

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

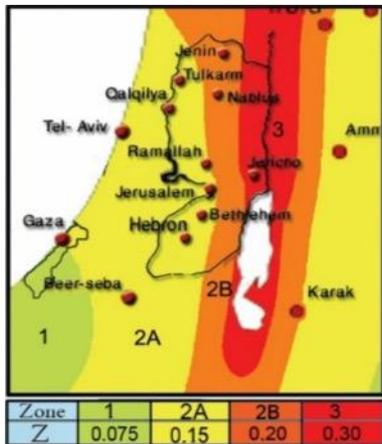
School for Advanced Studies – IUSS, Pavia

**European Centre for Training and Research in Earthquake Engineering – EUCENTRE,
Pavia**





Hazard



Vulnerability



Exposure



Physical
Social
Economical

Structures
Population

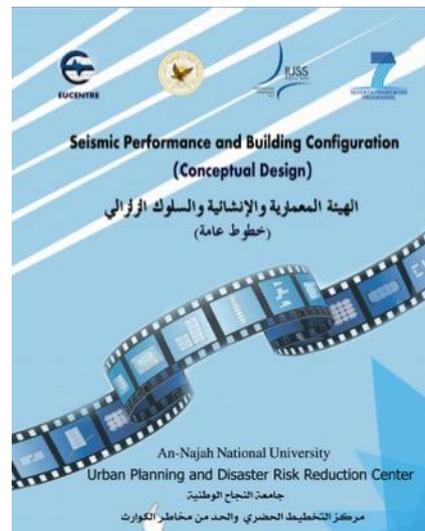
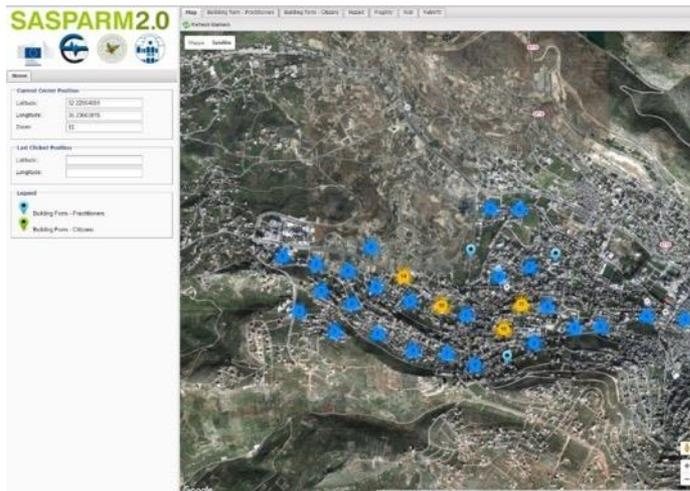


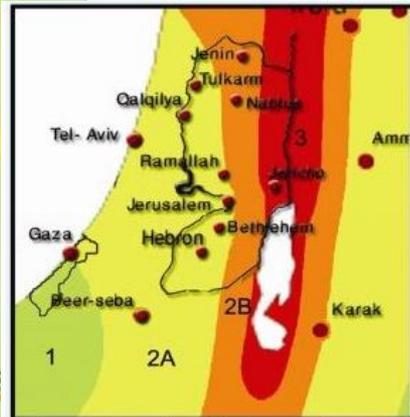
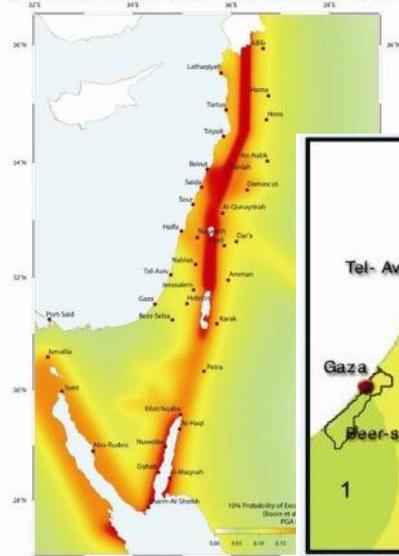
SASPARM 2.0 Project

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**





Zone	1	2A	2B	3
Z	0.075	0.15	0.20	0.30

Hazard

Hazard map with 10% probability of exceedance in 50y

- Boore et al, 1997

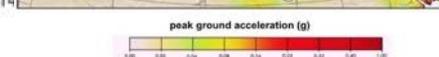
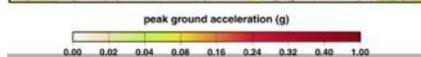
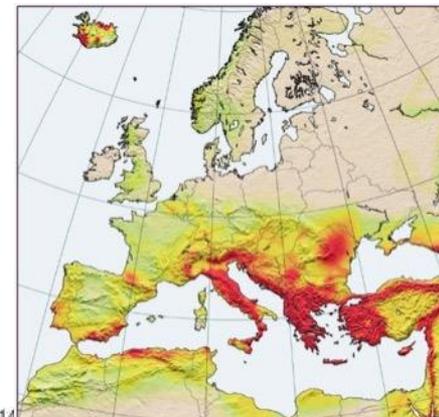
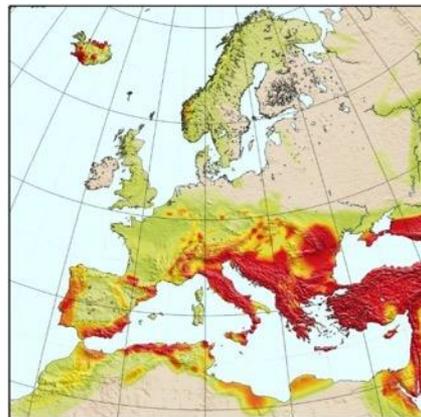


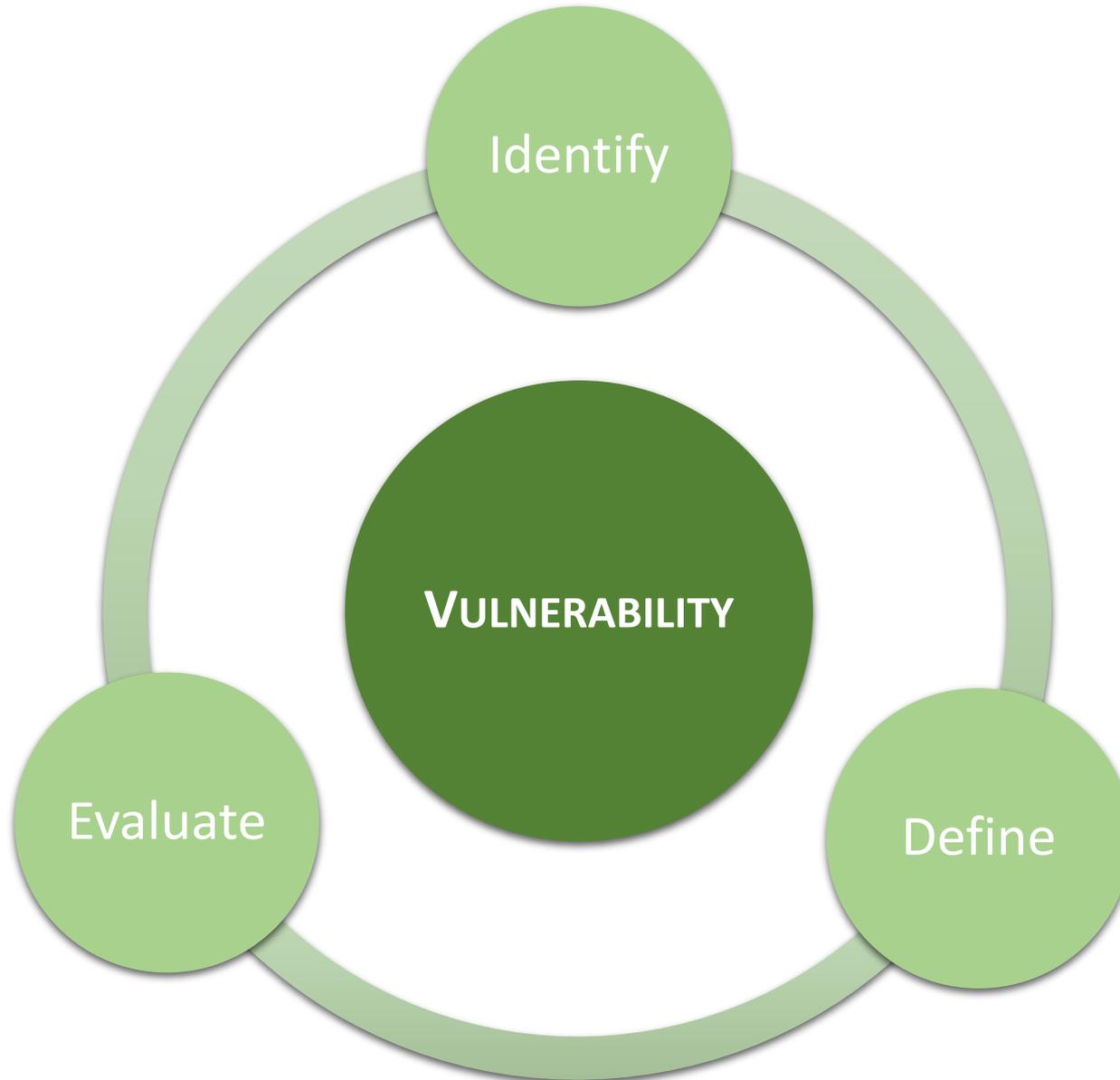
• 1992 - 1999

• 1996 - 2000

• 2002

• 2010 - 2013





Taxonomy

RC
Frame
Buildings



Shear
Walls
Buildings



Masonry
Buildings



RC Frame
Buildings
with Soft
Storey



WBP Collection Form: Practitioners

SASPARM2.0



Home

Current Center Position

Latitude:

Longitude:

Zoom:

Last Clicked Position

Latitude:

Longitude:

Legend

- Building Form - Practitioners
- Building Form - Citizens

Map **Building form - Practitioners** Building form - Citizens Ha

Building Form

New Form Delete Form Close Form Help

Date:

Name of the compiler:

Education level:

1. Identification of the Building

Municipality:

Street name: Street number:

Name of the building: Building number:

Geographical Coordinates (WGS 84 System - Decimal Degrees)

Latitude:

Longitude:

ex. 45.98763
[\(Get last clicked position\)](#)

Position of Building:

2. Description of the Building

Metrics

N° Total floors with basement:

N° Basements:

Average of floor height [m]:

Average of floor area [m²]:

Construction Year:

Renovation Year:

Type of Use

Insert the number of units for each type of use

Housing:	<input type="text"/>	% of Use:	<input type="text"/>
Productive:	<input type="text"/>	Property:	<input type="text"/>
Trade:	<input type="text"/>	Occupants:	<input type="text"/>
Offices:	<input type="text"/>		
Public Service:	<input type="text"/>		
Deposit:	<input type="text"/>		

Save Cancel



WBP Collection Form: Citizens

SASPARM2.0



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Map Building form - Practitioners **Building form - Citizens** Hazard Fragility Risk Retrofit Download

Building Form

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Name of the compiler:
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Faculty:
Department:

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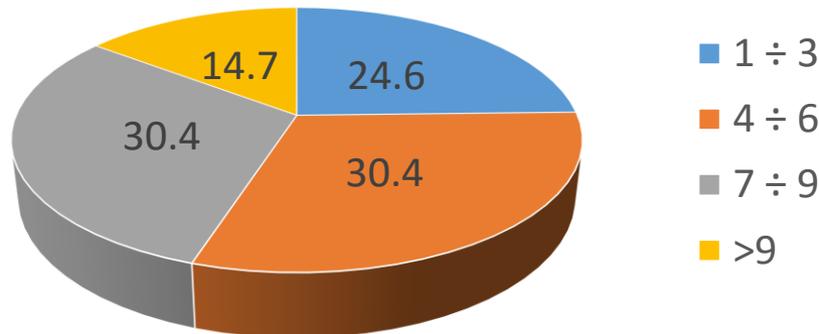
Save Cancel



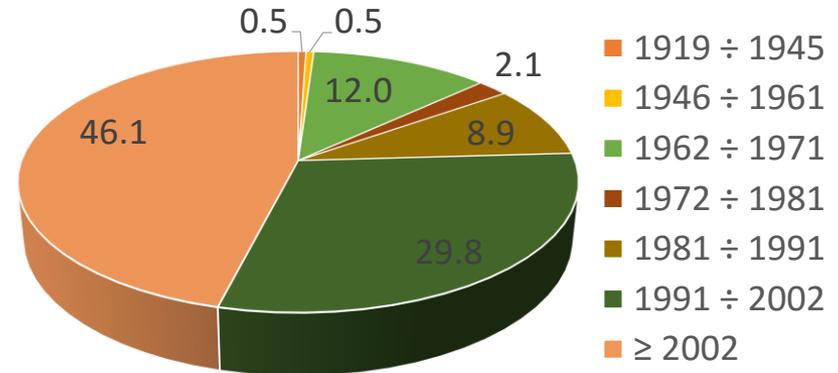
Preliminary Outcome of Collected Data

Metrical Data

Total number of floors with basement

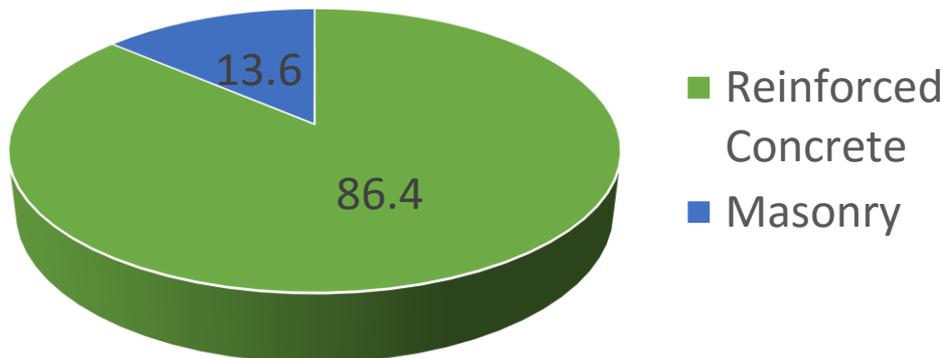


Construction year

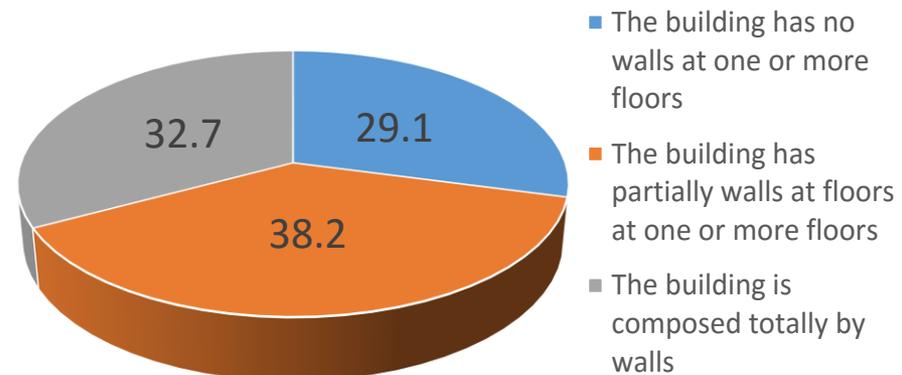


Vertical Structure

Vertical Structure of the buildings

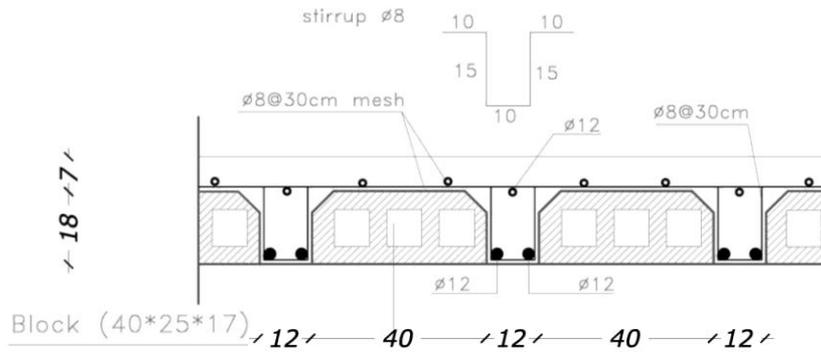


RC buildings



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**.

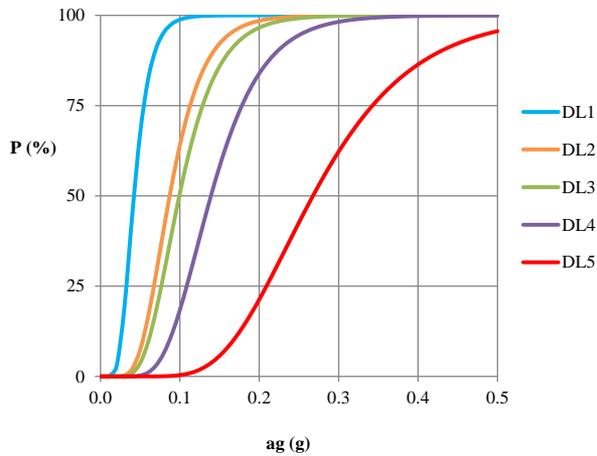


Fragility Curves

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

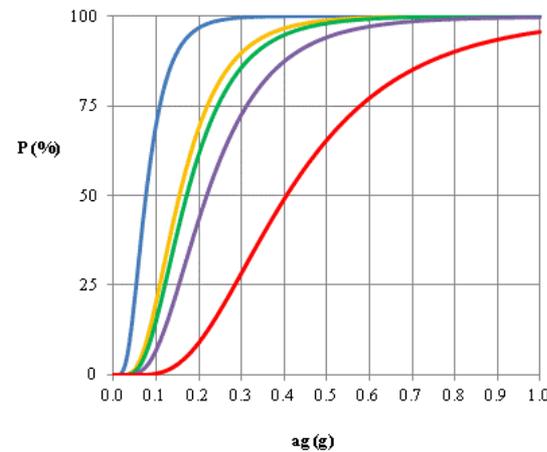
SP-BELA has been adapted to be representative of the reality of the as-built in Nablus.

2 storeys



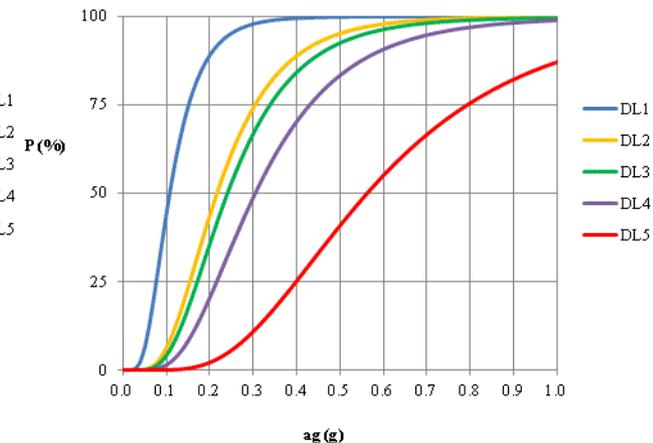
Fragility curves for **masonry** buildings with **2 storeys**

7 storeys



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

10 storeys



Fragility curves for **shear wall** buildings with **10 storeys**



Fragility Curves in WBP

SASPARM2.0



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Legend

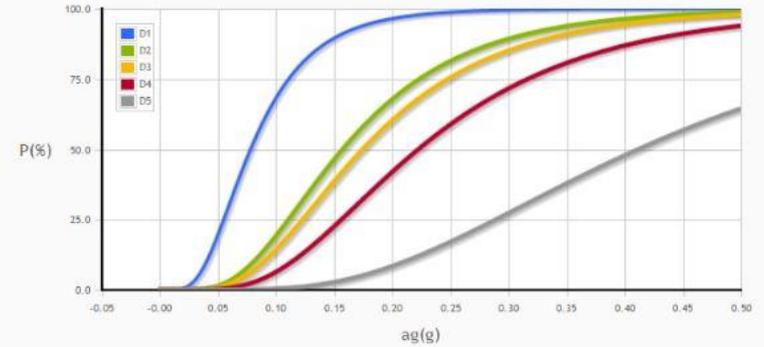
-  Building Form - Practitioners
-  Building Form - Citizens

Map Building form - Practitioners Building form - Citizens Hazard **Fragility** Risk Retrofit

Fragility Curve

Damage levels

Damage Level	Average [g]	Standard Deviat..
D1	0.08930	0.04990
D2	0.18010	0.10060
D3	0.19990	0.11170
D4	0.25520	0.14340
D5	0.47260	0.26560





Social Vulnerability Model



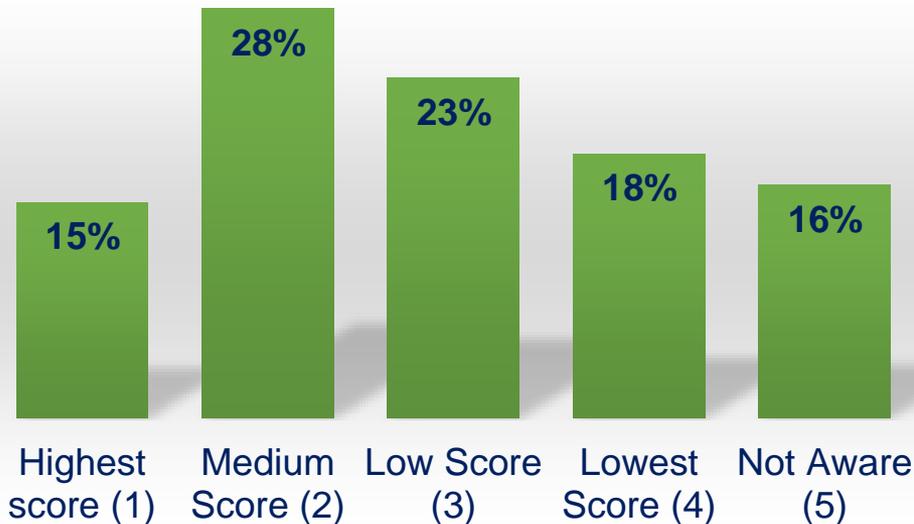
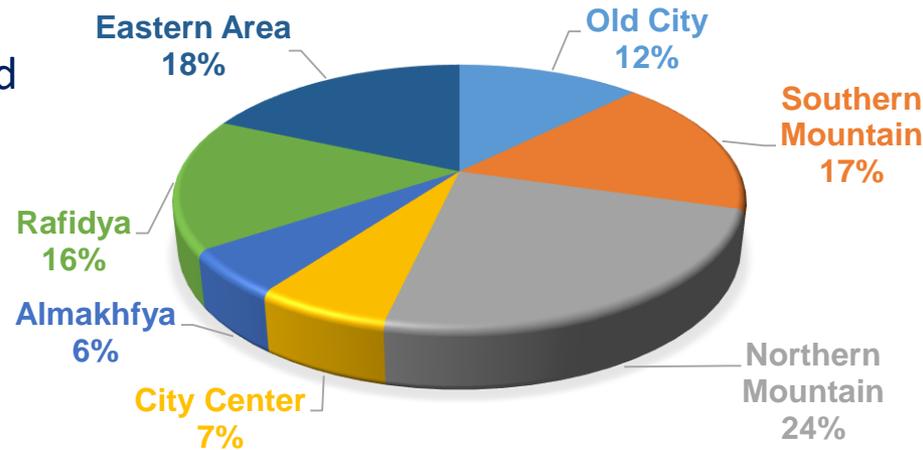
Social Vulnerability Questionnaire

Theme	General Question
Awareness and advocacy	What is the level of awareness and knowledge of earthquake disaster risk?
Social Capacity	What are the capacities of the population to efficiently prepare, respond and recover from a damaging earthquake?
Legal and institutional arrangements	How effective are mechanisms to advocate earthquake risk reduction in your quarter?
Planning, regulation and mainstreaming risk mitigation	What is the perceived level of commitment and mainstreaming of disaster risk reduction through regulatory planning tools?
Emergency preparedness, response and recovery	What is the level of effectiveness and competency of disaster management including mechanisms for response and recovery?
Critical services and public infrastructure resiliency	What is the level of resilience of critical services to disasters?

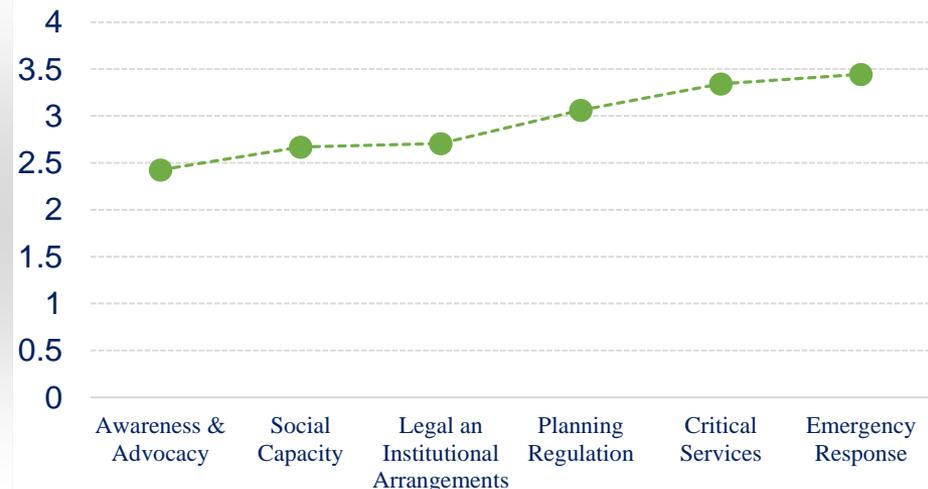


Preliminary outcome

526 Forms collected



Mean score distribution per theme



Legal and Regulatory Framework

Key institutional challenges: Outlook:

- **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
- 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)

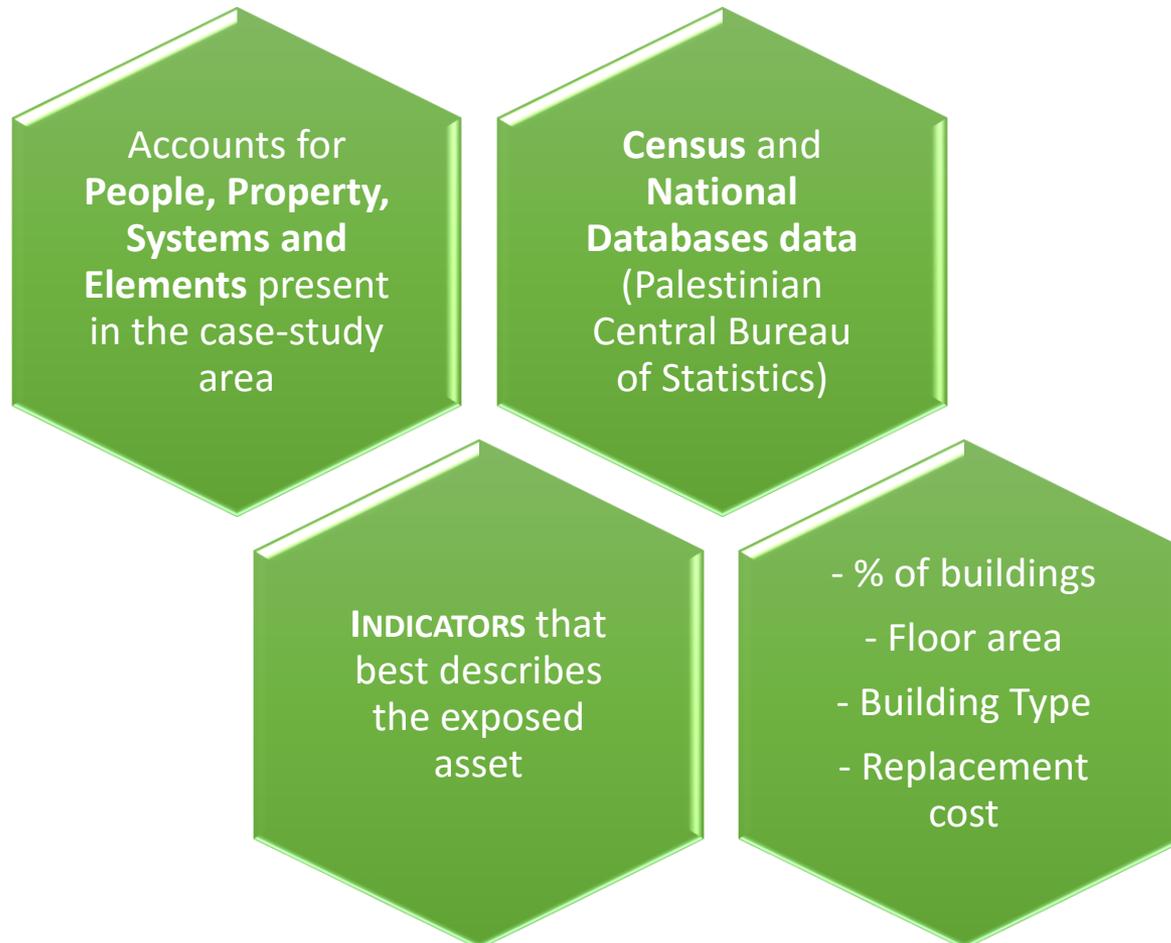


Risk Management Policy Questionnaire

- 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

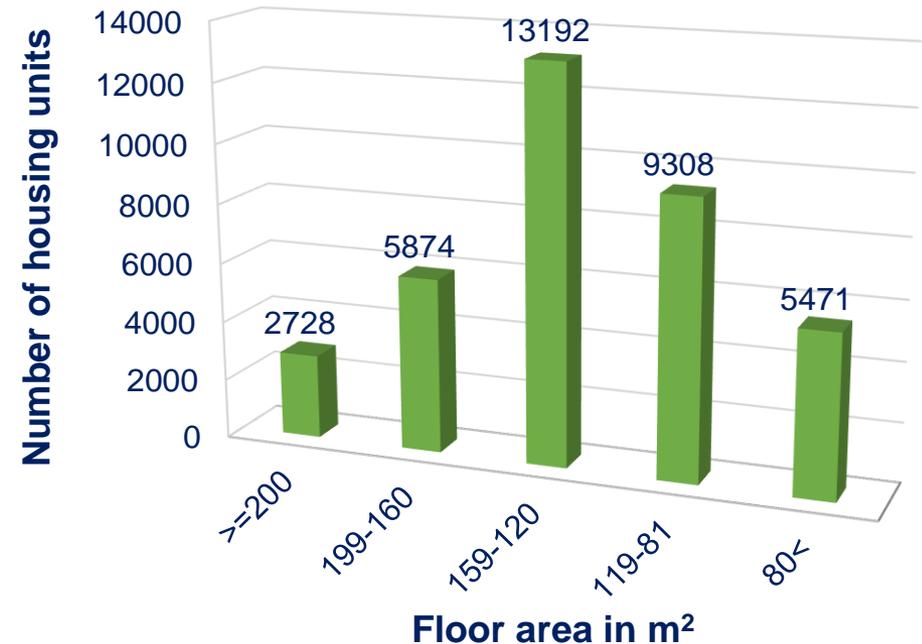


Preliminary exposure data

Percentage distribution of residential building typologies:



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



Evaluation of Replacement Costs:

- ❖ 91 \$/m², using data from PBCS
- ❖ > 550 \$/m², with feedback from practitioners, engineers, engineering associations.





Thank you for your attention.

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