Experimental investigations on wall-to-diaphragm connections

PhD student: Maria Pia Ciocci
Supervisors: Paulo B. Lourenço, Rui Marques
ISISE, University of Minho, Portugal

Seismic behaviour of URM buildings

Local out-of-plane mechanisms

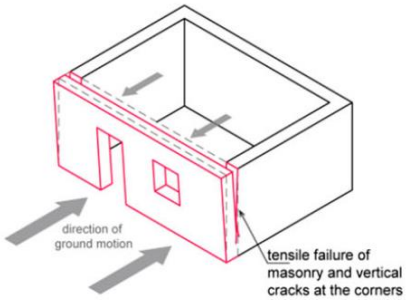
- ❑ Overturning
- ❑ Flexural failure

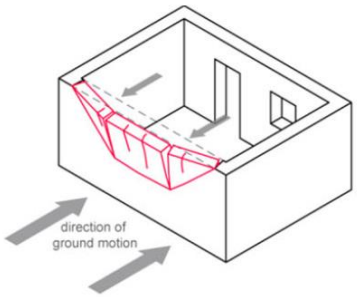
Global mechanism

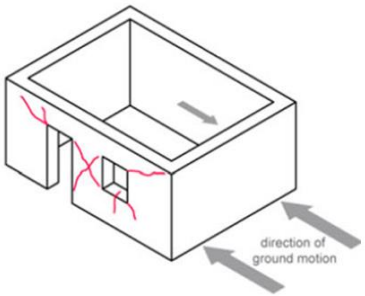
- ❑ Interaction between out-of-plane and in-plane walls

Vulnerabilities

- ❑ Low material properties
- ❑ Unfavourable geometrical layout
- ❑ High mass
- ❑ Inappropriate diaphragm stiffness
- ❑ Poor connections







Ortega et al. (2018)

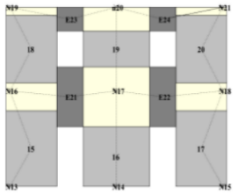
Modelling & Analysis

Macro-element models

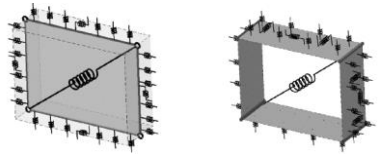
Refined FE models

Assumptions

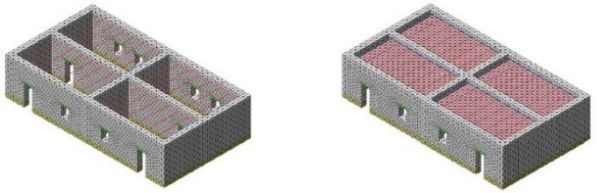
- ❑ Diaphragms: Linear elastic behaviour
- ❑ WTD connections: Hinged or fixed



Cattari et al. (2015)



Pantò et al. (2016)



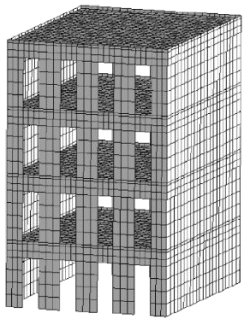
Ortega et al. (2018)

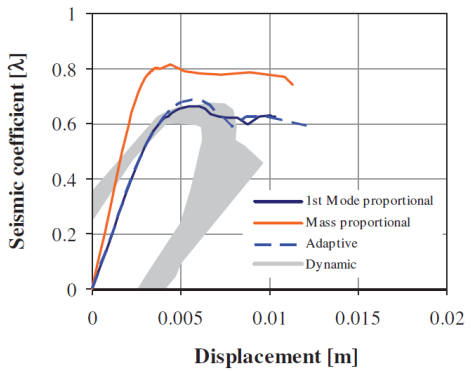
Time-history analysis

Pushover analysis

Assumptions

- ❑ Seismic input
- ❑ Control node

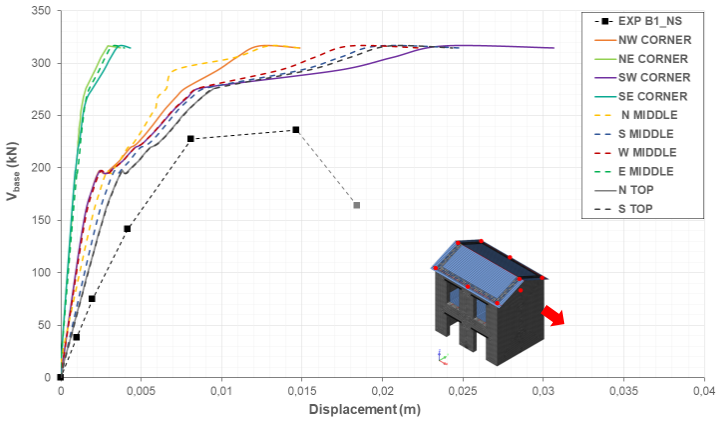




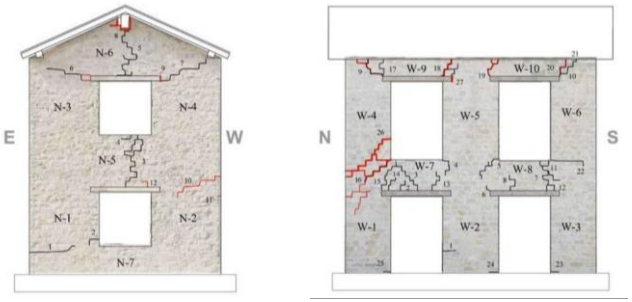
Mendes and Lourenço (2010)

Numerical study

Pushover (NS direction)

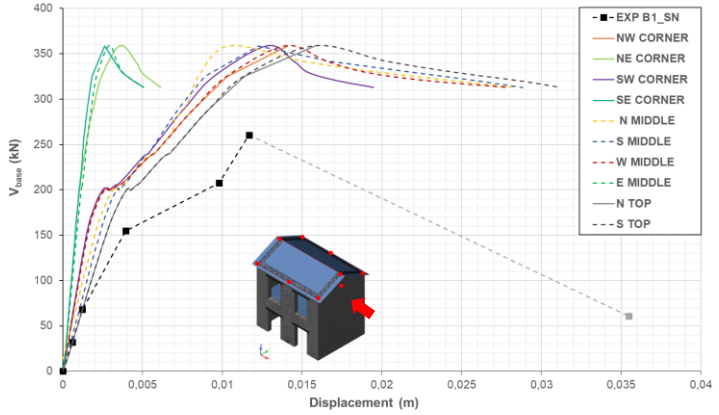


Experimental results

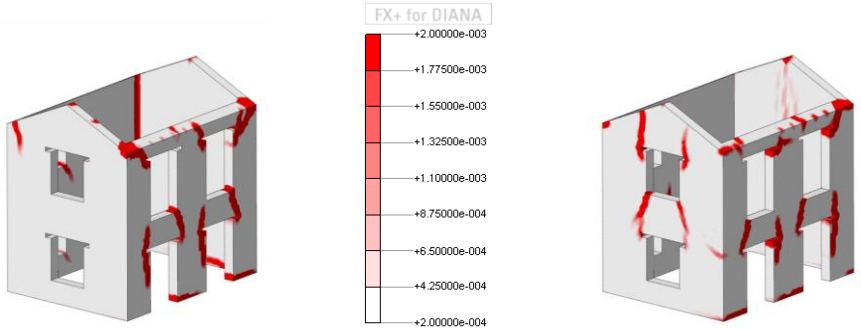


Senaldi (2012)

Pushover (SN direction)



Numerical model

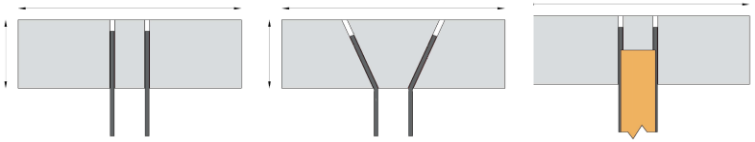


Ciocci et al. (2020)

Pullout tests at EPFL

Investigation

- Resistance of injection anchors
- Development of masonry cone breakout



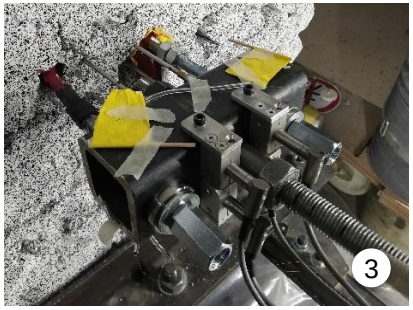
Walls

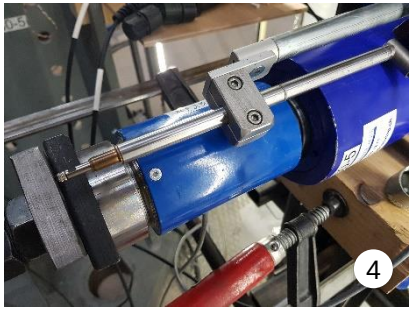
- Double-leaf masonry
- 900 x 900 x 300 mm^3

Anchoring system

- 16 mm diameter bars embedded 250 mm
- Epoxy resin adhesive (Hilti HIT-RE 500)

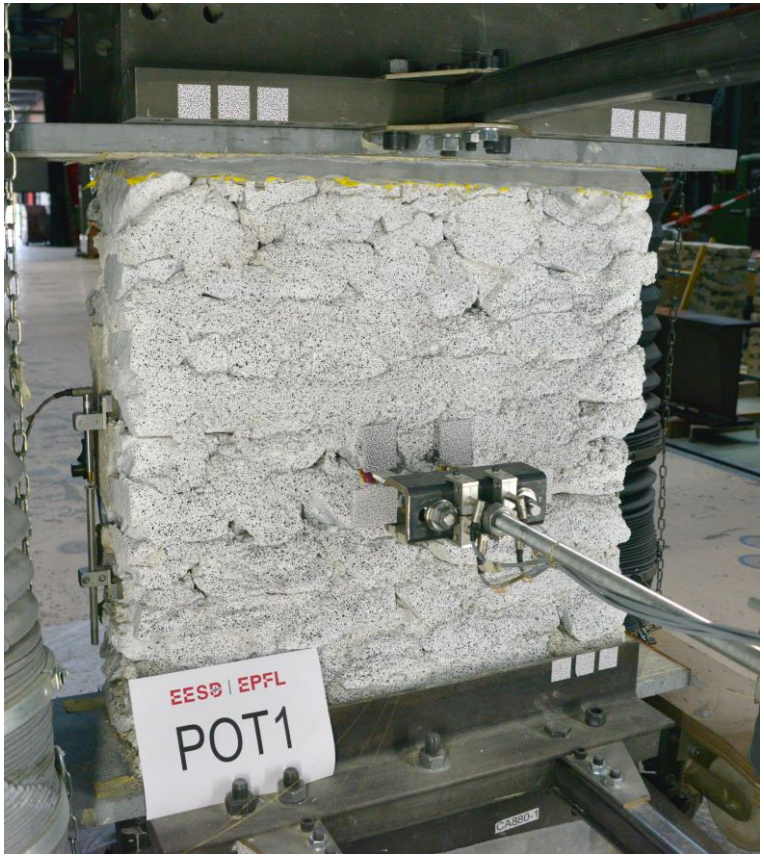
Setup





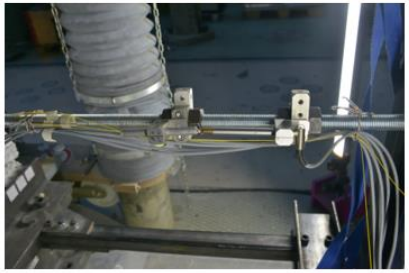
Instrumentation

DIC - Optical acquisition system



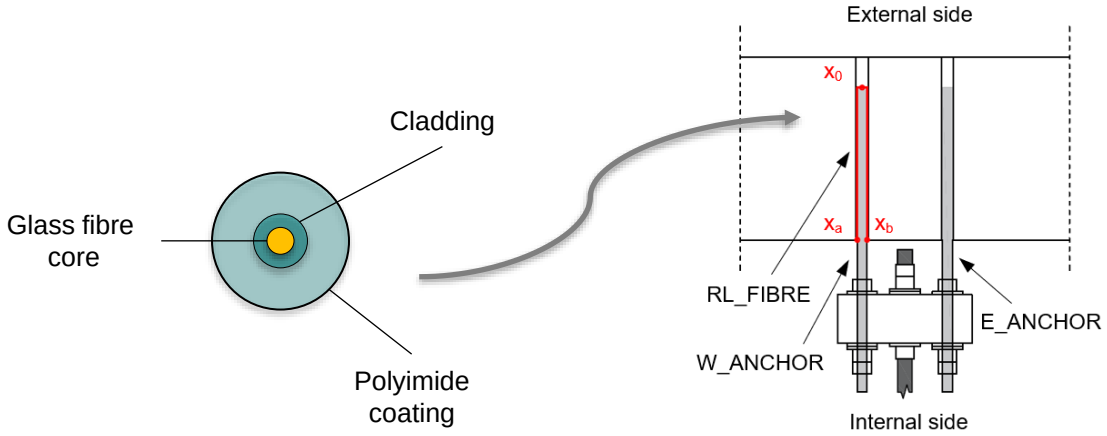
LVDTs

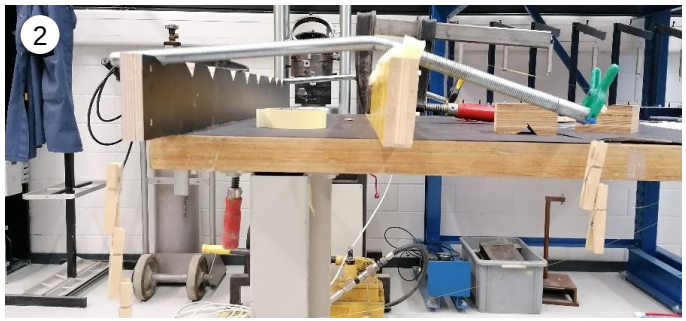


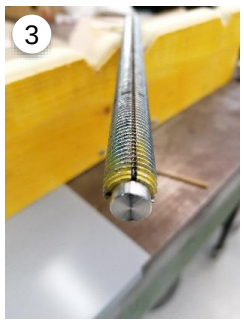


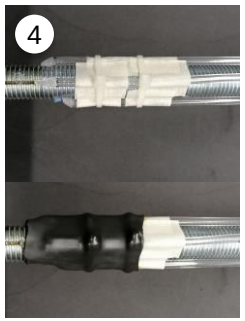

Instrumentation

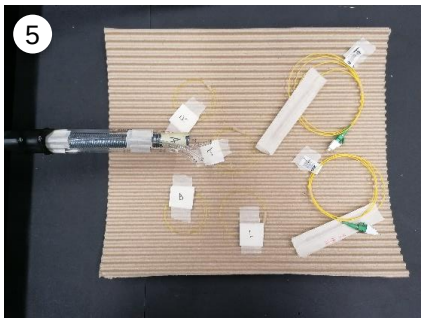
Fibre optical sensor

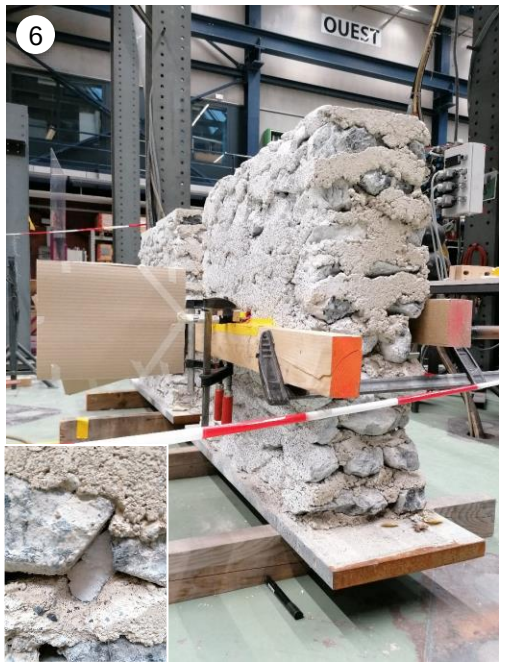




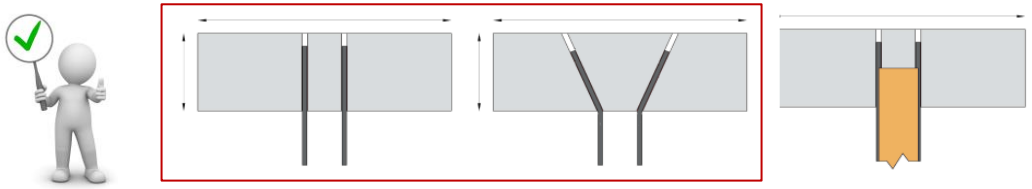








Overview

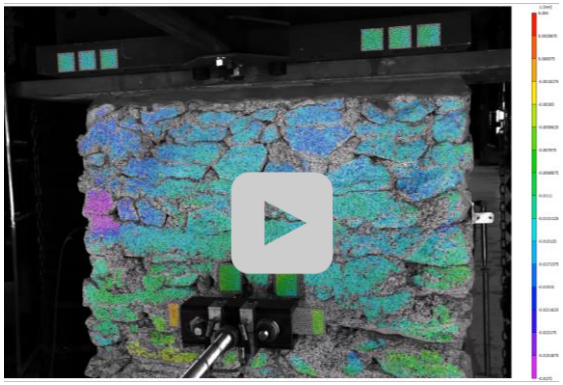


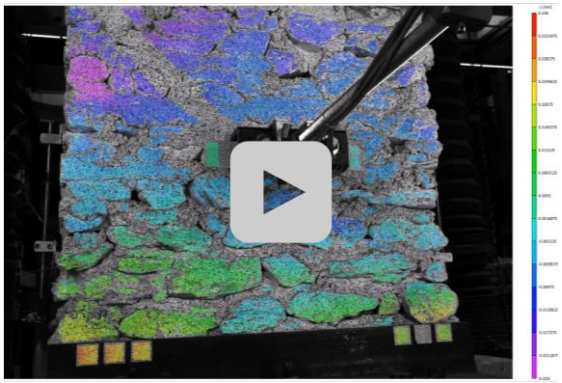
	ID specimen	σ_v (MPa)	Setup	
			BC top	*LVDTs at the back*
Parallel anchor group	POT5	0.20	Mortar + Plate	1
	POT6	0.10	Mortar + Plate	1
	POT8	0.10	Mortar + Plate	1
	POT7	0.10	Mortar + Plate	1
	POT7_2	0.20	Mortar + Plate	1

	ID specimen	σ_v (MPa)	Setup	
			BC top	*LVDTs at the back*
Inclined anchor group	POT2	0.20	Mortar + Plate	2
	POT4	0.20	Epoxy + Plate	2
	POT1	0.20	Epoxy + Plate	2
	POT3	0.30 0.20 0.40	Epoxy + Plate	2

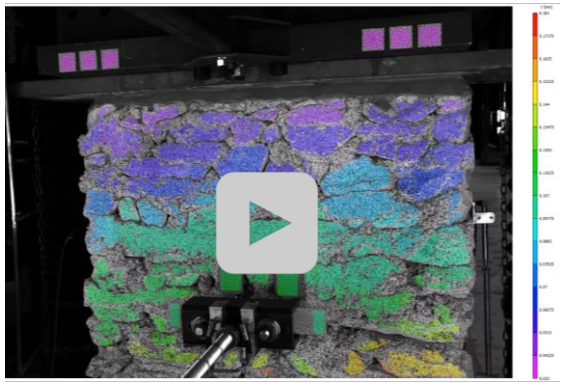
DIC results

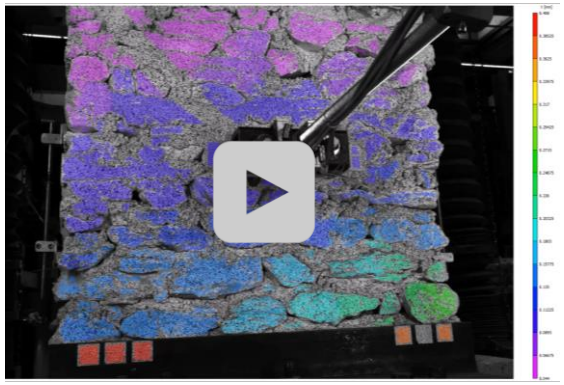
U direction



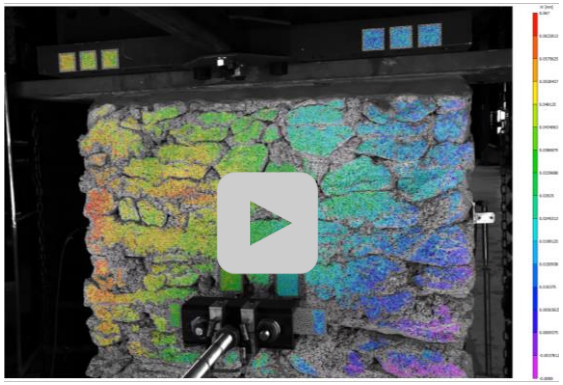


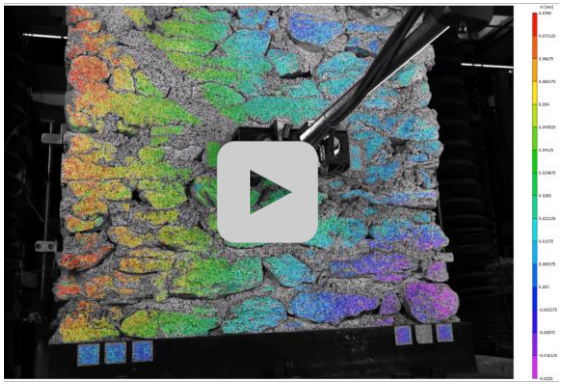
V direction





W direction





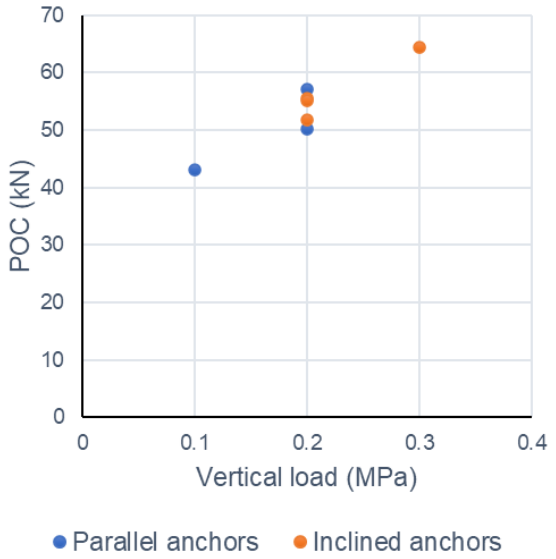
Results

Damage

- Combined cone-bond failure with higher participation of the cone breakout
- Cracking at interface mortar/stone, mortar and stones

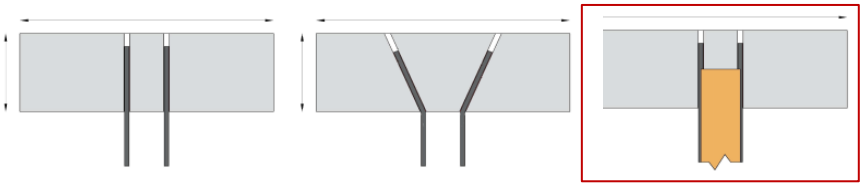
Pullout capacity (POC)

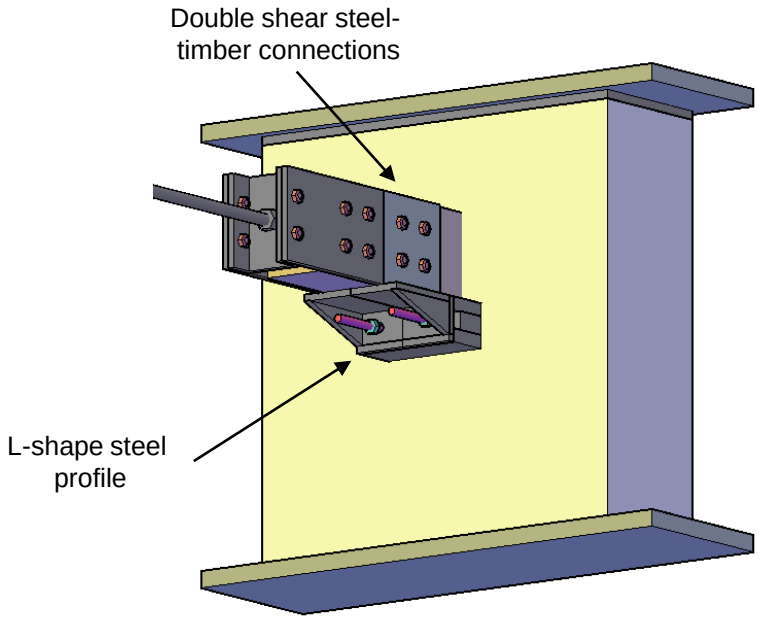
- No significant difference under same vertical load
  σ_V = 0.20 MPa
  - POC (parallel) = 53.7 ± 4.8 (kN)
  - POC (inclined) = 54.1 ± 2.1 (kN)

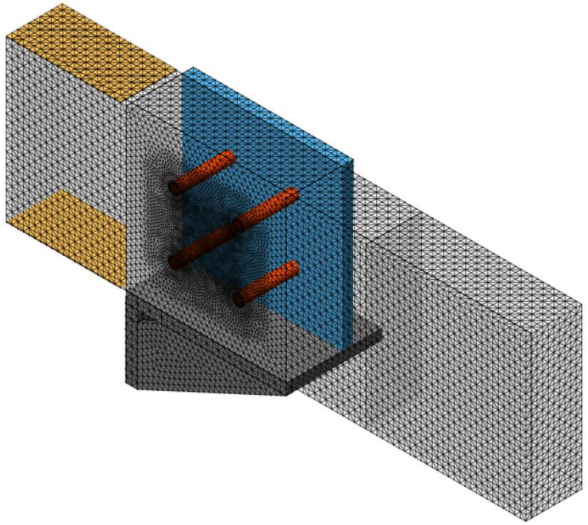


- Influence of vertical loading

Specimens with timber beam







Thank you

Maria Pia Ciocci
mariapiaciocci@gmail.com

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