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Experimental Study and Analysis of Self-Interlocking Blocks

Junaid N. Shikalgar[1], Rahul G. Kate[2]

[1]*Student, Dept. of Civil Engineering, Cusrow Wadia Institute of Technology, Pune, Maharashtra, India*
[2]*Student, Dept. of Civil Engineering, Cusrow Wadia Institute of Technology, Pune, Maharashtra, India*

Abstract – *A rise in demand for infrastructure has led the way towards requirement of fast construction practices while maintaining the quality of construction and at a low cost. Out of various components of the structure, partition wall was the most practicable choice as any alteration with the RCC members and the respective standards, specifications and procedures may hamper the safety of the structure. Construction of partition walls with conventional and aerated cement blocks is common practice in India. Hence, change in the system of partitioning wall by making alterations in the blocks was made to develop a new system of partition walls. A system of self-interlocking blocks was developed which enabled easy construction and provided the required bond in absence of mortar which in turn helps in reducing the cost of construction of walls. Self-interlocking blocks were developed by digital modeling and dimensions were fixed for the blocks. Further, physical model was casted with help of customized moulds. Ease of construction with help of self-interlocking blocks on test site and checking the stability of wall under horizontal vibrations on vibrating table was done. it was observed that the horizontal and vertical groves helped in maintaining the stability of the wall. Also, assembly and disassembly of wall was assisted by the groves and it also helped in maintaining the vertical plumb of the wall. In the end it can be concluded that further work in modification of the shape of the blocks for ease of mass manufacturing and transportation needs to be done. Also, performance of the block when casted in various materials needs to be studied.*

Key Words: Self-interlocking blocks, conventional blocks, customized moulds, stability, partition walls.

1. INTRODUCTION

At present there is a high demand for infrastructure in India which is difficult to be fulfilled by builders and contractors who adopt relatively slow construction practices and also result in high construction cost. There is demand for a product 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 performed and has high context of material requirement. Partitioning unit cost 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 system which will fulfill all the requirements. Hence a system of blocks named "Self-Interlocking Bricks" or blocks was developed and many models of the same were designed by various people, organizations. Self-interlocking blocks can be defined as the blocks which are locked against each other with help of groves without the use of cement mortar to form a structurally stable partition wall. It can be used in partitioning the space in framed buildings. These bricks will have inherent projecting parts, which fit exactly into depressions in the adjoin bricks placed aside, such that they are automatically aligned horizontally and vertically - thus bricklaying is possible without special masonry skills. It does not demand mortar for construction & plastering to conventional extent. This system aspires to reduce the material & labor cost of partitioning of space and speed up the construction.

1.1 Digital modeling and fixing of dimension of Self interlocking blocks.

Different companies or organizations have adopted different sizes and dimensions for there product i.e. self interlocking blocks. The dimensions adopted by those organizations depend on factor such as thickness of the wall, the interlocking system adopted and other design consideration such as the height of rise in each layer or interlocking system provided in vertical plane.

Based on the same factors as studied conducted on various available product dimensions for our self interlocking blocks were fixed. Digital model of the block was made in AutoCAD 3D software. The thickness of the block was fixed on the nominal thickness of wall. The height of the block was taken such that it would support the stability and the locking property of the vertical grooves. Similarly, the length of the block was taken by considering horizontal grooves and keys of the interlocking system adopted. The dimension of the block and the interlocking system provided in vertical and horizontal plane for straight and corner self interlocking block are shown in figure 1 and 2.

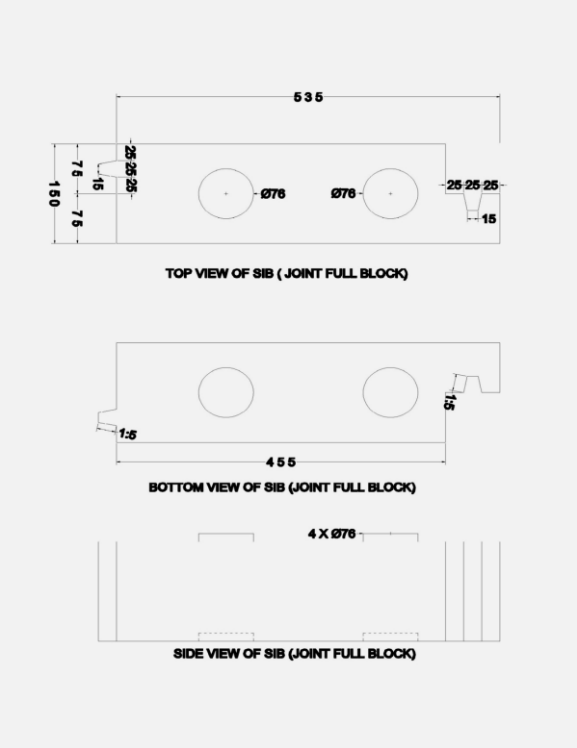

Fig -1: shape and dimensions of straight SIB

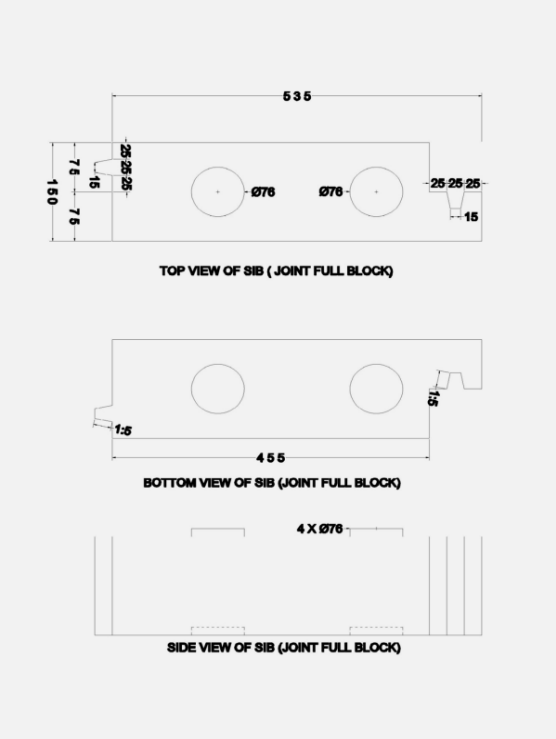

Fig -2: shape and dimensions of corner SIB

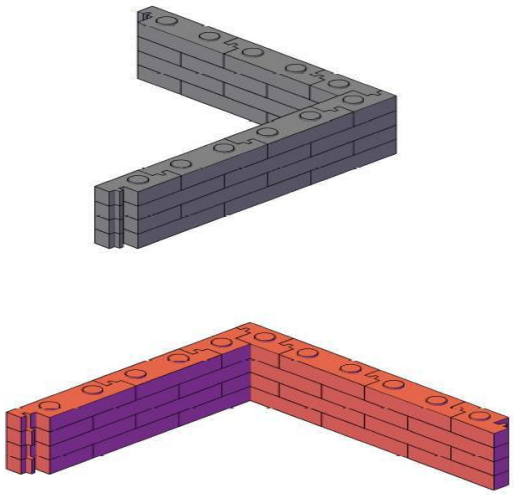

Fig -3: Digitally designed wall using SIB

1.2 Manufacturing of molds and Casting of trial blocks.

Mould is an essential part of block casting and can be made using different materials such as wood, steel, silicon etc. At initial stage, wooden moulds were made but unavailability of locking mechanism of wooden mould resulted in poor quality block. Also, the required finished was not achieved. Therefore steel moulds were made with efficient locking mechanism. With enabled us to cast blocks with straight edges and correct angles and smooth finish.

For trial purposes to check the efficiency of interlocking mechanism of self interlocking blocks were casted with Plaster of Paris. Sufficient numbers of blocks were casted and performance of vertical and horizontal interlocking system was analysed. The stability of the block in case of horizontal and vertical displacement was checked. Efficiency of vertical interlocking system in maintaining the plumb line was checked.

Fig -4: Steel plate cutting machine

Fig -5: Steel plates used for making molds

Fig -6: Trial blocks casted for checking suitability of SIB

2. Casting and Testing of Self interlocking blocks by using Aerated concrete.

After checking the performance of trial blocks casted out of plaster of paris, we must cast self interlocking blocks with the material which are usually used for casting blocks/bricks in general. Various types of material can be used for making blocks but aerated concrete has by far proven to be the best material. Due to the reason of having less weight and properties which make it of favorable material for casting of blocks. Aerated concrete is similar to foam concrete in properties and is used for the same purpose however it is simpler to manufacture and items form it have more stable quality than form foam concrete. Aerated concrete is manufactured by expanding the binding material paste, which may or may not include aggregates. It is also known as aerated concrete. The mix is expanded by gas forming substances, but care should be taken to synchronize the end of gas formation with the beginning of mix setting. The setting time of cement may be regulated with the aid of accelerators (such as dehydrate gypsum).Items from Aerated concrete are manufactured in the manner described below: A mixture of ground sand and water is fed to the stirrer and mixed with cement, aluminum powder, water and ungrounded sand, after which the mix is cast into mound. After 7 to 8 hours of autoclaving, aerated concrete temperature at 175^0C and a pressure of 8 atm. Autoclaving enhance strength of aerated concrete and, in addition substantially reduce the consumption of cement which can thus be fully partially replaced by fly ash.

2.1 Casting of Self interlocking blocks by using Aerated concrete.

The casting procedure was done in aerated concrete manufacturing plant. The first step is assembling the moulds. Care should be taken that the mould is fixed tightly and there are no gaps are present. Then oil is apply on the mould to provide lubrication so that the blocks can be removed easily after the process is complete. The mould is kept on a stable horizontal surface before pouring the mixture of aerated concrete. The moulds are filled with the mixture up to 2/3 rd height of the mould. The mould is shaken gently to late out any entrapped air from the mixture, As this may cause cracking and cavitations in the finished product. The moulds are kept a side for 1 to 2 minutes to allow the mixture to rise. The excess mixture is removed from the top of the mould with help of a steel wire. The moulds along with the mixture are carefully kept inside Autoclaving unit for 7 to 8 hours to allow aerated concrete to set properly. The moulds are removed after 8 hours and the moulds are disassembled.

Fig -7: AC material mixing machine

Fig -8: Assembled mold and oiled for pouring of AC mix

Fig -9: Filling the molds with AC mix

Fig -10: Molds filled up to 2/3rd height and left for rising

Fig -11: Mold after AC has fully risen

Fig -12: Autoclave for 8 hours

2.2 Testing of the Self interlocking system of the blocks

Self interlocking blocks depend on interlocking system for their stability. This blocks can be prepared with any desired material therefore the steps carried out should be done for checking the performance of the interlocking systems and should not be based on the performance of the material. The test assembly that we have utilized consist of L shaped wall of 2-meter length with first half having length 1 meter and other half perpendicular to the first half having length 1 meter. The height of the wall is taken as 1 meter. A vibrating table is used to induced the vertical and the horizontal forces on the wall. The wall was assembled on the vibrating table as per layout. The wall consisted of total 38 blocks out of which 10 blocks were corner blocks which were designed for perpendicular layout and remaining 28 blocks were designed for straight laying. The vibrating table was switched on and observations and vibrations were applied until failure was detected in the wall. The further analysis was carried out and results were taken.

3. Results

The results of the experimentation carried out until detection of failure are given. The mode of failure and the reason behind is stated for the test.

1) The failure was detected after 2 minutes of vibration.
2) The mode of failure was observed to be shear.
3) The failure took place in the vertical grooves of interlocking system.
4) The failure took place because of the test of the groove and key provided in the vertical interlocking system.
5) The groove and key are at 90 degree to the horizontal and have circular cross section. This causes development of shear stresses at the joint of the groove and top surface of the block.

Sample paragraph Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

4. CONCLUSION

The interlocking system designed works satisfactorily. Upon application it was observed that the blocks failed in the vertical interlocking system. The cause of failure was observed to be shear. Shear took place due to the shape of the protruding portion of vertical interlocking system and the top surface of the block. The reason for shear was found out to be the cylindrical shape of the protruding portion. Hence changes must be made in the shape to eliminate the failure. The horizontal interlocking system on the other hand worked efficiently. Yet during

transportation of blocks from casting area to testing area some blocks got damaged in places where dimensions of portions were less than dimensions of rest of the blocks. Hence, we can conclude that the blocks may work effectively in a wall as a group but are susceptible to damage as individuals. Also, natural frequency the constructed wall was not calculated. Hence more work needs to be done on method of testing. The process of making wall was eases due to the system of interlocking. It assisted in linear progression of brick laying and also helped in maintain plumb in vertical progression. In the end it can be concluded that adoption of interlocking system instead of conventional masonry is beneficial in terms of economy, time taken for construction. But more work needs to be done on the interlocking system itself to improve the performance of wall and also on the tests to check the performance of the wall. Compared with conventional masonry, the dry assembly of interlocking blocks saves construction time and a large amount of mortar, which would otherwise be required for the horizontal and vertical joints.

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