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Behavioural Study of Lego Blocks Having Variety of Qualities Against Conventional Building Blocks

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ABSTRACT: Lego blocks are commercially available interlocking piece of plastic that are conventionally used as toys. We described their shape as a building block and constructed a building block in the shape of Lego blocks with the composition of hollow bricks which provide modular building system. It is quick and easy to execute the construction by stacking and organising the blocks.

The construction process using conventional building block and masonry can be tedious, time consuming and expensive.

In this project we constructed a new building block to overcome the hardship and issues that are encountered during construction. Each block is constructively designed to lock itself to the other block without the use of binding material and each block have projections and grooves on it. It resists lateral movement and vertical compressive stresses. Blocks are constructed and experimental results are compared with ordinary building block.

These blocks provide clean construction sites, high strength, cost effective building blocks, it does not require skilled labours for construction, and is a highly time efficient construction, with well surface finish we can avoid plastering.

KEYWORDS: Interlocking building block, lego model building block in square and in rectangle, compressive strength

I. INTRODUCTION

Buildings, building materials and components consume nearly 40 percent of global energy annually in their life cycle stages, such as production and procurement of building materials, construction, use and demolition. The total life cycle energy of a building constitutes the embodied as well as the operational energy. Embodied energy is the total amount of energy consumed during the production, use (renovation and replacement) and demolition phase, whereas operational energy is the energy required to operate the building in processes, such as space conditioning, lighting and operating other building appliances. Compared to embodied energy, operational energy constitutes a relatively larger proportion of a building's total life cycle energy. However, recent research has emphasized the significance of embodied energy and has acknowledged its relative proportion of total energy, which is growing with the emergence of more energy efficient buildings. This system offers a modular building system of oversized blocks that facilitates the construction of all types of objects. It's quick and easy to build nearly anything, by stacking and organizing the universal blocks in nearly any shape, pattern, or size. No tools are required for installation or removal and life-sized block and when building walls, props, or displays there is none of the dirt and debris associated with traditional construction. Each module is designed to connect easily with the parts above and below, using a pressure fit which creates a strong link between blocks. Because of its unique lug system, you can stagger the blocks in 3" increments, to create all types of patterns. Each block is hollow, but contains support ribs for additional strength and to provide a tight fit with the connector lugs below. Choose between different sized blocks and finishing caps Anything we've built can be taken apart and re-assembled again, and the pieces can be reused to construct other objects, making this block a unique green building method. Easily reconfigure, transport, and re-assemble our designs in minutes and re-use blocks for all types of projects.

II. RELATED WORK

Robert I. Reid featured an article in the civil engineering magazine on the topic of "The House That Lego Built". Designed to resemble giant LEGO bricks stacked on top of one another, the LEGO House is an instantly iconic new building in Billund, Denmark. The 12,300 sq m facility houses multiple attractions and features 25

million LEGO bricks that were used to create numerous displays, including a towering tree that is considered one of the largest LEGO structures ever built

Simion Hosea Kintingu published a thesis on the topic “Design of Interlocking Bricks for Enhanced Wall Construction Flexibility, Alignment Accuracy and Load Bearing”. The objectives of this study were to; i) examine the performance of interlock bricks for the construction of walls, ii) identify patterns/bonds, joints and configurations, iii) develop remedial measures to reduce the effect of brick irregularities, iv) measure how brick imperfections affect dry-stack wall/column alignment accuracy and stability during construction. Below are the findings of the study. A major weakness of Mortarless Technology (MT) using interlocking dry-stack bricks before this research began was its poor architectural and construction flexibility. MT could only be used for stretcher-bond walling with right-angled corners. The introduction of the developed new brick shapes has much improved the flexibility of interlock construction.

ArnonRosan, a serial entrepreneur is the founder of EverBlock Systems and was formed to make it easy for companies and people everywhere to build large sized objects using a series of universal building blocks. EverBlock is a manufacturer of modular interlocking building blocks for a variety of real-world applications. We manufacture, sell, and rent EverBlock globally and are building a world-wide network of agents, renters, and distributors. Simplicity of design and construction is at the core of the company's view of the world and we want to make it easy to tap into people's imagination and love for creating new objects. Like the toys of our childhood, which enabled us to express ourselves and realize our vision in physical products, EverBlock was conceived to allow designers, decorators, and inventors everywhere to economically build their dream objects. What you construct is limited only by your imagination.

III. METHODOLOGY

A block of size 12 inch × 8 inch × 6 inch were constructed, which is manufactured by using a mix ratio of 1:7 cement aggregate ratio contains 11 kg cement 26.1 kg, fine aggregate and 126.6kg coarse aggregate using vibratory compaction which is similar to Lego block.



Fig 1: Lego model building block in square (LBS)

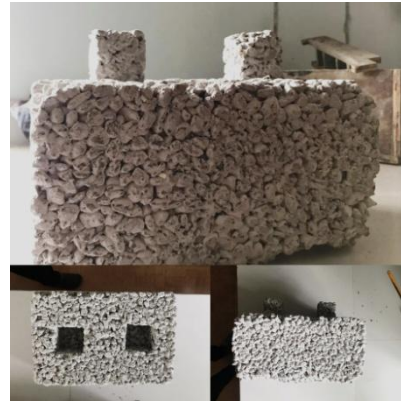


Fig 2: Lego model building block in rectangle (LBR)

Three cubes each were casted for each designs. Tests on Compression strength were conducted on the specimens after 28 days of curing. Tests of block density, shear test and compression test were done on Lego Model building blocks and compared with results of tests done on locally available concrete hollow bricks.

IV. EXPERIMENTAL RESULTS

A. Compression Test on specimens

The compressive strength of specimen was tested at 28 days after proper curing. The strength of specimen of proportion of (cement: aggregate) 1:7 at 28 days is shown in table 1, respectively.



Fig 3: Compression test on lego model building block

Table 1. Test Results of compression test on lego model building block specimen

Specimen	Mean Weight (kg)	Mean Density (kg/m ³)	Ultimate load (kN)	Compressive strength (N/mm ²)
LBS	12.775	2698.592	250.00	8.073
LBR	23.0667	2441.61	490.00	8.019

The compressive strength of specimen LBS (Lego Block Square) is found to be 8.073 N/mm² whereas the compressive strength for specimen LBR (Lego Block Rectangle) founded to be 8.019 N/mm².

The mean density of specimens LBS (Lego Block Square) is found to be 2698.592 kg/m³ and for the specimen LBR is found to be of 2441.61 kg/m³.

As per IS 2185:2005 (part 1) the minimum average compressive strength is 3.5 N/mm² for the brick with density greater than 1500 kg/m³. All the specimens in the study are satisfying the recommendations as per Indian standard code. Based on the experimental results obtained, Lego model building block can be used for the construction purpose.

B. Shear Test on specimens

The shear strength of specimen were tested at 28 days after proper curing. The strength of specimen of proportion of (cement: aggregate) 1:7 at 28 days is shown in table 2, respectively.



Fig 4. Shear test of the projection of lego model building block

Table 2. Test Results of shear test on lego model building block specimen

Specimen	Mean Area (kg/m ³)	Ultimate load (kN)	Compressive strength (N/mm ²)
LBS	2580.6	7.33	2.842
LBR	2580.6	9.33	3.604

The shear strength of the projection of specimen LBS (Lego Block Square) is found to be 2.842 N/mm² whereas the shear strength of the projection for specimen LBR (Lego Block Rectangle) founded to be 3.604 N/mm².

According to IS 1905:1987, the shear strength required for cement mortar used in brick masonry is by the expression,

$$f_s = 0.1 + f_d/6$$

by following those expression, here we require

$$f_s = 0.1 + 8/6 = 1.43 \text{ N/mm}^2$$

So, by experimental analysis we got the shear strength as 2.842 and 3.604 for LBS and LBR, which is more than the required.

As per IS code of cement mortar, so from that we can conclude that it gives enough shear strength.

C. Block Density of the Bricks.

Lego Model building blocks are mainly casted in square and rectangular shape. The block densities were checked as per IS 2185 (part 1): 2005. The density obtained for concrete hollow blocks and Lego Model building blocks is given in table 4.4

Even though every mix is satisfying the recommendations as per IS 2185:2005 (part 1) for building blocks, the specimens LBR and LBS are found to have higher density with better compressive strength, for a comparative study 4 inch and 6-inch hollow concrete blocks were obtained from local industry.

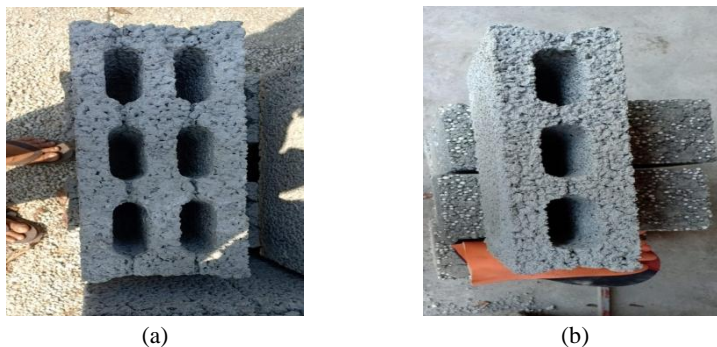


Fig 5. Locally available concrete hollow bricks. (a) 6-inch block. (b) 4-inch block

Table 3. Block densities of hollow concrete and polystyrene blocks

Specimen	Mean volume (cm ³)	Mean weight (kg)	Density (kg/m ³)
4" Hollow concrete block	8593.43	16.208	1886.091
6" Hollow concrete block	12971.02	22.267	1716.673
LBS	4733.955	12.775	2698.592
LBR	9447.324	23.0667	2441.61

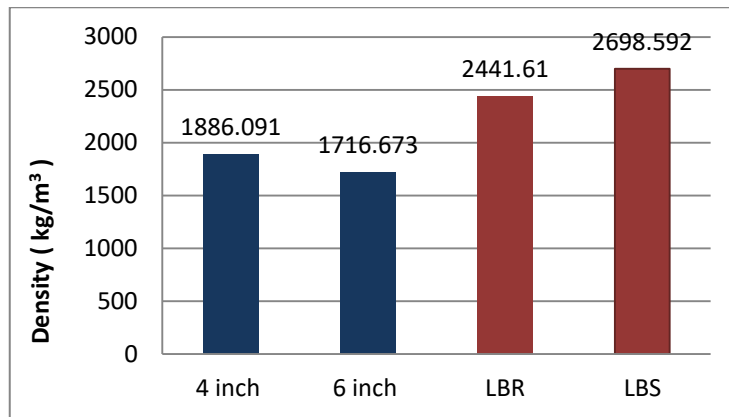


Fig 6. Graph showing mean density of Hollow concrete blocks and Lego model building blocks

From Fig 6, it can be seen that, density have increased for Lego model building block. Density of Hollow brick was found to be 1886.091 kg/m³ and 1716.673 kg/m³ respectively for 4 inch and 6inch blocks. Meanwhile the density of LBS and LBR are found to be 2698.59 kg/m³ and 2441.61 kg/m³ respectively.

D. Compressive Strength of Lego Model building block

Test on compressive strength conforming to IS 2185:2005 (part 1) was done normal hollow concrete blocks and lego model building blocks. The test results is provided in Table 4.

Table 4. Results of compression test on Polystyrene blocks

Specimen	Mean compressive strength(N/mm ²)
LBS	8.02
LBR	8.173
4” Hollow concrete block	1.807
6” Hollow concrete block	1.973



Fig 7 Compression Test on Lego Model building block

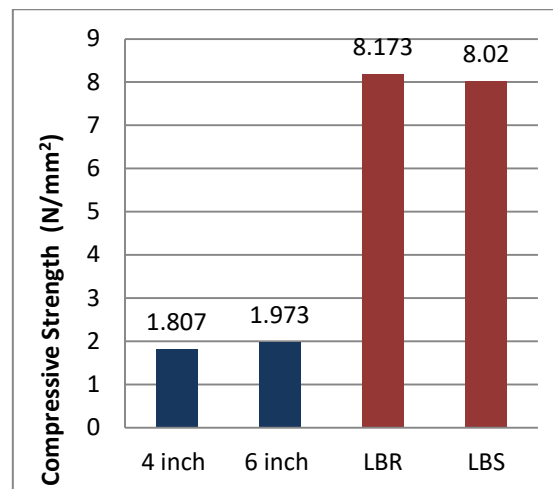


Fig 8 Graph showing average compressive strength of Hollow concrete blocks and Polystyrene blocks

As per IS 2185:2005 (part 1) the minimum average compressive strength required for building blocks is 3.5 N/mm^2 . But sample collected from the nearest Hollow Brick Industry gave an average compressive strength of 1.807 N/mm^2 for 4 inch brick and 1.973 N/mm^2 for 6 inch brick. These hollow concrete brick are being used to make non load bearing partition wall in framed buildings and construction of boundary walls. Whereas average compressive strength for LBR is found to be 8.173 N/mm^2 and LBS is found to be 8.02 N/mm^2 . The result indicates that Lego model building block can be used as a substitute for the locally available building blocks and can yield better results.

V. CONCLUSION

This study aimed in making construction easier. We designed or proposed an economical and eco-friendly model of the construction material. The production of the Lego model building block in this project was proceeded by modelling of blocks of $12 \times 3 \times 8$ and $12 \times 6 \times 6$ with projection of size $2 \times 2 \times 2$ (all dimensions are in inches). It is similar to the size of locally available building blocks. These are constructed with a mix ratio of 1:7 (cement: aggregate) as per mix proportion of hollow bricks.

Experimental studies were conducted on these blocks, Lego block of square (LBS) and Lego block of rectangular (LBR). The compressive strength of specimen LBS was found to be 8.073 N/mm^2 and its shear strength was found to be 2.842 N/mm^2 . The same for LBR were found to be 8.019 N/mm^2 and 3.604 N/mm^2 . The minimum average compressive strength was 3.5 to 5 N/mm^2 . The compressive strength of these blocks was found greater than that of locally used building blocks. These new blocks performed well in the experimental analysis compared to the locally available concrete hollow bricks. The density of the specimen was found to be greater than 1800 kg/m^3 and the compressive strength was found to be greater than 5 N/mm^2 , therefore it can be classified under Grade C (5.0) as per IS 2185:2005 (part 1) Recommendation. The projections provide required shear strength as per IS 1905:1987.

The studies have thus shown that the Lego model building block can be used as a suitable material over local masonry materials for construction of buildings. Compared to local building materials, these blocks reduce construction time, avoids dust or filthy construction site due to disuse of binding materials like mortar due to the interlocking property of these blocks. It also avoids need of skilled labours. By avoiding binding material and fast construction they reduce construction cost. This shape of block provides better strength, wall stability and disallows movements. These blocks can be adopted as a suitable substitute for traditional masonry.

REFERENCES

- [1] Robert L. Reid featured an article in the civil engineering magazine on the topic of "*The House That Lego Built*". Designed to resemble giant LEGO bricks stacked on top of one another, the LEGO House is an instantly iconic new building
- [2] Simion Hosea Kintingu published a thesis on the topic "*Design of Interlocking Bricks for Enhanced Wall Construction Flexibility, Alignment Accuracy and Load Bearing*". The objectives of this study were to; i) examine the performance of interlock bricks for the construction of walls, ii) identify patterns/bonds, joints and



- configurations, iii) develop remedial measures to reduce the effect of brick irregularities, iv) measure how brick imperfections affect dry-stack wall/column alignment accuracy and stability during construction.
- [3] ArnonRosan, a serial Entrepreneur is the founder of EverBlock Systems and was formed to make it easy for companies and people everywhere to build large sized objects using a series of universal building blocks.
 - [4] IS: 383 – 2016, *Coarse and Fine Aggregate for Concrete – Specification*, Bureau of Indian Standards, January 2016
 - [5] IS: 2185 – 2015, *Concrete masonry unit's specification*, Bureau of Indian Standards, August 2015.
 - [6] IS: 2185 – 2005, *Concrete masonry unit's specification*, Bureau of Indian Standards, August 2005.
 - [7] IS: 455 – 1989, *Portland slag cement- specification*, Bureau of Indian Standards, May 1990.
 - [8] IS: 2250 – 1981, *Code of practice for preparation and use of masonry mortars*, Bureau of Indian Standards, July 1981
 - [9] IS: 6042-1969, *Code of practice for construction of light-weight concrete blockmasonr*, October 1971
 - [10] IS 2386 – 1963, *Methods of test for aggregates for concrete Part I, Particle size and shape*, Bureau of Indian Standards, August 1997
 - [11] IS 516 – 1959, *Methods of tests for strength of concrete*, Bureau of Indian Standards, December 1959



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