

COST Action FP1004

Final Meeting

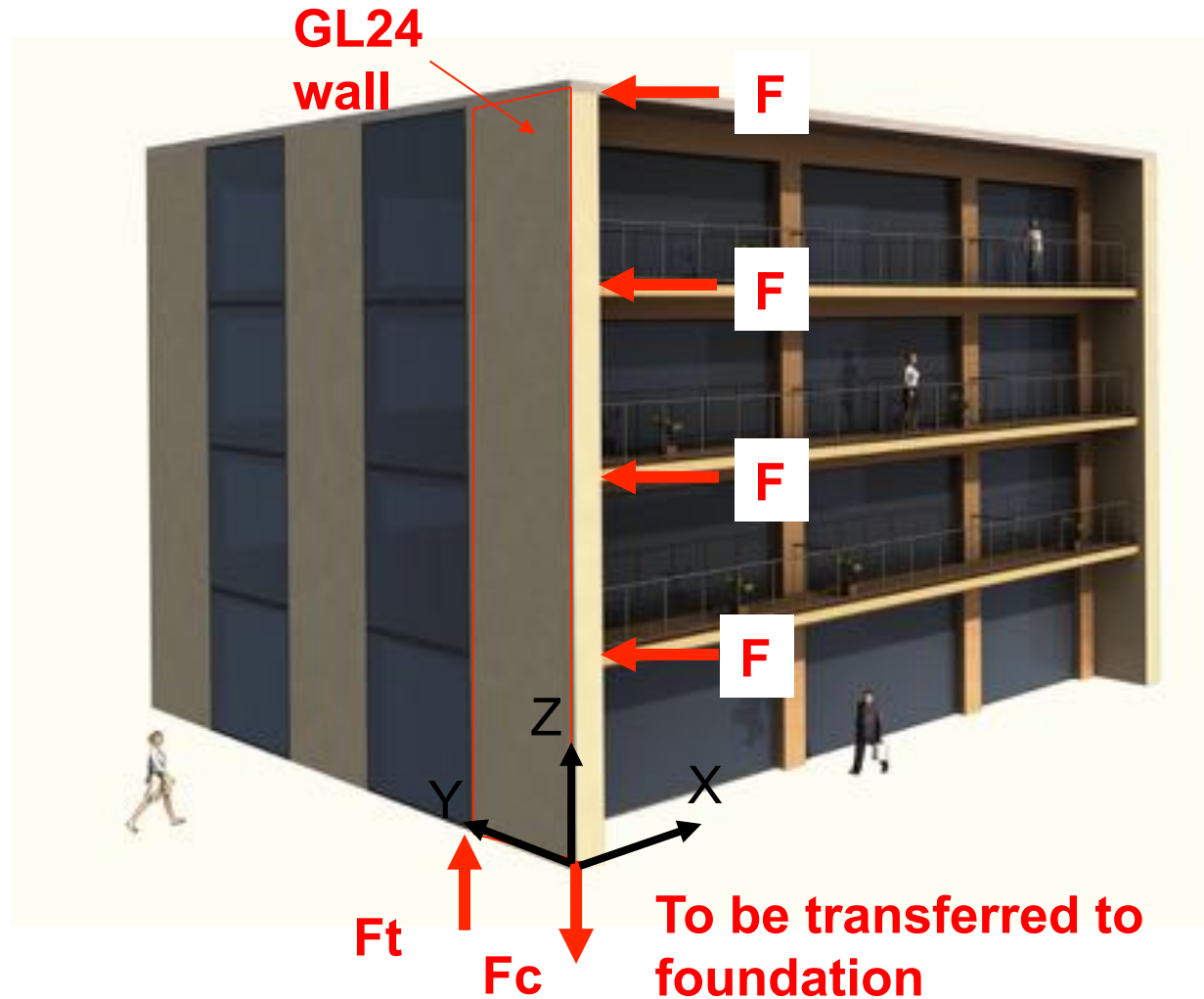
15 April – 17 April 2015 – Lisbon, Portugal



Cyclic behavior of cantilevered glulam walls with bolted connections

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Background



WALL CHARACTERISTICS:

- **Glue laminated timber**
- Fabricated as beam, then turned vertically
- Spanning over full height of structure **12.80m**
- Width: **3.0m**

Motivation - Connection possibilities



Viscous/Mild Steel Dampers
and Pre-stressed Tendons

Glued-in Rods, nailed or bolted
connections



Motivation – Bolted Connection



Why bolted connection?

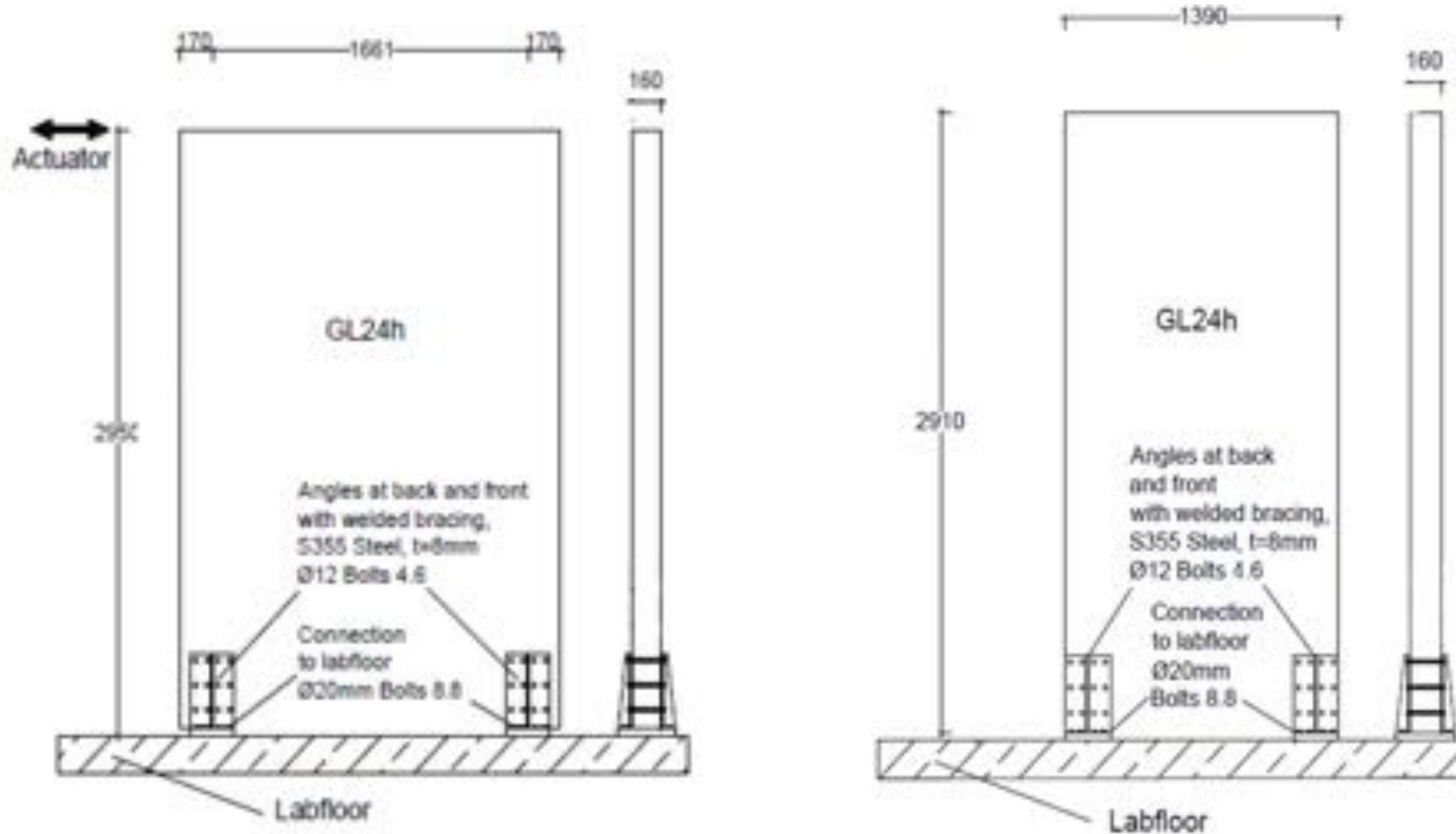
- *Common solution*
- *Easy and fast to assemble*
- *Less fasteners compared to nailed connections*



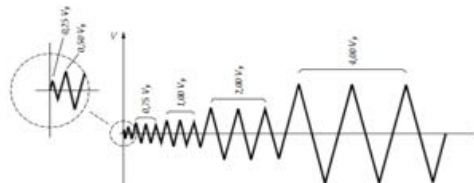
Key aspects of investigation:

- *Failure Mechanism*
- *Influence of fastener spacing and distances*
- *Feasibility*

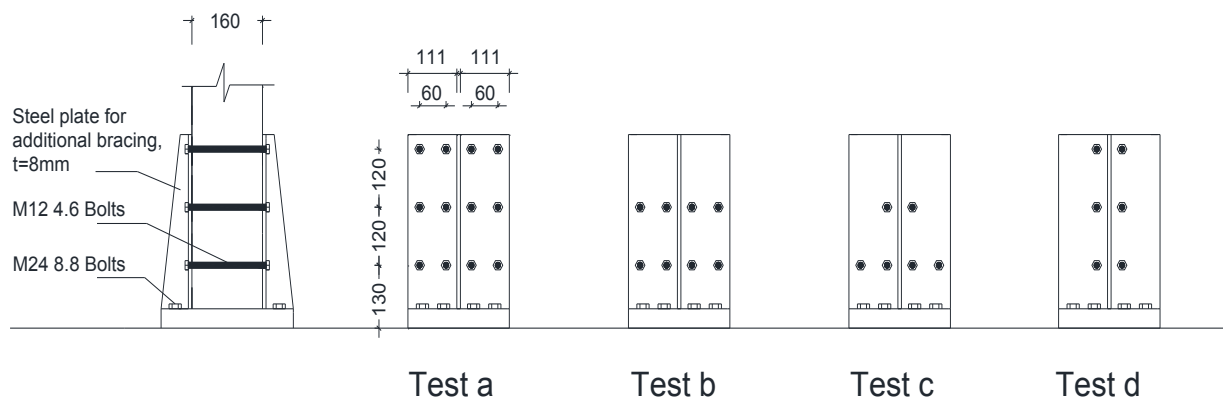
Laboratory Tests – Wall Specimens



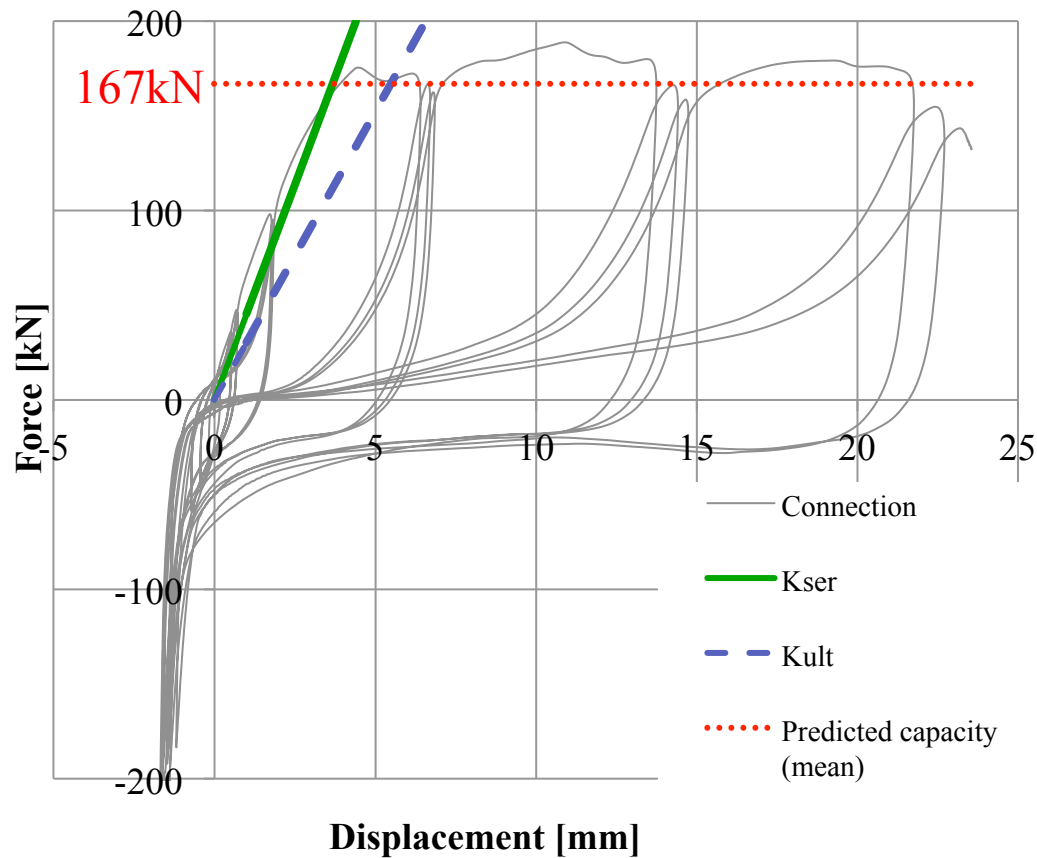
Laboratory Tests - Assembly



EN 12512
Amplitude



Test Results - Unreinforced Connection



Failure: Wood crushing, cracks along the row, initiation of 2 plastic hinges

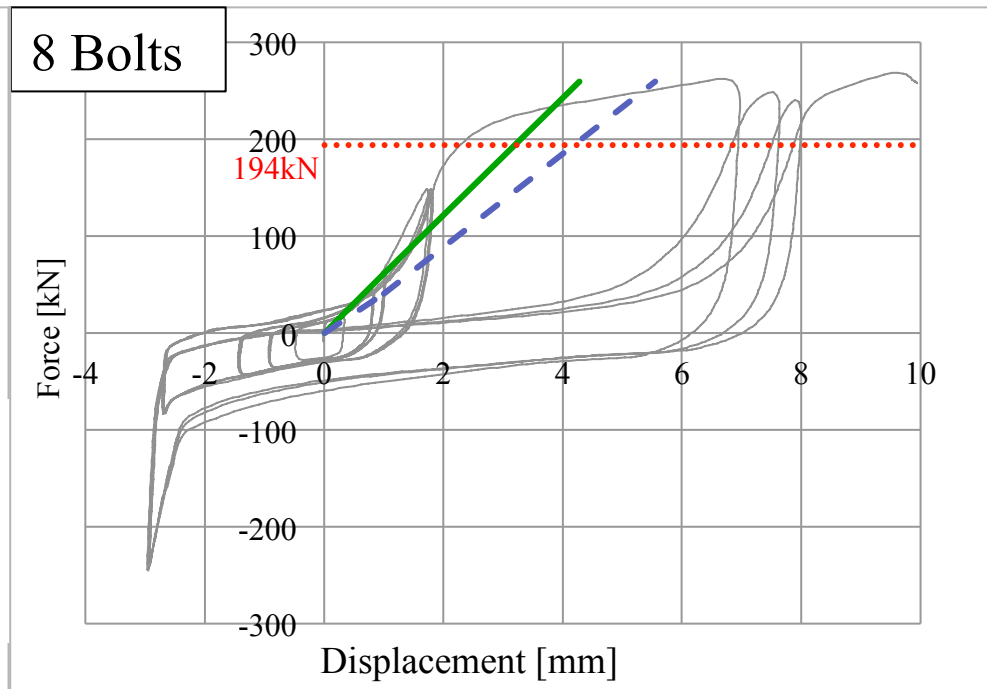
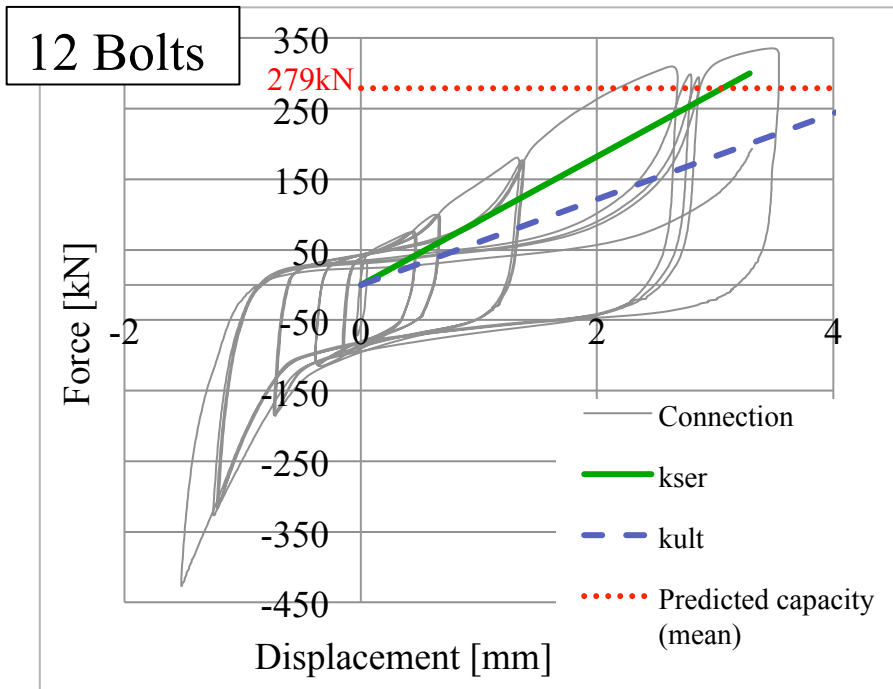
Block shear failure: No

n_{eff}: reached

Embedment strength: not reached



Test Results - Reinforced Connection

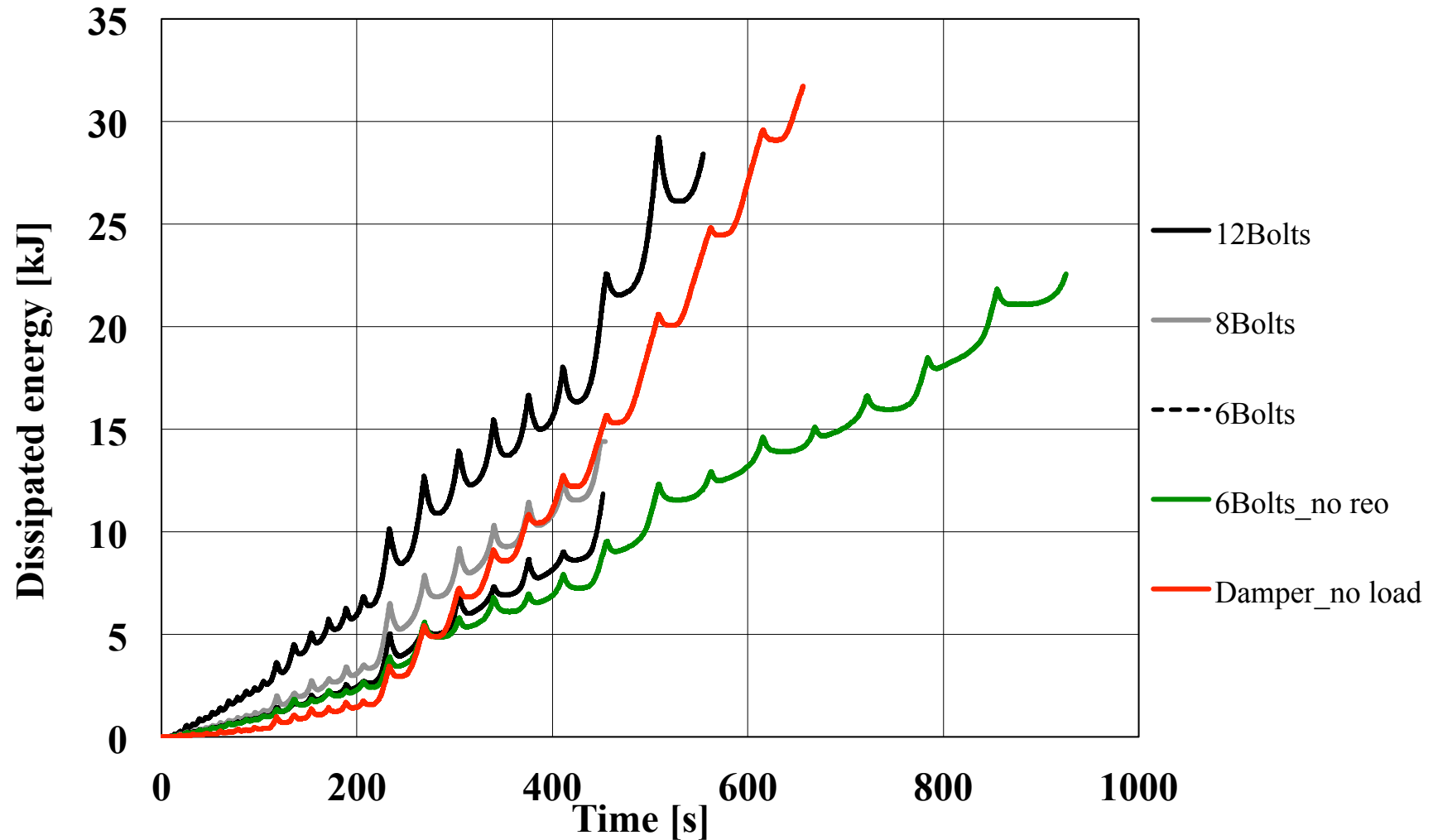


Embedding strength: reached

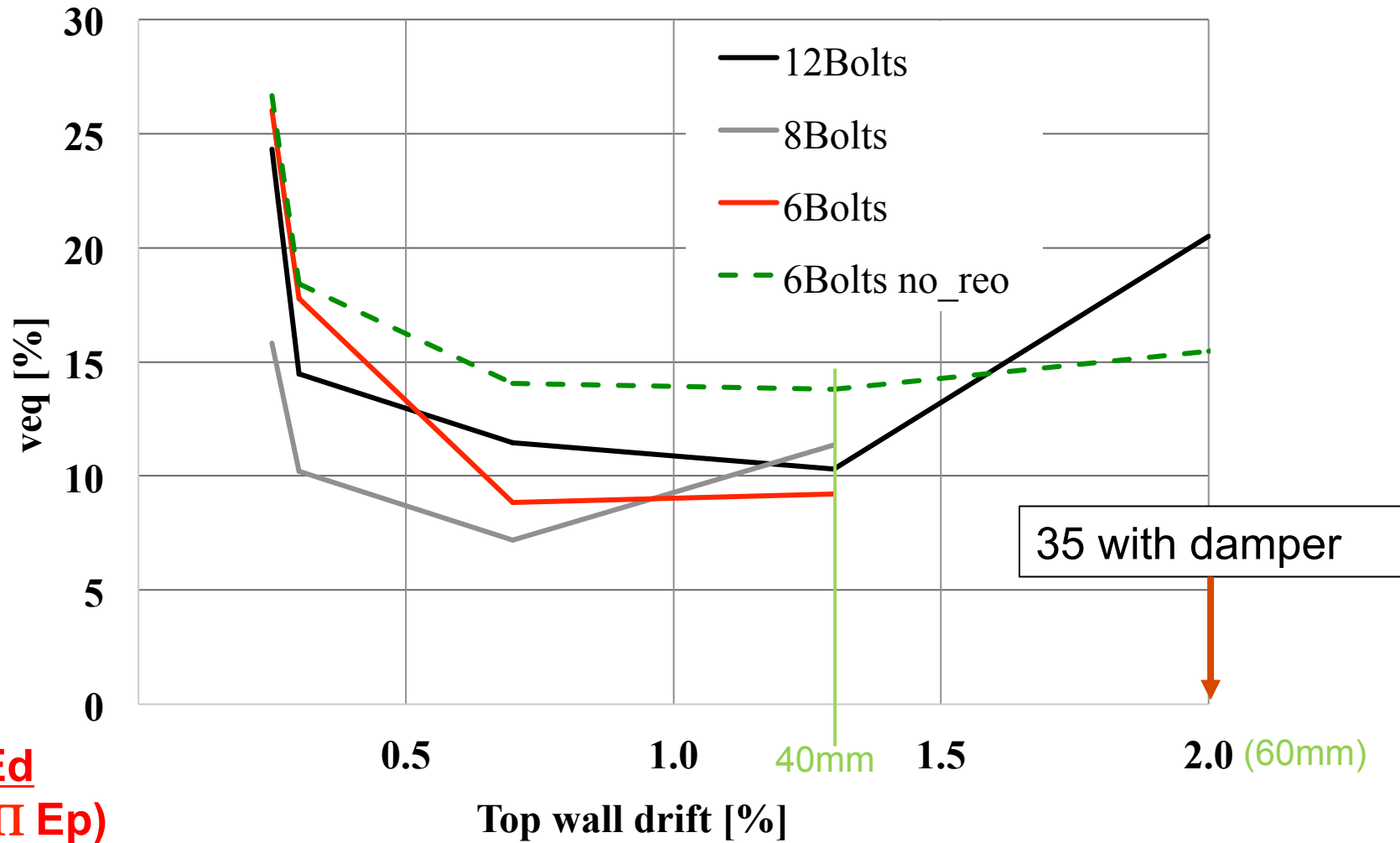
Failure: Bolts after 3rd test



Test Results – Dissipated Energy



Test Results – Viscous Damping Ratio



$$v_{eq} = \frac{E_d}{(2\pi E_p)}$$

Summary – Unreinforced Connection



For spacing $a_1 = 10d$ and $a_3 = 80\text{mm}$

- No block shear failure
- Capacity 20% higher than predicted by EC5
- n_{eff} reached
- $v_{eq} \sim 14$ (1.3% drift), 15 (2% drift)
- Ductility class M (EC8)
- Embedding strength not reached

Summary – Reinforced Connection



For spacing $10d$ and $a_3=80\text{mm}$

- Timber crushing around holes, no splitting
- Embedment strength reached
- 4 plastic hinges
- Bolt failure
- $v_{eq} \sim 10$ (1.3% drift),
20 (2% drift)

Entire ductile
behaviour

Bolted connections present a feasible solution with a reasonable amount of damping **but irreversible damage is to be expected!**



**THANK YOU FOR YOUR
ATTENTION!**