FLEXURAL STREI BEAM LATERITE SOIL

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ABSTRACT

Load bearing interlocking block (LBIB) is one of the methods in Industrialized Building System (IBS) as classified by the Construction Industry Development Board Malaysia (CIDB). Using the LBIB in the construction of houses is fast and does not require formwork. The channel blocks act as permanent formwork constructed as beams where lintels are placed above window and door openings. The aim of this research is to determine the flexural strength of lintels constructed using the interlocking channel blocks. Two types of channel blocks were used and two types of arrangements for block types and reinforcements were constructed. Four point bending test were carried out for the two beams of length 1800mm span. The experimental results were compared to theoretical calculations from basic mechanics of materials for composite beams and a formula derived by (Pongburanakit and Aramraks,2006). Results shows that the arrangement of two layers of channel blocks gives stronger flexural strength compared to that of the face to face channel blocks.

ABSTRAK

Block saling kunci tanggung beban (LBIB) adalah salah satu kaedah Industrialised Building System (IBS) diklasifikasikan oleh Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB). Menggunakan LBIB di pembinaan rumah adalah cepat dan tidak memerlukan acuan. Blok saluran bertindak sebagai acuan tetap dibina sebagai rasuk mana lintels diletakkan di atas tingkap dan bukaan pintu. Tujuan kajian ini adalah untuk menentukan kekuatan lenturan di atasnya dibina menggunakan blok saluran saling. Dua jenis blok saluran telah digunakan dan dua jenis pengaturan untuk jenis blok dan bala bantuan telah dibina. Empat titik ujian lentur telah dijalankan bagi kedua-dua rasuk rentang 1800mm panjang. Keputusan eksperimen dibandingkan dengan pengiraan secara teori daripada mekanik asas bahan untuk rasuk komposit dan formula yang diperoleh oleh (Pongburanakit dan Aramraks, 2006). Keputusan menunjukkan bahawa susunan dua lapisan blok saluran memberi kekuatan lenturan yang lebih kukuh berbanding dengan muka untuk menghadapi blok saluran.

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LIST OF SYMBOLS

ASTM	-	American Society for Testing Materials
Kg	-	Kilogram
kN	-	Kilo Newton
mm	-	Milimeter
N/mm^2	-	Newton per millimeter square
%	-	percent
Vs	-	Versus

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Masonry is one popularity conventional method for building construction in its type. This is widely using due to the useful properties such as durability, relatively low cost, faster construction, good sound and heat insulation, acceptable fire resistance, adequate resistance to weathering and attractive appearance. For past 60 year, technology to development and improve had been done by the researcher to seek the convenience way due to the technique of manufacturing and constructing this interlocking block. Research has now reached a more advanced stage with only begins with the use of soil-cement blocks for load bearing structure since the 1940's to the development of mutual discovery block techniques since the 1980's.(Jayasinghe & Mallawaarachchi, 2009) As a result, interlocking blocks became one of the economical alternatives to construction for low rise buildings.

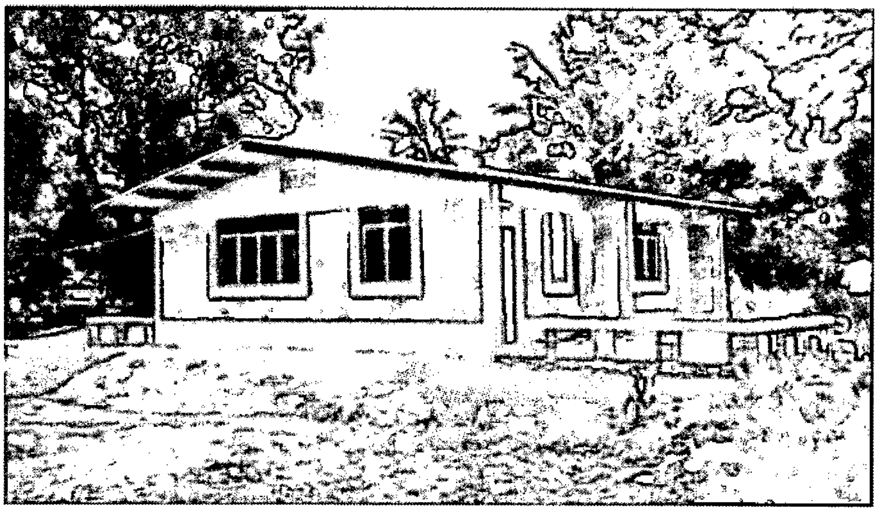

Figure 1.1 low rise building using interlocking block

(http://www.gtz.de/BASIN/gate/INTERLOCKING.HTM)

This system also is declaration as an IBS system due to the concept and the making the construction faster and low man power at site. Rahman and Omar (2006) defined IBS as a construction system using pre-fabricated components to build. The manufacturing of the structure is done using machine, formworks and other forms of mechanical equipment. Shaari, Bulletin Ingénieur, (2003) define this IBS systems as a techniques used in making construction less labor-oriented, faster as well as quality controlled. It generally involves prefabricated products, factory manufactured elements that transported to the construction sites and erected.

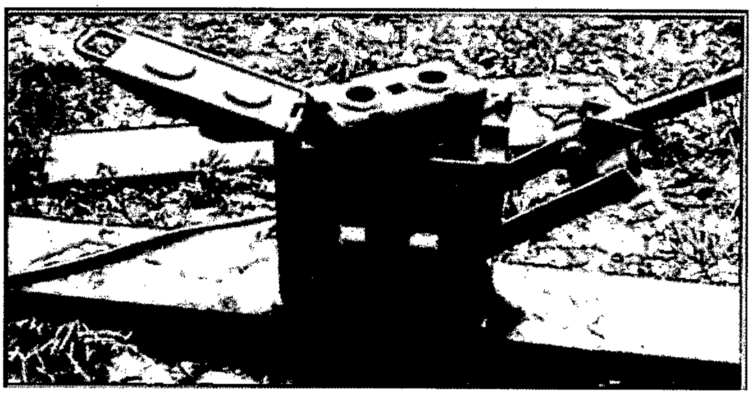

Figure 1.2 Compress Block Machine

(http://www.gtz.de/BASIN/gate/INTERLOCKING.HTM)

Block interlock has various form, it have tongue and had channel at bottom surface which aims to tie or lock between blocks. With this presence component in interlocking block, it will restrain horizontal movement when laying the interlocking block on top without mortar usage as binding to make wall strong enough to resist load from wind and carry loading from the upper slab or floor same to the conventional load bearing wall (Omar, 2009). At present, there are many different forms; dimension and geometry are produced, according to manufacturer and the usage of the block. Various size and dimension will give different (Aris, 2010)strength each. The strength depends on the material used and the dimensions and size to produce blocks. Normal interlocking block with sandcrete is weaker than interlocking block using laterite soil (Raheem, Momoh, & Soyingbe, 2012). Laterite soil can give more strength in flexural strength interlocking block compare to normal concrete and sandcrete, it also in low cost to produce.

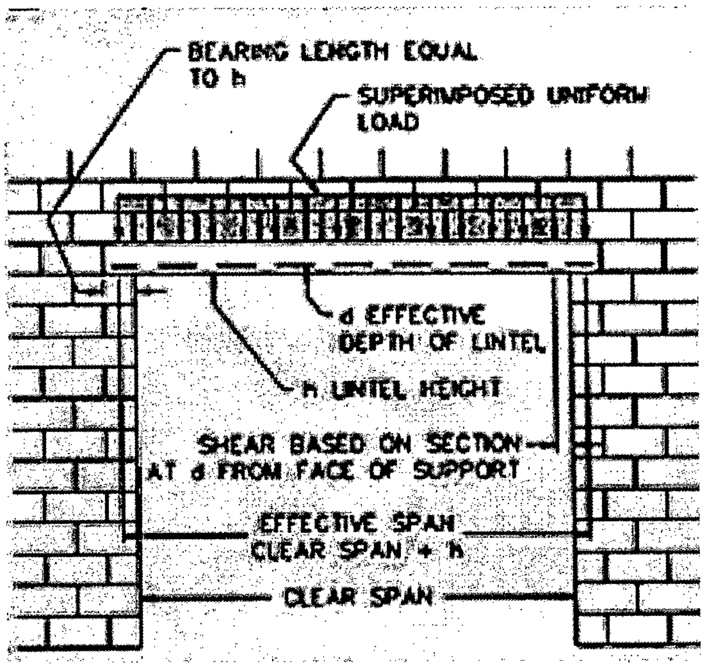

Figure 1.3 Lintel beam position

(http://www.fendtproducts.com)

In conventional method of construction, lintel beam is use to support load above of opening in building. The opening includes the window and door. For masonry method, interlocking block beam is alternative to solve the problem to replace the conventional method using the formwork.

1.2 PROBLEM STATEMENT

1. Lintel produce must use lots of formwork; using interlocking block beam can be decrease of wastage.
2. Using interlocking blocks to make a lintel is difficult, it cause by the hole at the block and problem regarding placement reinforcement steel bar at both end of the lintel.
3. Normal mix just adequate flexural strength, so it needs to increase the strength of interlock block to increase the beam strength.

1.3 OBJECTIVE

1. To determine the effect of interlocking block using laterite soil on the flexural strength of interlocking block beam.
2. To determine the effect of placement of reinforcement steel bar on the flexural strength of interlocking block beam.

1.4 SCOPE OF WORK

This is study is mainly about the interlocking block beam in the interlocking system for low rise building construction. In this research, we will replace the mix of interlocking block using laterite soil for properties in block. We will compare with previous research by S.F Omar 2009 flexural strength of interlocking block beam best arrangement of block and reinforcement placement. The result will be compare which one is better between normal one and using laterite soil for production, and we also will try another one arrangement combination of block and steel bar to try the new combination which can produce more strength than previous one. The result of this study will be very useful for ensuring the capability of the interlocking block beam in different material to replace lintel in construction of low-rise building construction.

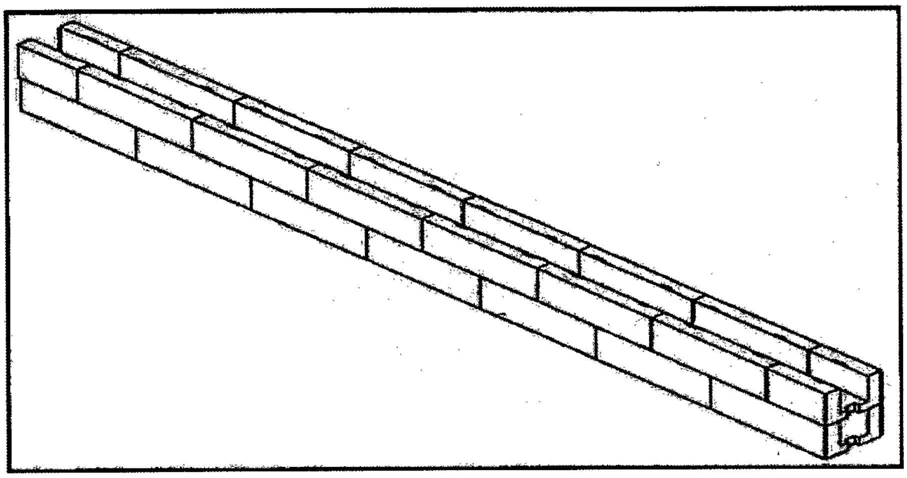

Figure 1.4 Best Arrangement by (Omar, 2009)

1.5 SIGNIFICANCE OF STUDY

This research is mainly to test the strength of the laterite soil material in producing interlocking block to make an interlocking block beam as replacement for lintel in low rise construction. With this research, will provide the knowledge to Malaysian about the various option to construct and material to use in order to give high strength and low cost.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Interlocking block or IBS is a system now used everywhere in world. In Malaysia, interlocking block is used to construct the low-rise small building for the time save consumption and cost effective term. With this factor, this system was used to developing low-cost houses with proven better than conventional method in term of time and cost. By using the laterite soil as material to provide the block, it will reduce the cost of materials that are easily available with low price. It also can build many type of building, the main design constraints being that the plan should be rectangular and all wall dimension openings must be more width. All the other principle of design and construction are the same as other standard building conventional.

2.2 VARIOUS IN SHAPE AND SIZE

For differ in shapes and sizes, those are full blocks (300x 150x 100 mm) for all standard walls (single or double brick thick), half blocks (150 x 150 x 100 mm), which can be molded to size, or made by cutting freshly molded full blocks in half and channel blocks, same sizes as full and half blocks, but with a channel along the long axis, into which reinforcing steel and concrete can be placed to form lintels or ring 9 beams which also called U-shape block and the vertical sides of the blocks can be flat or have recesses, and the vertical grout holes can be square or round. The interlocking U-block or U-shape block is a special configuration of blocks. The interlocking block beams composed of difference materials such as cement mortar, interlocking U-shape blocks with steel reinforcement at the bottom layer and regular interlocking blocks at the top layers. The purpose of having various size of interlocking block is to give various functions to the interlocking block itself. Full blocks are the standard blocks for construct beam. Half blocks are also use in constructing beams.

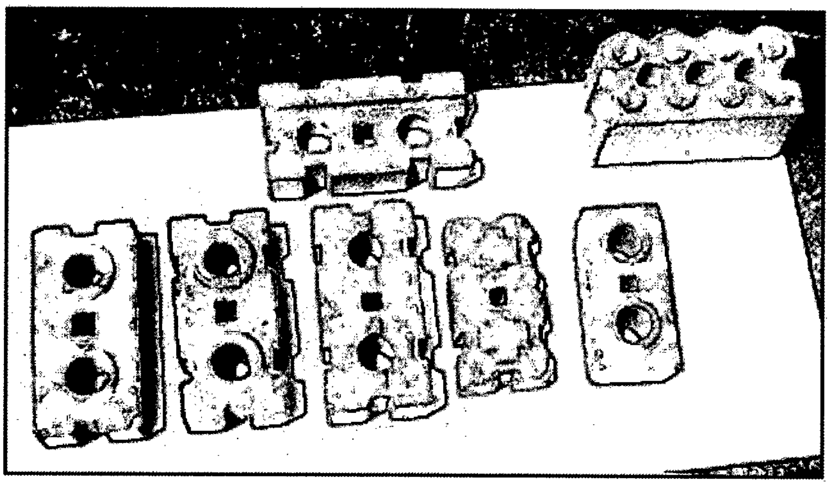

Figure 2.1 Various Type of interlocking Block

(http://www.gtz.de/BASIN/gate/INTERLOCKING.HTM)

2.3 DEVELOPMENT OF VARIOUS INTERLOCKING BLOCK

In recent past, this technology has been developing by varieties of research in this block. R. Thallon was the one develop for the construction of single-storey house. In the manufacturing process, the block will press through a machine those grids the top and bottom surfaces. This is for make sure the block can be laid up without mortar easily. The locking mechanism at block at sides will help to ensure the alignment of block during placement process. Grout is used to fill the core ((Thanoon et al., 2004)).

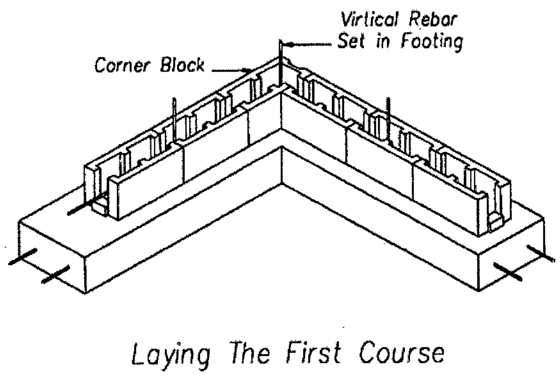

Figure 2.2 Interlocking block developed by (Thanoon et al., 2004)

In the Haenar development system by R. Thallon, for the construction of load bearing walls, three types of blocks are used as shown in Fig. 2.3, The alignment in Haenar blocks is achieved by providing interlocking keys at the sides, while the interlocking between the blocks is ensured by providing a key the top of the blocks in addition to the inside inclined web at the bottom. The inside web acts as a support to the top key to interlock the blocks. This interlocking mechanism is efficient to ensure self-alignment. Both horizontal and vertical reinforcement embedded in grout has been recommended to be placed at suitable intervals for load bearing walls. (W.A. Thanoon et al, 2004).

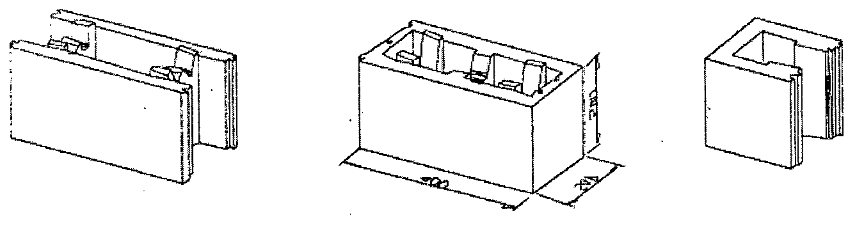

Figure 2.3 Haenar Interlocking system (Thanoon et al., 2004)

2.4 LATERITE SOILS

Laterite is a tropical soil that is rich in iron oxide and is usually derived from rock weathering. It forms in tropical and sub-tropical regions where the climate is humid (Mahalinga-Iyer and Williams, 1997).A modern interprelation on laterite state that laterite are the product of intensive and long lasting tropical rock weathering which is intensified by high rainfall andelevated temperatures. Bishopp(1937) defined laterite as the end or apical product of process of rock degradation which may stop short at the formation of the hydrated silicates, clays or lithomarge or continue right on to hydrate according to chemical and physical environment and nature of the parent rock.

Regarding the definitions based on hardening property, the term laterite was firstly introduced by Buchanan (1807) to describe a ferruginous, vesicular, unstratified and porous material with yellow ochres due to high iron content occurring in Malabar, India. This material is soft enough to be cut by trowel and will harden upon in contact with air, It was locally used by the native as brick for building and hence Gidigasu named it laterite from a Latin word "later" meaning brick. Fresh laterites are generally reddish or orange in colour. Upon exposed to continuos weathering, changes of chemical compound of the laterite soil will then leads to colour change. A colour change indicates the degree of maturity and is due to the various degree of iron, titatium and manganese hydration (Posnjak and Mervin, 1919).

The utilization of earth in housing construction actually is the oldest and most common methods used. However, soil generally considered as heavy and has low strength. But by the additional of stabilizer and compressed, the soil can have a high strength in compressive. The stabilizers that usually used for soil in improvement of soil strength are cement and lime (Raheem et al., 2012). This has been proved in a study by Reheem et. al (2010) which is cement stabilization involves the addition of small amount of cement while lime stabilization refers to the process of adding burned limestone product in order to improve the laterite soil properties. However, in their study it mentions that cement stabilized blocks is better quality in term of compressive strength, water absorption and durability compared to those stabilized with lime.

2.5 IMPROVING LATERITIC SOILS

The cost and the time will be cut for the stabilization process that done to the soil in purpose to the construction material. But this process is very complex because many parameters come into play. The knowledge properties can helps to better consider what changes, the economic studies, as well as production and construction techniques to use. The easier process consist of taking soil and drying it in open-air. Heat treatment, also one of the improving methods, and mixing with soil, ordinary Portland cement, lime, *etc.* there are principle for stabilization process such as cement stabilization, lime stabilization, chemical stabilization, physical stabilization and mechanical stabilization.

2.6 PRODUCTION OF INTERLOCKING BLOCK

Production of interlocking blocks depends on the block type, material used, quality required, and available resources. It is produced in special moulds where compaction can be done by hand or mechanically. The blocks can be made on a large scale in production yard or directly at a construction site (Uzoegbo H.C. and Ngowi J.V. 2002)

Laterite block acquire tamping or better steel vibration for proper compaction. This makes the manual block press to be not suitable. In term of great quality, high compaction performance can be achieved by placing the mould on a vibration against the sides. Manual tamping is done by jabbing the mix with a piece of wood or dropping the filled mould several times. Last stage is curing process where the block will be sack with the gunny and sprinkler water for several time.

2.7 LINTEL

In residential and commercial buildings of concrete masonry, lintels are often used to span openings min the walls. These horizontal members function as beams in supporting the weight of the wall, as well as other dead and live loads over the openings, and transmitting these loads to the adjacent masonry. Flexural strength, shear strength, and deflection are critical to the design of lintels. Because of their rigidity, strength, durability, fire resistance and aesthetics, the most common types of lintels for concrete masonry construction. Lintel also can be referred as small beam, usually use minimal reinforcement due to small load acted on it. lintel can be build by wood, steel, reinforced concrete or pre-stressed concrete; depends on the amount of loading that have to be carried by the element.

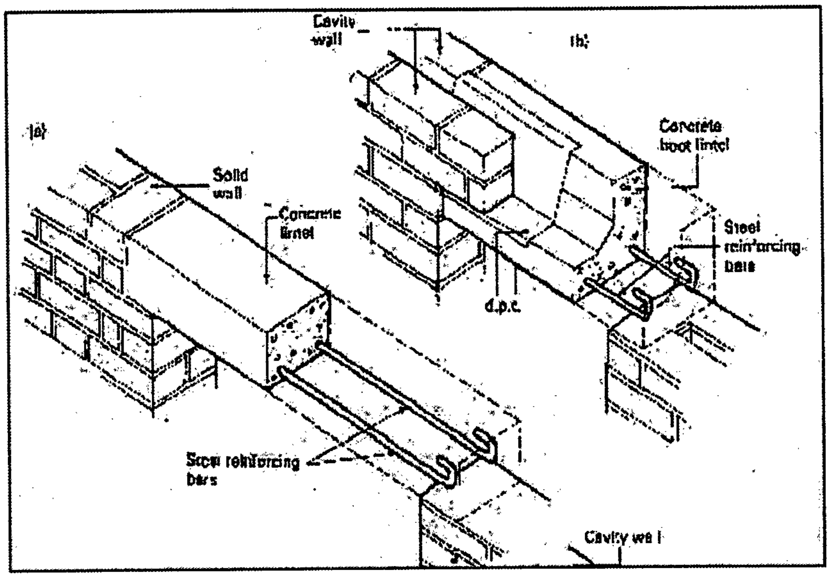

Figure 2.4 Typical reinforced concrete lintels (Omar, 2009)

2.8 MORTAR

The mortar that binds bricks, stone, and construction blocks together into a whole masonry is called masonry mortar. The load-bearing ability of masonry depends on not only the strength of bricks and stones, but also the strength of mortar. Mortar is plastic material with a low water/cement ratio and high in cement content. Mortar must be tough in order to be handled and trowel, to spread in the masonry placed it on. It stiffness is required for the masonry to bond around the locking block to be tough and strong. With the less consumption of water consumption, this ratio is further will decrease after the mortar is spread on the bed and the masonry units placed on it. Any excess water in mortar is absorbed both down into the masonry units placed on it. Regarding the research by S.F. Omar (2006) the result by compressive strength of specimen for mortar is 21 N/mm².