

Urban Energy Technical Note



Interlocking Stabilised Soil Blocks (ISSB)

The Eco-friendly Building Material

Building materials play a significant role in sustainable architecture. The choice of materials is crucial from the perspective of both the thermal performance and the environmental impact of the building.

In all tropical countries, traditional construction materials and methods are still used in buildings. Some of the advantages of traditional materials are their plentiful supply, low environmental impact, low cost, and good reaction to climate; moreover they can be handled by local skilled labour, who are familiar with both the production and repair of traditional constructions.

The use of modern building materials, which are generally imported, is now developing in towns. These are the materials used in developed countries and are characterised by a high environmental impact, especially as far as the embodied energy is concerned. It is thus desirable to focus on alternative materials that combine tradition and innovation, in order to reduce costs and energy consumption.

Eco-friendly materials are characterised by low embodied energy and low related emissions; they are durable and convenient for recycling and reuse.

Traditional building materials are mostly made from naturally available materials such as clay, stone, sand and biomass.

The selection of appropriate materials should be driven by local/ regional and environmental considerations.

Completed house built with Interlocking Stabilised Soil Blocks



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Appropriate technologies refer to materials, methods and/or practices which help protect the natural environment, take inspiration from the cultural values and practices in the area, make use of local resources, and contribute to local economic development.

Interlocking Stabilised Soil Blocks (ISSB) are made of a compacted mixture of soil and a stabilising agent such as lime or cement. They are formed in moulds that form grooves within the blocks such that they interlock horizontally and or vertically.

This technical note focuses on the use of Interlocking Stabilised Soil Blocks as an alternative building material.

Advantages of ISSB

Structural

- ISSB technology allows the production of uniform blocks with greater strength than fired blocks, concrete blocks etc. These blocks have a high density which gives it more load bearing capacity and improved water resistance.
- Due to the high density and thermal properties of soil, these blocks provide better thermal insulation by the ability to absorb heat during daytime – keeping buildings cool inside, and to release that heat inside buildings at night, keeping them warm.

Environmental

- ISSBs are cured in the sun hence there is no need for fuel such as wood thus saving the environment from degradation.

Financial

- Due to the interlocking nature of ISSBs, far less mortar is required thus saving on construction costs.
- Since the blocks can be made on site, costs associated with their transportation are eliminated.
- Due to their appearance, plastering of the walls can be avoided further reducing construction costs.
- Using the blocks results to fast construction since they are largely stacked and have no curing time.

Aesthetics

- The blocks have an appealing appearance with an elegant profile, uniform size and face-brick look that takes the natural colours of the soils used that does not require plastering.

Economic

- ISSB blocks are easy to manufacture and can be done by a small group of people.
- Youth and women who provide both skilled and unskilled labour in the technology are able to earn a living and be economically empowered.

Manual / hand pressed (left) and hydraulic (right) block making machines



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Challenges of ISSBs

- Availability of suitable soil for block making is such challenge.
- The quality of the blocks is determined by the quality of the raw materials introduced into the mould, the method used for mixing and the moisture content of the mix.

Types of ISSB machines

There are two main types of machines namely:

- the manual / hand pressed and
- hydraulic block making machine

When choosing the most appropriate machine, the following factors need to be considered:

- The type and scale of the building / structure to be constructed;
- Ease of maintenance of the machine;
- Availability, reliability and cost of electricity;
- The cost of the end product.

Of the two options, the manual / hand pressed machine is the most preferred option especially in a rural setting since it is manually operated and easy to use.

(a) Mixing sand and stabiliser (b) Pouring the mixture into the hydraulic block machine (c) Removal of compressed block from the mould



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ISSB production process

In order to achieve quality blocks, proper selection of the raw materials must be made. These materials that include soils, sand, water and stabilisers (cement or lime) must be carefully selected.

1. Soil selection

- Carrying out a site evaluation ensures that suitable soil is available for the preparation of the blocks.
- It is recommended to use sub-soil of a fine quality.
- The soil must be free of organic material and should not contain harmful quantities of salts.
- Soils with a high clay content result to cracked blocks and should be not used. However, if they must be used, then they must be mixed with a blending agent (such as sand or quarry dust) and a higher cement content to prevent the blocks from cracking.

2. Stabiliser

- The most commonly used stabilisers are cement and lime. Cement is best used with soils that have low clay content to achieve greater strength quickly. Lime is recommended for high-clay content soils but takes longer to harden and to produce strong blocks.
- Sand and gravel may be added into high clay content soil to increase its density.

- Fibrous material such as dried grass, or synthetic fibres can be introduced into the soil mixture as reinforcers.

3. Mix preparation

- The soil must be sieved to remove foreign elements and organic matter.
- Mix the sieved soil with stabilisers at predetermined ratios until the mixture has a uniform colour. Mixing can be done either by hand or using a mixer.
- Water should be added gradually to the mixture until it is moist but not too wet (no water should run between the fingers when the mixture is squeezed).
- This water must be clean and should not contain any harmful quantities of salts, acids, alkalis or any other organic chemicals.

4. Compaction

- The soil mixture is then loaded into the machine's mould and compacted

to ensure strength and quality.

- The resulting block should be removed carefully from the mould and checked for texture and quality.

5. Curing

- Curing is the process of hardening the soil blocks so that they can gain maximum strength.
- The blocks should be placed on a flat surface with adequate spacing between the stacked rows.
- The blocks can be stacked in layers of five and covered either with grass or polythene paper to protect from direct sunlight and to reduce the rate of evaporation in order to maintain proper humidity.
- Curing starts from the second day after the blocks have been prepared. They should be watered every morning and evening for a minimum of 7 days. In hot climates / weather, curing may need to be done three times a day. Full curing takes 28 days.

The strength of an ISSB is determined by its constituents and the water curing process undertaken after production. The composition of stabilized soil block consists of 60 - 70% soil, 20 - 30% coarse sand and 8 - 10% cement.

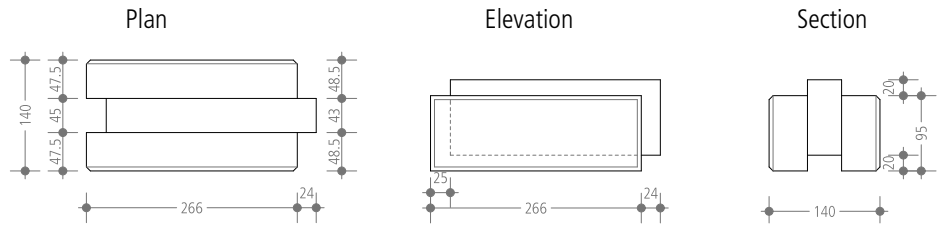
(d) Stacking and curing of the blocks (e) Building using the blocks (f) Resulting block wall



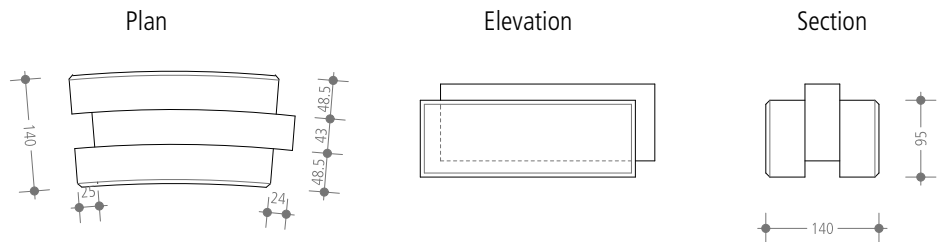
Types of ISSBs

Depending on the machine, different types of ISSBs can be produced:

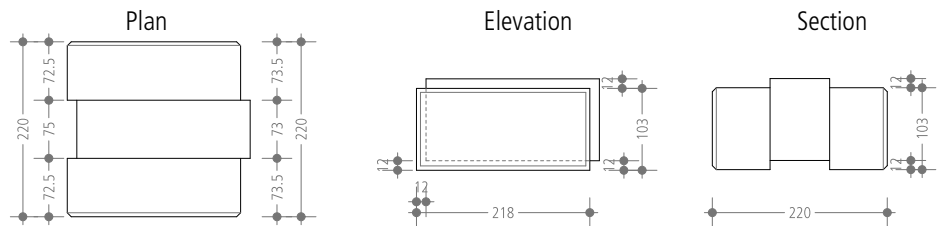
Straight Double Interlocking Block



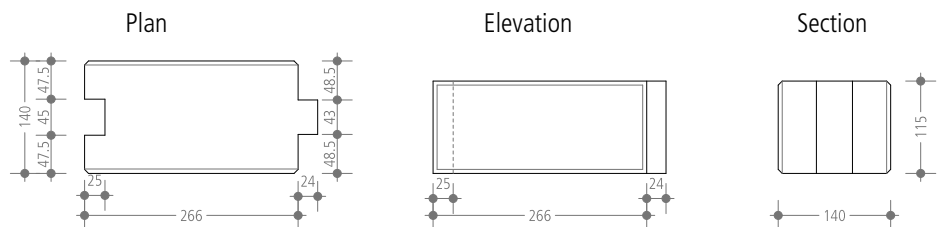
Curved Double Interlocking Block



Wide Format Interlocking Block



Straight Single Interlocking Block



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Executed by UN-Habitat with the support of GEF, UNEP and NCF



The purpose of this Technical Note is to call reader's attention to new technical issues in the field of sustainable human settlements development. They are not meant to be final or exhaustive. For more information, contact the Urban Energy Unit. Prepared by Vincent Kitio and Jerusha Ngungui.