GLOBAL OR LOCAL MATERIALS FOR POST-DISASTER RECONSTRUCTION?

Sustainability assessment of twenty post-disaster shelter designs

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PRESENTATION OUTLINE:

• Introduction
• Project’s background
• Objectives
• Methodology
• Results
• Discussion and Conclusion
• Outlook
CHAIR OF SUSTAINABLE CONSTRUCTION

Promotion of sustainable construction

Life cycle and Sustainability assessment

Development of alternative construction materials
PROJECT BACKGROUND:

• Started on 2013

• Focused on environmental impact assessment (LCA)

• Research projects with Students (BSc. and MSc.)

• Presentations at Shelter Meeting, World Sustainable Building Conference

• Scientific Article in the Journal Building and Environment

• Supplementary material on the Journal (Open access) Data in Brief
OBJECTIVE:

To identify which strategy for post-disaster reconstruction is most appropriate:

using local or global materials
METHODOLOGY:
**METHODOLOGY: definitions**

**Sustainable:**
State in which the coherence defining factors allows for the process/activity to continue over the time

**Global construction materials:**
industrialized and engineered materials like concrete and steel

**Local construction materials:**
used on vernacular and traditional architecture, like bamboo, earth, wood
Methodology: Sustainability assessment

Impact Categories

- Environmental impact
- Cost
- Technical performance
Methodology: Data sources

Transitional shelters
Eight designs

Post-disaster shelter:
Ten designs
Methodology: Environmental Impact Assessment (LCA)
Methodology: Cost Assessment

- Approximate project cost per shelter (CHF)
  (no disaggregation of cost, due to lack of information)

- Shelter’s life span (months)

- Shelter’s covered area (m2)

CA = Cost / Life span / Area
Methodology: Technical performance assessment

Risk classification

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Earthquake</th>
<th>Wind (approximate)</th>
<th>Flood</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Seismic Design Category *</td>
<td>Less than 113</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>C</td>
<td>113 to 160</td>
<td>1-2</td>
</tr>
<tr>
<td>HIGH</td>
<td>D</td>
<td>Over 160</td>
<td>3-5</td>
</tr>
</tbody>
</table>

Source: IFRC

Performance classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Meaning of classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN:</td>
<td>Structure performs adequately under hazard loads</td>
</tr>
<tr>
<td>AMBER:</td>
<td>Structure is expected to deflect and be damaged under hazard loads</td>
</tr>
<tr>
<td>RED:</td>
<td>Structure is expected to fail under hazard loads</td>
</tr>
</tbody>
</table>

Source: IFRC
Methodology: Technical performance assessment

- Scores were defined for each hazard level and Performance of structures.
- The best score is obtained when the structure performs adequately (green) on the «high» level of hazard.
- The scores were calculated for earthquake, wind, and flood.

<table>
<thead>
<tr>
<th>Hazard level</th>
<th>Performance of structures</th>
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</thead>
<tbody>
<tr>
<td>High</td>
<td>Green 3</td>
</tr>
<tr>
<td>Medium</td>
<td>Amber 2</td>
</tr>
<tr>
<td>Low</td>
<td>Red 1</td>
</tr>
</tbody>
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The best score is obtained when the structure performs adequately (green) on the «high» level of hazard.
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Risk / performance matrix

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<tr>
<th>Hazard/Performance</th>
<th>Green</th>
<th>Amber</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Medium</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Low</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Authors
Results: Environmental Impact

Materials: Bamboo (B), Brick/Concrete (C), Steel (S), Wood (W).

Locations: Afghanistan (1), Bangladesh (2), Burkina Faso (3), Haiti (4), Indonesia (5), Pakistan (6), Peru (7), Philippines (8), Sri Lanka (9), Vietnam (10) and Nicaragua (11).
Results: Contribution to Environmental Impact

- W5 Indonesia
  - Roof: 20.2%
  - Walls + Structure: 39.3%
  - Foundation: 10.4%
  - Transport: 30.2%

- C9 Sri Lanka
  - Roof: 17.8%
  - Walls + Structure: 23.5%
  - Foundation: 46.9%
  - Transport: 11.9%

- C11 Nicaragua
  - Roof: 19.4%
  - Walls + Structure: 47.4%
  - Foundation: 21.6%
  - Transport: 11.6%
Results: Cost

Materials: Bamboo (B), Brick/Concrete (C), Steel (S), Wood (W). Locations: Afghanistan (1), Bangladesh (2), Burkina Faso (3), Haiti (4), Indonesia (5), Pakistan (6), Peru (7), Philippines (8), Sri Lanka (9), Vietnam (10) and Nicaragua (11).
Results: Technical performance

Materials: Bamboo (B), Brick/Concrete (C), Steel (S), Wood (W). Locations: Afghanistan (1), Bangladesh (2), Burkina Faso (3), Haiti (4), Indonesia (5), Pakistan (6), Peru (7), Philippines (8), Sri Lanka (9), Vietnam (10) and Nicaragua (11).
Results: Sustainability Assessment

Materials: Bamboo (B), Brick/Concrete (C), Steel (S), Wood (W).

Locations: Afghanistan (1), Bangladesh (2), Burkina Faso (3), Haiti (4), Indonesia (5), Pakistan (6), Peru (7), Philippines (8), Sri Lanka (9), Vietnam (10) and Nicaragua (11).
DISCUSSION and CONCLUSIONS:
Discussion: Sustainability Assessment
Conclusions

Shelters with high cost and/or environmental impact do not necessarily perform the best from a technical viewpoint.
Conclusions

No direct correlation between type of construction material and shelter sustainability.
Conclusions

Proper design and material selection drive the sustainability performance
Conclusions

Both global and local construction materials can be used to produce sustainable solutions for post-disaster reconstruction projects.

- local materials: higher potential for low environmental impacts and costs
- global materials: higher potential to produce better technical performances.
Lookout

Current works:
. Shelter evaluation: speed and manpower
. From shelter to camp: the upscaling challenge
. Investigate appropriate technologies

Upcoming:
. Safe shelter construction: setting guidelines
THANK YOU FOR YOUR ATTENTION

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