

Shake-table prototype testing for sensor-based seismic monitoring of non-structural elements

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The structure was safe... The building stayed closed.

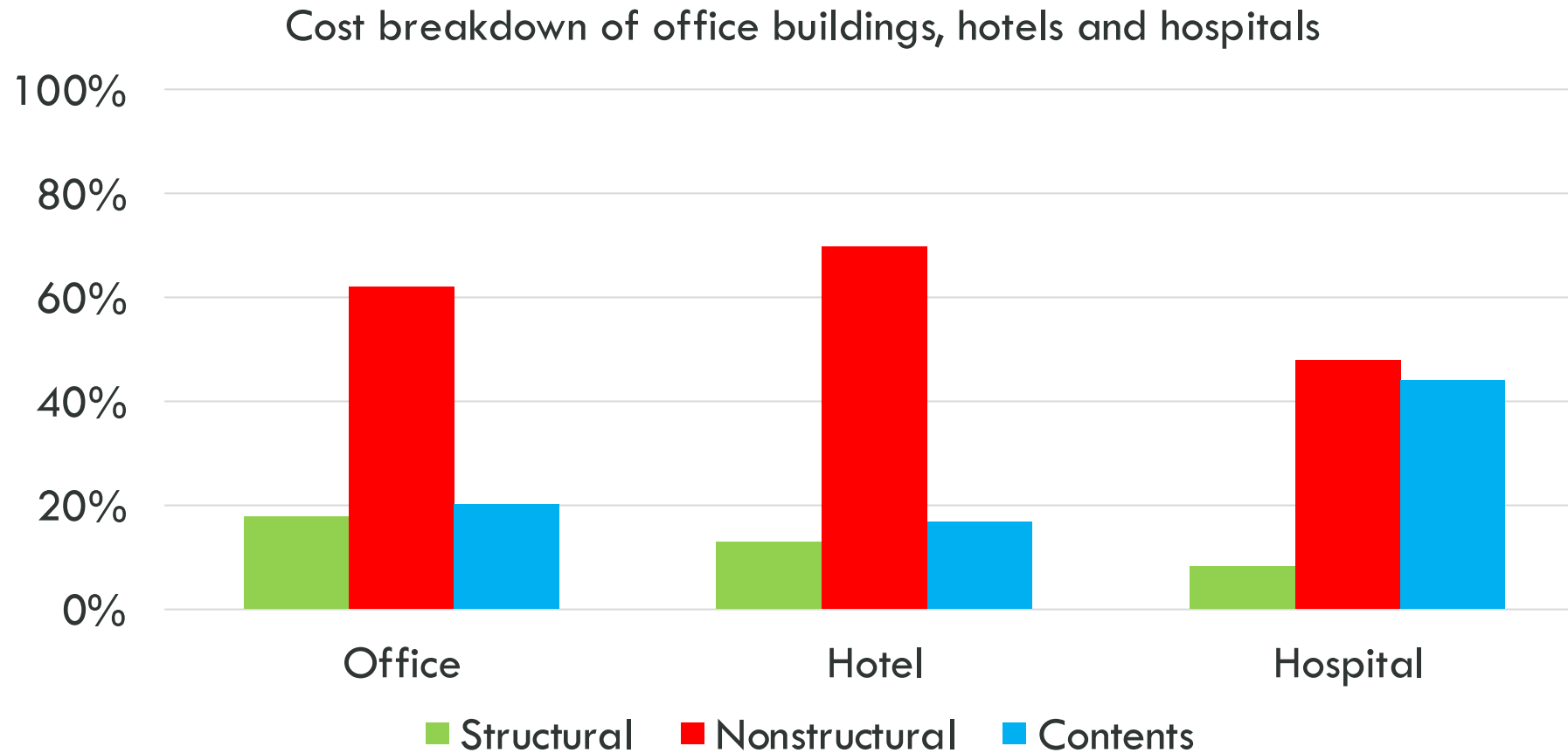


Photo by Bill Holmes, Rutherford & Chekene (FEMA E-74, Fig. 6.3.4.1-3). 2010 M8.8 Chile earthquake

The structure is a fifth of what a building costs

The structure is about 20% of the total building cost, the rest goes into non-structural components and contents.

Taghavi & Miranda (2003), PEER Report 2003/05



We still record non-structural damage by hand



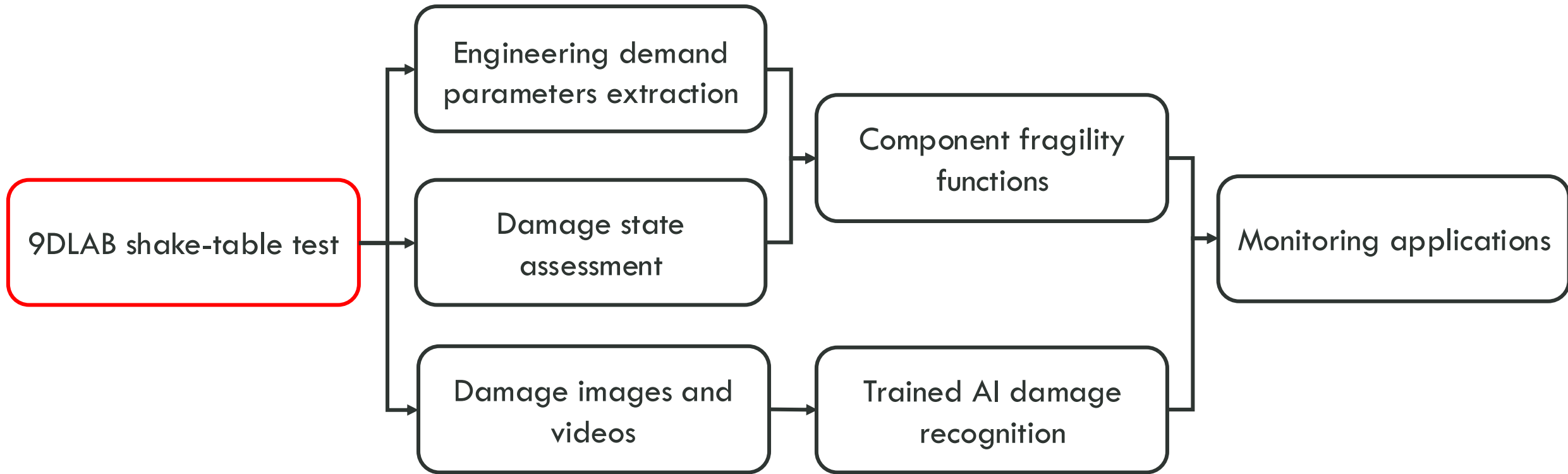
IDEA dataset, Casarotti et al. (2025), EUCENTRE Foundation, CC BY-NC-ND 4.0

SECTION 5 - DAMAGE TO NON-STRUCTURAL ELEMENTS and emergency countermeasures (E.C.) carried out

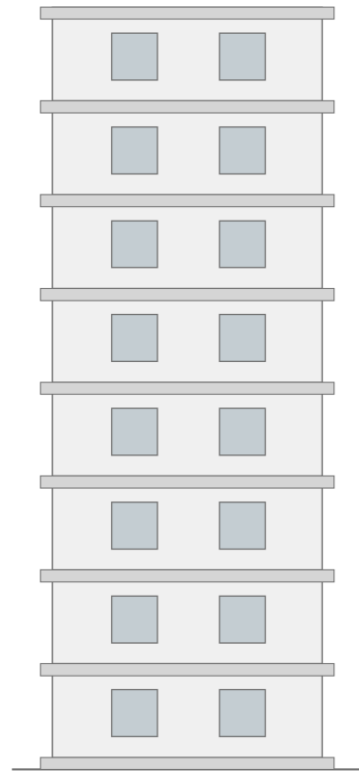
Type of damage		Presence of damage	Emergency countermeasures carried out					
			None	Removal	Shoring	Repair	Access prohibition	Barrier & passage prot.
			B	C	D	E	F	G
1	Detachment of plaster, claddings, suspended ceilings, ...	☐	☐	☐	☐	☐	☐	☐
2	Falling of tiles, chimney pots, flues, ...	☐	☐	☐	☐	☐	☐	☐
3	Falling of cornices, parapets, ...	☐	☐	☐	☐	☐	☐	☐
4	Falling of other internal or external objects	☐	☐	☐	☐	☐	☐	☐
5	Damage to the water, sewer or heating-plumbing network	☐	☐	☐	☐	☐	☐	☐
6	Damage to the electrical or gas network	☐	☐	☐	☐	☐	☐	☐

Section 5 of the Italian post-earthquake inspection form (AeDES), Department of Civil Protection

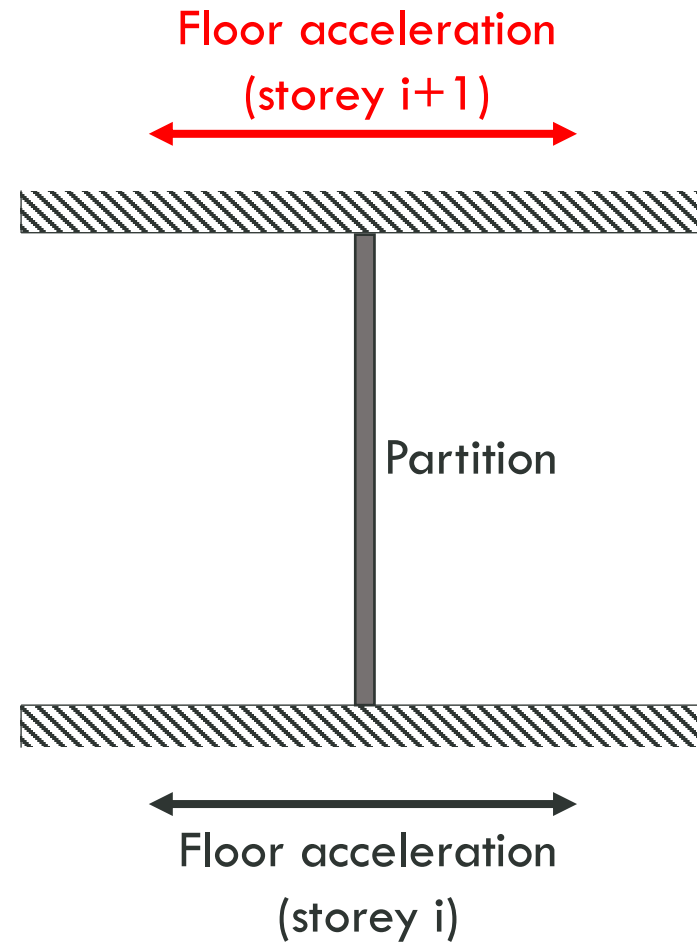
This is where sensors and images come in



A dual table imposes drift without building the storey



9DLAB, TWO TABLES

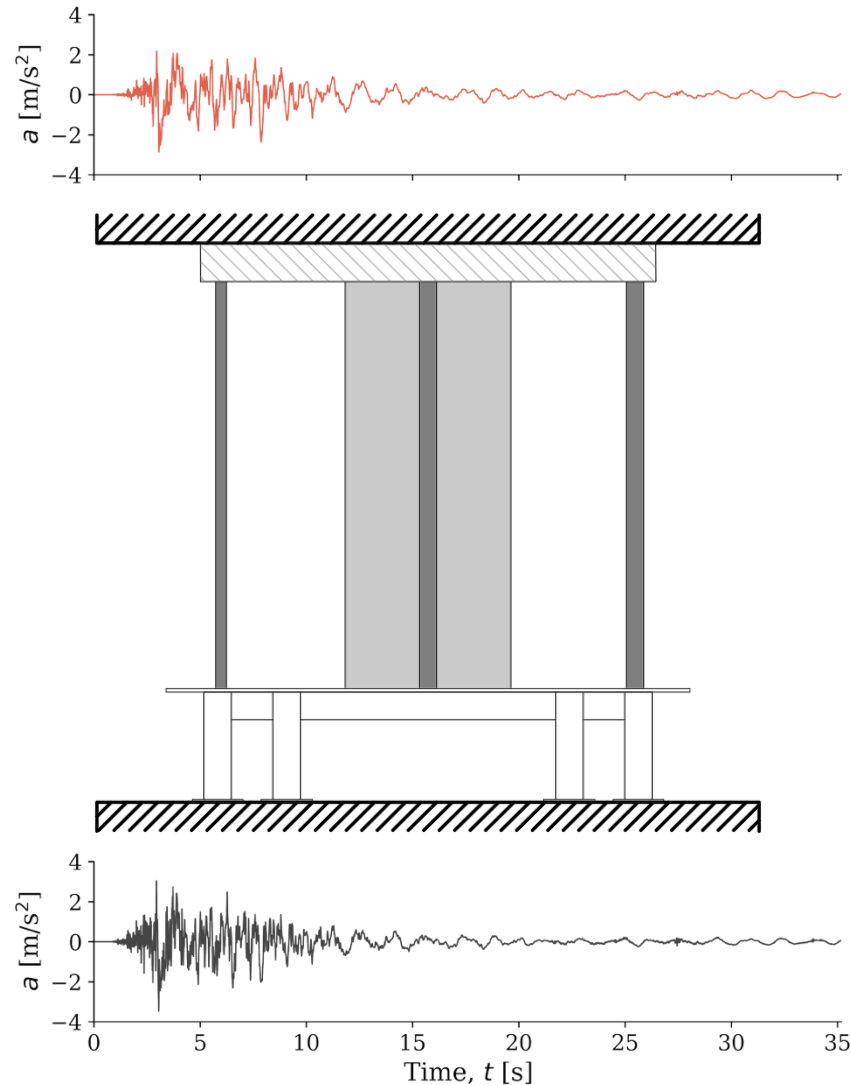


Three partitions were tested in the same runs



Three full-scale gypsum partitions, 3 m clear height, single-layer and double-layer, one with a T junction

Each table replays one floor of the same building



The 2009 L'Aquila record drives a non-linear model of an eight-storey building.

Two consecutive floor levels feed the two tables, at increasing amplitude until the partitions reach severe damage.

Low-amplitude white noise between runs, to follow the change in dynamic properties.

Same mechanisms in all three, at similar drifts

P01 single-layer at DS3



Corner crushing

P02 double-layer, T shaped at DS3



Total collapse

P03 double-layer at DS3



Sliding

Drift at first attainment [%]	Damage State 1 (DS1)	Damage State 2 (DS2)	Damage State 3 (DS3)
P01 single-layer	0.56	1.21	1.87
P02 double-layer, T-shaped	0.73	1.21	2.22
P03 double-layer	0.73	1.48	1.87

In conclusion, the tick box can be replaced

- The campaign produced damage observations with the corresponding measured drift, for three partition types, with the floor motion imposed at both storey levels.
- Because the drift is measured rather than estimated, these data will be used to update existing component fragility functions.
- The damage images and video will be used to train image-based damage recognition.
- Suspended ceilings are next in the campaign.



Todaro, Marco; Guamán, Mauricio; Shahnazaryan, Davit; Sivori, Daniele; Ozsarac, Volkan; O'Reilly, Gerard J. (2026) "Shake-table prototype testing for sensor-based seismic damage assessment of non-structural elements", 18th European Conference on Earthquake Engineering, Berlin, Germany.