

# A Review Paper on Self Interlocking Masonry Block by Using Recycled Aggregate with Brick Masonry

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**Abstract** - The main aim of this paper is to carry out the environmentally based enhancement of a concrete mixture containing recycled materials whilst considering natural resource consumption as well as mechanical and thermal property levels. The developed concrete is intended to be used in mortar less masonry wall structures. Ten concrete mixtures with different types and replacement rates of recycled masonry aggregate and recycled expanded polystyrene were prepared, and their mechanical and thermal properties were experimentally investigated. It was found that the use of recycled masonry aggregate led to better thermal properties while maintaining sufficient mechanical properties. On the contrary, the addition of recycled expanded polystyrene did not significantly affect the thermal properties of concrete, but the mechanical properties considerably declined. For this reason, the recycled masonry aggregate is suitable to use as an aggregate for concrete masonry blocks for wall structures.

**Index Terms** - Cost effectiveness, Time effectiveness, Quality control, Quantity parameter.

## I.INTRODUCTION

A. Masonry- Masonry is a construction of building units bonded together with mortar. The selection of the type of material i.e. brick or stone etc. for the masonry is made keeping in view the requirement of strength, waterproofing, thermal insulation, fire resistance, durability and economy. Masonry is basically a wall material. Masonry walls can be divided into following three categories-

### 1. Load bearing walls

A wall designed to carry superimposed loads from floors and roof is termed as load bearing wall. Such

walls have continuous foundation to carry the entire superimposed load including their self-weight.

### 2. Non-Load Bearing Walls

Also known as panel wall, curtain wall or filler wall is a type of wall which carries no superimposed load. It is provided to serve as a screen for privacy and to keep out wind and weather. The load from floors and roofs in this case is borne by either brick piers or by system of RCC or steel beam and column frames.

### 3. Retaining Wall

This is type of wall built to resist the pressure of earth, granular material or liquid field behind it after it is built.

Depending upon type of material used, masonry can be broadly divided in the following categories-

### B. Brick Masonry

Construction of brick units bonded together with mortar is termed as brick masonry. The strength of the brickwork primarily depends upon quality and the strength of the brick, the type of mortar and method of bonding, adopted in construction. In addition, the strength of brick wall is also dependent upon its slenderness ratio, lateral pressure due to wind and degree of soundness in construction. Mortar not only acts as a cementing material but also impart strength to the work by holding the individual brick together to act as a homogeneous mass. Mortar is usually a mixture of cement and sand or lime and sand or a mixture of three.

#### 1.Bricks can be divided into two types

##### Traditional Bricks

Its dimension varies from 21 to 25cm in length, 10 to 13cm in width and 7.5 cm in height in different parts of the country. The commonly adopted nominal size of traditional brick is 23x11.4x7.6cm.

### Modular Brick

With a view to achieve manufacture of uniform size of bricks all over the country IS institution has established a standard size for the brick. Such a brick known as Modular brick. The nominal size of modular brick is taken as 20x10x10cm whereas its actual dimensions are 19cmx9cmx9cm.



Fig No.1 – Brick masonry

## 2.Types of Bond in masonry construction

### Stretcher Bond

Longer narrow face of brick is called a stretcher as shown in elevation of fig below. Stretcher bond also called as running bond, is created when bricks are laid with only their stretchers. Showing overlapping mid-way with courses of bricks below and above.

### Header Bond

Header is the shorter square face of the brick which measures 9cmx9cm. Header bond is also known as heading bond in header bond. All bricks in each course are placed as header on the faces of walls.

### English Bond

English bond in brick masonry as one course of stretcher only and a course of header above it i.e., it has alternating courses of stretcher and headers. Headers are laid center on the stretcher in course below and each alternate row is vertically aligned to break the continuity of vertical joints, quoins closure is used in the beginning and end of wall after first header.

### Flemish Bond

For the breaking of vertical joints in the successive courses, closure is inserted in alternate courses next to the quoin header. Flemish bond is also known as Dutch bond, is created by laying alternate headers and stretchers in a single coats.

### Stone masonry

The construction of stones bonded together with mortar is termed as stone masonry where the stones are available in abundance in nature, on cutting and dressing to the proper shape, they provide an economical material for the construction of various

building components such as walls, columns, footings, arches, lintels, beams etc.

### Types of Stone Masonry

#### Un-coursed squared rubble

In this type the stone blocks are made roughly square with hammer. Generally, the facing stones are given hammer-dressed finish. Large stones are used as quoins. As far as possible the use of chips in bedding is avoided.



Fig. No.2 – Stone masonry

#### Ashlar Masonry

This type of masonry is built from accurately dressed stones with uniform and fine joints of about 3mm thickness by arranging the stone blocks in various patterns. The backing of Ashlar masonry walls may be built of Ashlars masonry or rubble masonry.



Fig. No.3 – Ashlar Stone masonry

#### Composite Masonry

Walls constructed from two or more building materials are termed as composite walls. The combination may be stone slab in the face work and brick masonry at the backing, or superior stones in the facing with rubble stone masonry at the backing and so on. Composite masonry is adopted to improve the appearance of the structure by concealing the inferior work by use of superior quality of material in the desired positions. The result in great saving in cost and, if properly constructed, the structure remains equally strong and durable. Stones, bricks, concrete and tiles are the materials commonly used in such constructions.

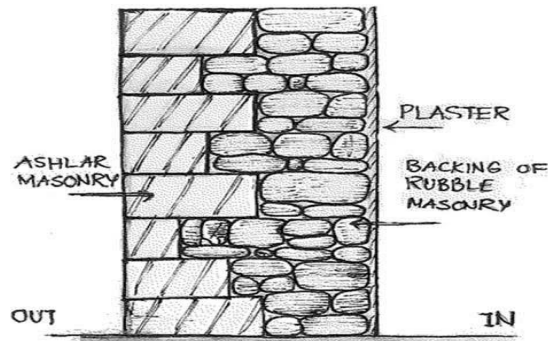


Fig. No.4 – Composite masonry

#### Advanced Masonry Construction (Concrete Block masonry)

Concrete block masonry which is also known as concrete masonry unit (CMU) have advantages over brick and stone masonry. Concrete blocks are manufactured in required shape and sizes and these may be solid or hollow blocks. The common size of concrete blocks is 39cm x 19cm x (30cm or 20 cm or 10cm) or 2-inch, 4-inch, 6-inch, 8-inch, 10 inch and 12-inch unit configurations.

Cement, aggregate, water is used to prepare concrete blocks. The cement-aggregate ratio in concrete blocks is 1:6. Aggregate used is of 60% fine aggregate and 40% coarse aggregate. Their Minimum strength is about 3N/mm<sup>2</sup>.

Types of Concrete Blocks or Concrete Masonry Units- Depending upon the structure, shape, size and manufacturing processes concrete blocks are mainly classified into 2 types and they are

#### Solid Concrete Blocks

Solid concrete blocks are commonly used, which are heavy in weight and manufactured from dense aggregate. They are very strong and provide good stability to the structures. So for large work of masonry like for load bearing walls these solid blocks are preferable. They are available in large sizes compared to bricks. So, it takes less time to construct concrete masonry than brick masonry.



Fig. No. 5 – Solid Concrete Block  
Hollow Concrete Blocks

Hollow concrete blocks contain void area greater than 25% of gross area. Solid area of hollow bricks should be more than 50%. The hollow part may be divided into several components based on our requirement. They are manufactured from lightweight aggregates. They are light weight blocks and easy to install.



Fig. No. 6 – Hallow Concrete Block

#### Drawbacks of conventional masonry construction

- Conventional masonry construction is slow which increased project duration.
- It requires more material to construct.
- It requires more natural material which are not adequate hence it causes un-availability of material.
- Conventional masonry requires plastering for getting smooth surface.

By considering above drawbacks there is need to identify innovative masonry to supplement age-old concrete and masonry work. To overcome above drawbacks we need technologies which are sustainable in terms of one or more parameters i.e. - locally available resources, effectiveness, ecofriendly, easy to adopt in construction practice, faster to build and energy efficient. The self-interlocking block (SIB) is one of the technologies.

#### Introduction to Self-Interlocking Block (SIB)

The blocks which are locked against each other without use of cement mortar to form a structurally stable wall that reduces the cost and time of construction to almost half.

- At present there is a high demand for houses in India which is finding difficult to be fulfilled by builders and contractors adopting relatively slow construction practices leading to high construction cost.
- Thus, there is demand for products 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 activity in the context of material requirement, speed & cost. Partitioning unit is costing 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 product named “Self-Interlocking Blocks”. It will be used in partitioning the space in framed buildings. It will not demand mortar for construction & plastering to conventional extent. It will reduce the material & labour cost of partitioning of space and will speed up the construction.



Fig.No.7- Few Interlocking bricks available in market

- Generally for casting of SIB the material such as Clay, Concrete, Fly ash etc. is commonly used, but for good strength concrete is preferable. In concrete natural aggregates are used. From environmental point of view, for production of natural aggregates of 1 ton, emissions of 0.0046 million ton of carbon exist whereas for 1ton recycled aggregate produced only 0.0024 million ton carbon is produced. Considering the global consumption of 10 billion tons/year of aggregate for concrete production, the carbon footprint can be determined for the natural aggregate as well as for the recycled aggregate. The use of recycled aggregate generally increases the drying shrinkage creep & porosity to water & decreases the compression strength of concrete compared to that of natural aggregate concrete. The recycling and use of construction and demolition waste

seems to be feasible solution in the construction after the natural disaster or demolition of old structure due to shortage of aggregate and increasing transportation cost, there is continue pressure to use recycle material in the construction industry as these material can provide cost effective and environmentally friendly alternatives to the NA.

- The waste can be originated from the various operations and before, during and after construction. They found that there are several causes of construction waste according to the origin of the waste.



Fig. No 8- Construction and Demolition waste

## II. LITERATURE REVIEW

Use of recycled aggregate in moulded concrete brick and block

C.S.Poon, S.C.Kou, L.Lam, 05th July, 2002, Elsevier Science Limited” Volume 16

This study aimed is to developed technique for producing concrete block from construction and demolition waste. Replacement of aggregate by recycled aggregate by 25%-50% shows little effect on compressive strength. By replacing 50% aggregate it results in compressive strength 49Mpa with incorporation of fly ash.

Study of new interlocking stabilized compressed earth masonry block

RuteIres, Thomas Sturm, Aires Camoes, Luis Ramos, April 2012,“Research in material and technology for construction and contemporary architecture conference paper”

In this paper it is found that earth is available in every location of world hence compress earth block can be produced in-situ. This block are unburned and requires

very less energy to transport them. Currently there is ongoing study of optimal composite of soil for manufacture of CEB. This paper present some result from that it is conclude that CEB are cost effective opportunity for locals to have better houses while reducing deforestation.

Study of interlocking light weight cement block

R. Sayanthan, S. Imran, Mohamad Rifdy S.M.A Nanayakkara, 13<sup>th</sup> 14<sup>th</sup> 15<sup>th</sup> Dec, 2013 ,“4<sup>th</sup> International Conference on structural engineering And Management,”

Kandy ShriLanka

This paper developed interlocking light weight cement block in mix proportion of 1:1:2 of cement, Sand and Polystyrene beads to achieve target strength and density with water cement ration 0.35. From compressive strength and wall panel test they revealed that masonry wall can be constructed for five storied, and it was also observe ductile load deformation behavior at the failure of masonry panel.

To study the behavior of interlocking masonry block Sajad Ahmad, Sadam Hussain, MohdAwais, Mohd Asif, Hakim Muzamil, Rafiq Ahmad, Shakeel Ahmad, 03<sup>rd</sup> March 2014, “IOSR journal of engineering” Volume 04

This paper study was about the compressive strength analysis and cracking pattern of interlock pattern of Concrete block. In this study two different types of block were studied and it is seen that the compressive strength of this type Masonry is higher by 20% with respect to concrete masonry and 40% with respect to brick masonry and further cost saving is achieved because of its simplicity.

Performance of steel fiber reinforcement interlocking hollow block as load bearing wall

Sarath P, Pradeep P, ShemyBabu, Sept-Oct 2015, “IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)” Volume12.This paper facilities provision of electrical conduit, water, and sewer pipes without causing much damage to block. Hollow block strengthened with steel fibers can be effectively used as load bearing wall and it concludes that load carrying capacity of 90cm wide and 90cm high wall made with hollow block is compared with hollow block prepared by using locally available materials and it also gives higher strength and reduce cost of construction. Cost

of steel fiber is compensating by saving time of construction and avoiding plastering of wall. It reduces dead load by 28% and 11% compared to locally available solids and hollow blocks.

Concrete block production from recycled aggregate Aires Camoes, Luis Ramos, 01<sup>st</sup> Jan 2016, “Eindhoven University of Technology Nederland.

The aim of paper was to investigate the extent to which recycled aggregate is used for concrete block production. The reused of recycled aggregate the aim is not only to reduce down cycling but also to solve the problem of material storage. Aggregate was tested to understand their physical and mechanical characteristics and result were applied in design mix production of concrete block. The result shows that concrete block produced from recycled aggregate have achieved 7 N/mm<sup>2</sup> as minimum strength for load bearing capacity.

Design of interlocking block and replacement of m-sand by concrete roof tile waste.

I.P.Malavika, Nipuna M, Raina T.R, SreelakshmiA.V, Kripa K.M , 05<sup>th</sup> may 2017 , “International Research journal Of Engineering and Technology (IRJET)” Volume 04.

This paper deals with replacement of M sand by roof tile waste and finding optimum percentage of tile waste through testing cubes, casted for compressive strength with that optimum percentage of tile waste. Its result compared with ordinary solid block and that indicate the block are slighter lighter in weight, durable in aggressive environment and have better strength for their use in building construction.

Sustainable dry interlocking block masonry construction

Bansal Deepak, 2016, 15<sup>th</sup> international brick and block masonry conference.

There is need to identify innovative technology to supplement age old concrete and burnt clay brick mortar-based construction for masonry work. Today we need technology which is sustainable in terms of one or more parameters i.e, use of locally available resources like material and manpower, cost effectiveness, Eco friendly, easy to adopt in construction practice, faster to build and energy efficient.

### Development of interlocked blocks

Pravin Kumar, R. Vighneshwar, Aug 2017, journal of civil engineering and environmental technology

Cost effective earthquake resistant housing is desirable in seismically active in rural areas of developing countries. In this paper we can study it is anticipated that the mortar free construction can reduce the impact of earthquake to greater extent due to relative movement of interlocking blocks. In this study the general study about the existing interlocked patterns, sizes, types, and characteristic of our innovative interlocking.

### III. CONCLUSION

1. By using recycled aggregate for manufacturing of SIB there is saving of natural resources which ultimately prove it ecofriendly.
2. By performing compressive strength test it is conclude that the SIB has more strength than conventional masonry hence it is suitable for using in masonry work.
3. As block masonry does not require skilled labour and construction time require is less which conclude that it is beneficial to use than conventional masonry.
4. By performing friction test, the coefficient of friction for SIB (0.96) which is less than conventional brick (1.15) Which conclude that, it is suitable for resisting the sliding horizontally and vertically and also grooves and keys are strong enough to resist shear and deterioration due to minor impacts while handling.

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