CAPTURING UNCERTAINTY IN THE DESIGN OF PRESCRIPTIVE GUIDELINES FOR CONFINED MASONRY HOUSING IN HAITI

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30 SEPTEMBER 2014
Build Disaster-Resistant Buildings
Change Construction Practice Permanently
**Task 1:** Develop architectural and engineering criteria for housing design

**Task 2:** Develop prescriptive guidelines for confined masonry housing
**TASK 1:** DEVELOP ARCHITECTURAL AND ENGINEERING CRITERIA FOR HOUSING DESIGN

**TASK 2:** DEVELOP PRESCRIPTIVE GUIDELINES FOR CONFINED MASONRY HOUSING

**UNCERTAINTIES IN LOADING, MATERIAL TYPES AND QUALITY**

**UNCERTAINTIES IN CONFIGURATIONS, DIMENSIONS AND CONSTRUCTION**
TASK 1: DEVELOP ARCHITECTURAL AND ENGINEERING CRITERIA FOR HOUSING DESIGN

UNCERTAINTIES IN LOADING, MATERIAL TYPES AND QUALITY

UNCERTAINTIES IN CONFIGURATIONS, DIMENSIONS AND CONSTRUCTION

UNCERTAINTY

TASK 2: DEVELOP PRESCRIPTIVE GUIDELINES FOR CONFINED MASONRY HOUSING
DESIGN ECONOMY vs. DESIGN SAFETY

- Design Economy
- Design Safety

Balanced Scale

- Design Economy
- Design Safety

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Balanced Scale

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Balanced Scale
CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA

DESIGN CODE
CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA

WIND AND SEISMIC LOADING

Wind Speed Maps for the Caribbean for Application with the Wind Load Provisions of ASCE 7

Prepared by
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Raleigh NC 27615
ARA Report 15108-1

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World Health Organization
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CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA
WIND AND SEISMIC LOADING

Documentation for Initial Seismic Hazard Maps for Haiti

By Arthur Frankel, Stephen Harmsen, Charles Mueller, Eric Calais, and Jennifer Hasse


U.S. Department of the Interior
U.S. Geological Survey
CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA

WIND AND SEISMIC LOADING

2 VARIABLES FOR SEISMIC LOADING:

- 0.6g PGA (ORANGE)
- 1.0g PGA (RED)
CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA

MATERIAL PROPERTIES
CAPTURING UNCERTAINTIES IN ENGINEERING DESIGN CRITERIA

MATERIAL PROPERTIES

3 VARIABLES FOR CONCRETE BLOCK STRENGTH

4.8 MPa (700 psi) MINIMUM PERMITTED

6.9 MPa (1000 psi) INTERMEDIATE VALUE

11.7 MPa (1700 psi) MAXIMUM ASSUMED ACHIEVABLE
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS

LAYOUT TYPE 1 - KAY HOUSE (ALTERNATES)

LAYOUT TYPE 2 - CREOLE HOUSE (TWO-STORY)
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS

LIMITATIONS SET ON CONFIGURATIONS AND DIMENSIONS
CONSISTENT WITH LOCAL PRACTICES

- MAXIMUM SPACING BETWEEN ADJACENT WALLS
- MAXIMUM STORY HEIGHT
- ROOF TYPE (2 VARIABLES: TIMBER GABLE/HIP OR FLAT CONCRETE)
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA

HOUSING CONFIGURATIONS AND DIMENSIONS

RESTRICTIONS PLACED ON UNSAFE LOCAL PRACTICES

- WALL CONFIGURATION ASYMMETRY
- WALL DISCONTINUITIES (SOFT STORIES, OVERHANGS)
- DETAILING PRACTICES (EG STAIRS, PORCHES)
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS
CAPTURING UNCERTAINTIES IN ARCHITECTURAL DESIGN CRITERIA
HOUSING CONFIGURATIONS AND DIMENSIONS

2 VARIABLES FOR NUMBER OF STORIES AND ROOF TYPE COMBINATION

SINGLE STORY HOUSE WITH LIGHTWEIGHT (TIMBER) ROOF
SINGLE STORY HOUSE WITH CONCRETE ROOF OR TWO-STORY HOUSE
CAPTURING UNCERTAINTIES IN DESIGN

SUMMARY OF VARIABLES

**ENGINEERING DESIGN CRITERIA**
- 2 VARIABLES FOR SEISMIC LOADING
- 2 VARIABLES FOR CONCRETE BLOCK STRENGTH

**ARCHITECTURAL DESIGN CRITERIA**
- 2 VARIABLES FOR COMBINATION OF ROOF TYPE/NUMBER OF STORIES
CAPTURING UNCERTAINTIES IN DESIGN

SUMMARY OF VARIABLES

ENGINEERING DESIGN CRITERIA
2 VARIABLES FOR SEISMIC LOADING
2 VARIABLES FOR CONCRETE BLOCK STRENGTH

ARCHITECTURAL DESIGN CRITERIA
2 VARIABLES FOR COMBINATION OF ROOF TYPE/NUMBER OF STORIES

8 SETS OF ENGINEERING GUIDELINES
CAPTURING UNCERTAINTIES IN DESIGN
ENGINEERING GUIDELINES

2 SETS OF ENGINEERING GUIDELINES

<table>
<thead>
<tr>
<th>Concrete Block Strength</th>
<th>Seismic Design Criteria</th>
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</thead>
<tbody>
<tr>
<td><strong>Case 1: Single Story with Lightweight Roof</strong></td>
<td></td>
</tr>
<tr>
<td>4.8 MPa (700 psi) min</td>
<td>Permitted in all zones (Orange and Red)</td>
</tr>
<tr>
<td><strong>Case 2: Single Story with Concrete Roof / Two Story</strong></td>
<td></td>
</tr>
<tr>
<td>4.8 MPa (700 psi) min</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>6.9 MPa (1,000 psi) min</td>
<td>Permitted in orange zones only</td>
</tr>
<tr>
<td>11.7 MPa (1,700 psi) min</td>
<td>Permitted in all zones</td>
</tr>
</tbody>
</table>
CAPTURING UNCERTAINTIES IN DESIGN
ENGINEERING GUIDELINES

Design and construction guidelines for confined masonry housing

Build Change Post-Earthquake Housing Reconstruction Technical Assistance Program, Haiti

Prepared for
Build Change Denver CO

31 January 2011

Guy Nordenson and Associates
New York NY

Calculation report for confined masonry housing

Build Change Post-Earthquake Housing Reconstruction Technical Assistance Program, Haiti

Prepared for
Build Change Denver CO

31 January 2011

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CAPTURING UNCERTAINTIES IN DESIGN
ENGINEERING GUIDELINES
THANK YOU!

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