



Update from the

WORLD HOUSING ENCYCLOPEDIA

Read about new initiatives and reports from EERI/IAEE's World Housing Encyclopedia project

Look for ways to get involved!

After a hiatus of several years, the WHE project has renewed the Farzad Naeim prize. But rather than give an award to individual report authors, prize money will be used to underwrite the publication of an annual insert, featuring the Best Recent Report, as well as other recent WHE activities.

Best Recent Report

EL SALVADOR: VIVIENDA DE BAHAREQUE

Report #141 Written by Dominik Lang (m. EERI) Norway; Roberto Merlos (El Salvador); Lisa Holliday, U.S.A.; and Manuel A. Lopez M, El Salvador. Reviewer in the open review process was Qaisar Ali (Pakistan).

Bahareque refers to a mixed timber, bamboo and mud wall construction technique which was the most frequently used method for simple houses in El Salvador before the 1965 earthquake. In 1971 bahareque buildings had a share of 33.1 % of all buildings in El Salvador, while by 2004 this number was about 5 %. The term 'bahareque' (also 'bajareque') has no precise equivalent in English, however in some Latin American countries this construction type is known as 'quincha' (engl.: wattle and daub).

Bahareque buildings are characterized by high flexibility and elasticity when carefully constructed and well-maintained, and thus originally display good performance against dynamic earthquake loads. However, bahareque buildings in most cases show high vulnerability due to poor workmanship, lack of maintenance and structural deficiencies such as a heavy roofing made out of tiles.

The WHE report describes this construction type in detail, includes many figures and photos, is very well-referenced and has an outstanding discussion of performance in past earthquakes.



Figures from Report #141. Top: bahareque house has pedestal made of clay brick; bottom: low adherence of plaster due to weathering and missing connection to wall material

What is the WHE?

The World Housing Encyclopedia is a project of the Earthquake Engineering Research Institute and the International Association for Earthquake Engineering. It's a uniquely successful global network of individuals committed to making communities safer in earthquakes. The network is a web-based and freely available resource of housing construction technologies, practices and guidance in seismically active countries of the world.

You can participate by preparing a report on a common construction type in the country where you live, the country you are from, or a country you have visited.

The printing of this insert has been supported by a gift from Farzad Naeim, Vice President/General Counsel, John Martin & Assoc., and EERI President. The selection committee for the best recent report included Chris Arnold (chair); Andrew Charleson, and Heidi Faison. Layout and content of this insert by Marjorie Greene.

CONFINED MASONRY NETWORK



Confined masonry house designed and built by Build Change in Indonesia. (Photo courtesy of Build Change)

Promoting Confined Masonry

Confined masonry is a technology that, if designed and built correctly, performs very well in earthquakes. It uses the same basic materials of concrete and brick that are found in unreinforced masonry construction and in reinforced concrete frame construction with masonry infills, but with a different construction sequence and system. In confined masonry construction, the masonry walls carry the seismic loads and the concrete is used to confine the walls.

With initial funding support from Risk Management Solutions, the Confined Masonry Network is completing two documents that will help introduce this technology and/or its correct construction practices more widely in the world. Developed by an international committee chaired by Svetlana Brzev and Roberto Meli, the global design guideline will soon be available for wide review.* The template for a construction guideline, under development by a committee chaired by Marcial Blondet and Tom Schacher**, will be ready in spring 2010.

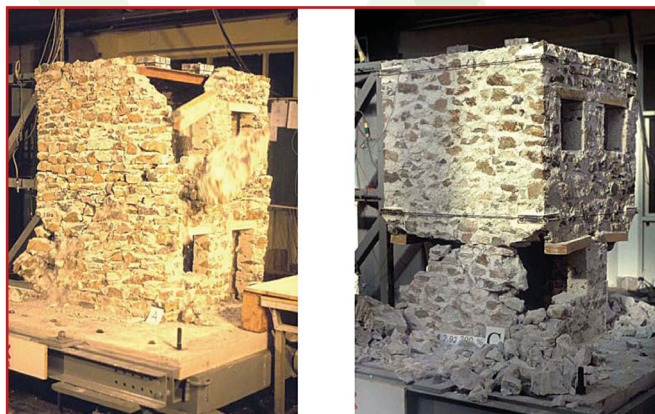
*Members of this committee: Maximilano Astroza (Chile); Teddy Boen (Indonesia); Junwu Dai (China); Mohamed Farsi (Algeria); Tim Hart (USA); A.S. Mohagdam (Iran); Daniel Quiun (Peru); Miha Tomazevic (Slovenia) and Luis Yamin (Colombia).

**Members of this committee: Francisco Crisafulli (Argentina); Jonathan Galindo (Peru); Tim Hart (USA); Elizabeth Hausler (China & Indonesia); Tim Matthews (USA); Ahmed Mebarki (France); Zahra Riahi (Canada).

The Confined Masonry Network was established at an International strategy workshop in 2008 in Kanpur, India. The Network continually welcomes new participants. Currently, active participants are developing a template for a global construction guideline and a global design guideline.

WHE-PAGER PROJECT

The WHE Project is participating in an effort to understand and summarize worldwide construction types, building inventory and seismic vulnerability. The construction types and estimates of who lives and works in these buildings are being used in the development of a rapid post earthquake casualty estimation program, PAGER, at the U.S. Geological Survey. The data will also enhance the housing stock distribution and vulnerability data for existing WHE housing reports for different countries. Dina D'Ayala of the University of Bath is chairing this effort.



Testing of rubble stone masonry by Tomazevic & Lutman. Example of a non-HAZUS structure type for which analytical push-over curves are being developed

Get Involved!

Visit the websites for these two WHE activities:

www.confinedmasonry.org

**Sign up to be part of the network
and share knowledge**

<http://pager.world-housing.net>

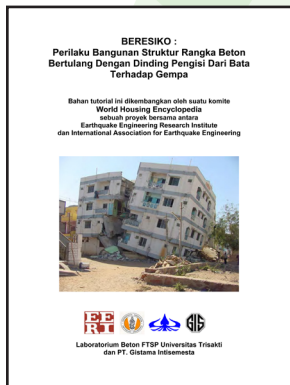
**Contribute information on construction types,
structural capacity curves
& vulnerability functions**

Available Tutorials

Earthquake-Resistant Construction of Adobe Buildings: A Tutorial (Authors: Marcial Blondet, Gladys Villa Garcia; Svetlana Brzev). Available in English and Spanish.

Construction and Maintenance of Masonry Houses. For Masons and Craftsmen (Editor: Marcial Blondet). Available in English, Spanish and Chinese.

At Risk: The Seismic Performance of Reinforced Concrete Frame Buildings with Masonry Infill (Authors: C.V.R. Murty; Svetlana Brzev; Heidi Faison; Craig D. Comartin; Ayhan Irfanoglu). Available in English and Indonesian.



Recently, WHE Editorial Board members Sugeng Wijanto and Takim Andriono translated the RC frame construction tutorial into Bahasa Indonesian. The confined masonry and adobe tutorials are both in Spanish and English, and the confined masonry tutorial is also available in Chinese.

Consider volunteering to translate a tutorial into an additional language!

Under Development

Two tutorials are currently under development:

Tutorial on Rubble Stone Masonry Construction

Building from work conducted by WHE Editorial Board members, including Jitendra Bothara and Svetlana Brzev, and others, this tutorial is focusing on vulnerabilities of rubble stone construction, and several basic techniques that can improve life safety in these buildings. Available spring 2010.

Tutorial on Straw Bale Construction

Structural engineer Dmitry Ozeryansky and architect and straw bale expert Martin Hammer are leading the effort to develop a tutorial to promote this sustainable, appropriate technology for countries where climate and agricultural practices permit its use. This work also builds on work conducted by former UC Berkeley graduate students Kate Coffaro and Shinjinee Pathak. Available winter 2010.

WHE TUTORIALS

Considered by some to be one of the most valuable features of the WHE, a series of tutorials on different construction materials have been prepared by volunteer participants. Two more are in the pipeline, and more are solicited.



An RC building with masonry infill that performed poorly in the Abruzzo, Italy earthquake of April 2009. The WHE Tutorial on RC frames addresses this type of construction and recommends alternatives. (photo: P. Bazzurro)



Damaged stone masonry construction in the September 2009 earthquake in Bhutan. A tutorial on stone masonry construction will be released later in 2010, with some funding support from the New Zealand Society of Earthquake Engineering and the UET of NWFP in Pakistan. (photo: K. Vatsa)

RECENT HOUSING REPORTS

A number of housing reports have been completed since the last Farzad Naeim prize was awarded. Several of these are highlighted in abbreviated form here:

BANGLADESH: MUD HOUSES Report #143
(Prepared by Amrita Das, Mohammad Shariful Islam, Dr. Md. Jahangir Alam, Nusrat Hoque)

One of the traditional housing types that are used by poor families mainly in rural areas as well as in the outskirts of small cities. Highly vulnerable to both seismic forces and flooding. The main load bearing system consists of mud



walls of 1.5 to 3.0 ft thickness, which carry the roof load. Clay tiles, thatch or CI sheets are used as roofing materials.

PERU: REINFORCED ADOBE Report #107
(Prepared by Daniel Quiun)

Report describes a reinforcement system for existing adobe houses, and adaptation for new adobe houses, with the objective of preventing collapse. A major research project concluded that the most appropriate strengthening technique was to reinforce the walls with horizontal and vertical strips of wire mesh electrically welded, covered with mortar. Technique applied in 1998 as pilot project



in 20 houses in 6 cities in Peru. In the earthquake of June 23, 2001 (Mw=8.4) six reinforced adobe houses had no damage. Neighboring dwellings of unreinforced adobe suffered heavy damage or collapsed. This led to its application in more than 500 houses, described in this report.

Get involved in the WHE project!--contribute a report, a news item, summaries of interesting new projects, items for the online library. Contact Andrew Charleson, Dominik Lang, Heidi Faison, Marjorie Greene or any member of WHE Editorial Board

GUATEMALA: ADOBE BRICK Report #144 (Prepared by Dominik Lang, Lisa Holliday, Omar G. Flores Beleton)



Adobe brick masonry can still be found in all parts of Guatemala. Generally adobe houses characterized by only one story, no basement, and sometimes irregular plan shape. Main use

is residential or small commercial (retail trade). In 1970's was a prevalent construction type, representing more than 39% of buildings. Percentage of adobe buildings at that time higher in urban areas than rural. Today, adobe structures prevail in rural areas--only remainders of this traditional construction technique found in cities.

INDIA: KOTI BANAL Report # 150 (Prepared by Piyoosh Rautela, Girish Chandra Joshi, Yogendra Singh, Dominik Lang)

Koti Banal is name of village in Yamuna Valley. Region



evolved this elaborate and magnificent earthquake-safe construction style as early as 1,000 years ago. Architectural style based on principles akin to that of blockhouse construction. Many features of these buildings considered as basics of modern earthquake-resistant design. Locally available building materials

such as long thick wooden logs, stones and slates judiciously used. Buildings withstood and performed well during many past damaging earthquakes.

Other Recent Reports:

ARGENTINA: BASE-ISOLATED CONFINED MASONRY
Report #152 (Prepared by Noemi Graciela Maldonado, Dr. Miguel Eduardo Tornello)

INDIA: NAGA HOUSING Report #147 (Prepared by Amir Ali Khan)

NEPAL: PILLAR WALAGHAR (URM INFILL RC FRAME)
Report #145 (Prepared by Yukta Bilas Marhatta, Jiten-dra K Bothara, Meen Bahadur Magar, Gopal Chapagain)

TRINIDAD & TOBAGO: SINGLE STORY RESIDENTIAL CONSTRUCTION Report #156 (Prepared by Richard P. Clarke and Rakesh Ramnath)

COMING SOON!

Reports on unreinforced masonry, confined masonry and RC frame construction in **China**
Dhajji dewali construction in **Pakistan**