83 = 0.0698 brass (1 Brass = 2.83 Cum)

c. Material cost-

- Bricks – 525 x 6 = 3150 (Assume material cost for brick without profit = 6 Rs)
- Cement = 270 x 1 = Rs. 270 (taken from DSR 2017)
- Crush sand = 2300 x 0.0698 = Rs.160. 57
- Total materials cost for 1 cum brick masonry = 3580.57 ≈ Rs. 3581

B- SIB Masonry

a. Summary

- Volume of masonry = 1 cum
- Materials – Cement, Fly ash, Recycled fine aggregates and coarse aggregates
- Mix proportion – 1:3.2:5
- Fly ash – 15 % of total cement weight
- Size of SIB = 0.4m x 0.2m x 0.15 m = 0.012 cum
- No. of blocks for 1 cum = 1 / 0.012 = 83.33 ≈ 84 no's

b. Materials quantities

- Dry volume of concrete = 1.52 x 0.012 x 84 = 1.532 cum
- Total quantity of cement = 1.532 / (1 + 3.2 + 5) = 0.166 cum
  So no of bags of cement = 30 x (0.166 – 0.0249) = 4.23 Bags
- Total quantity of fly ash = 15 / 100 x (249) = 37.35 ≈ 38 Kg
- Total quantity of recycled fine aggregates = 0.166 x 3.2 = 0.531 cum = 0.187 brass(1 brass = 2.83 cum)
- Total quantity of recycled coarse aggregates = 0.166 x 5 = 0.83 cum = 0.293 brass
- Assume the cost of recycled aggregates is 70 % of the cost of natural aggregates

c. Material Cost

- Cement = 4.23 x 270 = Rs 1142
- Fly ash = 3 x 38 Rs 114=
- Recycled Fine aggregates = 0.187 x 2300 x 0.7 = Rs 301 (Current rate of F.A 1brass = Rs 2300)
- Recycled coarse aggregates = 0.293 x 3000 x 0.7 =Rs 615 (Current rate of C.A 1brass = Rs3000)
- Total materials cost for 1 cum SIB masonry= Rs 2172
- Hence, the total cost required for the 1 cum Brick masonry is 64 % more than SIB masonry.

V. RESULT AND DISCUSSION

5.1Comparison of Brick masonry with SIB masonry

Table No. 4 - Comparison of SIB masonry with brick masonry

Sr. No.	Particulars	SIB Masonry	Brick Masonry
1.	Strength	High	Medium
2.	Water absorption	Less than 1 %	Less than 20 %
3.	Construction Cost	Less	More
4.	Construction speed	Fast	Slow
5.	Skilled labor	Not required	Required

5.2 Advantages of SIB

- Compared with conventional masonry the dry assembly of interlocking block saves construction time and large amount of mortar.
- Without the need of high waged skilled masons, by saving cement and with speed of construction the building coast are lower than for standard masonry construction.

- It requires low maintenance cost throughout the year.
- It also helps to customized dimensions & designs.
- In case of self-interlocking faster construction is possible.
- With the help of SIB we can provide better architectural appearance.
- In case of SIB plastering work is not mandatory.

5.3 Limitations of SIB

- Although skill mason is not needed for constructing wall a certain amount of training is required to ensure that the walls are properly aligned and no gaps are left.
- Even with the greatest care in assembling the walls the joints are not entirely resistant to wind and rain penetration therefore plastering the interior wall surfaces is usually necessary.
- As it has high self-weight which leads to great gravity and seismic loads.
- It's quite difficult to get a recycled aggregate from dismantled property for small scale production.

5.4 Applications of SIB

- Self-Interlocking Block technique is applicable for multistorey buildings same way as for standard masonry construction.
- SIB can be used for retaining walls, Foundation Walls, Partition Walls, compound wall and bearing walls up to certain height.
- In areas in which timber is scarce and expensive, construction with SIB have environmental advantage (Low energy requirement, no deforestation)
- It can be used as paving blocks by reducing the depth and width of blocks and by removing top projections.
- Cost effective earthquake resistant housing is desirable in seismically active in rural areas.

VI. CONCLUSION

The purpose of this project was to develop an interlocking block system which does not require mortar for construction of masonry walls and to reduce the cost by using recycled aggregate and time of the construction. The blocks developed by us where provided with projection and depression to interlock them horizontally and vertically and to prevent them from sliding. The blocks are efficient in resisting the sliding horizontally and vertically. The grooves and keys are strong enough to resist shear and deterioration due to minor impacts while handling.

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