Confined masonry: A viable alternative for Haiti?

Sources: S Brzev and S Jain, Tom Schacher, Elizabeth Hausler

Photo: Ofelia Moroni, Chile
Confined masonry is a construction system where the walls are built first, and RC “columns” and “beams” are cast afterwards.

Confined masonry

RC frame with masonry infill
The most important structural elements are the confined masonry walls. The confining elements do not work as beams and columns.
The walls are built as follows:
Good connections are of critical importance in order for all the structural elements to work well together.
Confined masonry houses are built in many seismic countries

Indonesia

Pakistan

Mexico

Peru
Confined masonry construction performed well in several destructive earthquakes (some damage, no deaths):

- 1985 Llolleo, Chile (magnitude 7.8)
- 1985 Mexico City, Mexico (magnitude 8.0)
- 2001 El Salvador (magnitude 7.7)
- 2003 Tecoman, Mexico (magnitude 7.6)
- 2003 Bam, Iran (magnitude 6.6)
- 2004 Sumatra, Indonesia (magnitude 9.0)
- 2007 Pisco, Peru (magnitude 8.0)
- 2010 Maule, Chile (magnitude 8.8)
There are many excellent confined masonry construction manuals

General rules for column reinforcements

- Bend hooks at 45 degrees
- Alternate position of hooks
- Always use steel bars with ridges (smooth rebars may only be used for stirrups)
- All rebars must be covered by at least 1 inch of concrete
There are many excellent confined masonry construction manuals

Prepare columns reinforcements:

– Through plinth and bond beams place stirrups at 4” intervals.

– Keep this interval for 2 ½ feet in the lower and upper part of the column.
There are many excellent confined masonry construction manuals

Two pages from the Universal Confined Masonry Construction Guideline (under development by members of the Confined Masonry Network [www.confinedmasonry.org])
A manual developed at the Catholic University of Peru has been translated into kreyol

English and Spanish (and Chinese) versions can be downloaded from the World Housing Encyclopedia website www.world-housing.net
The manual shows step by step what to do (and what **not** to do) to build a safe confined masonry house.
There are several other confined masonry construction manuals available in Haiti.
Members of the Confined Masonry Network have developed a Design Guideline. The Construction manual will comply with these guidelines.

Confined Masonry: Key Design Provisions

- Tie-beam in parapets ≥ 500 mm
- Tie-columns in parapets
- Tie-beam spacing

\[ \frac{H}{t} \leq 25 \]
\[ t \geq 120 \text{ mm} \]

Tie-columns at wall intersections

Confining elements around openings

Svetlana Brzev has published an excellent book on confined masonry

NICEE Publication
December 2007

To obtain a copy, contact
nicee@iitk.ac.in

Or order online at
www.nicee.org

(or you can download each chapter separately)
The properties of concrete block and fired clay brick are very different.

Reference: A. San Bartolomé

The recommendations on the CM manuals are based on fired clay brick construction.
The recommendations on the Peruvian CM manual are based on Peruvian materials (fired clay bricks) and Peruvian construction practice and conditions.

The recommendations on the Peruvian CM manual should not be applied directly to building with Haitian materials (concrete blocks) and Haitian construction conditions.
Laboratory testing is required to calibrate the technical recommendations presented in the Peruvian manual to make them applicable to construction with concrete blocks in Haiti.
Concrete block confined masonry could be a viable alternative for building low-cost earthquake-resistant houses in Haiti.

An example from Indonesia (Source: C. Meisl, EERI)

Any questions?