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Design and Development of an Interlocking Type Brick for Sustainable Construction

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ABSTRACT: The modern construction practices demand construction materials which are efficient, economical and sustainable in environment. Traditional brick masonry often relies on the highly skilled labor, which leads to the higher construction time and increased cost of project. To overcome these problems, this study came up with an innovative concept of *Interlocking Brick System* which helps to connects adjacent units without using the cement mortar. The proposed *Interlocking Brick System* gives a precisely designed geometric shape to enhance the alignment accuracy, load transferability and stability. This design is created using the CAD software and evaluated conceptually using CAD software to examine the geometric alignment and assembly feature. Based on this conceptual evaluation and design perspective, when compared with traditional bricks, the design of *Interlocking Brick System* minimizes the materials requirements, reduces the time required for construction, and the system has the potential to provide the better alignment and better load distribution. By looking to its cost-effectiveness and sustainability, this design of *Brick* is suitable for the low-cost eco-friendly building projects.

KEY WORDS: *Interlocking Brick System,* Sustainable Building Materials, CAD design, stable structure, cost efficiency, easy assembly.

I.INTRODUCTION

Due to global urbanization, inflation in the raw materials cost and the need of eco-friendly building practices, the demand for time efficient, instantly constructable, sustainable and economical construction system has gained the significance in the past few years. The traditional brick masonry is also one of the oldest and most widely used construction method which also possesses some challenges.

Traditional brick requires the precise alignment and continuous application of the mortar, which makes us to depend on the skilled labour to maintain the structural stability and integrity. This contributes to the excessive time requirement for construction and higher project cost with the high wastage of the materials. Significantly, the uneven quality and quantity of the manually applied mortar can lead the structure to the inconsistent joints which reduces the load-bearing capacity, and long-term maintenance issues.

To address these issues, we have explored alternative construction systems that reduces the material wastage and simplify the assembly process with structural reliability. *Interlocking Brick System* came as a solution because this design incorporates geometric interlocking feature that allows adjacent units to fit together mechanically without the need of application of mortar between them during the placement.

This system gives benefits such as fast construction, alignment accuracy with low efforts and skills, reduced labour dependency, and enhanced aesthetic uniform looks.

However, some existing interlocking brick solutions still face some limitations. Many designs depend on the friction between two units and dry interlocking without mortar for stability, which will not provide the sufficient bind strength for multi-storey application with high-load. Some designs have vertical cavities for partial fulfillment, but they lack an integrated mechanism to make the uniform mortar flow throughout the complete structure to ensure the stability.

We need a brick system such that it considers rapid dry construction and strong structural bonding, and combines the advantage of both the factors. The current work overcomes these limitations by introducing Interlocking Type Brick. This brick uses male-female interlocking for friction-free alignment during assembly. Additionally, the brick also includes strategically engineered network of interconnected vertical and horizontal holes. The purpose of holes is to automatically aligns, forming a continuous channel throughout the wall. Furthermore, cement slurry can be poured from the top, allowing to spread evenly throughout the network, this allows transforming dry-assembly structure into uniformly bonded providing extra strength to the structure.

By incorporating this approach, we can significantly reduce mortar usage, minimize errors while construction, and significantly decrease labour cost. Along with this it enhances structural strength, making it suitable for low-cost housing and demanding applications. The use of CAD-based modelling ensures dimensional precision and effective alignment for interlocking and mortar dispersion.

This paper includes the complete design process along with conceptual development of Interlocking Type Brick. Working mechanism and potential use of the concept in sustainable construction is further augmented in the paper. Even though physical prototype and testing remain as future concern the design itself promises efficient and eco-friendly alternative for both traditional and current interlocking approaches out there.

II. SIGNIFICANCE OF THE SYSTEM

This *Interlocking Brick System* design addresses the major limitations of the traditional brick masonry practices in construction and leads to some important benefits, as mechanically interlocking system based on the geometry of the design and inbuilt mortar spreading network, which connects with the adjacent unit providing improved construction efficiency, structural reliability and sustainability.

This system reduces the dependency of skilled labour requirements. Traditional brick masonry construction needs the precise and aligned placement of brick with the even quantity of mortar dispersed, but the *Interlocking Brick Design* proposes the solution with the automatic mortar dispersion network within the brick itself in the design. This ensures the less errors made by labours and speed up the construction to make it suitable for large-scale construction projects.

This design includes the vertical and horizontal holes made for mortar to be spread evenly once after the assembly. This enables the single point filling of mortar ensuring the uniform bonding in the whole structure. With these holes the designed brick reduces the material requirement and wastage of the overall project.

By reducing the amount of the mortar requirement, this brick system enhances the environmental sustainability which supports the ecofriendly constructions. Its interlocking system makes it suitable for low-cost housing, rapid construction practices.

III. LITERATURE SURVEY

Interlocking brick systems have been studied for many years as a practical alternative to traditional mortar-based construction. Researchers point out that conventional brickwork needs skilled labour, accurate mortar application, and more time, which increases the overall cost of a project. Interlocking bricks help reduce these issues because their geometric shape allows them to fit together more easily, improving alignment and reducing the amount of mortar needed during construction.

Many earlier designs mainly focused on creating vertical or horizontal key-locking shapes to improve stability when the bricks are stacked. Different types of interlocking bricks—such as compressed stabilized blocks, hollow blocks, and dry-stack units—have been developed to make construction faster and simpler. Although these designs offer advantages, most of them still depend on friction or limited grouting and do not support a system that allows mortar to spread evenly through the whole wall after it is assembled.

Some previous designs added vertical holes so that reinforcement or grout could be added if needed. However, these holes generally allow mortar to flow only downward, and very few models include horizontal channels. Because of this, the mortar does not spread evenly across the structure. Several studies also highlight the need for continuous load paths and accurate interlocking geometry, but they rarely focus on creating a connected system of vertical and horizontal internal cavities.

The main gap in current research is the lack of an interlocking brick that combines accurate geometric locking with a fully connected mortar-flow network. Such a design would make it possible to assemble the structure without mortar at first and then fill the entire wall with mortar from a single point, ensuring both speed and strong bonding.

The design proposed in this study aims to fill this gap by introducing an improved interlocking concept that is simpler to construct, cost-effective, and suitable for sustainable building practices.

IV. METHODOLOGY

The methodology used in this design completely focuses on the design and conceptual development of the interlocking type brick. This process involves studying the existing limitations, designing the better geometric shape which can ensure the interlocking mechanism and mortar flow system work together efficiently. The following steps are taken under this approach

A. Problem Identification
The first important step is to identify the flaws in the existing traditional brick systems, like material wastage, slow speed construction, labour dependency. The existing interlocking brick designs are reviewing to understand their advantages and limitations to keep their design improved as needed.

B. Concept Development
By looking at the problem identified, the interlocking brick design with an inbuilt mortar dispersion is developed. The aim was to design a brick which can be placed without mortar dispersion and can be uniformly filled with mortar with the help of the vertical and horizontal cavities.

C. CAD Modeling
The shape and geometry of the design is developed using the CAD software. Various views of the design are developed such as top, bottom, front, rear to define the dimensions and the interlocking system. The CAD software helped with alignment of male and female interlocking alignment, connecting accuracy of the vertical and horizontal cavities, and assembling ability of brick in multiple directions.

D. Alignment and Interlock verification
The model is verified for the alignment accuracy by stacking up the bricks virtually in CAD software. The fitting check is also verified to ensure that no gaps between two faces. This verifies the brick does not the mortar while placement.

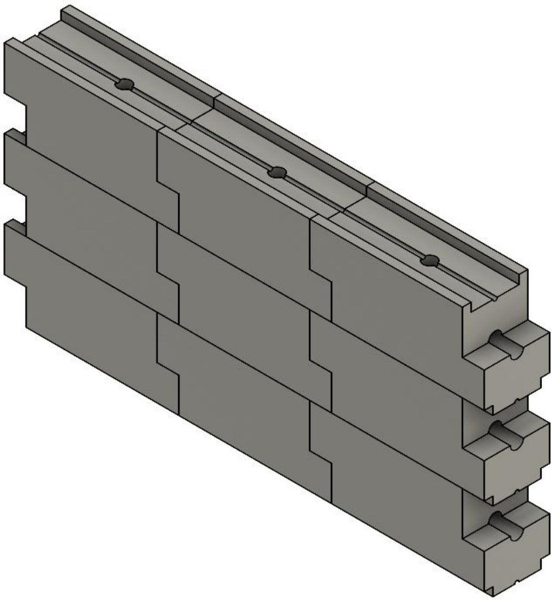

Fig. Alignment and Interlocking verification

E. Mortar Flow Pathway Design

We can say that the main part of this brick system is the internal path of mortar flow. These holes are placed in such a way ensuring the accurate alignment of the one over other which ensures once the mortar is poured on the top brick then it will be flown to entire structure vertically and horizontally through the holes provided.

V. DESIGN REPRESENTATION

A. Front View

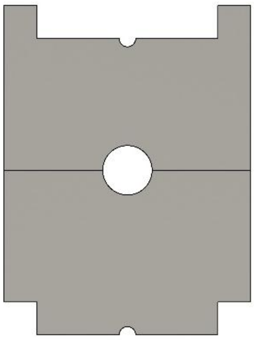

Fig. Front View

This view shows the main face of the brick, highlighting the external geometry and interlocking system.

B. Rear View

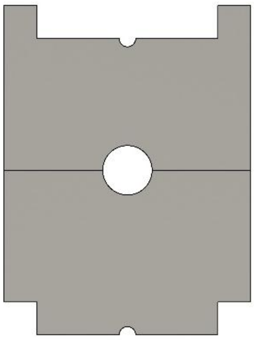

Fig. Rear View

This view displays the opposite face of the brick, showing the complementary geometry for proper alignment and fitting.

C. Right Side View

Fig. Right Side View

This side view illustrates the brick's depth and side profile features that contributes to its interlocking mechanism.

D. Left Side View

Fig. Left Side View

This view presents the left surface of the brick, showing the matching interlocking edges and side configuration.

E. Top View

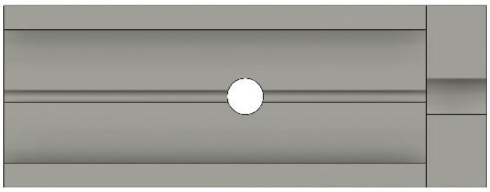

Fig. Top View

This view reveals the top geometry, including interlocking elements and the arrangement of holes designed for vertical and horizontal mortar flow.

F. Bottom View

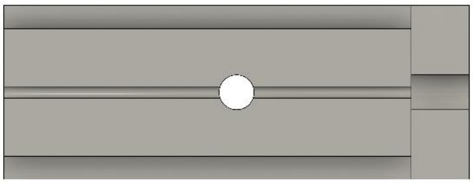

Fig. Bottom View

This view represents the underside of the brick and shows how the bottom shape interfaces with the top interlock of adjacent brick.

G. Perspective View

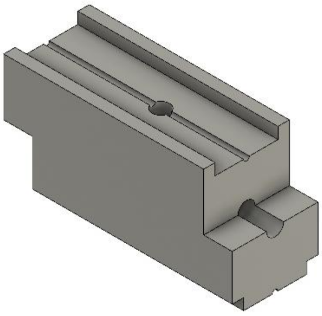

Fig. Perspective View

This 3D view provides an overall visual representation of the brick, combining all geometric features into a single perspective.

VI. CONCLUSION AND FUTURE WORK

This study presents the design and development of an Interlocking Type Brick aiming at improving an efficiency and sustainability of construction methods. This proposed design offers a simple but effective way to reduce mortar usage, minimize construction time, and decrease dependency on skilled labour. By using a male–female interlocking geometry along with a network of interconnected vertical and horizontal cavities, the brick allows the structure to be assembled without mortar placement, followed by even mortar filling through a single hole. This approach brings together the benefits of rapid construction and strong internal bonding. The CAD-based modeling confirms the feasibility, accuracy, and practical applicability of the design. Overall, the concept has strong potential to support low-cost, eco-friendly construction systems.

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