

COMMUNITY
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WEST NEPAL EARTHQUAKE DAMAGE ASSESSMENT CSEB INTERLOCKING BRICK BUILDINGS



CSEB Residential building
Bheri 01, Jajarkot

On 3rd November 2023, a 6.4 magnitude earthquake struck west Nepal. It claimed over 100 lives, destroyed 26,000 houses and damaged 35,000. This assessment evaluates how Build up Nepal's interlocking Compressed Stabilized Earth Brick (CSEB) buildings withstood the earthquake and compares the benefits of our technology to other construction materials.

Watch the [video](#) and hear from earthquake survivors whose homes were built by Community Impact & Build up Nepal's enterprises [here](#).

Current construction methods are inadequate



95% of stone & mud houses collapsed or had severe structural cracks.



Stone masonry mud mortar

This is the primary building method in Jajarkot & Ruklum but lacks adherence to NBC standards, seismic bands & round stones.



Solid concrete block buildings have structural cracks.



Solid concrete blocks

Fared better than stone but often lacks reinforcement, leading to structural cracks.



Most have severe cracks and need retrofitting.



RCC structure with stone masonry

Fared better than stone but often lacks reinforcement, leading to structural cracks.

Build up Nepal has two entrepreneurs in Jajarkot and Rukkum, who have been building with CSEB interlocking bricks. **We inspected 16 buildings.**

CSEB Loadbearing houses – No damage



Some construction mistakes were found- 2 out of 3 houses lacked seismic bands but despite this the buildings were without damage.



Residential building

2-room
Bheri 01, Jajarkot



CSEB small house

3-room, Bheri 01, Jajarkot



CSEB Agriculture storage

1-rooms, Rukkum West

No damage and in full operation



✓ **CSEB Municipality hospital**, Kharaneta, Tribeni Municipality, Rukum West



✓ **CSEB Municipality Office Tribeni**
Rukum West



✓ **CSEB Ward Office Tribeni-06**
Rukum West



✓ **Municipality Conference hall**
Tribeni, Rukum West



✓ **CSEB Health post Tribeni-06**
Rukum West

No damage

3 of 4 schools buildings we assessed were completely intact. One had some cracks due to hammering against the adjacent building (details on next page).



✓ **Janachetna primary School**, Tribeni Municipality-06, Rukum West



✓ **Shri Srijana Adharbhut School**, Pipalchaur, Aathbiskot-14, Rukum West



✓ **Chandra Surya Adharbhut School**, Tribeni Municipality-03, Rukum West

Some damage due to hammering against adjacent building.

The Janapriya Secondary School Tribeni-06, Rukum was built with RCC frame and CSEB bricks for infill walls. Some of the walls showed cracks due to the double- and single-story buildings being built too close together, making them hammer against each other during the earthquake.

Conclusion: No major damage. Retrofitting recommended. This highlights the need to ensure building codes are adhered to.



The single and double story buildings are touching each other. This is in violation of the building code and has caused cracks in walls and beams.

No damage



✓ CSEB single-storey with RCC frame & slab roof. Bhrei 01, Jajarkot



✓ 2.5-storey RCC and CSEB, Tribeni, Rukum West



✓ 2-storey RCC and CSEB Tribeni, Rukum West



✓ RCC and CSEB house Tribeni, Rukum West

What is CSEB interlocking brick?

Compressed Stabilized Earth Brick (CSEB) is made by mixing sand, soil and cement and compressing this in a machine. It can also be made from stone dust, cement and other stabilizers.



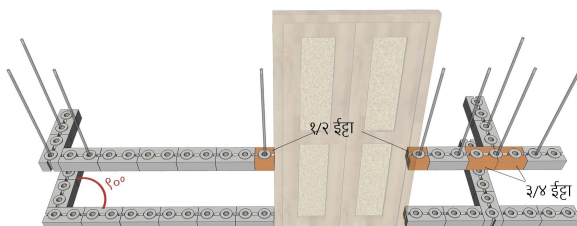
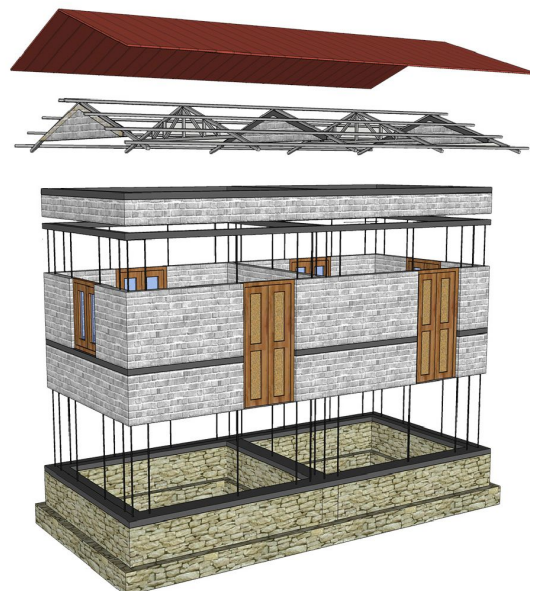
The bricks can be made in small manual machines.

Advantages:

- 40% lower cost of walls compared to fired bricks
- Highly disaster resilient
- 75% less CO2 emissions, 90% less air pollution
- Produced locally, creates jobs

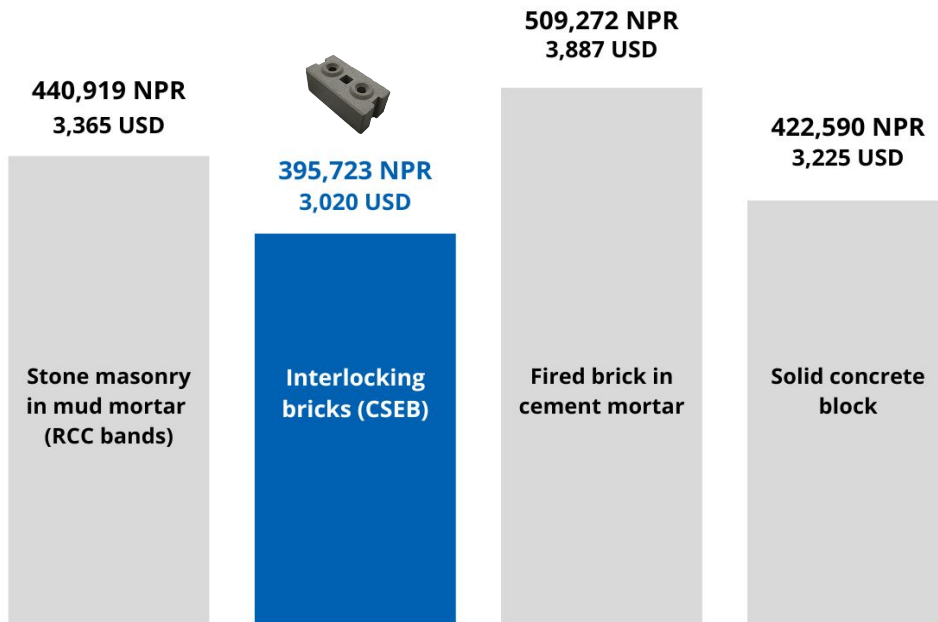
How is CSEB highly earthquake resistant?

The bricks interlocks like LEGO holding the wall together in an earthquake. The holes in the bricks are used to add vertical reinforcement that goes through the wall connecting to seismic bands and making the building highly earthquake resistant.



Cost comparison: 2-room house

Below is a cost comparison for building a two-room house, using stone masonry, interlocking CSEB, fired bricks and solid concrete block. This is based on December 2023 rates in Bheri-01, Jajarkot.



Assumptions:

- Stone is available free of cost
- 30% of the wood for doors and windows can be salvaged
- Cost of toilet is not included in the calculation and will be additional.

Conclusion

Our assessment indicates that buildings constructed with interlocking Compressed Stabilized Earth Brick (CSEB) outperform alternative materials in terms of earthquake resilience. It is also the most cost-effective method for construction in remote areas and has a low-carbon footprint- especially compared to fired bricks or solid concrete blocks.

However, the superiority of any construction technology is contingent upon strict adherence to building codes and proper construction techniques. Ensuring compliance is essential for any earthquake-resistant structures.