Sustainable Construction Techniques
USE OF INTERLOCKING STABILIZED SOIL BLOCKS

ISSB Double Shelter, Nigeria

BACKGROUND

Interlocking Stabilized Soil Block (ISSB) technique has not been widely used in housing programmes for forcibly displaced. This short guidance aims at providing key facts and figures, with the objective of expanding knowledge around this smart way of building adequate housing in humanitarian contexts.

Information presented in this document has been gathered from previous UNHCR experiences in the use of ISSB.
ISSB is also known as Hydraform, although this is just one of several company brands that produce the machines.

Curing Blocks

CONCEPT

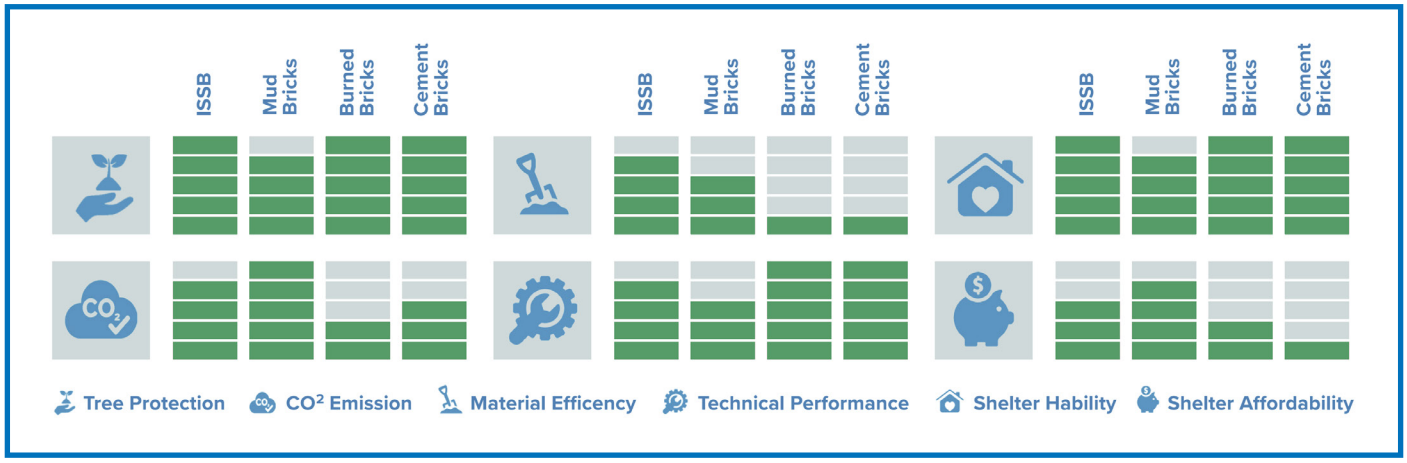
ISSB entails the use of sandy soil to produce blocks which are chemically stabilized, commonly with cement or lime, and then compressed manually or by motor-driven machines.
Soil stabilization refers to the application of additional supplements or forces to the soil to make it waterproof and stronger. The quality of the block depends on the properties and mix of soil types, the amount of force applied for compaction, and the addition of chemical products to further stabilize and strengthen the blocks.
Compared to alternatives such as red fired bricks or cement blocks, it offers lower construction costs with comparable quality in terms of structural and isolation performance speed of construction, easy-to-learn technique. ISSB is also suitable for a wide range of environments, and significantly reduces environmental impact, comparable to the use of sun-dried mud bricks.

The advantageous, ecological properties only come into play with the ISSB if the required material is available in suitable quality and quantity and in the proximity of both production and construction sites, thus avoiding the addition of a lot of cement and long supply chains.
As with any construction technology, the ISSB has advantages and disadvantages relevant to specific contexts, situations and needs, therefore any consideration on its use should be based on several factors including the following:

- Timeframe for delivery of raw materials and compaction machines
- Local building culture
- Availability of appropriate soils
- Availability of necessary expertise and the possibility to train labour.

SUSTAINABILITY SCORE CHART

The Life Cycle Sustainability Assessment (LCSA) approach is a trans-disciplinary framework which allows the comparison of different design options through a multi-criteria decision analysis with the aim of finding the best compromise between costs, environmental impacts and functionality for a specific shelter.



KEY ADVANTAGES

- ISSB does not need to be fired to gain weatherproof capability.
- ISSB is assembled without mortar and thus reduces the amount of cement.
- ISSB have high insulation properties, hence maximizing the use of passive energy
- ISSB have a high-quality finish without the need for additional plastering
- ISSB blocks have acceptable bearing capacity from 4 to 10 MPa depending on the amount of added cement or lime.
- ISSB machinery is portable
- The blocks can be used for structural and/or infill purposes.
- The machine has wheels and can be moved by hand or towed.

KEY CONSIDERATIONS

Block production with a portable, hydraulic machinery

Production Rate
- The manufacturer states that the single machine (M7 model) production rate is 1,300 blocks per day.
- However, based on conditions encountered in the field, the daily production rate is closer to 500 blocks.
- It takes 4.4 machine days to produce 2,200 ISSB which are required to build a typical house.
- One machine can produce sufficient blocks to build up to 82 houses per year.
- To build ISSB housing for 10,000 people, 25 machines will be needed with ongoing production for 365 days.

Soil Type and Quantity
- Soil tests are mandatory to determine the soil composition.
- Suitable soil type should have a clay content of between 15% and 35%.
- High-clay soils will require the addition of sand and a higher cement content to prevent blocks from cracking.
- Low clay soil may not sufficiently bind the block without additives.
- Each m3 of soil produces approximately 110 blocks.
- 20 m3 of soil are needed to produce 2,200 ISSB required to build a typical house.
- The above is the equivalent of a 5m x 4m x 1m depth hole

Cement Quantity
- One bag of 50Kg will produce 76 blocks.
- 29 bags of 50 KG of cement each, are needed to produce 2,200 ISSB required to build a typical house.

Training and Workforce
- In a two-week training course, the knowledge of production and block laying can be imparted to workers.
- Based on previous experiences, at least 8 workers will be needed to operate in a block production yard.
- 1 team leader, 1 trained foreman, 1 trained mechanic and 1 trained senior and assistant supervisor are needed to produce ISSB required to build a typical house.

Machine Cost
- The approximate cost of one machine (M7 model) including a pan mixer, spare parts and other accessories such as a trailer is 32,000 USD.
- One machine should be able to support the production of the equivalent to 82 houses per year.
- To procure 25 machines to produce enough ISSB blocks for 2,000 houses for 10,000 people over a one-year period, the cost would be 800,000 USD.
- The estimate is based on the Tanzania 2014 proforma invoice.

FEEDBACK FROM THE FIELD

Brick laying, ISSB-Construction, Nigeria

Ouallam, Niger

In Ouallam, a small village in Niger, women are producing eco-friendly interlocking bricks that are used to build social houses for Malian refugees, internally displaced persons and vulnerable Nigeriens. Since 2012, Niger has been hosting around 60,000 Malian refugees, who mostly stay in the Tillabery region in western Niger as well as in Niger's capital, Niamey. Despite receiving humanitarian aid, Maimouna, a 34-year-old Malian refugee and mother of six, opted to work as a housekeeper to make ends meet. Later, she joined a training program on brick making and was quickly employed as a brick producer. Mariama, a 25-year-old Nigerien single mother of one daughter, faced discrimination from her community for joining the factory as the work was traditionally seen as a man's job. Thanks to the support of GIZ and BMZ, UNHCR and partners have trained more than 12,000 people, with over 4,000 employed after the training.

Adamawa State, Nigeria

The UNHCR, in collaboration with partners, constructed a settlement consisting of 225 double housing units in Adamawa State, Nigeria, to provide durable housing solutions for internally displaced persons (IDPs). The use of interlocking stabilizing soil bricks (ISSB) makes the construction process environmentally friendly and sustainable, while the involvement of both IDPs and the host community in the production of bricks and shelter construction promotes social cohesion. The ISSB system is suitable for a range of contexts, offers lower construction costs, and has a minimum environmental footprint. The project is an ideal model for the context, representing a durable solution that involves IDPs and the local population in the construction process. The Labondo settlement is a model that can be used for other similar programs in Nigeria and beyond.

In conclusion, ISSB is a durable and sustainable solution for contexts with sandy soil and has many advantages to its use; including a much stronger and considerably less expensive alternative to hollow concrete block walls, the elimination of transport costs since it is made on site, it is environmentally friendly with low energy input, attractive face-brick appearance in the natural colours of different soils, very fast to build because the blocks are largely dry stacked and highly insulating; ISSB buildings are cool in summer and warm in winter, the blocks have a high density coupled with the thermal properties of soil, which gives them excellent 'thermal capacity'

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