Build Change

Earthquakes Don't Kill People
Poorly Built Buildings Do

Dr. Elizabeth A. Hausler
Founder and CEO

36th Annual Natural Hazards Workshop
July 10, 2011

About Build Change

→ US 501(c)3 international non-profit social enterprise with programs in Indonesia, China and Haiti

→ Founded in 2004 by Elizabeth Hausler, bricklayer and Ph.D. earthquake engineer from University of California, Berkeley

→ Goals: Design earthquake resistant houses; train builders, homeowners, government officials and engineers to build them; change construction practice permanently

→ Mission: Greatly reduce deaths, injuries, economic losses from housing collapses due to earthquakes in developing countries

→ Impacts: 72,000 people living in houses improved by Build Change, over 12,000 people trained; no damage to minimum standard houses in 2009 earthquake; governments adopting Build Change model


Stimulate Local Demand
(Homeowners)
HAITI

WHAT'S HAPPENING NOW IN HAITI on HOUSING

1. BUILDING ASSESSMENTS

- 394,803 buildings tagged

2. YELLOW HOUSE REPAIRS

- Several 1,000 buildings repaired

3. DEBRIS REMOVAL

- 2 million cu m cleared

4. TRANSITIONAL SHELTER

- 39,219 shelters built

WHAT BUILD CHANGE IS DOING IN HAITI on HOUSING

1. DESIGNING HOMES

- Confined Masonry
- Reinforced Masonry
- Timber Frame
- Concrete Moment Frame
- Retrofitting Options
- Inputs on Repair Guideline

2. TRAINING PEOPLE

- Builders > 1,000
- Homeowners > 2,400
- Engineers ~80
- *Relief Agency Staff*
- *Government Officials*
- *Building Materials Producers*

3. INFLUENCING POLICY

- Ministries
- Donors
- Cluster Agencies
- BBBC Jury

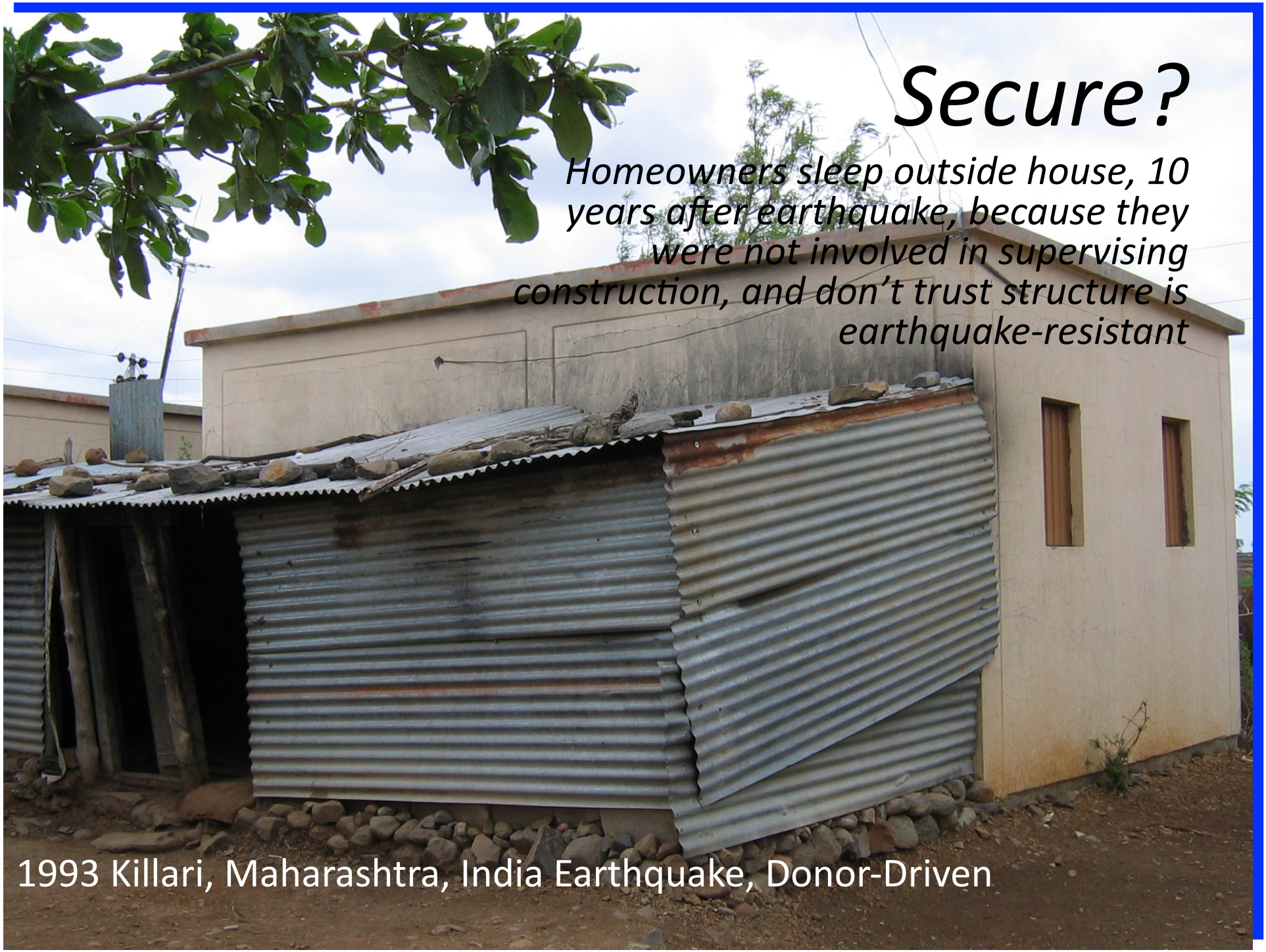
4. PROVIDING HANDS-ON TECHNICAL ASSISTANCE to HOMEOWNERS

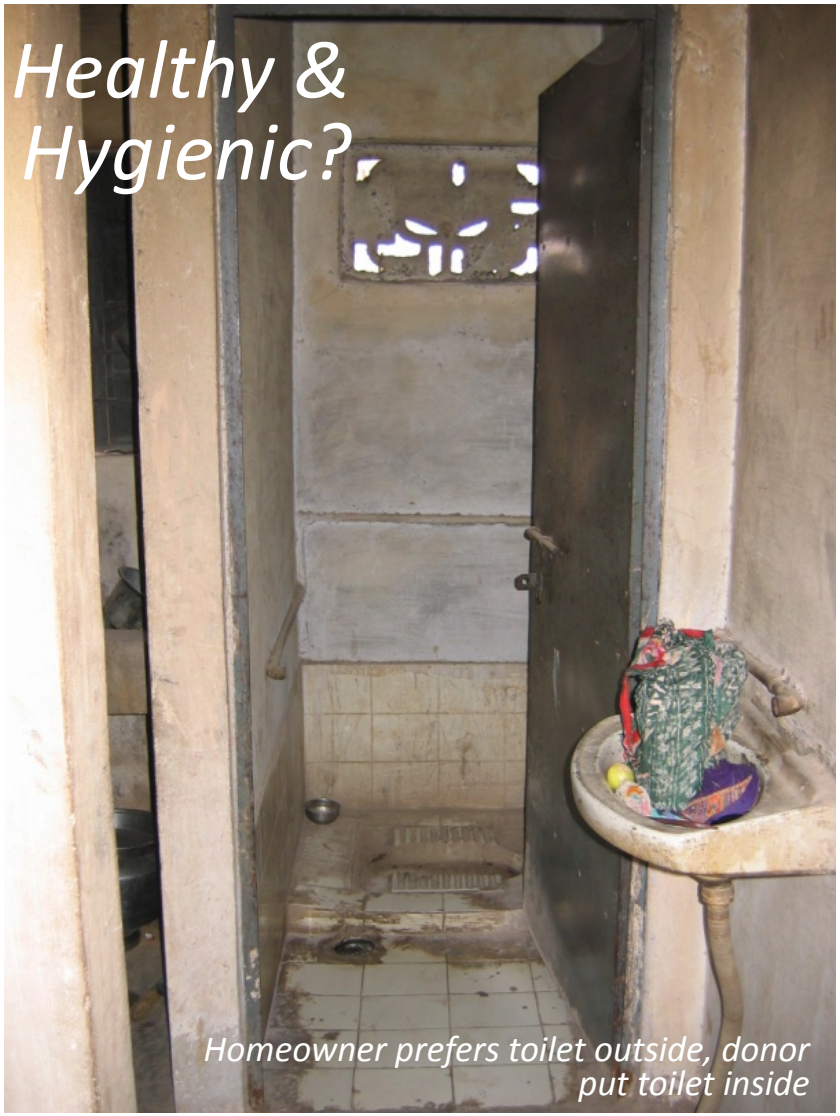
- 76 homeowners
- Partnerships for Scale

Culturally Appropriate?

Dome house has poor air circulation, low natural light, and difficult to divide interior space. Homeowners extended using old methods; opportunity to train on better methods was missed.

1993 Killari, Maharashtra, India Earthquake, Donor-Driven


Secure?
Homeowners sleep outside house, 10 years after earthquake, because they were not involved in supervising construction, and don't trust structure is earthquake-resistant
1993 Killari, Maharashtra, India Earthquake, Donor-Driven



2001 Bhuj, India Earthquake, Donor-Driven


2001 Bhuj, India Earthquake, Homeowner-Driven

Housing Reconstruction is Development

And like any development challenge, it comes down to money, technology and people

TECHNOLOGY

Earthquake-resistant construction will become common if the right technology is widely known, locally available, and culturally accepted.

MONEY

If the technology is too expensive, people will not use it. Homeowners need sufficient funds to build a safe house.

PEOPLE

Someone has to want the house to be earthquake-resistant: homeowner, government official, relief agency, or donor.

Build Change Six Step Model

1. Learn First → Technical and Market Research
2. Design Earthquake-Resistant Houses for Local Context
3. Build Local Capacity → Builders, Engineers, Construction Professionals
4. Stimulate Local Demand → Homeowners and Government Officials
5. Facilitate Access to Capital
6. Measure the Change

Step 1: Learn First

WHY DID BUILDINGS COLLAPSE? AND WHY DID THEY NOT?


Why Did Buildings Survive?
And Why Did They Collapse?

Build Change Three C's for Safe Construction

Configuration

- Simple, Square, Symmetric
- Light, flexible = good
- Heavy, brittle = bad

Connections

- Everything tied together: walls to foundation, walls to beams and columns, beams and columns to each other, roof to walls

Construction Quality

- Clean sand, angular gravel, fully fired bricks, well made blocks, new steel of sufficient diameter, timber protected from insects and water, good masonry workmanship

Barbending Training


Stimulate Local Demand (Homeowners)
Steel Reinforcement Detailing

Step 2: Design Disaster-Resistant Houses

WHAT TYPES OF HOUSES DO PEOPLE WANT TO BUILD HERE, NOW?

Housing Subsector Study in Haiti

TECHNOLOGY – MONEY – PEOPLE

1. What type of house do people want to build here, now?
2. Materials? Architecture? Size, layout, lifestyle, climate? Hazards?
3. What codes apply?
4. Who builds? With what skills/tools?
5. Who buys materials? From where?
6. Who pays? How does money flow?

The Technology

LOW OR NO-COST IMPROVEMENTS, COMMON BUILDING TECHNOLOGIES

Earthquake-Resistant Confined Masonry House for Aceh, Indonesia

WINNER
2006 Excellence in Structural Engineering Award
Structural Engineers Association of Northern California

Lightweight roof cover on timber truss connected to the walls

Traditional Acehnese timber in the gable

Simple, square, symmetric layout

Reinforced concrete tie columns and bond beams “confine” the masonry wall together

Steel reinforcement in between the bricks, connects the walls to the columns

Masonry wall built with locally available, good quality materials and workmanship

Good quality steel tied together

If Bricks Are Laid Dry…

Soaking Bricks in Clean Water Prior to Laying

is one of the most important steps to improve the strength of masonry walls built in Indonesia, and their performance during earthquakes

Common Building Types - Haiti

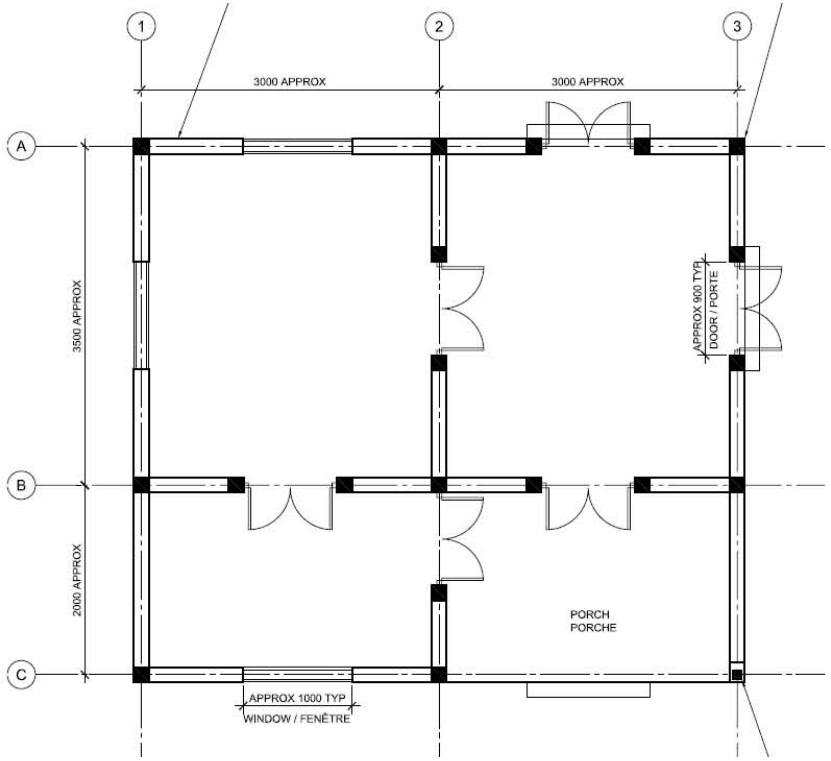
1. Concrete Moment Frame
2. Reinforced Masonry
3. Confined Masonry
4. Timber Frame
5. Retrofitting

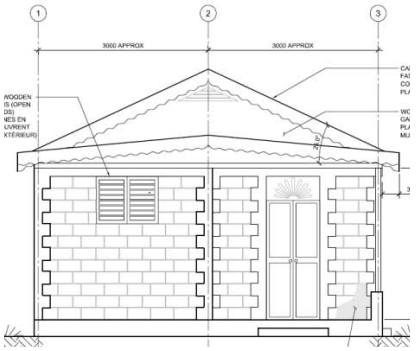
Build Change designed systems (with Memorandum of Agreement with MTPTC)

USAID
FROM THE AMERICAN PEOPLE

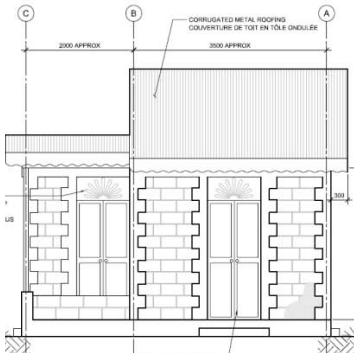
ECAP
EMERGENCY COMMUNITY ASSISTANCE AND PLANNING
A Partnership of Habitat for Humanity
Development Innovations Group (DIG)
and Build Change

EXAMPLE PLAN FOR SINGLE STORY HOUSE

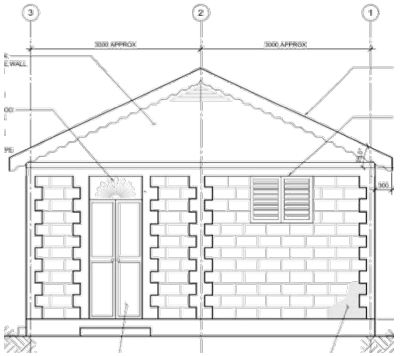




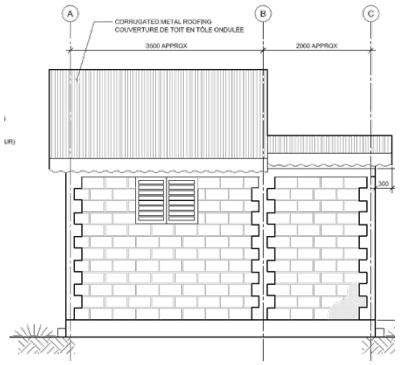
FRONT VIEW



SIDE VIEW



BACK VIEW



SIDE VIEW

TOTAL AREA: 33 m^2 (27 m^2 INDOORS)
COST PER SQ M: US $450-460 APPROX
TOTAL COST: US $15,000 APPROX (HTG 597,000)

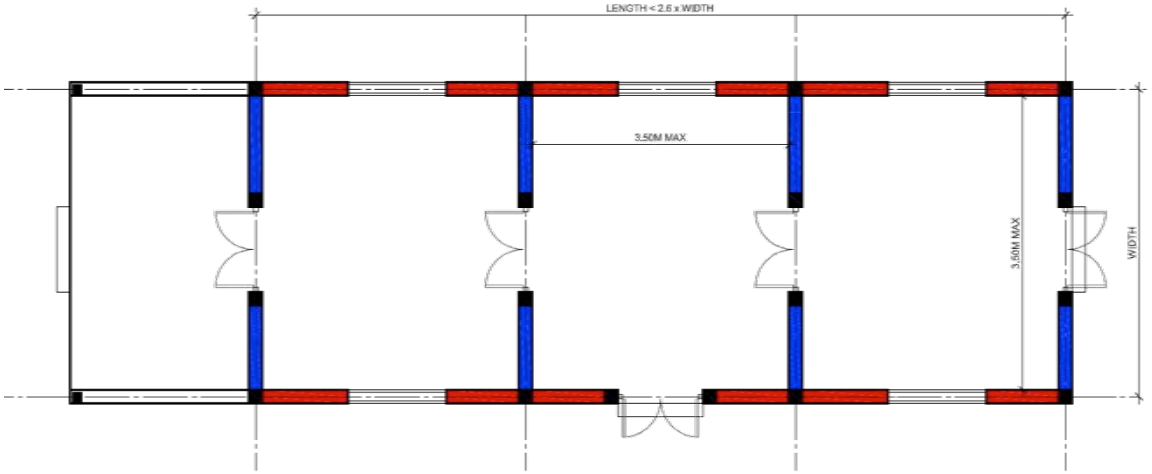
USAID
FROM THE AMERICAN PEOPLE

ECAP
EMERGENCY COMMUNITY ASSISTANCE AND PLANNING
A Partnership of Habitat for Humanity
Development Innovations Group (DIG)
and Build Change

CONFINED MASONRY – KEY DESIGN DETAILS AND GUIDELINES

CONFIGURATION

- LIMIT LENGTH OF LAYOUT TO 3 TIMES WIDTH (SINGLE STORY) OR 2.6 TIMES WIDTH (TWO STORY)
- PROVIDE 5% WALL AREA IN BOTH DIRECTIONS
- LAYOUTS SHOULD BE SYMMETRICAL WITH A MINIMUM OF TWO SEPARATE LINES OF WALLS IN EACH DIRECTION
- MAXIMUM DISTANCE BETWEEN ORTHOGONAL WALLS IS 3.5M
- MAXIMUM FIRST STORY HEIGHT IS 2.75M / MAXIMUM SECOND STORY HEIGHT IS 2.55M
- PLACE RC TIE COLUMNS AT EACH CORNER AND WALL INTERSECTION AND AT BOTH SIDES OF DOORS AND CONTINUOUS RC BEAMS ABOVE AND BELOW ALL MASONRY WALLS



USAID FROM THE AMERICAN PEOPLE
ECAP EMERGENCY COMMUNITY ASSISTANCE AND PLANNING
A Partnership of Habitat for Humanity Development Innovations Group (DIG) and Build Change

The Money

ARE THESE CHANGES AFFORDABLE? ARE THEY TOO CONSERVATIVE?

MTPTC APPROVED DESIGN CRITERIA

- WIND LOAD BASED UPON PAHO WIND SPEED MAPS FOR CARIBBEAN FOR APPLICATION WITH WIND LOAD PROVISIONS OF ASCE 7 2008 (119 MPH, EXPOSURE CATEGORY C) *(DOES NOT GOVERN CONFINED MASONRY DESIGN, GOVERNS TIMBER FRAME ROOF)*

- SEISMIC LOAD DETERMINED FROM 2010 USGS SHORT PERIOD SPECTRAL ACCELERATION MAPS FOR 2% PROBABILITY OF EXCEEDANCE IN 50 YEARS *(SEVERAL CASES CONSIDERED)*

- MATERIALS AND MATERIAL PROPERTIES BASED UPON SURVEY OF LOCALLY AVAILABLE MATERIALS

- REINFORCING STEEL: GRADE 40, RIBBED

- CAST-IN-PLACE CONCRETE: 3000 PSI (2500 PSI USED IN DESIGN) FOR CONFINING ELEMENTS AND ROOF, 2200 PSI FOR FOUNDATION

- CONCRETE BLOCK: SEVERAL CASES CONSIDERED

- TIMBER: VISUALLY GRADED SOUTHERN PINE NO. 2

USAID FROM THE AMERICAN PEOPLE ECAP EMERGENCY COMMUNITY ASSISTANCE AND PLANNING A Partnership of Habitat for Humanity Development Innovations Group (DIG) and Build Change

DESIGN CRITERIA

SEISMIC PERFORMANCE AND BLOCK STRENGTH

Single-Story House with Lightweight Roof

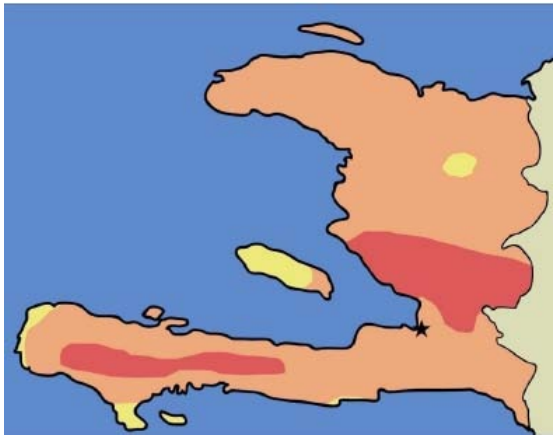
CONCRETE BLOCK STRENGTH	SEISMIC DESIGN CRITERIA
4.8 MPa (700 psi)	Minimum Standard Case A (Sds = 0.5g)
8.3 MPa (1200 psi)	Limited Zone Case B (Sds = 1.05g)
11.0 MPa (1600 psi)	All-inclusive Case C (Sds = 1.67g)

Single-Story House with Concrete Roof

CONCRETE BLOCK STRENGTH	SEISMIC DESIGN CRITERIA
4.8 MPa (700 psi)	Not Permitted
8.3 MPa (1200 psi)	Minimum Standard Case A (Sds = 0.5g)
16.5 MPa (2400 psi)	Limited Zone Case B (Sds = 1.05g)

Two-Story House with Concrete or Lightweight Roof

CONCRETE BLOCK STRENGTH	SEISMIC DESIGN CRITERIA
4.8 MPa (700 psi)	Not Permitted
8.3 MPa (1200 psi)	Minimum Standard Case A (Sds = 0.5g)
16.5 MPa (2400 psi)	Limited Zone Case B (Sds = 1.05g)



Case A

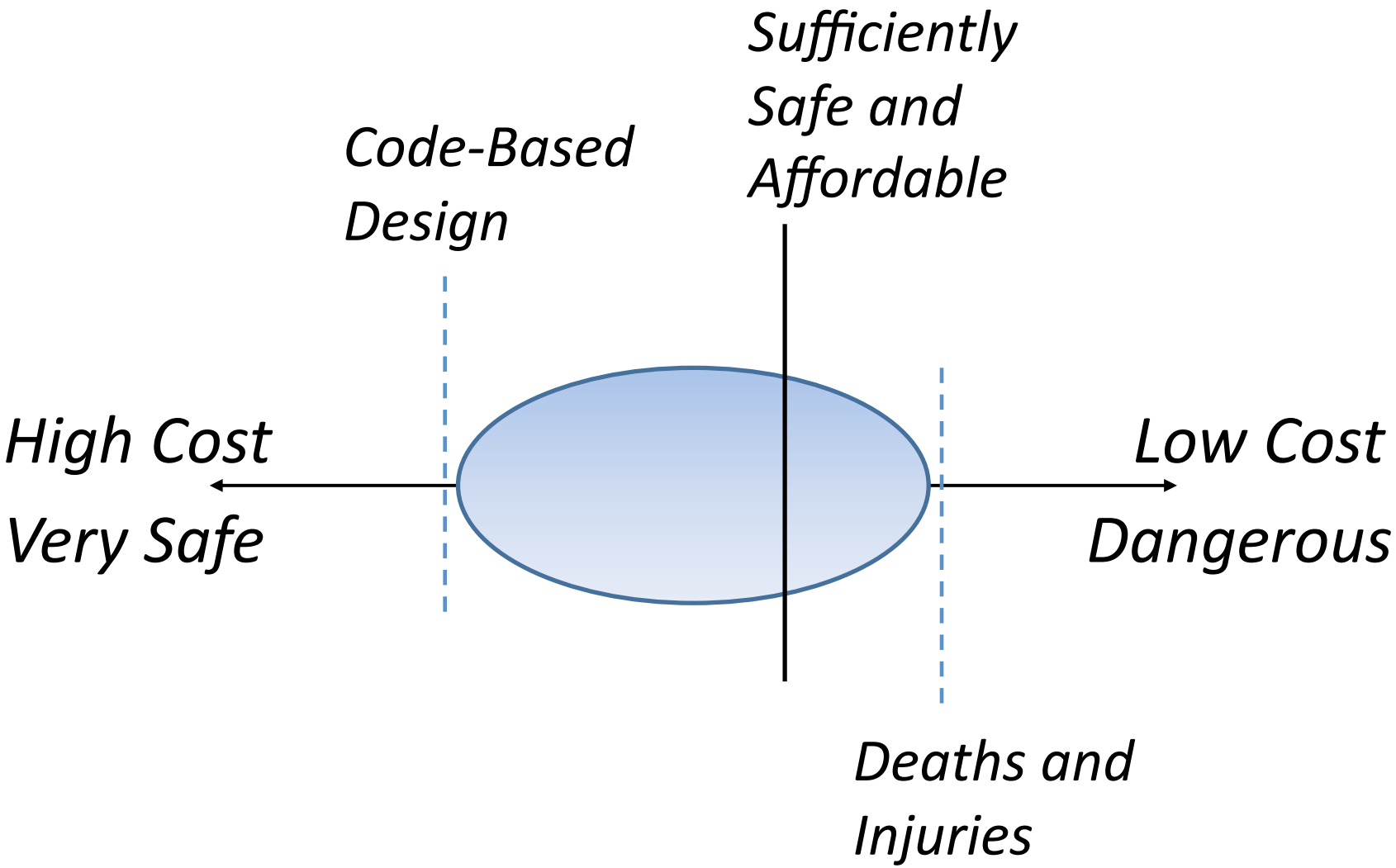
Case B

Case C

USAID FROM THE AMERICAN PEOPLE

ECAP EMERGENCY COMMUNITY ASSISTANCE AND PLANNING
A Partnership of Habitat for Humanity, Development Innovations Group (DIG) and Build Change

Earthquake-Resistant Design Continuum for Housing



The Technology

R&D ON LOCALLY SUSTAINABLE HOUSING SOLUTIONS

Simple Field Tests for Materials and Construction Quality

→ Simple Field Tests

Clean Sand

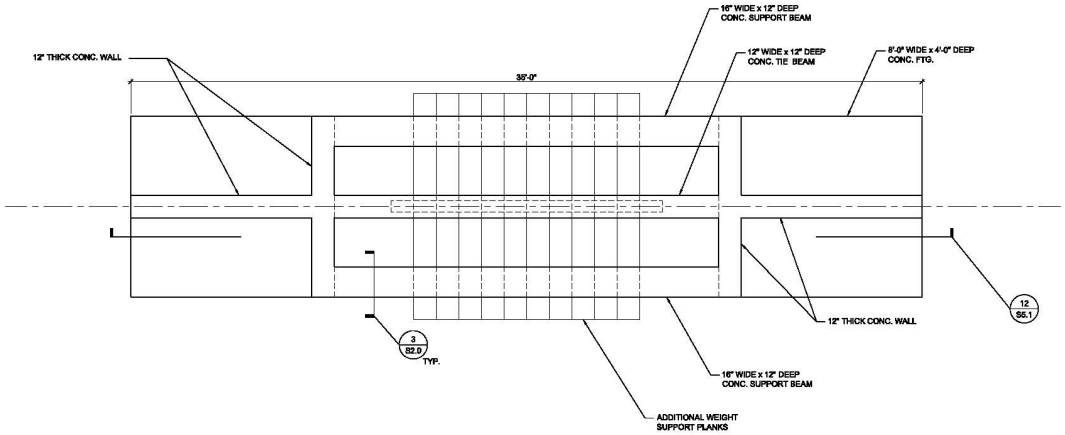
Sand with too much mud

Strong Brick

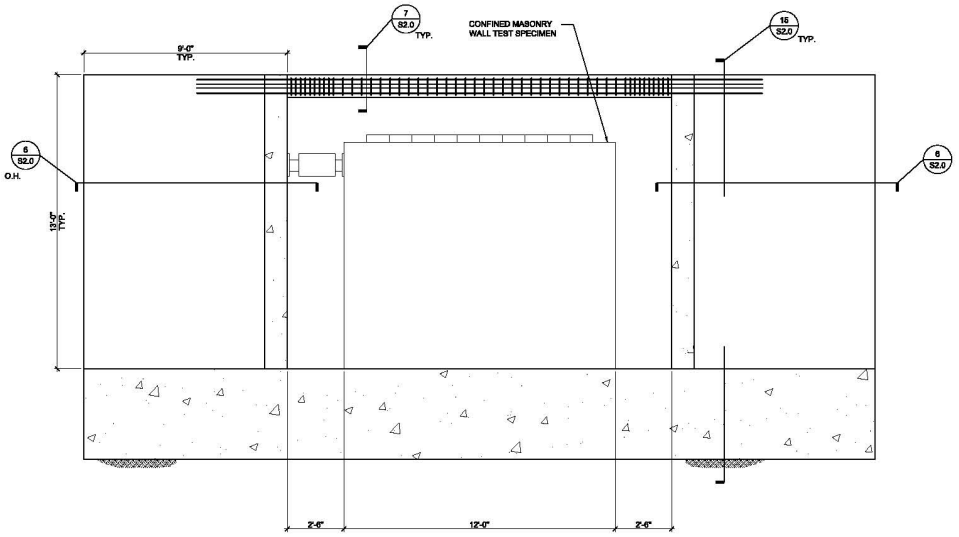
Weak Brick

→ "Laboratory" Tests

→ Full-Scale Tests



18 PLAN
1/2" = 1'-0"



20 ELEVATION
1/2" = 1'-0"

build change
BUILD CHANGE
USA HEADQUARTERS
1416 LARIMER STREET, SUITE 301
DENVER, CO 80202
TEL 303-953-2563

No.	Descriptions	Date

REVISIONS

Work/Travail

WALL TESTING FACILITY

Structural Engineer/Ingenieur Structure

Degenkolb

Project/Projet

POST-EARTHQUAKE RECONSTRUCTION TECHNICAL ASSISTANCE PROGRAM

Location/Emplacement

HAITI
HAITI

Sheet Title/Titre Du Dessin:

PLAN AND ELEVATION

Scale/Echelle: AS NOTED

Job Number:

Drawn by/Etabli Par:

Design by:

Checked by/Controle Par: MS

Date/Date: 2011/24/01

Drawing Number/Fichier:

S1.0

of Sheets

Construction Supervision Checklists

Homeowner:_____ ID No:_____ GPS: _____

BC Engineer:_____ Address: _____

BUILD A STRONG MASONRY WALL

	1 MORTAR MIXING	Planned?	Date	Photo #	Recommendation Made
a	Use mortar 1:3 mix (add 0.5 parts lime if available)	Oui / No			
b	Use clean, fine river sand	Oui / No			
c	Use clean water (not salty or muddy)	Oui / No			
d	Use Type 1 Cement	Oui / No			
e	Mix a clean, concrete or asphalt surface, not on dirt	Oui / No			
f	Using a mechanical mixer is best	Oui / No			
g	Batch out gravel, then sand, then cement	Oui / No			
h	Turn over 3 times or until color is uniform	Oui / No			
i	Do not use too much water! Add water slowly	Oui / No			
	2 WALL MASONRY	**Planned?**	**Date**	**Photo #**	**Recommendation Made**
a	Use 15 cm wide concrete block ("Bloc 15")	Oui / No			
b	Wet concrete blocks prior to use	Oui / No			
c	Use a line and deadman	Oui / No			
d	Prop up column steel so it remains plumb	Oui / No			

Step 3

BUILD LOCAL CAPACITY (TRAIN PEOPLE)

Build Capacity: Mentor Local Professionals

Build Change Haiti Team

Build Capacity: Mentor Local Professionals

Build Change China Team

Build Capacity: Mentor Local Professionals

Build Change Indonesia Team

Build Capacity: Train Local Builders

Short Courses – Haiti

Build Capacity: Train Local Builders

Apprenticeship Programs – Indonesia

Build Capacity: Train Local Builders

On-the-Job, As Needed Training – Indonesia

Build Capacity: Train Trade School Students

Construction Technical School Training – China CIVTC

Construction Technical School Training – China CIVTC

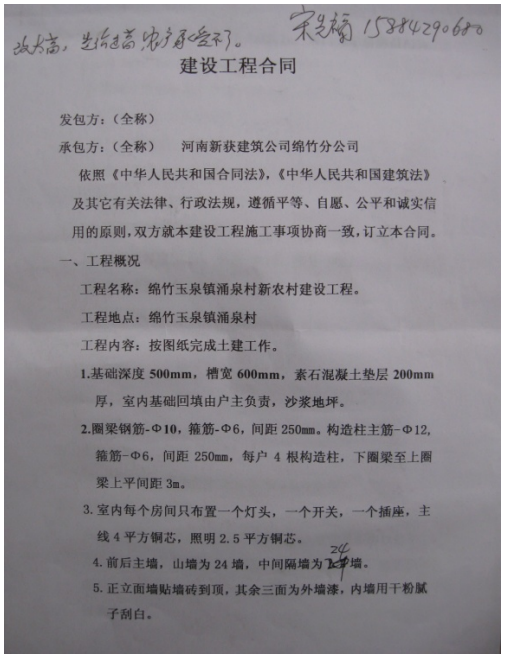
Build Capacity: Mentor Materials Producers

Step 4

STIMULATE LOCAL DEMAND (EMPOWER PEOPLE)

Stimulate Local Demand (Homeowners)

1. Why Houses Collapse, and Simple Ways to Prevent
2. How To Sign a Good Contract and Read a Drawing
3. How to Check Materials and Construction Quality



建设工程合同

发包方：（全称）

承包方：（全称）　河南新获建筑公司绵竹分公司

依照《中华人民共和国合同法》,《中华人民共和国建筑法》及其它有关法律、行政法规，遵循平等、自愿、公平和诚实信用的原则，双方就本建设工程施工事项协商一致，订立本合同。

一、工程概况

工程名称：绵竹玉泉镇涌泉村新农村建设工程。

工程地点：绵竹玉泉镇涌泉村

工程内容：按图纸完成土建工作。

1.基础深度 500mm，槽宽 600mm，素石混凝土垫层 200mm 厚，室内基础回填由户主负责，沙浆地坪。

2.圈梁钢筋-Φ10，箍筋-Φ6，间距 250mm。构造柱主筋-Φ12，箍筋-Φ6，间距 250mm，每户 4 根构造柱，下圈梁至上圈梁上平间距 3m。

3. 室内每个房间只布置一个灯头，一个开关，一个插座，主线 4 平方铜芯，照明 2.5 平方铜芯。

4. 前后主墙，山墙为 24 墙，中间隔墙为 24 墙。

5. 正立面墙贴墙砖到顶，其余三面为外墙漆，内墙用于粉腻子刮白。

Homeowner-Driven Reconstruction

1. Decide Structure Type (Timber? Confined Masonry?)
2. Draw Layouts
3. Estimate Costs
4. Select a Good Builder and Sign a Fair Contract
5. Check Materials Quality and Supervise Construction

Xing Dayan

Stimulate Local Demand (Homeowners)

Homeowner and Builder Technical Assistance

Multi-Laterals and Humanitarian Agency Partners

- → Australian Red Cross
- → CARE International Indonesia
- → Catholic Relief Services
- → CHF International
- → Cordaid
- → International Federation of the Red Cross and Red Crescent Societies
- → International Organization for Migration
- → Mercy Corps
- → Oxfam International GB
- → Save the Children
- → USAID OFDA (through Mercy Corps, Asia Foundation, Habitat for Humanity)

Stimulate Local Demand (Government Officials)

→Build Change invited by Tumen Party Secretary to oversee/inspect houses

→Developed easy-to-implement minimum standard checklist

→Now expanding government training programs


First Ever Training on Retrofitting for Gov't Engineers in Haiti

First Ever Training on Retrofitting for Gov't Engineers in Haiti

Step 4: Stimulate Local Demand

GETTING THE WORD OUT THROUGH SOCIAL MARKETING

Social Marketing Campaigns

Target: Homeowners

Message: Don't use broken or poor quality blocks; don't use recycled or rusty steel

Dissemination: Training programs, one-on-one technical assistance, community buildings, billboards

Country: Haiti

Social Marketing Campaigns

Target: Homeowners

Message: If you can just do these six things, your masonry home will be much safer

Dissemination: Training programs, one-on-one technical assistance, community buildings

Country: Indonesia

Social Marketing Campaigns

Target: Homeowners and builders

Message: Translating complicated technical details (concrete strength) into understandable terms

Dissemination: Training programs, one-on-one technical assistance, community buildings

Country: China

Billboard on Rue Delmas, Port-au-Prince, Haiti

It's time to change the way we build
Use good quality material and a qualified builder

Step 5

FACILITATE ACCESS TO CAPITAL

Overall Cost Per House is Less When Homeowners Lead

Effective Grant

West Sumatra: US$3,000 - $8,000

Includes government grant, homeowners own funds, Build Change technical assistance. Homeowners

→ Use more recycled materials

→ Build only what they need, no waste and theft

→ Support local economy by buying local materials and hiring local builders

Less Effective Grant

Aceh: US$12,000 - >$20,000

Includes donor-funded materials and labor, overheads, warehousing, construction management, quality control, retrofitting and rebuilding.

Homeowner-driven model stretches donor dollars further.

How to Learn More About Homeowner-Driven Reconstruction

"Earthquake-Resistant Houses" in Build Back Better Issue of Innovations Journal, Prepared for Clinton Global Initiative Annual Meeting

Step 6

MEASURE THE CHANGE

The Impact – INDONESIA, CHINA, and HAITI

> 72,000 PEOPLE IN SAFER HOUSES

> 12,000 PEOPLE WITH BETTER SKILL

> LONG-TERM CHANGE

BUILD CHANGE EXPANSION PLANS

Indonesia

1. Hands-on Technical Assistance
2. Trade School Student Training
3. Better Brick Manufacturing

China

1. Government Officials Training
2. Technical College Training

Haiti

1. Hands-on Technical Assistance
2. Vocational Training with Job Placement
3. Better Block Manufacturing and Marketing
4. Materials Testing and Research
5. Social Marketing thru Radio, Posters, Billboard

BUILD CHANGE NEEDS and OPPORTUNITIES

Haiti – Train the Trainers

1. Structural Engineering – Retrofits and New Construction
2. Construction Supervision and Training – Retrofits and New Construction
3. Geotechnical Engineering, Slope Assessment and Stability
4. Materials Testing and Research Assistance
5. Better Block Manufacturing and Marketing Promotion

Research Opportunities

Homeowner Satisfaction, Cost Per Impact, Contrasting T-Shelter, Core House, Permanent House

Thank You - Contact Us

Dr. Elizabeth Hausler, Founder + CEO

elizabeth@buildchange.org

US Mobile: 1.415.235.9930

Haiti Mobile: +509-3702-8251