DESIGN AND MODELLING OF INTERLOCKING BRICKS FOR STRENGTHENING OF WALLS

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Abstract— Several interlocking bricks has been developed and implemented in building constructions and a number of researches had studied the manufacturing of interlocking brick and its structural behaviour. Interlocking blocks are produced in special moulds, in which compaction can be done mechanically or by hand depending on the type of block, material used, required quality and available resources. The blocks can be made directly at the building site, or on a larger scale in a production yard. Various test like Compressive strength test using compressive strength testing machine, Water absorption test, Test on Wall Panel, Dry density test is conducted to analyze the structural behaviour and to know the strength of the bricks. Various models of bricks are developed on software and are analyzed. Small physical models are also prepared of cardboard for the better presentation and understanding. This report aims to develop new interlocking concrete blocks and analyze its structural behaviour for its use in retaining wall for strengthening purpose.

I. INTRODUCTION

Bricks are a construction material widely used in the construction industry. It serves as a partition member or wall component in the building. Brick is made from cement and mud clay with other fine aggregate material to achieve maximum structural and mechanical properties.

Brick masonry is an ancient material and one of the most significant construction materials all over the world. The conventional techniques for bricks making had brought irrefutable drawbacks.

The main feature of the interlocking block system is the elimination of mortar layers the blocks are interconnected through interlocking keys. There are different types of interlocking bricks like interlocking paving bricks, interlock wall bricks, interlocking landscape bricks, interlocking retaining wall bricks, mud interlocking bricks etc. One of the significant benefits of interlocking bricks is they act as good earthquake resistance.

There are various stresses on the structure due to earthquakes. Interlocking bricks are equipped to transfer the seismic forces equivalently across the whole structure because of the self-locking pattern. It also has less density than conventional bricks that allow good air-flow. So, walls with these bricks furnish a much cooler interior. So, there is no need for air-conditioners which minimizes power consumption and saves money.

The goal in any interlocking system is to ensure efficient construction formation with well-aligned masonry structures, even without skilled masons.

Advantages of interlocking concrete blocks in construction are:-

1) Interlocking Bricks are more resistant to earthquakes.
2) They are durable and need less maintenance.
3) If damaged, interlocking bricks are easy to recover.
4) They are also favourable for hot climates.

II. LITERATURE REVIEW

Author Name- Ahmad Aswad, Mahmut Cemyılmaz, Salah Haj İsmail

Summary- It aims to demonstrate different configurations of ICBs incorporated with recycled concrete aggregate and other additive materials used for construction. This paper provides a comprehensive literature review about different types of ICBs. To achieve this, it compares different related studies which analyze the compressive strength results of RCA mixtures with different RCA replacements, w/c ratio, and mix proportions. Additionally, the paper discusses several techniques and methods to improve the behaviour of ICBs.

Author Name- Rahul Kumar, Ankur Thakur

Summary- The purpose of this study is to demonstrate the potential of AAC blocks as infill material to replace clay bricks to encourage its usage in construction to create more energy efficient, sustainable structure. Autoclaved Aerated Concrete (AAC) has recently emerged as a viable alternative to clay and fly ash bricks. In this work, a comparison of clay bricks and AAC blocks is explored. Autoclaved Aerated Concrete (AAC) has recently emerged as a viable alternative to clay and fly ash bricks. In this work, a comparison of clay bricks and AAC blocks is explored.

Author Name- Eddy Syaizul Rizam Bin Abdullah, Dr Hidayati Bte Asrah

Summary- The aim of this paper is to present the latest and related research on the performance and effectiveness of ICEB for wall elements as a load-bearing structure. ICEB gives more advantages in terms of cost, time, and sustainable development. The review of literature on the ICEB give a positive impact before, during, and after construction. This paper also aware the public of the existence of the ICEB system in construction as well as a reference on future practices.

Author Name- Vijay Adhithya A.Kalpana V. G

Summary- This project aims to create low cost, eco-friendly, sustainable and durable system for the construction of load bearing walls using the Interlocking Bricks. The interlocking brick wall panel was tested by applying axial compressive load and software analysis is carried out using ANSYS 2021 R1 to compare it with the experimental results to find the degree of accuracy between theoretical and experimental models. Cost analysis is done to compare the rate of construction with conventional red brick masonry and was found that it was almost 40% cheaper.

Author Name- Siri Reddy Pannala, Synthia Maiyukhi Kotamraju

Summary- The purpose of this technical paper is to investigate how effectively a wall built using interlocking blocks withstands lateral loads, such as seismic loads. The analysis is compared with the conventional bricks. The structure is modelled in STAAD PRO software.

Author Name- E S R Abdullah,A K Mirasa, H Asrah and C H Lim

Summary- This paper aims to review the interlocking compressed earth bricks (ICEB). High pressure of compression is used to produce the interlocking bricks and it is at high speed of production compared to conventional method which is firing process that can contribute to the environmental issues. To achieve sustainable development, interlocking compressed earth bricks have been developed which can reduce cost, environmental-friendly, and energy-efficient.

Author Name- Meghana A Patankar, Ankith Gowda, Sandeep TD

Summary- The design is being done to check the suitability of interlocking blocks in buildings and is found safe for up to G+4 storey, that is interlocking blocks can be used for load bearing walls for up to 5 storey. In this dissertation work, tests like water absorption test, dimensionality test, modulus of elasticity test, compression test on prisms, shear strength test on wallets are conducted for both interlocking block masonry and conventional brick masonry. The test results proved that interlocking block masonry gave better results than conventional brick masonry.

Author Name- Amin Al-Fakih, Bashar S Mohammed

Summary- The concept of interlocking system has been widely used as a replacement of the conventional system where utilized either as load bearing non load bearing masonry system. Several interlocking bricks has been developed and implemented in building constructions and a number of researches had studied the manufacturing of interlocking brick and its structural behaviour as load bearing and non-load bearing element. This technical paper aims to review the development of interlocking brick and its structural behaviour.

Author Name- Anurag Wahane

Summary-This study deals with the manufacturing process of the autoclaved aerated concrete blocks. It is manufactured through a reaction of aluminium powder and a proportionate blend of lime, cement, and fly ash or sand. AAC is a masonry material that is lightweight, easy to construct, and economical to transport. AAC is one of the materials which can cope up with the shortage of building raw materials and can produce a light weight, energy efficient and environmentally friendly concrete.

Author Name- Jaswanth Reddy, S. Kesavan

Summary- The interface bonding of Interlocking blocks under lateral loads was studied in this paper, by modelling a 4’ × 4’ masonry wall. This masonry wall was analyzed by assigning in-plane lateral load with varying magnitudes and compared the results with a conventional brick masonry wall. Percentage variations had also observed in terms of deformation at a specific load when compared with a conventional brick masonry wall.

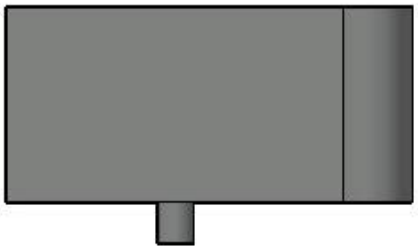
III BRICK DESIGN

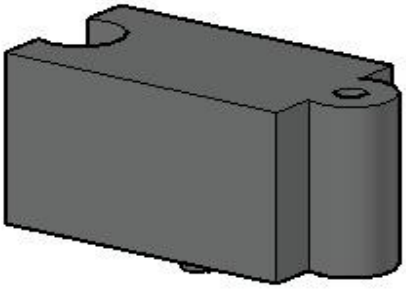
Modelling Parameter

After proper conduction of literature review various dimensions were obtained of which the best dimensions were adopted and hence the modelling parameters were decided.

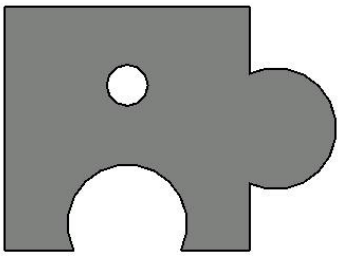
Parameter	Values
Length of concrete brick	400mm
Breadth of concrete brick	230mm
Height of concrete brick	230mm

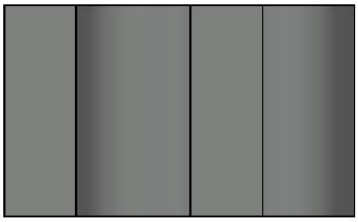
Brick Design

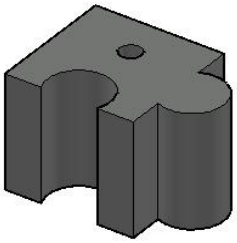




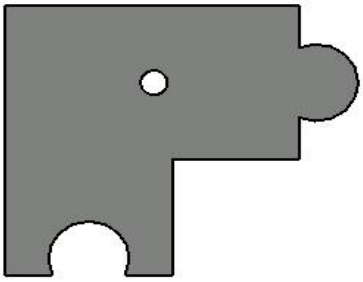
Half Brick

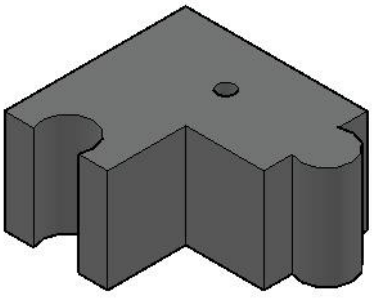






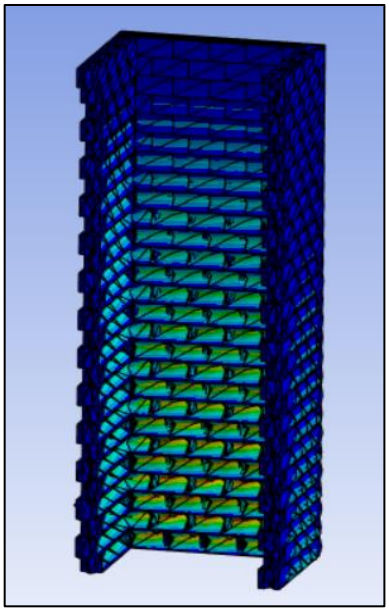
Side Brick



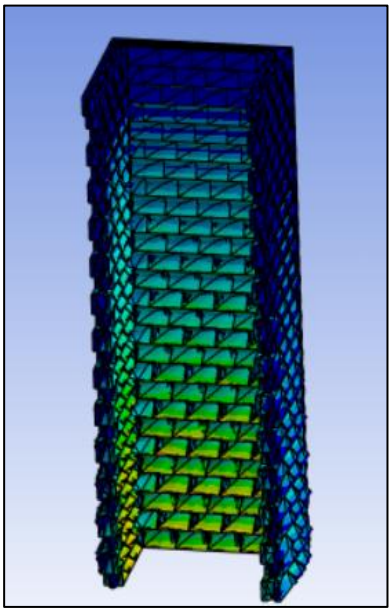


Results And Analysis

Deformation



Maximum sheer stress



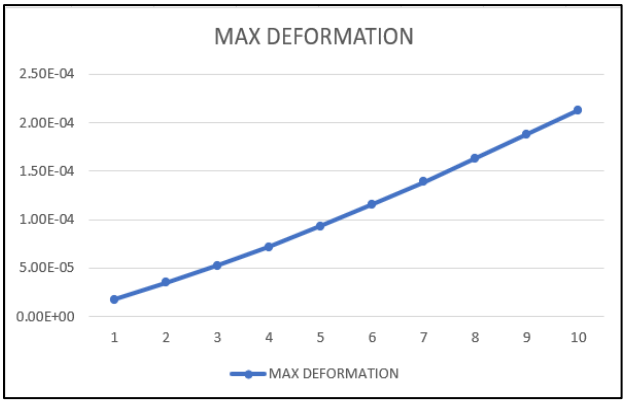
Deformation results

TIME	MAXIMUM DEFORMATION (m)
1	1.7406e-005
2	3.4812e-005
3	5.2549e-005
4	7.1853e-005
5	9.324e-005
6	1.1573e-004
7	1.3907e-004
8	1.6317e-004
9	1.8772e-004
10	2.1262e-004

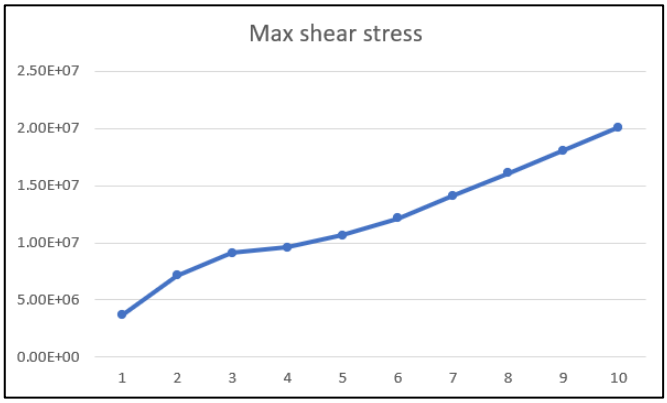
Sheer stress result

TIME	MAXIMUM SHEAR STRESS (Pa)
1	3.6679e+006
2	7.148e+006
3	9.1223e+006
4	9.6172e+006
5	1.0672e+007
6	1.2148e+007
7	1.411e+007
8	1.6091e+007
9	1.8076e+007
10	2.0071e+007

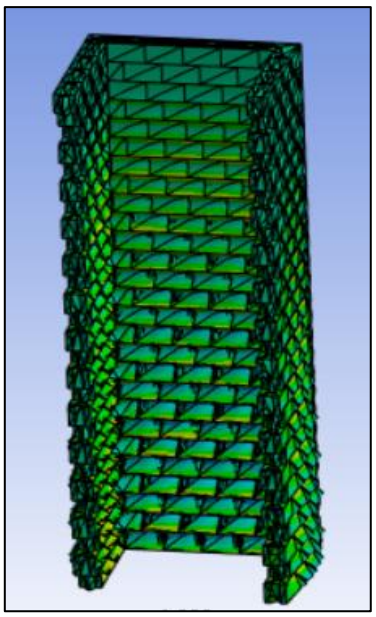
Deformation Graph



Shear stress graph



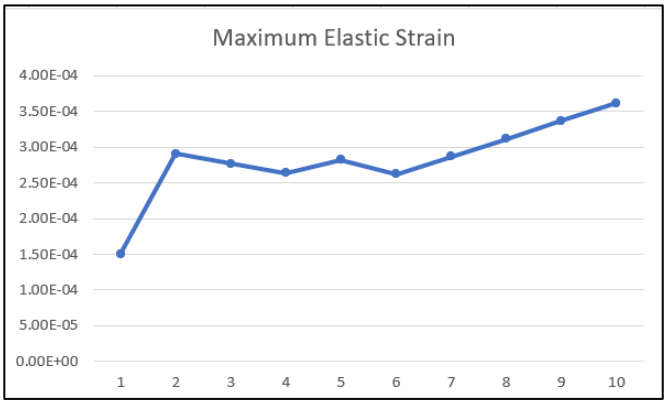
Maximum Elastic Strain



Strain Result

TIME	MAXIMUM STRAIN
1	1.5061e-004
2	2.9058e-004
3	2.7689e-004
4	2.6401e-004
5	2.823e-004
6	2.6237e-004
7	2.8667e-004
8	3.1174e-004
9	3.3667e-004
10	3.6154e-004

Elastic strain graph



Conclusion

We have designed three models out of which one model has been finalized. We have designed and constructed a wall design and made required adjustments to the bricks according to the design.The required adjustments were that we had to design two different corner bricks for the alignment of walls on both sides as well the continuation of walls in the further L cross section.Concrete of grade M40 was tested and strength of 41 KN was achieved on 28 days.Concrete was replaced with GGBS by 40 % which helps to achieve greater strength overtime.Analysis of structure was done on Ansys software and displacement of 0.212 mm was achieved.

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