

Interlocking block masonry (ISSB) for low-cost housing in Thailand and Cambodia.

As part of *ASEAN¹ Next 2019* Conference, held in March 2019 in Bangkok, the Thailand Institute of Scientific and Technological Research (TISTR) presented its ISSB technology, developed for housing and other structures. Other ASEAN countries, such as Malaysia and Cambodia, are also working on comparable renewable earth-based technologies, as part of the ongoing search for modern eco-friendly building materials that are affordable for a growing number of households. The central aim is to distribute the technology to the local and regional levels for the benefit of households, communities, and micro, small and medium enterprises (MSMEs).

Historical development

The *Interlocking Stabilized Soil Blocks* (ISSBs) were developed in Thailand by TISTR in the mid-1980s. These interlocking construction blocks, which in other countries are also called *Compressed Stabilized Earth Blocks* (CSEBs), are made of local raw materials – earth, loam, or soil – which are mixed in the right proportion with a low percentage of cement, and compressed using simple machinery. The resulting building blocks have high compressive strength and are suitable for constructing both outer walls and inner walls with load-bearing capacity. In addition, there are several other applications, including round water-storage tanks. It is widely understood that the use of ISSB for house construction supports green technology, as it is more sustainable than using fired clay bricks or concrete building blocks. Construction processes using ISSB and the associated building technology are not very complicated and the brick laying process is faster than traditional masonry, resulting in fast and cost-effective construction. The use of ISSB in the construction of homes is sustainable because it reduces emission of greenhouse gasses, protects the environment, and requires limited energy consumption. Local communities and households can use ISSB technology for the construction of high-quality homes. The composition of the mixtures is always a specialized matter that demands professional investigation. Moreover, some properties of the mixtures for the interlocking building blocks can be improved, for example to increase the compressive strength in order to build several floors, and to optimize water resistance and water conductivity of walls. Research is being conducted on aspects such as the use of larger spans in building constructions, the strength of load-bearing walls and columns, and the use of alternatives to cement as a stabilizer in mixtures for blocks. Thailand's housing issues in rural areas, villages, and smaller cities differs from those in the urban areas. The building of modest middle class housing is mostly done by individual households. The ISSB building blocks are very suitable for families building homes on private land. Having one's own home is vital for many families in Thailand. The modest housing type is a model with 45 m² floor space. According to TISTR, the houses built with the first-generation ISSBs – around 35 years ago – are still in good condition.

Thailand's Interlocking Stabilized Soil Blocks

The Thailand ISSB has been developed as a load-bearing building block. Its pattern of holes enable the addition of horizontal and vertical reinforcements in the walls. The reinforcements are not visible, from the outside or the inside, which is really an architectural advantage. The blocks can be stacked by local people with proper training, but it is normally done under the supervision of an experienced construction worker. By making use of local raw materials, such as gravel, sand, silt, clay and loam, the use of cement can be reduced. This also makes the blocks lighter than the first generation of interlocking blocks. According to TISTR, the use of ISSB helps to reduce construction costs by more than 20% compared to conventional materials. The ISSB as developed and tested in Thailand, has a development history of several decades. The first interlocking building blocks were

¹ Association of Southeast Asian Nations.

introduced in 1982, but they turned out to be quite heavy to use. The shape and dimensions of the blocks have been improved over the years. The current interlocking block is already the fourth generation, and in the beginning of 2019 TISTR is working on the next generation of building blocks, which will be suitable for load-bearing walls in stacked homes with more than two floors, as well as lightweight hollow panels that can be used for interior walls.



The provision of the ISSB in Thailand has also changed over the years. Before 1998, the TISTR interlocking block method was taught to rural communities to enable them to build their own houses. After 1998, the blocks were produced and sold at small-scale factories. There are now 665 factories spread out all over the country. In 2012, construction material retailers emerged with retail prices, free delivery services, and a house construction package. In 2017, the construction material was also offered in the online market with its traders and retailers, free delivery services, and a house construction package.



After the ISSB bricks are made, they have to be stored and dried for 24 hours. They can be used for construction the next day. A first layer of building blocks is positioned carefully on a concrete foundation, which must be dried for one day. Then the masonry of the rest of the wall can be executed. The following aspects are addressed: (i) reinforced corner joints, (ii) horizontal and vertical reinforcements, (iii) finish of the reinforced top layer, (iv) filling the vertical holes with cement, and (v) treatment of the outside with a water-repellent coating.



Masonry for a wall with a corner joint

Facade of an outside wall with ISSB

Houses and structures built with ISSB are of high architectural quality, which makes ISSB applicable for all kinds of housing types. TISTR has tested the ISSB over the years with regard to the most important properties: (i) compressive strength in wet and dry conditions, (ii) compressive strength dependent on density of block and cement ratio, (iii) water absorption capacity; with variations of cement ratio and density (iv) flexural bond strength, (v) optimum ratio Portland cement. Furthermore, columns and walls are tested under various circumstances. The TISTR also tests: (i) behavior of interlocking block walls under lateral load in full scale load testing (ii) behavior of walls under conditions of severe flooding, (iii) behavior of walls under conditions of earthquakes.



Housing type built by Hav Kongngy of 'My dream Home' in Cambodia. ISSB technology is comparable to TISTR technology in Thailand.

The ISSB technology as developed by TISTR is suitable for all kinds of housing, from low-cost to middle- and high-income housing solutions. Micro, small and medium enterprises can partake in the production and promotion of ISSBs, and give technical advice to families. Communities of residents can grow economic activities in the form of a community enterprise. Transference of knowledge is also done by the many entrepreneurs who have already set up building block factories where ISSBs are produced and sold. These entrepreneurs can also act as contractors. Building blocks as developed by TISTR are suitable for green social housing projects. Moreover, ISSBs are suitable for housing by individual families who self-build and expand their homes over time. In the latter case, technical assistance is necessary but Thailand's housing institutions and ISSB producers are capable of delivering such services.

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