WP 2 – Inventario delle tipologie strutturali ed edilizie esistenti (CARTIS) | Task 2.3
Simplified method for the fragility analysis of unreinforced masonry buildings at the territorial scale: Maranello case study

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1| Data collection through the CARTIS form

Interview-based **CARTIS 1st level survey**

→ Identification of n.10 Sectors

C001 - Historical centre   **C006** - City capital

C002 - First expansion   **C007** – Ferrari expansion

C003 - Second expansion   **C008** - Residential Ferrari Park

C004 - Last expansion   **C009** - Graziosi district

C005 - Crociale district   **C010** - La Punta expansion

2| Characterization of the building stock
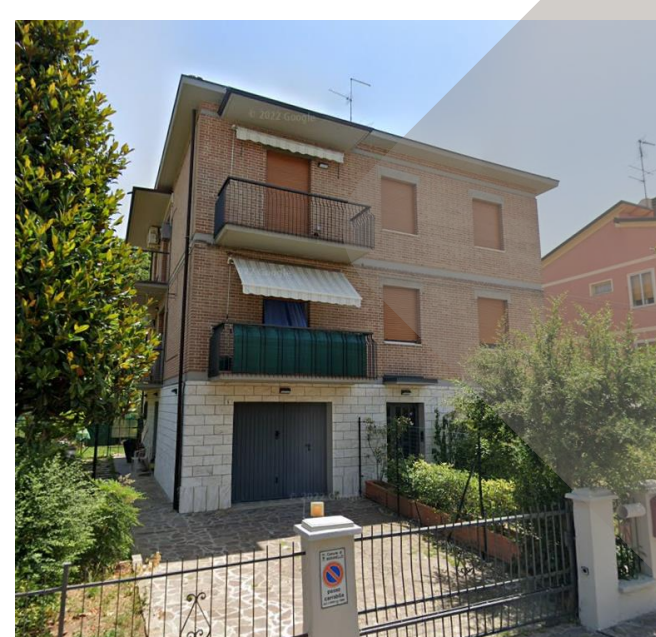
■ *Masonry* ■ *Reinforced concrete*
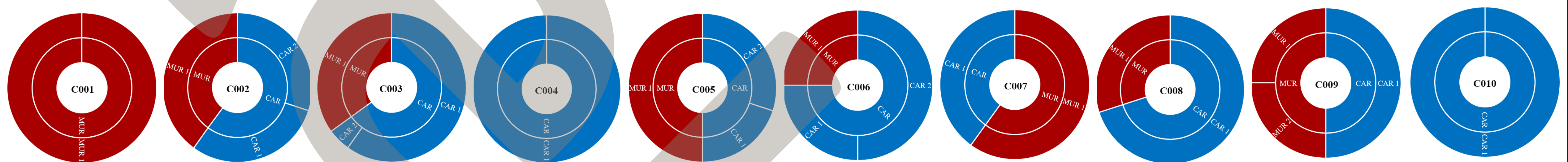
3| Typological identification

MUR A0
- early 20th century
- clay-brick masonry and hollow-block concrete slabs
- 3 stories
- A = 70-130 m²

MUR A
- second half of the 20th century
- clay-brick masonry and hollow-block concrete slabs
- 2-4 stories
- A = 70-170 m²

MUR B
- second half of the 20th century
- clay-brick masonry and hollow-block concrete slabs
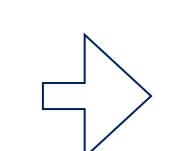- 3-5 stories
- A = 170-300 m²

MUR C
- late 19th – early 20th century buildings
- stone or brick masonry and wooden floors
- 2-3 stories
- A = 70-170 m²

4| Application of the simplified methodology to evaluate the structural capacity

Selection of building reports representative of the masonry typologies

* Distinction between 'strong' (maximum PGAc) and 'weak' (minimum PGAc) directions
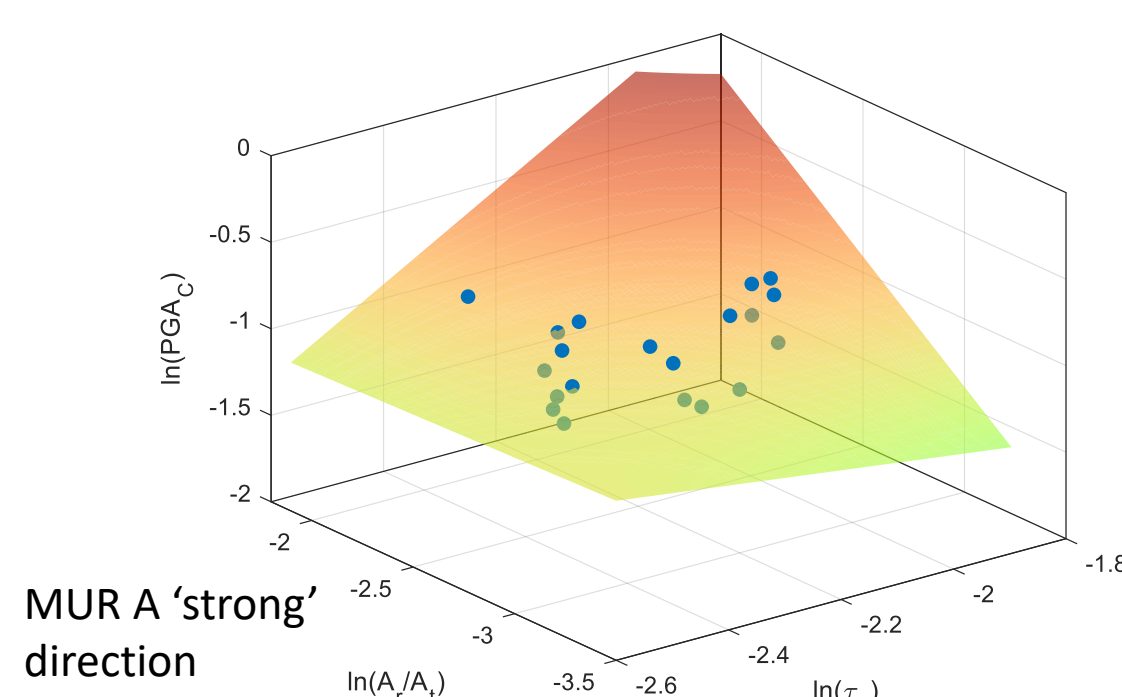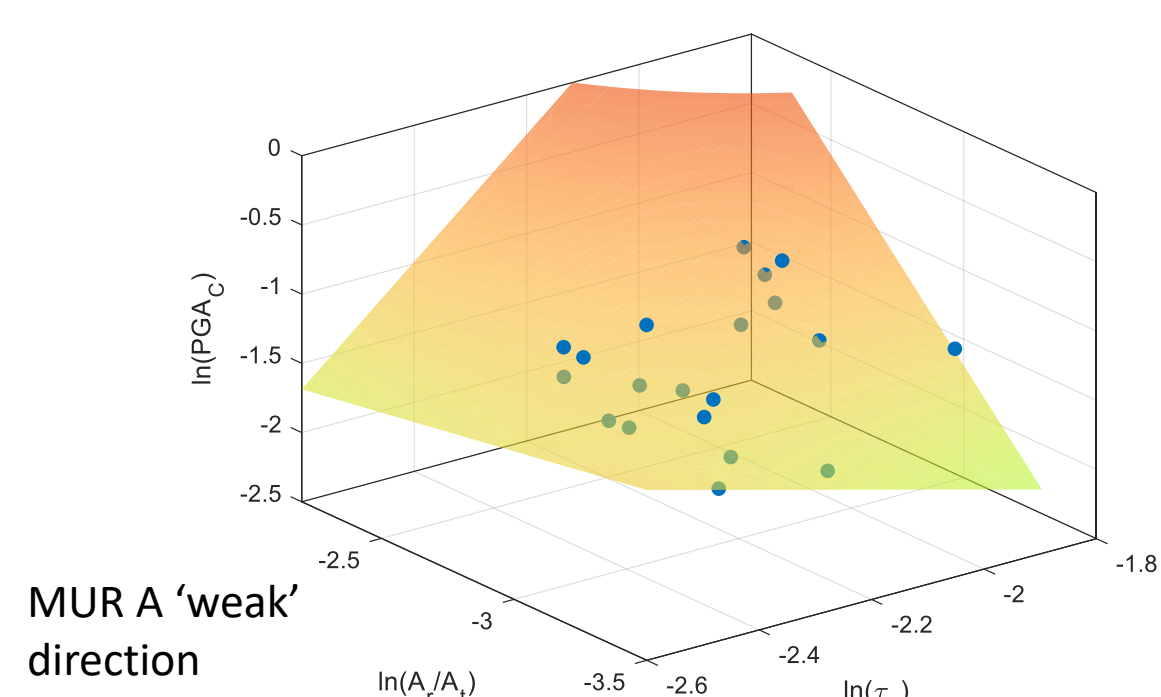
⇨ **Main parameters:**
- Resistant area over total area (A_r/A_t)
- Average shear strength (τ_0)
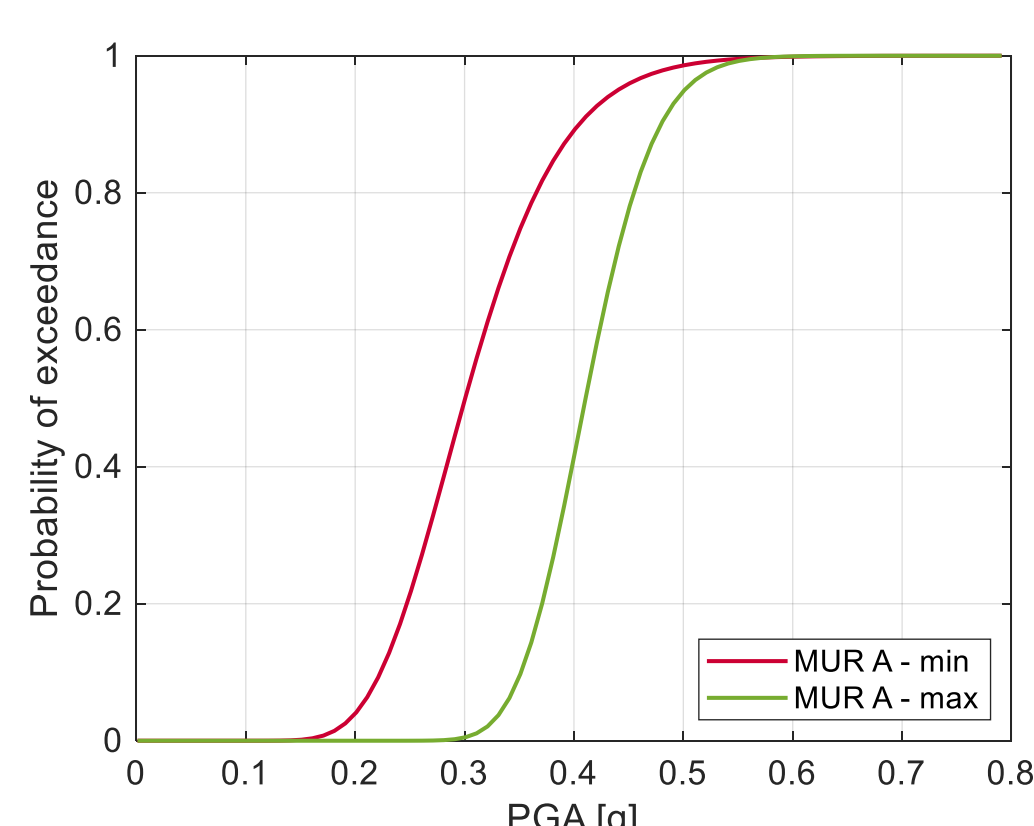
DERIVATION OF FRAGILITY CURVES

Definition of response surfaces

MUR A0, MUR C: $\ln(PGAc) = \beta_1 + \beta_2 \cdot \ln(A_r/A_t) + \beta_3 \cdot \ln(\tau_0) + \varepsilon$

MUR A, MUR B: $\ln(PGAc) = \beta_1 + \beta_2 \cdot \ln(A_r/A_t) + \beta_3 \cdot \ln(\tau_0) + \beta_4 \cdot \ln(A_r/A_t) \cdot \ln(x_2) + \varepsilon$

MUR A 'weak' direction

MUR A 'strong' direction

Extension of available data using Monte Carlo method

Masonry type	'minimum' μ_{ln}	'minimum' σ_{ln}	'maximum' μ_{ln}	'maximum' σ_{ln}
MUR_A0	-1.231	0.167	-1.161	0.070
MUR_A	-1.202	0.232	-0.890	0.121
MUR_B	-1.259	0.166	-1.040	0.107
MUR_C	-1.472	0.231	-1.290	0.206

Derivation of typological fragility curves for Sectors

Masonry type	CARTIS Sector									
	C001	C002	C003	C004	C005	C006	C007	C008	C009	C010
MUR A0	90%	-	-	-	-	-	-	30%	-	-
MUR A	-	50%	56%	-	100%	100%	100%	-	92%	-
MUR B	-	50%	44%	-	-	-	-	70%	-	-
MUR C	10%	-	-	-	-	-	-	-	8%	-

Combination of fragility curves using the approach proposed by Shinozuka et al. (2000)

⇩

—C001 —C002 —C003 —C005,C006,C007 —C008 —C009