Towards Integrated Seismic Risk Assessment in Palestine – Application to the City of Nablus

Ricardo Monteiro, Paola Ceresa, Vania Cerchiello, Jamal Dabeek, Antonella Di Meo, Barbara Borzi
School for Advanced Studies – IUSS, Pavia
European Centre for Training and Research in Earthquake Engineering – EUCENTRE, Pavia
Hazard  

Vulnerability  

Exposure  

Physical  
Social  
Economical  

Structures  
Population
SASPARM 2.0 Project

Elaboration of Web-Based Platform for seismic risk mitigation

Awareness of community to monitor individual properties and understand if houses can withstand an earthquake

Practitioners, GO, NGO Stakeholders made aware of the importance of the right application and implementation of new Seismic Building Code
Hazard

Hazard map with 10% probability of exceedance in 50y

- Boore at al, 1997

GHAP
- 1992 - 1999

SESAME
- 1996 - 2000

ESC/WG-SHA
- 2002

EMME
- 2010 - 2013
VULNERABILITY

- Identify
- Define
- Evaluate
Taxonomy

- RC Frame Buildings
- Shear Walls Buildings
- Masonry Buildings
- RC Frame Buildings with Soft Storey
Data Collection
## WBP Collection Form: Citizens

### 1. Identification of the Building
- **Municipality:**
- **Street name:**
- **Name of the building:**
- **Geographical Coordinates (WGS 84 System - Decimal Degrees):**
  - **Latitude:**
  - **Longitude:**
  - **Ex. 45.98751:**
  - **Out last clicked position:**
- **Position of building:**
  - **Select a position:**

### 2. Description of the Building
- **N° Total floors with basement:**
- **N° Basements:**
- **Construction Year:**
- **Renovation Year:**
- **Type of Use:**
  - **Housing:**
  - **Productive:**
  - **Trader:**
  - **Office:**
  - **Public Service:**
  - **Depot:**

### Additional Information
- **Date:**
- **Name of the compiler:**
- **Education level:**
- **Faculty:**
- **Department:**

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**Preliminary Outcome of Collected Data**

**Metrical Data**

**Total number of floors with basement**
- 1 ÷ 3: 24.6%
- 4 ÷ 6: 30.4%
- 7 ÷ 9: 30.4%
- >9: 14.7%

**Construction year**
- 1919 ÷ 1945: 46.1%
- 1946 ÷ 1961: 12.0%
- 1962 ÷ 1971: 29.8%
- 1972 ÷ 1981: 8.9%
- 1981 ÷ 1991: 2.1%
- 1991 ÷ 2002: 0.5%
- ≥ 2002: 0.5%

**Vertical Structure of the buildings**
- Reinforced Concrete: 86.4%
- Masonry: 13.6%

**RC buildings**
- The building has no walls at one or more floors: 38.2%
- The building has partially walls at floors at one or more floors: 29.1%
- The building is composed totally by walls: 32.7%
Preliminary Outcome of Collected Data

Horizontal Structure

Most of the buildings have heavy and flat roof (99.5%) and reinforced concrete ribbed slab (73%)

Regularity in Plan and in Elevation

Regularity in plan

- Regular
- Not regular

Regularity in elevation

- Regular
- Not regular
How to use the gathered data

Using the information collected through the forms it is possible to assign each building to one of the following structural typologies:

✓ Masonry
✓ RC in which torsional modes do not play a major role
✓ RC in which torsional modes govern the response
✓ Shear Wall in which torsional modes do not play a major role
✓ Shear Wall in which torsional modes govern the response

The assigned typology, combined with the number of storeys of the building, allows to connect each building with a set of fragility curves, for 5 damage levels (D1 to D5 – light damage to collapse) of the EMS98 scale.
Fragility Curves

The fragility curves have been developed using **SP-BELA** (Simplified Pushover-Based Earthquake Loss Assessment) method.

SP-BELA has been adapted to be representative of the reality of the as-built in Nablus.

Fragility curves for masonry buildings with **2 storeys**

Fragility curves for RC frame buildings with **7 storeys**

Fragility curves for shear wall buildings with **10 storeys**
Fragility Curves in WBP

<table>
<thead>
<tr>
<th>Damage Level</th>
<th>Average (g)</th>
<th>Standard Dev. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>0.08930</td>
<td>0.04965</td>
</tr>
<tr>
<td>D2</td>
<td>0.18030</td>
<td>0.10060</td>
</tr>
<tr>
<td>D3</td>
<td>0.19690</td>
<td>0.11170</td>
</tr>
<tr>
<td>D4</td>
<td>0.25520</td>
<td>0.14340</td>
</tr>
<tr>
<td>D5</td>
<td>0.47200</td>
<td>0.29600</td>
</tr>
</tbody>
</table>
Social Vulnerability Model

- Measure the vulnerability of society
- Coping with earthquake events
- Measure of CITY RESILIENCE TO CRISIS AND DISASTERS
- INDICATORS to capture social characteristics (cultural context, knowledge)
- SCORECARD Approach (Hyogo Framework and UNISDR’S 10 Essentials to Make Cities Resilient)
- Participatory assessment process
<table>
<thead>
<tr>
<th>Theme</th>
<th>General Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness and advocacy</td>
<td>What is the level of awareness and knowledge of earthquake disaster risk?</td>
</tr>
<tr>
<td>Social Capacity</td>
<td>What are the capacities of the population to efficiently prepare, respond and recover from a damaging earthquake?</td>
</tr>
<tr>
<td>Legal and institutional arrangements</td>
<td>How effective are mechanisms to advocate earthquake risk reduction in your quarter?</td>
</tr>
<tr>
<td>Planning, regulation and mainstreaming</td>
<td>What is the perceived level of commitment and mainstreaming of disaster risk reduction through regulatory planning tools?</td>
</tr>
<tr>
<td>emergency preparedness, response and</td>
<td>What is the level of effectiveness and competency of disaster management including mechanisms for response and recovery?</td>
</tr>
<tr>
<td>recovery</td>
<td></td>
</tr>
<tr>
<td>Critical services and public infrastructure resiliency</td>
<td>What is the level of resilience of critical services to disasters?</td>
</tr>
</tbody>
</table>
Preliminary outcome

526 Forms collected

- Eastern Area: 18%
- Southern Mountain: 17%
- Northern Mountain: 24%
- Old City: 12%
- City Center: 7%
- Almakhfya: 6%
- Rafidya: 16%
- Eastern Area: 18%
- City Center: 7%
- Almakhfya: 6%
- Rafidya: 16%

Mean score distribution per theme

Awareness & Advocacy
Social Capacity
Legal & Institutional Arrangements
Planning & Regulation
Critical Services
Emergency Response

Highest score (1): 15%
Medium Score (2): 28%
Low Score (3): 23%
Lowest Score (4): 18%
Not Aware (5): 16%
Legal and Regulatory Framework

Key institutional challenges:

- **Occupation** of the State of Palestine
- **Fragmentation** of the population into different areas
- Limited control over planning, trade and the economy
- Severely **restricted access** to land (no border control), water and other resources
- Major **restrictions** on Palestinian movement and access within and between East Jerusalem, the rest of the West Bank, and the Gaza Strip

Outlook:

- Reform of DRM governance structure
- Coordinating role of the PM at national level *(accountable to the President)*, Ministry of Interior *(civil protection)*, Ministry of Social Affairs *(relief)*, Ministry of Economy *(reconstruction)*
- New DRM Standing Committees *(national, district and local level)* – more emphasis on **prevention/mitigation**
- **Financial management** of earthquake risk
- Economic agents able to **absorb and recover from disaster costs** given disaster risk **exposures and financial (risk-bearing) capacities** ▶ the ability to absorb loss and damage, minimize impacts and bounce forward *(resilience)*
Risk Management Policy Questionnaire

- The proposed *questionnaire* is based on the **Self-Assessment Guiding Tool** annexed to the G20/OECD Methodological Framework on Disaster Risk Assessment and Risk Financing (2012).

- The questionnaire aims at the elaboration of *guidelines* and *recommendations* in order to promote risk governance in Palestine.

- The questionnaire is spread among three main stakeholders: **Government, private sector** (plus (re)insurance and finance sectors) and the **civil society** (Engineering Association).

- Processed outcomes will suggest **roles** and possible forms of **partnership** between the three main actors for a better management of seismic risk.
Exposure Model

Accounts for People, Property, Systems and Elements present in the case-study area

Census and National Databases data (Palestinian Central Bureau of Statistics)

INDICATORS that best describes the exposed asset

- % of buildings
  - Floor area
  - Building Type
  - Replacement cost
Preliminary exposure data

Percentage distribution of residential building typologies:

- Individual houses: 44%
- Apartments (multi-storey buildings): 54%
- Villas: 2%

Estimated distribution of housing units by floor area for 2016 [PCBS]:

- Floor area in m²:
  - ≥200: 2728
  - 199-160: 5874
  - 159-120: 13192
  - 119-81: 9308
  - 80-2: 5471

Evaluation of Replacement Costs:

- 91 $/m², using data from PBCS
- > 550 $/m², with feedback from practitioners, engineers, engineering associations.
Thank you for your attention.

This project is Co-funded by ECHO – Humanitarian Aid and Civil Protection.