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INTERLOCKING MASONRY SYSTEM

1.0 lkeU;@General

Interlocking Masonry System is an innovative technology that is suitable for both load bearing structures as well as framed structures – single or multi-story. It replaces the conventional brick and mortar by using the interlocking masonry blocks. The blocks offer keys that lock into the next layer of masonry, giving superior strength in case of a shear and tear stress event like an earthquake or a super-storm.

The technology is sustainable in terms of one or more of the following parameters i.e.

- use of locally available resources – material & manpower,
- cost effectiveness, eco-friendly,
- easy to adopt in construction practice,
- can be cast – in situ to reduce transportation,
- faster to build and energy efficient.

This masonry system, generally divided into two categories as **mortar** and **dry stack,** can be effectively used for earthquake resistant construction. The system is perfect for Indian conditions where 60% of land area is prone to earthquake i.e. under moderate to severe hazard (IS: 1893-2002).

2.0 ekVkM i}fr dh dfe;k@Drawbacks of Mortared System

The mortared system in a building compromises a masonry assembly's performance, often increasing maintenance and repair costs, mainly due to the reasons:

- Building mortared masonry is time-consuming, which affects the productivity rate to apply mortar and maintain the proper horizontal and vertical alignment.
- Many common workmanship problems relate to mortar e.g., moving a unit after its initial set; improper tooling; incompletely filling head and bed joints; omitting horizontal wire reinforcing; and leaving mortar droppings in cores to be grouted.

Minimizing such problems would greatly increase interlocking masonry's attractiveness to building owners and designers.

3.0 CykdkefdxBlock Making

A block is produced from a soil and cement mixture. The soil type is classified as a sandy – loam, which contains more sand than clay and silt (fines). Sub-soil one meter below ground level is preferred in block-making, leaving top soil that contains organic material.

If the clay content is too high, sand will need to be blended in with the soil. The clay keeps the block together so it is easy to carry the block during block-making.

The sandy portion is what binds with the cement to give the block its ultimate strength. Too little clay will make block handling difficult, too much clay will make the block shrink and crack during curing.

The interlocking blocks can also be made using industrial waste as additive to meet relevant technical requirements. These blocks are made using block making machine with an option to make them at the site of construction itself.

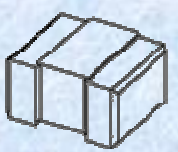
4.0 bVjykfdx i}fr d fl}kr@ Principles of Interlocking Systems

Any practical block system has to follow some basic principles:

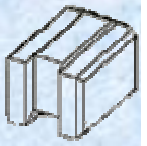
- **Ease of Design:** The interlocking mechanism must be clearly thought out and explained so that architects can understand how it works and design with it easily. The geometric relations of the system/ or blocks should be expressed as equations that allow design in accordance with established structural principles and building codes.
- **Ease of Production:** The blocks must be capable of being produced economically on conventional block machines.
- **Ease of Construction:** The system should be designed from the outset for un-grouted, partially grouted, or fully grouted applications.

5.0 bVjykfdx eluj Qhpj@Interlocking Masonry Features

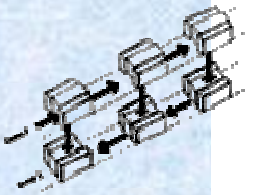
- **Interlocking Block:** An Interlocking Compressed Earth Block is referred to as a block, mainly of following sizes to suit standard application requirements:


220mm


220mm conduit


150mm

- **Interlocking Profile:** The locking of a male face of one block with the female face of another or the locking



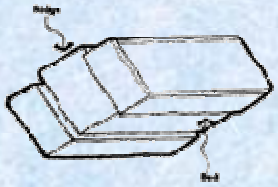
of the bed of one block with the ridge of the one below it is called Interlock.

- **Parameters for Interlocking Blocks:**

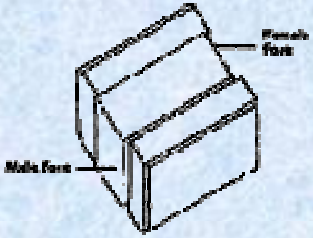
Para-meters	Block 220/ Conduit	Block 150
Use	External Walls /Boundary wall	Interior/Partition Walls
Width	220mm (9 inch)	150mm (6/4.5 inch)
Height	115 mm	115 mm
Length	100- 240 mm	100- 240 mm
Weight	9-11kg approx	4.5 -6 Kg approx

Other size options can be made depending on design requirement.

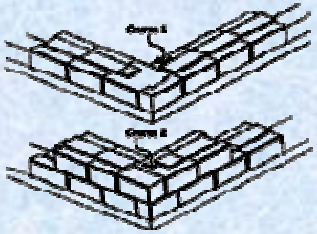
- **Bed and Ridge:** The recessed under surface of the block is referred to as the bed. The raised top surface of the block is called the Ridge.



- **Male and Female Face:** The side face of the block with an extension is called the Male face. The side face of the block with a recess is called the female face.



- **Block laying Courses:** One (horizontal) layer of blocks is called a course. Height of a course = 115 mm.



6.0 Mk;&LVDM bVjykfdx eLujh i}fr@Dry-stacked Interlocking Masonry System

The dry-stacked masonry comprises of *compressed earth blocks/ fly-ash interlocking blocks* that can be laid dry-stacked or using minimal mortar slurry in a stretcher bond.

- The system enables aesthetic and affordable building, speedier construction of high quality in stretcher bond. The walls may be left exposed, plastered or finished with cement paint.
- A mortar-less method of constructing masonry, in which blocks are not laid on mortar except first two block layers above DPC and top two courses leading to roof band. As per the requirement of IS 4326:1993 (Indian Standard on Earthquake Resistant Design and Construction of Building – Code of Practice), a thin mortar of the specified type can be used even in these Interlocking types of the blocks.



- There are many examples of dry stacked structures, one such being in the Egyptian Pyramids that relied on their self weight to resist external forces through interlocking mechanisms of shear keys.

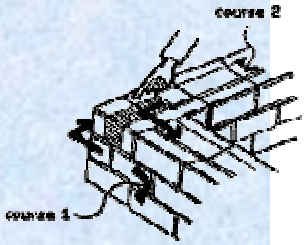
7.0 i.krk fodYi@Completion Options

Depending on the building's final occupancy, the assembly can be completed in one of three ways: plain, surface bonded, and grouted.

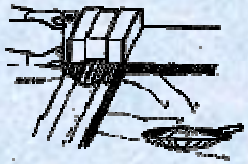
- **Plain dry-stacked units** can be used for retaining walls, foundation walls, partitions, and load-bearing walls up to about 9 feet tall in structures not intended for human occupancy.
- **For surface-bonded walls**, dry stacked units can be finished on both sides with a cementitious or acrylic bonding matrix reinforced with fiberglass mesh or plastic fibers as a rain and air barrier, as well as providing the final surface finish and color. Height limits can be as high as 21 feet 8 inches for two-story load bearing walls.
- **In grouted construction**, dry-stacked units have their cores partially or fully filled with grout, including horizontal and vertical reinforcement. Reinforced, grouted walls provide masonry assemblies with properties and load capacities similar to conventional reinforced masonry systems. Height limits can approach 36 feet for three-storied load bearing walls.

8.0 fuek.k gr lkekU; fcUn@General Points on Construction

a) Corners:

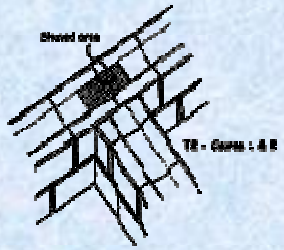


Masonry should be started at the corners. One must start the first course with a shaved ½ block. It must be remembered to shave off the ridge and male face of the corner block, and further ensuring that the shaved ridge points upward

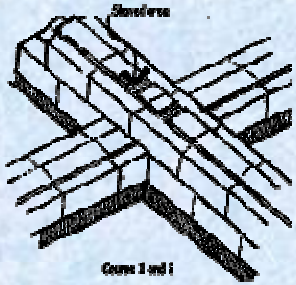


and the shaved male face point's outwards. The aim is to make the corner an integral part of the structure.

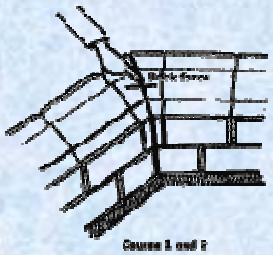
b) T Junctions: For a T Junction of n courses, shaved ½ blocks and shaved full blocks are required to start the first course having shaved faces pointing upwards.



c) Cross-Junctions: For a cross junction that is an integral part of both the walls, only full blocks with ridges shaved off are required, ensuring that there are no straight joints.



d) Joints and Angles: Each course will have to be connected at the corner with a brick force that should be always nailed in the centre of the block and not near the edge.



9.0 Mk;&LVDM bVjykfdx elujh d ykHk@Benefits of Dry-stacked Interlocking Masonry System

- Reduction of building costs due to saving in construction time.
- Reduced requirement for skilled labor, costly material (cement) and reusability of blocks.
- Blocks are water cured and do not require burning of Fuel.
- Wall face surfaces are even. Plastering not required but can be done as an option.
- The requirement for un-skilled labor makes dry stacking particularly attractive against labor based work.
- Self-aligning masonry system that uses minimal amounts of mortar (or no mortar).
- Problems associated with mortared joints e.g. inadequate bond and mortar cracking that provide an obvious path for water penetration would no longer be factors in dry-stacked assembly's performance.
- Quality control of the assembly would lie with the manufacturer of the interlocking block, substantially reducing responsibility at the job-site.
- Using interlocking units without mortar, the mason could put more units in the wall in a given period of time. Output has been as much as 900 to 1,200 units a day per crew.
- The combined effect of less skilled labor and increased output has been estimated to reduce labor cost by as much as 80%.
- Interlocking block provide stability during construction, floor and roof loads could be placed on wall assemblies without waiting for mortar to cure, thus further speeding construction.
- The blocks have an extremely appealing face-brick finish and provide a pre-pointed straight masonry that uses minimal or no mortar. The thickness of the masonry can be controlled giving more carpet area and less cubic contents of the blocks.

10.0 bVjykfdx Cykd&od dh mi;Drrk @Suitability of Interlocking Block-work

- **In Load Bearing Masonry:** Since blocks are on 220 mm width and can be made of block strength > 75 N/mm^2, same can be safely used for Load Bearing construction. In terms of IS 1905, masonry can be done with thin mortar slurry of 1:3.
- **In Framed Structure Masonry:** Brick/ block work is to be used as an infill only. Dry-stacked block work can be used in out-walls of +/- 220 mm thickness. For block work of lesser width it is recommended to use mortar slurry.



- **In Reinforced Masonry:** Interlocking blocks with horizontal and vertical cavity provide an ideal solution for using reinforcements to suit the structural design requirements, of reinforced masonry.



- **In Boundary Walls:** Dry stacked block work is well suited for this application and is very fast, aesthetic and cost effective.



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