A HOME FOR EVERY FILIPINO: TURNING DREAMS INTO REALITY
CREBA
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Presentation Outline

• Introduction: Disasters in the Philippines
• Definitions
• Risks, Hazards, Exposure, Vulnerability
• Disaster Resilience Scorecard
• How Safe Is My House?
• Mitigating Measures Against
  – Typhoons: floods and strong wind
  – Earthquake
  – Landslides
• Concluding Remarks
Disasters in the Philippines
Earthquakes

Over 10,000* earthquakes across the Philippine Islands since the 70’s

7 “Deadliest”**

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moro Gulf</td>
<td>1976</td>
<td>8.0</td>
</tr>
<tr>
<td>Laoag</td>
<td>1983</td>
<td>6.5</td>
</tr>
<tr>
<td>Luzon</td>
<td>1990</td>
<td>7.7</td>
</tr>
<tr>
<td>Mindoro</td>
<td>1994</td>
<td>7.1</td>
</tr>
<tr>
<td>Central/South Mindanao</td>
<td>2002</td>
<td>7.5</td>
</tr>
<tr>
<td>Visayas</td>
<td>2012</td>
<td>6.7</td>
</tr>
<tr>
<td>Bohol</td>
<td>2013</td>
<td>7.2</td>
</tr>
</tbody>
</table>

* USGS ConCat Earthquake Catalog
Earthquakes
Liquefaction
Landslides
10 strongest earthquakes in the Philippines

- 1. Magnitude 8.0 earthquake in Mindanao (August 17, 1976) - 8,000 dead
- 2. Magnitude 7.8 earthquake in Northern and Central Luzon (July 16, 1990) - 2,412 dead
- 3. Magnitude 7.5 earthquake in Luzon (November 30, 1645) - 600 dead
- 4. Magnitude 7.3 earthquake in Casiguran (August 2, 1968) - 268 dead
- 5. Magnitude 7.2 earthquake in Bohol (October 15, 2013) - 222 dead
- 6. Magnitude 7.1 earthquake in Mindoro (November 15, 1994) - 78 dead
- 7. Magnitude 6.9 earthquake in Central Visayas (February 6, 2012) - 51 dead
- 8. Magnitude 7.5 earthquake in Central and Southern Mindanao (March 5, 2002) - 15 dead
- 9. Magnitude 6.5 quake in Ilocos Norte (August 17, 1983) - 16 dead
- 10. Magnitude 7.6 earthquake happened near Guiuan, Eastern Samar (August 31, 2012)
Philippines' deadliest typhoons

1. Haiphong - October 8, 1881: 20,000 dead
2. Haiyan (Yolanda) - November 8, 2013: 6,300 dead
3. Thelma (Uring) - November 4, 1991: 5,081 to 8,165 dead
4. Bopha (Pablo) - December 3, 2012: 1,067 dead
5. Angela Typhoon - 1867: 1,800 dead
6. Winnie - November 27, 2004: 1,600 dead
7. October 1897 Typhoon: 1,500 dead
8. Ike (Nitang) - August 31, 1984: 1,492 dead
9. Fengshen (Frank) - June 21, 2008: 1,371 dead
10. Durian (Reming) - November 25: 800 to 1,000 dead
Definitions

• Resilience - A community’s capacity to provide viable continued use in the built environment through extended service life; adaptive re-use; and the ability to resist, absorb, and recover from hazards.

• UNDP defines building resilience as a “transformative process of strengthening the capacity of men, women, communities, institutions, and countries to anticipate, prevent, recover from and transform in the aftermath of shocks, stresses and change.” (UNDP, no date).
Definitions

• Disaster Resilience - The ability to mitigate and recover from disaster events.

• Exposure -Who or what (people, land, ecosystems, crops, assets, infrastructure, economic activity) is potentially in harm’s way as a result of a hazard. Different exposures and/or vulnerabilities may combine,

• Hazard -Some event or phenomenon (for example, hurricane, flood, fire, earthquake, tsunami) that may lead to a disaster.

• Risk - A probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action.

• Vulnerability - Degree to which people, property, resources, systems, and cultural, economic, environmental, and social activity is susceptible to harm, degradation, or destruction on being exposed to a hostile agent or factor.
1. Organisational base at Village Development Committee (VDC) / ward and community level
2. Access to Disaster Risk Reduction (DRR) information
3. Multi-hazard risk and capacity assessments
4. Community preparedness / response teams
5. Disaster Risk Reduction / management plan at Village Development Committee (VDC) / municipality level
6. Disaster Risk Reduction (DRR) Funds
7. Access to community managed Disaster Risk Reduction (DRR) resources
8. Local level risk / vulnerability reduction measures
9. Community based early warning systems
Defining Hazard, Vulnerability and Risk

Hazard
- Earthquake
- Tsunami
- Floods
- Cyclones
- Bushfires
- Landslides
- Volcanoes

Vulnerability
- Engineering
- Economic
- Social

Exposure
- People
- Buildings
- Businesses
- Infrastructure

Risk = Hazard & Exposure x Vulnerability x Cost

Potential Hazard

High Exposure
- Low Vulnerability (Reinforced Structure)

Low Exposure
- High Vulnerability (No Reinforcement)

Elements-at-Risk
Disaster Resilience Scorecard

The scorecard provides an aspirational definition of disaster resilience. Its intention is to guide cities towards optimal disaster resilience, and to challenge complacency. It serves as a reminder that there is always more that could be done, and to establish investment goals (including time and effort) for achievement over a period of years.
## Dimensions of Disaster Resilience

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Natural 50%</th>
<th>Human 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulnerability</td>
<td>Poverty 35%</td>
<td>Livelihood 35%</td>
</tr>
<tr>
<td></td>
<td>Dependency 25%</td>
<td>Environment 5%</td>
</tr>
<tr>
<td>Capacity</td>
<td>Institutional 33%</td>
<td>Economic 33%</td>
</tr>
<tr>
<td></td>
<td>Infrastructure 33%</td>
<td>Humanitarian 100%</td>
</tr>
</tbody>
</table>

**Focus**
- Hazard 30%
- Vulnerability 30%
- Capacity 30%
- Humanitarian 10%
Dimensions of Disaster Resilience

**INFORM**

**Dimensions**
- Hazard & Exposure
- Vulnerability
- Lack of coping capacity

**Categories**
- Natural
- Human
- Socio-Economic
- Vulnerable Groups
- Institutional
- Infrastructure

**Components**
- Earthquake
- Tsunami
- Flood
- Tropical cyclone
- Drought
- Conflict intensity
- Projected conflict intensity
- Development and Deprivation (50%)
- Inequality (25%)
- Aid Dependency (25%)
- Uprooted People
- Other Vulnerable Groups
- DRR
- Governance
- Communication
- Physical Infrastructure
- Access to Health System
Disaster Resilience

Community resilience requires building neighbor to neighbor reliance and organizational connection.

- There are strong relationships between organizations
- Organizations are ready and prepared to respond and recover
- There are enough volunteers to help in a disaster
- People can rely on each other (neighbor to neighbor)
- Individuals/families have the knowledge to prepare for and respond to disaster
Disaster Resilience Frameworks

Coping capacities

- Government and authorities
  - A. Corruption Perceptions Index
  - B. Good governance (Failed States Index)

- Disaster preparedness and early warning
  - National disaster risk management policy according to report to the United Nations

- Medical services
  - C. Number of physicians per 10,000 inhabitants
  - D. Number of hospital beds per 10,000 inhabitants

- Social networks
  - Neighbors, family and self-help

- Material coverage
  - E. Insurances (life insurance excluded)

Adaptive capacities

- Education and research
  - A. Adult literacy rate
  - B. Combined gross school enrollment

- Gender equity
  - C. Gender parity in education
  - D. Share of female representatives in the National Parliament

- Environmental status / Ecosystem protection
  - E. Water resources
  - F. Biodiversity and habitat protection
  - G. Forest management
  - H. Agricultural management

- Adaptation strategies
  - Projects and strategies to adapt to natural hazards and climate change

- Investment
  - I. Public health expenditure
  - J. Life expectancy at birth
  - K. Private health expenditure

Insufficient global data available
How Safe Is My House?

- Self-check for Earthquake Safety" is a 12-point questionnaire homeowners can use to assess the earthquake readiness of their house.
- The checklist was tailored for concrete hollow block (CHB) houses, one of the most common types of Philippine homes because of its low construction cost.
- The features recommended by the checklist are based on the National Building Code and Structural Code of the Philippines.
Features

• An "earthquake-resistant" house is a house that will not collapse even in the face of an intensity 9 earthquake.
• A house designed by a civil engineer or architect instead of a mason or carpenter has a higher chance of not collapsing because the professional is expected to follow the Building Code and Structural Code.
• A house built in 1992 or after is also more earthquake-ready because it was the year after more earthquake resistance standards were introduced to the codes.
Features

• A regular-shaped house – symmetrical, rectangular, box-type – is also more stable than an irregularly-shaped house.

• "The shape influences the behavior of the building during ground shaking. If it's irregular, the house will be twisted and various parts will move in various ways, so it's not good," explained Solidum.

• The building materials used also determine the strength of the house. Walls made of 6-inch (150 mm) thick concrete hollow blocks are much stronger than the cheaper but more commonly used 4-inch blocks.
Features

• The reinforcement of vertical and steel bars embedded in the walls are important. Vertical bars have to have a diameter of 10 mm and must be only 40 centimeters away from each other. Many substandard homes have thinner bars (6 mm) spaced farther away from each other (90 cm).

• For horizontal bars, they must be 10 mm diameter and spaced 60 cm from each other (or between 3 layers of concrete hollow blocks).

• Walls that are more than 3 meters wide must be supported to prevent it from falling down during a quake.
Features

• Many homes also have a gable wall, or the triangular area between the A-frame of the roof and the wall around the house. To keep the gable wall from falling, materials for it must be light. If it's made of concrete hollow blocks, they must be well-anchored to the rest of the house. Houses with no gable wall are far safer. Examples of these are houses with flat roofs.

• A foundation of reinforced concrete would resist the shaking of an earthquake making it the ideal foundation for a house. This is much more stable than a foundation of stones or unreinforced concrete.
Features

• The kind of soil on which the house is built is another factor. Rock or stiff soil is more stable while muddy or reclaimed soil literally puts your house on shaky ground.

• A well-maintained house with damages from previous earthquakes or other calamities repaired stands a much better chance of surviving a quake than a deteriorated one.
## How Safe Is My House?

### Question 1: Who built or designed my house?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Built or designed by a licensed civil engineer/architect.</td>
<td>1</td>
</tr>
<tr>
<td>B: Not built by a licensed civil engineer/architect.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This question refers to the person who supervised the building of the house.

### Question 2: How old is my house?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Built in or after 1992.</td>
<td>1</td>
</tr>
<tr>
<td>B: Built before 1992.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This check if your house was built under more recent earthquake-resistant building standards.

### Question 3: Has my house been damaged by past earthquakes or other disasters?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: NO or YES but repaired.</td>
<td>1</td>
</tr>
<tr>
<td>B: YES but not yet repaired.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This checks if the house sustained structural damage and had undergone repair works.
How Safe Is My House?

**Question 4**

What is the shape of my house?

- **A**: Regular (symmetrical, rectangular, box-type, simple) - 1 point
- **B**: Irregular/Complicated - 0 point
- **C**: It is not clear or unknown - 0 point

This checks the shape of your house which influences behavior during strong ground shaking.

**Question 5**

Has my house been extended or expanded?

- **A**: NO or YES but supervised by a civil engineer/architect - 1 point
- **B**: YES, but not supervised by a civil engineer/architect - 0 point
- **C**: It is not clear or unknown - 0 point

This checks if additional construction was properly executed and correctly attached to the original structure.

**Question 6**

Are the external walls of my house 6-inch (150mm) thick CHB?

- **A**: YES, it is 6-inch - 1 point
- **B**: NO, it is thinner than 6-inch - 0 point
- **C**: It is not clear or unknown - 0 point

This checks if the standard size of at least 6" thick CHB was used.
How Safe Is My House?

**Question 7:** Are steel bars of standard size and spacing used in walls?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: YES (10mm diameter, tied and spaced correctly)</td>
<td>1</td>
</tr>
<tr>
<td>B: NO, fewer and smaller than 10mm.</td>
<td>0</td>
</tr>
<tr>
<td>C: None or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This checks if standard size and spacing of steel bars were used as reinforcement.

**Question 8:** Are there unsupported walls more than 3 meters wide?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: NONE, all unsupported walls are less than 3m wide.</td>
<td>1</td>
</tr>
<tr>
<td>B: YES, at least one unsupported wall is more than 3m wide.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This checks if the wall is properly supported from falling down.

**Question 9:** What is the gable wall of my house made of?

<table>
<thead>
<tr>
<th>Items</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Light materials, properly anchored CHBs, no gable wall.</td>
<td>1</td>
</tr>
<tr>
<td>B: Not properly anchored CHBs, Bricks, Stone.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This checks if the gable wall is properly supported by sufficient steel bars or by a lintel beam.
**How Safe Is My House?**

**QUESTION 10**  
**What is the foundation of my house?**

<table>
<thead>
<tr>
<th>Items</th>
<th>point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Reinforced concrete.</td>
<td>1</td>
</tr>
<tr>
<td>B: Stones or unreinforced concrete.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This check if the foundation is properly constructed to support the walls.

**QUESTION 11**  
**What is the soil condition under my house?**

<table>
<thead>
<tr>
<th>Items</th>
<th>point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Hard (rock or stiff soil).</td>
<td>1</td>
</tr>
<tr>
<td>B: Soft (muddy or reclaimed)</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This checks if the house was built over a stable or stabilized ground.

**QUESTION 12**  
**What is the overall condition of my house?**

<table>
<thead>
<tr>
<th>Items</th>
<th>point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Good condition.</td>
<td>1</td>
</tr>
<tr>
<td>B: Poor condition.</td>
<td>0</td>
</tr>
<tr>
<td>C: It is not clear or Unknown.</td>
<td>0</td>
</tr>
</tbody>
</table>

This describes the overall physical state of the house and checks defect or any deterioration.
How Safe Is My House?

The higher the total score, the more earthquake-resistant the house:

- **11-12**: Though this seems safe for now, please consult experts for information.
- **8 - 10**: This requires strengthening, please consult experts.
- **0 - 7**: This is disturbing! Please consult experts soon.
Build Your House Disaster Resistant

- **Basic Concept:** design the entire house to withstand earthquakes, typhoons, water damage, fire damage, and other natural hazards.
- Use concrete or concrete blocks
- Build at least one full story above the one hundred year flood plain.
- The house should be designed for seismic load.
- Lift the entire primary dwelling areas along with the utilities to the second level, or higher. The ground floor is best used for parking and for a secondary dwelling unit.
To Protect From Floods or Typhoons

• Avoid building in a floodplain or in an area that could experience wave action.
• Elevate the primary dwelling areas above the base flood elevation “b.f.e.”.
• Locate the furnace, water heater, and electrical panel above the “b.f.e.”.
• Seal walls in the basement with waterproofing materials.
• Install a foundation drainage system.
• Install a sump pump for floors that are below grade.
To Protect From Floods or Typhoons

• Install backflow valves in sanitary and storm lines.
• Strengthen walls to withstand floodwater pressures.
• Anchor the building to the foundation so that it will resist flotation.
• All hardware below the b.f.e should be stainless or galvanized steel.
• Build with flood resistant materials below the b.f.e.
Strong Winds From Cyclones

The following are the main principles for safe construction against cyclones:

• Sitting: do not build at the head of the valley or on the side of an exposed hill where the wind speed can be much stronger;

• Location: take advantage of natural protection such as rocks, banks and strong bushes or plant strong bushes nearby the house;

• Planning: build a short distance away from the other houses and never directly next to them as this can cause destructive wind turbulence
Strong Winds From Cyclones

• Tie the structure to the ground: connect the roof, the walls to the floor; the floor to the stumps or stilts and these to the foundations, creating a chain of anchorage;
• Support walls where possible: build internal walls to brace the outside walls and prevent them from caving in;
• Brace all walls and roof: brace all the walls, and across the corners of the walls and diagonally across the underside of the roof with timber braces to make the walls stiff;
• Make strong connections: ensure that all structural members are securely connected. Using only nails is not good enough; there should be a bracing of wire, vine or other material;
Strong Winds From Cyclones

• Join parts together securely: use construction joints which are notched and tied together. There needs to be sufficient overlap and a strong bracing;

• Roof pitch: pitch the roof to rise at least one foot for every three foot. This reduces the forces on the roof and makes the roof stronger;

• Avoid wide overhangs and eaves: make overhangs small, less than 600 mm. and eaves less than 400 mm;

• Verandas: the wind can be trapped beneath the veranda; therefore it should be connected in a way that the veranda can break away separately from the main structure;

• Loose edges: tie down the edges and comers of the roof so that the wind cannot attack one part and tear it away;
Strong Winds From Cyclones

• Smooth corners: smoothen corners of the house in order to allow the wind to slide around;

• Weathering details: seal edges of window openings and where the roof meets the walls to prevent rain and wind from entering; Closing off windows and doors: close of window and door openings with firm shutters when a cyclone approaches;
To Protect From Strong Winds

- Install shutters at all windows.
- In areas prone to typhoons, have doors facing potential high winds open out rather than in.
- Reinforce garage doors.
- Secure siding and roofing.
- Brace gable end framing.
- Use steel framing connections.
Earthquakes.

The following are the main principles to be considered in earthquake resistant housing:

- Location Stability of slope: only stable slopes, without signs of previous landslides, should be chosen to build; a site subject to danger of rock fall should be avoided as well;

- Soil types: avoid constructing on very loose sands or sensitive clays; these can compact or loose their bearing capacity in an earthquake and cause large unequal settlement and damage or destroy the building; Shape of building Symmetry: the building as a whole Or its various blocks should be kept symmetrical about both axes; asymmetry leads to torsion and danger of collapse. Symmetry is also desirable in the placement and sizing of door and window openings as far as possible; shape of a building
Earthquakes.

- Regularity: simple rectangular shapes behave better in an earthquake than shapes with many projections. Torsional effects of ground motion are pronounced in long narrow rectangular blocks; therefore it is desirable to restrict the length of a block to three times its width;
- Simplicity: ornaments should be avoided; they can fall off and cause injuries;
- Enclosed area: a small building enclosure with properly interconnected walls will act like a rigid box; very long rooms should be avoided; use enclosed areas
Earthquakes.

- Foundations: strong wall to ground connections are necessary and a complete concrete or rock foundation is preferred; construction on short columns should be avoided because the house is often shaken from its footing;
Construction

• Openings: openings should be constructed away from corners; moreover, the total length of openings should not exceed 50% of any single wall;

• Ring beam: the most important horizontal reinforcement of the house is the construction of one or more ring beams to connect together all walls of the house. These beams can be located at all critical levels of the building, namely plinth, lintel, roof and gables;

• Walls: depending on the material applied, diagonal braces and horizontal beams are necessary to give the walls sufficient stiffness to resist earthquake force;
Construction

• Concrete block walls: use enough vertical reinforcement and fill all openings with mortar; use sufficiently strong mortar, with a cement: sand mix of 1:6;

• Connections and joints: connections and joints should be strong. For timber construction, braces are necessary to keep the construction together: When using reinforced concrete blocks, there should be sufficient overlap of reinforcement steel;

• Roof: use light roof constructions, with timber and irons sheeting or traditional materials;
To Protect From Earthquakes

• Brace cripple walls.
• Use steel framing connections.
• Bolt sill plates to the foundation.
• Use flexible connections on gas and water lines.
• Ensure that there are adequate shear walls.
Bracing
To Protect From a Landslide

- Install ground cover on slopes.
- Build retaining walls at slopes.
- Build deflection walls or channels in potential mudflow areas.
- Install flexible pipe fittings for gas and water lines.

 Properly anchored walls are key to earthquake resistance in low rise buildings (http://www.cement.org/)
To Protect From Fires

• Enclose eaves and overhangs.
• Cover house vents with 12mm, or smaller, corrosive resistant wire mesh.
• Use fire resistant siding.
• Use safety glass and non-combustible shutters at windows.
• Install non-combustible roofing.
• Create an external water storage supply.
• Install chimney and stovepipe spark arrestors.
Some considerations in building a disaster resilient housing

• Current local construction practices remain important to the achievement of a disaster resilient housing.

• Applying safety-related codes and criteria for local construction increase disaster resilience.

• There is a need for technical professionals (architects and engineers) to be accessible to at-risk low income groups.

• Improving awareness of households and communities is an important component in building a disaster resilient housing.
Vinci Nicholas R. Villasenor, PhD

e-mail: vnrv333@yahoo.com
Thank You