Volunteer Work for Earthquake Response in Puerto Rico

Presented by Jose A. Sanchez

March 4, 2020
Agenda

• Building Codes in Puerto Rico
• Seismic Background
• The Earthquake Event
• Volunteer Call to Action & Assembling the Team
• Inspection Process
• Identified Poor Construction Practices
• Concluding Remarks
Puerto Rico Design Codes

Buildings Regulations, Regulation No. 7

- 1954 Edition
- 1968 Edition
- 1987 Edition

Ductile Design is Introduced

- 1997 Uniform Building Code (UBC) is adopted in 1999
- 2000 International Building Code (IBC) is adopted
- 2011 Puerto Rico Building Code
  Based on the 2009 IBC, with local revisions
Hurricane Maria: September 21, 2017
Puerto Rico Design Codes

- Hurricane Maria, September 21, 2017

- 2018 Puerto Rico Building Code (Current Code)
  Based on the 2018 IBC

As a response to Hurricane Maria:
Wind Study is conducted:
Microzoning maps amend the ASCE7-16 wind maps.
Puerto Rico Seismic Background

Historical seismic events in Puerto Rico:

- **August 15, 1670**: First significant earthquake on record. Only two cities at the time, San Juan and San German.

- **May 2, 1787**: The strongest earthquake felt in Puerto Rico. Causing serious damages and collapse of several buildings. Estimated as 8.0 Mw. Epicenter unknown.

- **November 18, 1867**: Epicenter was in the US Virgin Islands between St. Thomas and St Croix. 7.3 Mw, caused 20 tsunami waves in the Virgin Islands.

- **October 11, 1918**: San Fermin Earthquake. 7.3 Mw while its intensity was estimated at VIII-IX (MM), caused 20 feet tsunami waves in the northwest of PR.
The Earthquake Event
The Earthquake Event

January 7, 2020:
- 4:24am local time
- 6.4 MW
- Depth 7.4 km
The Earthquake Event
The Earthquake Event

PGA = 0.40 g

Duration = 20 sec

Sds = 0.83 g
Call to Action & Assembling the Team
Hola a todos. Un grupo de ingenieros estructurales boricuas en los Estados Unidos estaremos viajando a Puerto Rico la próxima semana a inspeccionar estructuras de forma voluntaria y libre de costo. El grupo estará liderado por este servidor y mi colega Jose A. Sanchez. Ya tenemos los puntos de contacto en Puerto Rico y las áreas que inspeccionaremos. Costos de desayuno y almuerzo para los ingenieros ya están cubiertos.

Si tienes licencia PE, y capacitado para inspeccionar, n... See More
In lieu of recent earthquake events in Puerto Rico, a group of Puerto Rican professionals and engineers, from the island and in the diaspora, joined forces to provide Puerto Rico with free home inspection services for disadvantaged communities.

https://www.ingenierospr.org/
Call to action & Assembling the Team

Request for inspection

Volunteer Information

Inspecciones
Si usted o un familiar en Puerto Rico quiere evaluar la vulnerabilidad de su hogar y cómo hacerla más segura, llene este formulario. Estaremos dando prioridad al sur de la isla, envejecientes, y otras poblaciones desventajadas afectadas por los terremotos. Este servicio será gratuito.

* Required

Email address *

Your email

Nombre y Apellido *

Your answer

Celular
Solo incluya los números. No símbolos.

Your answer

Dirección del lugar a evaluar (numero de casa, calle, km, Bo. Urb.) *

Formulario para Voluntarios (NO ES PARA INSPECCIONES)

ESTE FORMULARIO NO ES PARA INSPECCIONES. Si usted necesita inspecciones use este formulario:
https://forms.gle/HYDd4g55WnMbG4eEZ
Estamos buscando ingenieros civiles, geotécnicos y estructurales.

* Required

Este formulario no es para inspecciones *
Si usted necesita una inspección, por favor llene el formulario para inspecciones:
https://forms.gle/BR1bL7Ko1W9QLAy3

Ok

Nombre y Apellido *

Your answer

Email *

Your answer
Call to action & Assembling the Team

8,525
Peticiones para inspecciones

11.7%
Casas en columnas o Zancos

29.9%
Casas de 2 pisos

40.6%
Casas de 1 piso

Personas describiendo su situación

<table>
<thead>
<tr>
<th>Código</th>
<th>Descripción</th>
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<tr>
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<td>Casa de dos pisos</td>
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<tr>
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<td>Casa de un piso</td>
</tr>
<tr>
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<td>Casa de dos pisos</td>
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</tr>
<tr>
<td>00653</td>
<td>Casa de dos pisos</td>
</tr>
</tbody>
</table>

Otras tipicas de edificios como escuelas, condominios, Walk-uvos, negocios, etc.

Peticiones por toda la isla

[Simpson Gumpertz & Heger - Engineering of Structures and Building Enclosures]
Team and Execution

Execution Model

Operations

Jesabel Rivera
Coordination

Alondra Sierra
Post-processing

Jeyra Rivera
Post-processing

Ing. Sandy Brodahl
Entrevistas

Lic. Aixa Gonzalez
Legal

Jesabel is responsible for coordinating inspections in the municipalities. Jesabel is the point of contact for inspectors with the alcaides.

Alondra and Jeyra are responsible for obtaining the data from the inspections and processing it for final reports to the mayors and residents.

Sandy is responsible for interviewing interested persons and new members to our group of inspectors.

Aixa provides consultation and assistance for any legal uncertainty related to the practice of engineering in Puerto Rico and applicable laws to manage emergencies.

Inspections

Team and Execution

SIMPSON GUMPertz & HEGEr
Engineering of Structures and Building Enclosures
The Team
# The Team

## 2020 January

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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<td>31</td>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
</tr>
<tr>
<td>06</td>
<td>07 (QUAKE)</td>
<td>08 (CALL OF ACTION)</td>
<td>09</td>
<td>10</td>
<td>11 (TEAM IS ASSEMBLED)</td>
<td>12</td>
</tr>
<tr>
<td>13 (SAN SEBASTIAN)</td>
<td>14 (YAUCO)</td>
<td>15 (GUANICA)</td>
<td>16 (YAUCO)</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>
Day 1: San Sebastian

Jan-13-2020
28 miles from Epicenter

Hon. Javier Jimenez
Mayor
Good Samaritan Law

RELEVO

Autorizo en mi capacidad oficial como Alcalde de Yauco a que el grupo de Ingenieros Profesionales Voluntarios provean servicios o inspecciones arquitectónicas, estructurales u otros servicios de ingeniería, arquitectura o agrimensura en este estado de emergencia debido a los recientes terremotos ocurridos en el Estado Libre Asociado de Puerto Rico, por lo cual no serán responsables de cualquier daño corporal, muerte o daños a la propiedad o cualquier otra perdida relacionada a sus actos, errores u omisiones causados en el desempeño de sus funciones. Hoy 19 de enero de 2023

Para los fines que así procedan.

Líderes de inspección:

[Signature]
Eddie M. Guerra, PE

[Signature]
Jaime Orenzo, PE

[Signature]
Rubén Vélez, PE

Autorizado por:

[Signature]
Hon. Ángel L. Torres Ortiz
Alcalde
Day 2: Yauco

Jan-14-2020
6.0 miles from Epicenter

Hon. Luigi Torres
Mayor
Day 3: Guanica

Jan-15-2020
6.3 miles from Epicenter

Luis Guillermo Torres
Region Director for Emergency Management
Inspection Process
Inspection Process

• **ATC-20-1: Procedures for Post-earthquake Safety Evaluation of Buildings**

• **Green Sign - INSPECTED:** No apparent hazard found at time of inspection (no guarantee of future performance); Lawful occupancy permitted.

• **Yellow Sign - RESTRICTED USE:** Building is damaged, may or may not be habitable. May be damage to lateral force and/or vertical load systems, still able to resist loads; Access to specific areas might be restricted.

• **Red Sign - UNSAFE:** Extreme hazard, building may collapse. Unsafe for occupancy or entry except by permission of authorities.
# Inspection Process

## ATC-20 Rapid Evaluation Safety Assessment Form

### Inspection
- Inspector ID: ____________________
- Inspection date and time: _______ AM / _______ PM
- Affiliation: ____________________
- Areas inspected: □ Exterior only □ Exterior and interior

### Building Description
- Building name: ____________________
- Address: ________________________
- Building contact/phone: ____________________
- Number of stories above ground: _______ below ground: _______
- Approx. "footprint area" (square feet): _______
- Number of residential units: _______
- Number of residential units not habitable: _______

### Type of Construction
- □ Wood frame
- □ Steel frame
- □ Tilt-up concrete
- □ Concrete frame
- □ Concrete shear wall
- □ Unreinforced masonry
- □ Reinforced masonry
- Other: ____________________

### Primary Occupancy
- □ Dwelling
- □ Other residential
- □ Public assembly
- □ Emergency services
- □ Commercial
- □ Government
- □ Office
- □ Historic
- □ Industrial
- □ School

### Evaluation
- Investigate the building for the conditions below and check the appropriate column.
- Observed Conditions:
  - Collapse, partial collapse, or building off foundation: □ Minor □ None □ Moderate □ Severe
  - Building or story leaning: □ Minor □ None □ Moderate □ Severe
  - Racking damage to walls, other structural damage: □ Minor □ None □ Moderate □ Severe
  - Chimney, parapet, or other falling hazard: □ Minor □ None □ Moderate □ Severe
  - Ground slope movement or cracking: □ Minor □ None □ Moderate □ Severe
  - Other (specify): ____________________
- Comments: ____________________

### Estimated Building Damage (excluding contents)
- □ None
- □ 0-1%
- □ 1-10%
- □ 10-30%
- □ 30-60%
- □ 60-100%
- □ 100%

### Posting
- Choose a posting based on the evaluation and team judgment. Severe conditions endangering the overall building are grounds for an Unsafe posting. Localized Severe and overall Moderate conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.
- □ INSPECTED (Green placard)
- □ RESTRICTED USE (Yellow placard)
- □ UNSAFE (Red placard)
- Record any use and entry restrictions exactly as written on placed: ____________________

### Further Actions
- Check the boxes below only if further actions are needed.
  - □ Barricades needed in the following areas: ____________________
  - □ Detailed Evaluation recommended: □ Structural □ Geotechnical □ Other: ____________________
  - □ Other recommendations: ____________________
- Comments: ____________________
Inspection Process

**ATC-20 Voluntariado de Ingenieros**

Name
First
Last
Inspector ID
Provide License Number
Affiliation

**Social Work comments**

*i.e. was sent to refuge; needs emotional help, etc.*

Please upload pictures here

**IMPORTANT:** Include picture of placard

**SUBMIT**

**Other Recommendations**

Persona se re localizó
temperamente fuera de PR.

Please upload pictures here

![Photo.jpg](Photo.jpg)

**Added Time** 25-Jan-2020 11:55:16

**SIMPSON GUMPertz & Heger**

Engineering of Structures
and Building Enclosures
## Inspection Results

<table>
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<tr>
<th>Added Time</th>
<th>IP Address</th>
<th>Name</th>
<th>Inspector ID</th>
<th>Affiliation</th>
<th>Inspection Date</th>
<th>Exterior and Interior, Other, Code, State, Zip</th>
<th>Original OSE</th>
<th>Type of Def</th>
<th>Primary Occurrence</th>
<th>Debris, Obstruction</th>
<th>Racking</th>
<th>Chimney</th>
<th>Ground, Area Estimated Dam</th>
<th>Comment on Inspection</th>
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<tbody>
<tr>
<td>23-Jan-2020 12</td>
<td>172.56.157</td>
<td>Eddle, Guest</td>
<td>24-153</td>
<td>Volaris/Exsis</td>
<td>29-Jan-2020</td>
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<td>Unidentified</td>
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<td>23-Jan-2020 18</td>
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<td>Nonnette, Jo</td>
<td>83244</td>
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<td>Concrete F/F</td>
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<tr>
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<td>Eddle, Guest</td>
<td>24-153</td>
<td>Volaris/Exsis</td>
<td>29-Jan-2020</td>
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<td>Wood Plan</td>
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</tbody>
</table>

*SIMPSON GUMPERTZ & HEGER*

Engineering of Structures and Building Enclosures
Inspection Process – Lessons learned

- Clear communication and expectations with people. The objective and process was explained before starting any inspection. Rapid emergency response inspection not equal to structure certification.

- Aftershocks of magnitude 4 – 5.3 were too frequent, ATC-20 procedure, additional guidance or reevaluation of the procedure is needed.

- People were still under a lot of stress and shock evaluation alone would not bring people back home and to normality

- Municipalities responded per neighborhood, rather than priority and critical cases
Poor Construction Practices

• “Soft first story” homes
Poor Construction Practices

• “Soft first story” homes
Poor Construction Practices

• “Soft first story” homes
Poor Construction Practices

• “Soft first story” homes
Poor Construction Practices

• Improper Additions
Poor Construction Practices

- Infill walls
Poor Construction Practices

- Stairs
Poor Construction Practices

- Schools short column

- 1978 Nicaragua earthquake raised this problem. No action from PR to solve it.
Poor Construction Practices

- Schools with short column

Ductile flexural failure is desired. If detail for assumed full column length case is used, fails in shear.

\[
V = \frac{2 \times M_p}{L}
\]

\[
V = \frac{2 \times M_p}{L/3}
\]

\[
V = \frac{6 \times M_p}{L}
\]
Poor Construction Practices
Poor Construction Practices
## Inspection Summary

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<th>YELLOW</th>
<th>RED</th>
<th>Totals per Town</th>
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<td>37%</td>
<td>19%</td>
<td></td>
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</table>
Concluding Remarks and Next Steps

• Results from inspections during the week of January 13, 2020
  – Inspection process setup in less than 24 hours
  – 8000 inspection requests registered and prioritized in less than 4 days
  – Prioritization was key. Through the request system, database allowed us to identify about 1,500 critical high priority cases
  – 300 inspections completed during the week of Jan 13… still a lot of work to do!

• Re-thinking the ATC-20 process
  – first response inspection during a moment of stress.
  – include social counselors and professionals in the brigades.
  – Main shock inspection process (traditional) vs inspections during active earthquake sequence
  – Engineers must connect on a personal level with residence owners, take the time to listen

• Must have clear communication and expectations with people
• Still, a lot of work to do – inspectors needed!
• Inspection system in place and coordination with local partners established
Love for our communities

jasanchez@sgh.com