INDIA

Introducing Sustainable Technologies Creating Resilient Shelters

HUMANITARIAN RESPONSE CASE STUDY 02

CRS
CATHOLIC RELIEF SERVICES

PROJECT DESCRIPTION

Country: India

Project location: Kutch, Gujarat

Disaster: Earthquake

Disaster date: 2001

Project timescale: 2001 - 2004

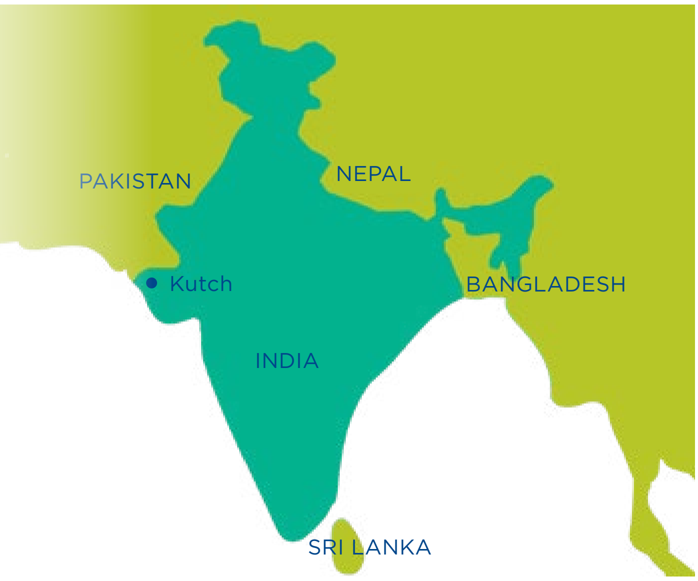
Houses damaged: 339,000 buildings destroyed and 783,000 damaged

Affected population: 25,000 fatalities, 1 million people homeless

CRS target population: 2,700 households

Project cost per shelter: US$ 900(35,000 Rs to 45,000 Rs) for core house

Partners: USAID, OFDA, CRS Private funds



"The whole process of shelter construction within the community was a magnificent experience. We worked with a large monitoring system in place to rebuild 2,700 permanent shelters to strong CSEB earthquake-resistant shelters where every stage of the construction process was felt and tested by the community."

— Mehul Savla, CRS project architect

Building Back Better with Compressed Stabilized Earth Blocks (CSEB)

In Gujarat, CRS' resilient shelter project aimed to enhance local construction technology with the introduction of Compressed Stabilized Earth Block (CSEB) technology. This sustainable technology is environmentally sound as it uses a limited amount of cement and water. The technology can also be linked with livelihoods since local tradesmen can be involved in block production from the outset.

Capacity building to improve skills of local tradesmen was a core element of this project. CRS established 100 mason groups, who helped to build 2,700 disaster-resistant homes and 10 community buildings. New production centers with 60 machines helped 600 workers produce blocks over the course of the project. CRS also worked with communities to improve their construction techniques, and with the Government of India Gujarat State Disaster Management Authority (GSDMA) to approve recommended construction guidelines.

What did CRS do?

- Initially constructed transitional shelters.
- Built 2,700 disaster-resilient hollow interlocking CSEB homes.
- Built 10 community buildings using CSEB technology.
- Established block production centers and training for local masons.
- Introduced improved local construction techniques into the region.

Background

The earthquake, magnitude 7.7, was felt throughout northwest India and much of Pakistan on January 26, 2001. The epicenter was in the district of Kutch, Gujarat. At least 25,000 people were killed and 166,836 injured. Approximately 339,000 buildings were destroyed and 783,000 damaged in the Bhuj-Ahmadabad-Rajkot area and other parts of Gujarat, leaving about 1 million people homeless. The commercial capital of Gujarat, Ahmedabad, was severely affected, and a number of multi-story buildings collapsed, killing several hundred people. In Kutch, 60 percent of food and water supplies were disrupted as well as 90 percent of housing stock. Bhuj Civil Hospital was destroyed, which was a major setback to emergency relief. Much essential infra-structure, such as bridges and roads, were extensively damaged in Gujarat. News of the quake rapidly spread through the international media. Local communities, central and state governments, defense forces, and national and international NGOs all responded to the emergency.

Project Principles

CRS responded to the initial emergency with emergency relief of essential items and shelter later with trainings for masons and block production, construction of core houses and community halls, and livelihoods including trauma counseling activities. CRS aimed to integrate the capacity building of local skill sets with improved technical inputs to "build back better."

Implementing a CSEB Production System

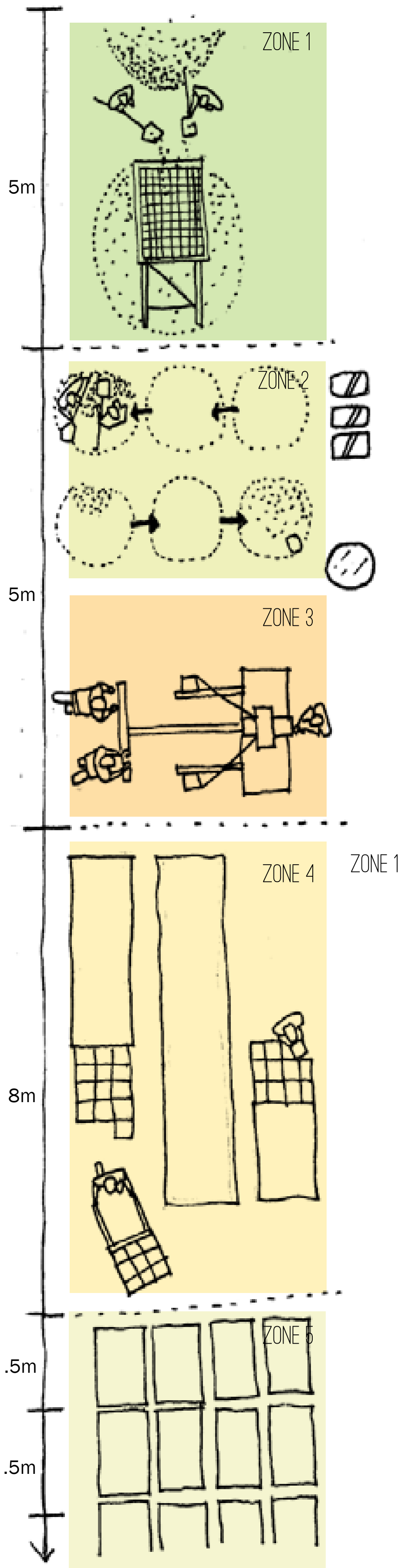
In order to introduce and embed the technology across Gujarat, CRS established a CSEB program that supported a range of activities:

- Trainings for masons, and advocacy for improved construction technology among local NGOs;
- Exposure visits for CRS engineers and technical staff to see CSEB technology, enabling them to oversee the production and construction process, and to advise local staff;
- Newly established local production centers, and facilitated trainings for community members in production and masonry work. Women were included in the construction efforts.

At the peak of the project, 60 machines were used in production centers with a minimum of 150 sqm area per machine, employing 600 people. This built the capacity of the community to construct and monitor disaster-resistant core homes using CSEB, and 2,700 homes were built with this technology. An in-house testing laboratory was established to ensure highest quality blocks, in addition to the government block-testing facilities.

CSEB Technology

CSEB is a sustainable technology that is able to achieve disaster resilience, and easily adaptable to rural and low-income communities. At least 85 percent of the world's soil can be used for CSEB production. The blocks are composed of local soil and stabilized with a small portion of cement and sand. The amount depends on the natural composition of the soil. The block is formed by compression in a mechanical manual press such as an auram press, which does not require any fuel and is operated by a minimum of 8 people per machine. The blocks do not require firing, but are simply cured in the open air for 28 days. Vertical and horizontal reinforcement is used, similar to traditional construction techniques of wattle and daub (bhunga). They are generally cheaper and more eco-friendly than concrete blocks or fired bricks as little cement is needed to make them, and cement mortar is not needed to laying brick courses. Additionally, as a construction material, they have high thermal mass, keeping a house cool during the day and warm at night, very appropriate in the hot/dry climate of Gujarat.



SCREENING

Throw the soil through a wire mesh screen, with a size of 4-6mm. This stops very large gravel passing through ensuring that the soil has a reasonable mixture of sand, gravel, silt and clay

MEASURING

Fill a wheelbarrow with soil to the top and level with a ripper. Deliver to mixing area as per calculation

DRY MIXING

Pour cement on top of the earth and sand if necessary. Mix all components. Move pile 2 or 3 times to ensure mix is homogenous and of uniform colour

HUMID MIXING

Sprinkle water on the dry pile, mix the humid pile again until colour is homogenous and mix is even.

CHECK MOISUTURE

Drop a squeezed ball from 1 metre high. If ball crumbles into small pieces, moisture content is too low.

MOULDING

Put wet mixture into the machine, close lever and compress with handle. Block will come out after it has been adequately compressed.

QUALITY CONTROL

Regularly test the compression of blocks (the first block of every new mix) with a pocket penetrometer. Check block height with a block height guage.

HUMID CURING

Carefully stack the blocks under a thick plastic sheet for 2 days and 2 nights. The piles must be airtight and the blocks wet throughout this time.

FINAL CURING AND STACKING

Move bricks from humid curing into the stacking area for 28 days. Sprinkle blocks with water daily. Cover with coconut leaves to avoid direct sunlight.

Diagram of layout of a block production facility and different processes that occur in each zone.
Credit: Auroville Earth Institute

Completed disaster resilient hollow Interlocking Compressed Stabilized Earth Block homes.
Photo: Mehul Savla / CRS

Various types and shapes of hollow interlocking CSEB block produced for construction.
Photo: Mehul Savla / CRS

Technically, the advantage of interlocking hollow CSEB compared to hollow plain concrete blocks is that the shape of them offers keys to interlocking with other blocks in the course, thus increasing the wall's shear resistance and strength. CSEB production creates income-generating opportunities for communities and can contribute to the establishment of a thriving local construction industry. The management of local resources needed for production - such as earth and water - is essential for production. Block production can also be integrated into village development - for instance, through rainwater harvesting tanks or waste water treatment plants, if planned properly. A well-planned sourcing of local resources is greatly helpful for communities. For example, discarding the top fertile soil since it is not used for production, and planning excavations to increase the reservoir capacity with artificial storage tanks.

Program Participants

CRS team leaders and animators, in consultation with community leaders and committees, selected the individuals who would benefit from this project. CRS held community meetings to ensure the community was aware of the project, and conducted house-to-house visits before finalizing the program participants. The community mobilizers organized the community to see a model house (one sample house was built in Khavda) in the nearby village before the community agreed to participate in the program. CRS provided sample CSEB blocks to communities as well as a clear understanding of the technology and material through exposure visits to other communities and production centers.

Challenges

- Technology: As hollow, interlocking CSEB is an improved form of a traditional construction technique, efforts were needed to educate the community, as well as make the teams within CRS understand the advantages of the technology. Time and effort had to be invested before a successful scale up could occur.
- Production: A large-scale, decentralized production line was needed to meet the supply needs in the community. Systematic production management was required, from establishing the center to managing the quality, work force, quality control and payment.
- Scale: Large-scale logistics were needed at community level for raw material supply, production of bricks, distribution of finished products, construction of homes and supervision of sites distributed over a large geographical area.

Reflections

After the project finished, the production machines were distributed to CRS' in-country partners. Some local organizations have taken the technology forward and implemented it in an urban setting. The technology is new and will need more effort to disseminate it further. While it is not yet commonplace, its use is growing: In Bangalore, over 1,500 homes have been constructed with CSEBs. Expertise is also expanding, and a local NGO has taken the technology abroad to provide technical support in post-tsunami Indonesia.

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