

09

FERRO-CEMENT CONSTRUCTION IN CUBA



Tropical/equatorial climate zone

1. Brief project description

In the 20th Century concrete replaced timber as the principal construction material in Cuba. Structures of reinforced concrete with infill of cement blocks and burnt clay bricks are ideal materials for the rigorous weather with torrential rainfalls and frequent hurricanes. The revolutionary Government embarked after 1960 in large housing projects setting reinforced concrete panels as standard. The high cost of such structures animated

Prof Hugo Wainshtok to apply his experience of building boats in ferrocement, to design a scaled down and more flexible panel system. Together with Prof Emilio Escobar the developed the system named SERF.

2. Organization

CREDEF, at the Polytechnic University of Havana promotes the technology within Cuba and the EcoSur Network has exported it to several Latin American Nations.



SERF inventor Wainshtok in front of a 20 year-old ferro-cement building © Ecosur

3. Target group

The population in general.

4. Project goal and results

Reducing the consumption of raw materials in construction, mainly cement and steel. The small scale local production also reduces transport. As a fact, the construction costs could be reduced by about 30% as compared to the accustomed technologies. Since 1990 SERF has been used in Nicaragua, Dominican Republic, El Salvador and after the 2010 earthquake also in Haiti.

5. Brief country context

In Cuba, housing delivery is a responsibility of the state: the state builds apartments/houses or supplies materials/credit for self builders. The apartments are assigned to the owners who pay a mortgage calculated on the base of their income over a period of maximal 20 years. More than 80% of the housing stock is privately owned.

In Cuba the situation is very different from most developing countries. In the rural areas and intermediate towns the housing stock is generally better than in the centers of the larger towns. The Government has made great efforts to upgrade housing outside of the cities and almost all Cuban households nationwide enjoy basic services like drinking water and electricity.

6. Local context

The National Housing Institute has an office in every Municipality and all buildings are registered. There exists clear information on the general state of the buildings and their potential degree of vulnerability. In the event of foreseeable hurricanes or inundations vulnerable locations are evacuated. While the owner of the house or apartment is responsible for its upkeep and minor renovations, the Municipality operates work brigades who undertake major repairs and new constructions, they also make minor repairs in the households of disabled people.



A mobile vibrator forms the panels (above). Alternatively panels are produced by hand (below) © Ecosur



One mason and three helpers assemble the house © Ecosur

SERF is an ideal platform for extending houses /building new ones. Most of those units have been built by the Municipal brigades within the planned activities of the Housing Directorate.

7. Climate zone and project's suitability to the climate

The type of building is suited to the warm and humid climate. The frequent hurricanes demand solid construction. Cubans prefer concrete construction over all other options.

8. Main material

Ferrocement panels are made with microconcrete (cement and well graduated sand), some steel bars and a wire mesh. They are used for walls and ceilings, through their shape they are self-supporting and do not need additional reinforcement. Production is manual and does not need extensive areas nor power connection.

9. Construction and technical aspects

Foundations are made according to the situation, with a reinforced ringbeam that encloses the wall panels. The panels are topped

with another reinforced ringbeam, which is the support for the horizontal panel forming the ceiling or roof. The same ringbeam encloses the wall panels of the next floor.

10. Innovative aspects

Ferrocement is well known from massive applications, mainly in roof structures (Nervi). The application as medium size self-supporting wall and roofing elements produced in small workshops for social housing is a novelty and it has proven extremely versatile in post disaster reconstruction where permanent shelters made with those panels are a viable fast alternative.

11. Challenges

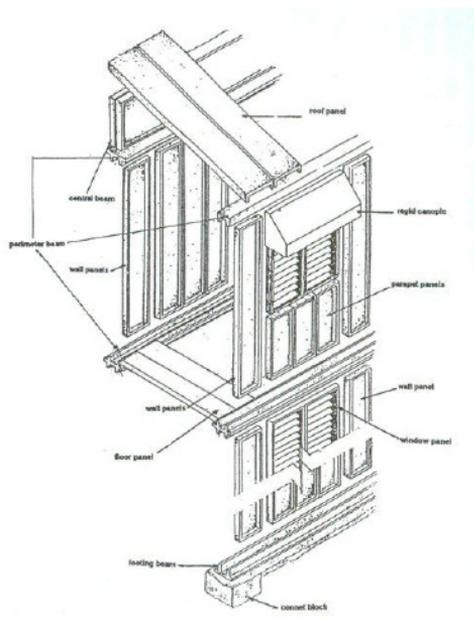
Introducing a new technology generally encounters resistance from a large part of the professional establishment and the skepticism of the engineers responsible for construction permits.

12. Holistic approach

Local production with low or no consumption of energy (other than human) and the optimized use of cement, sand and steel produce a



The panels are placed and then concreted into the ringbeam. © Ecosur



Construction scheme, taken from "Ferrocemento", book available at www.ecosur.org. © Ecosur

material that has a smaller ecological footprint than most durable housing solutions.

13. Environmental sustainability

The consumption of raw materials per square meter of construction is lower than most other walling or roofing systems. The elements are only 3 cm thick and due to careful curing of the concrete and ideal positioning of the steel rods, high efficiency of the materials are achieved, they are used close to their maximum capacity. Local production reduces transport emission.

14. Economic sustainability

The cost/square meter is complicated to indicate as materials assigned by the government are not accounted at market prices. However, it can be learned from the experiences from countries in the region that the real costs are approximately USD 150-200. The average income level/person/year in Cuba is USD 5,520 (WB 2010).

The low consumption of raw materials per produced unit combines with fast assembly of the panels, one qualified mason works with three helpers. Setting up local production of

panels is fast and low cost, as the moulds can be moved from site to site. Total cost per built unit is lower than most alternatives.

15. Cultural sustainability

Cubans prefer concrete structures over other structures, and once the initial skepticism about a new technology is overcome, the technology is well accepted. The same has been experienced in several other countries where the system was introduced.

16. Social sustainability

Local production of the panels with a simple technology is a good base for social sustainability.

17. Institutional sustainability

The technology is being promoted internationally by the EcoSur network and used in several projects (including a UNDP sponsored action in Haiti).

Sources: Professor Hugo Wainstock CREDEF, at the Polytechnic University of Havana; and Professor Kurt Rhyner, Ecosur



Using ferro-cement panels as floorslab in a conventional building © Ecosur



Placing the horizontal panels with the help of a chain-pulley © Ecosur