ESTIMATING WASTE INDUCED BY EARTHQUAKES WITHIN DAMAGE SCENARIOS

Waste management, an essential lifeline in post-earthquake urban resilience

Post-disaster waste is an important, often underestimated, aspect in territory resilience. Brown et al. (2011) observe the waste management after Christchurch earthquake in New Zealand. They underline that significant work needs to be done not only from a technical but also an organizational point of view. The objective of this work was to find and test new tools to estimate waste tonnage caused by earthquakes.

3 methods to estimate waste quantities after earthquakes

1. Hirayama et al. (2010). The simplest method, in tons/household and damage state
2. MECADEPI & HAZUS. Hybrid method developed in the framework of this project.
3. Furniture tons/household

<table>
<thead>
<tr>
<th>Equipment (tons/household)</th>
<th>Mixed waste (in m³)</th>
<th>Furniture tons/household</th>
<th>Total tons/household</th>
</tr>
</thead>
<tbody>
<tr>
<td>L218</td>
<td>7.08 (density could be considered in France 0.3 t/m³)</td>
<td>1.025</td>
<td>8.33</td>
</tr>
</tbody>
</table>

HAZUS based % waste produced by building collapse

<table>
<thead>
<tr>
<th>% waste (building)</th>
<th>% waste (non-structural)</th>
<th>% waste (total)</th>
<th>t/m² of gross floor area</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>10</td>
<td>0.9</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>70</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Masonry

<table>
<thead>
<tr>
<th>Waste volume/total building solid volume</th>
<th>1%</th>
<th>3%</th>
<th>12%</th>
<th>30%</th>
<th>50%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>D4</td>
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<td>D2</td>
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</tbody>
</table>

L'Aquila observations (ITC-CNVF 2010). First of all they calculate total building volume (as a parallelepiped) and secondly the solid portion (25% for RC buildings, 35% for masonry). Then they link damage states and % of solid building volume becoming waste.

Application in Nice city

- Waste quantity is estimated for the 2 seismic damage scenarios (Vesubie and Liguria sea)
- For the most damaging scenario, ~5 million tons in Nice city (only for current buildings)

Waste facilities’ capacities

- The waste estimation after earthquakes has to be compared with the territory’s capacity of treatment, in order to measure the degree of abnormality. Which is the normal capacity of the territory (in tons per year)? Where are the inert waste facilities located? Earthquake waste is expressed as “n” normal years of waste tons.
- For example, the most impacting earthquake scenario, X intensity, could produce the equivalent of 5 normal years of waste in Nice city alone.

Conclusions

- Repeatable method as it can be derived from seismic damage scenarios
- Agreement of results of all 3 methods, in the same order of magnitude
- Further work: use these methods in order to evaluate different actions strategies (prevention tasks) as it has been done by Zhi-Hua et al. (2013) in China

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