

# COST Action FP1004

## Final Meeting

15 April – 17 April 2015 – Lisbon, Portugal



# A Review of Dynamic Response of Buildings Modified by Connectors

Wen-Shao Chang

Richard Harris

University of Bath

# Enhance mechanical properties of timber structure?



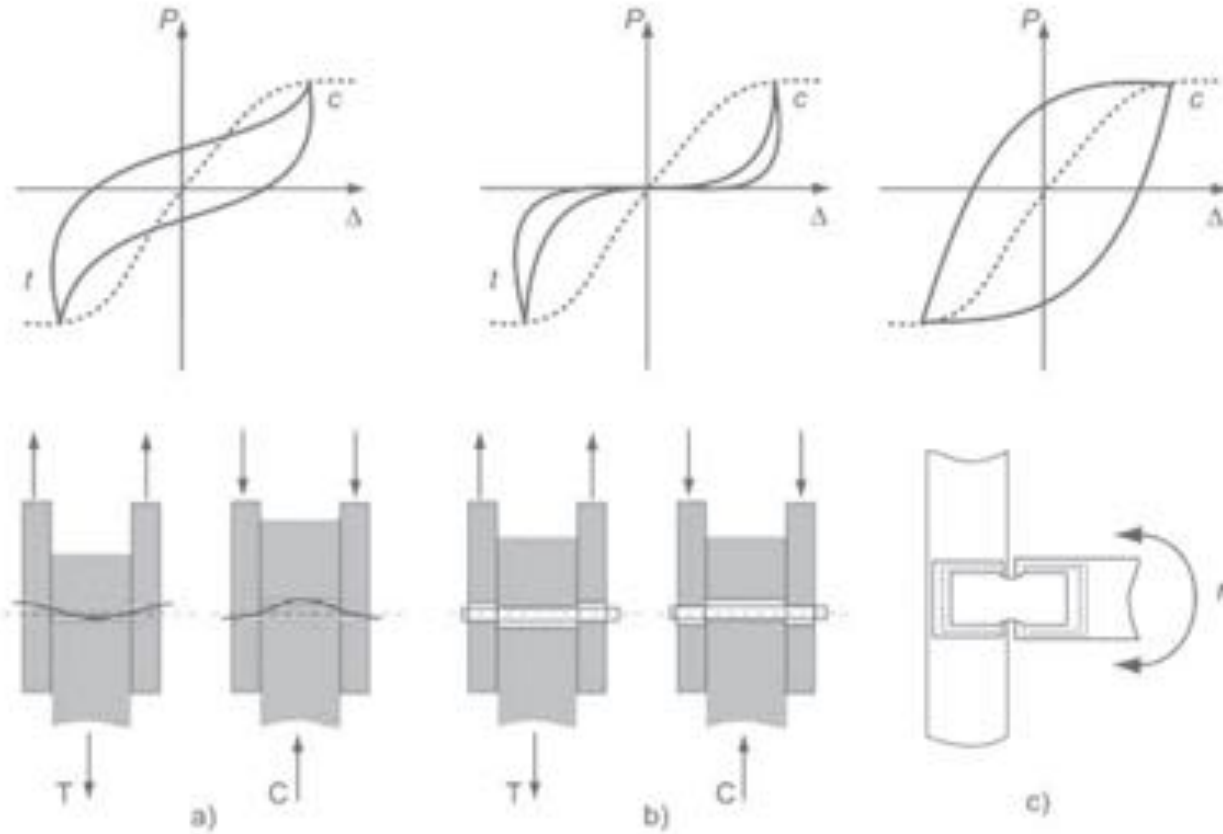
- Stiffness?
- Strength?
- Energy dissipation?

# General rules

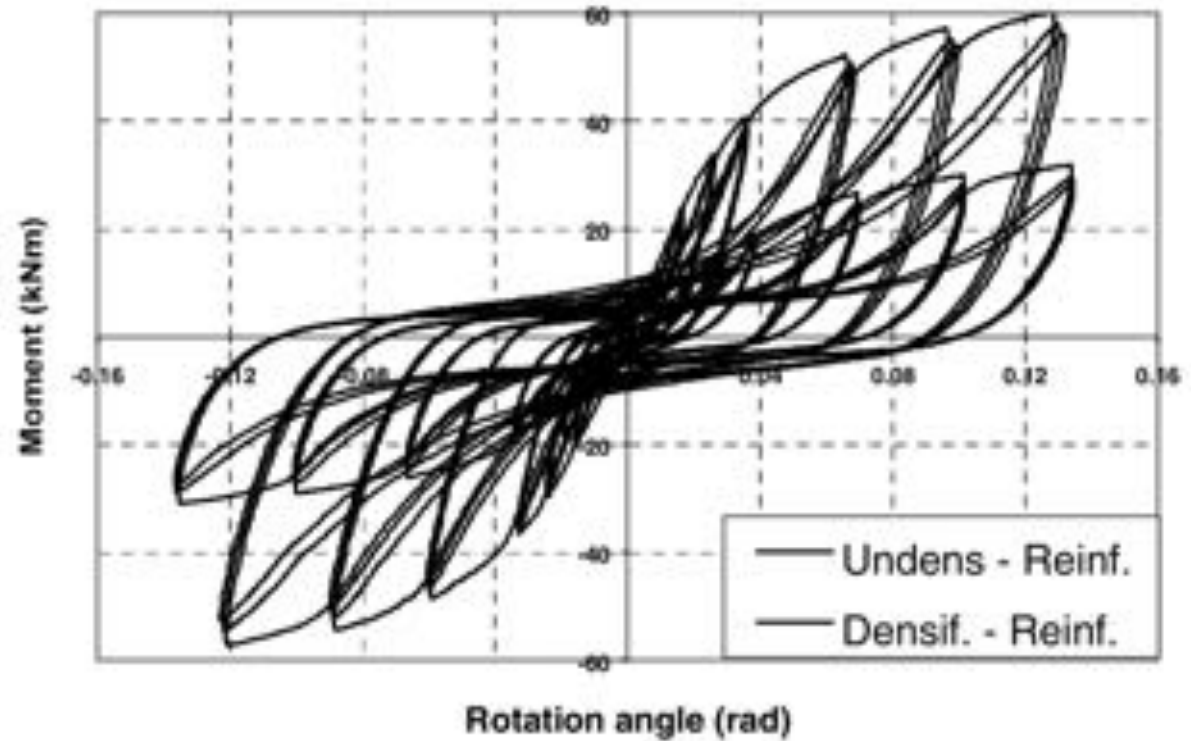
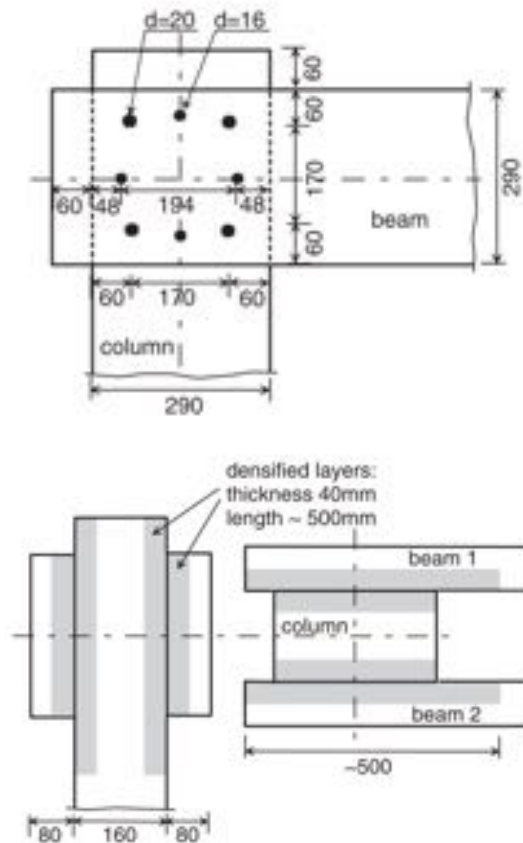


- Questions to ask:
  - What do we need from a connection?
  - How will the connections influence the global behaviour of a timber structure?

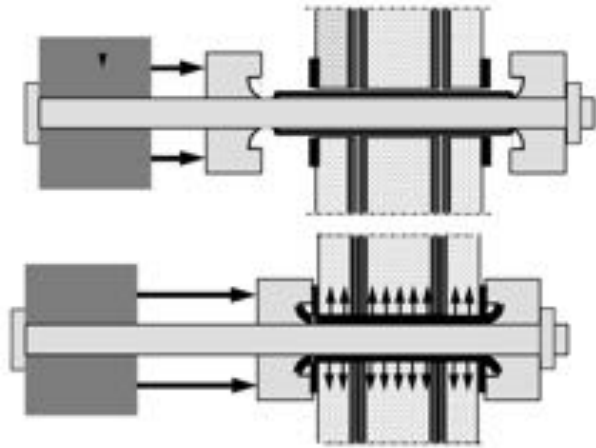
# General rules



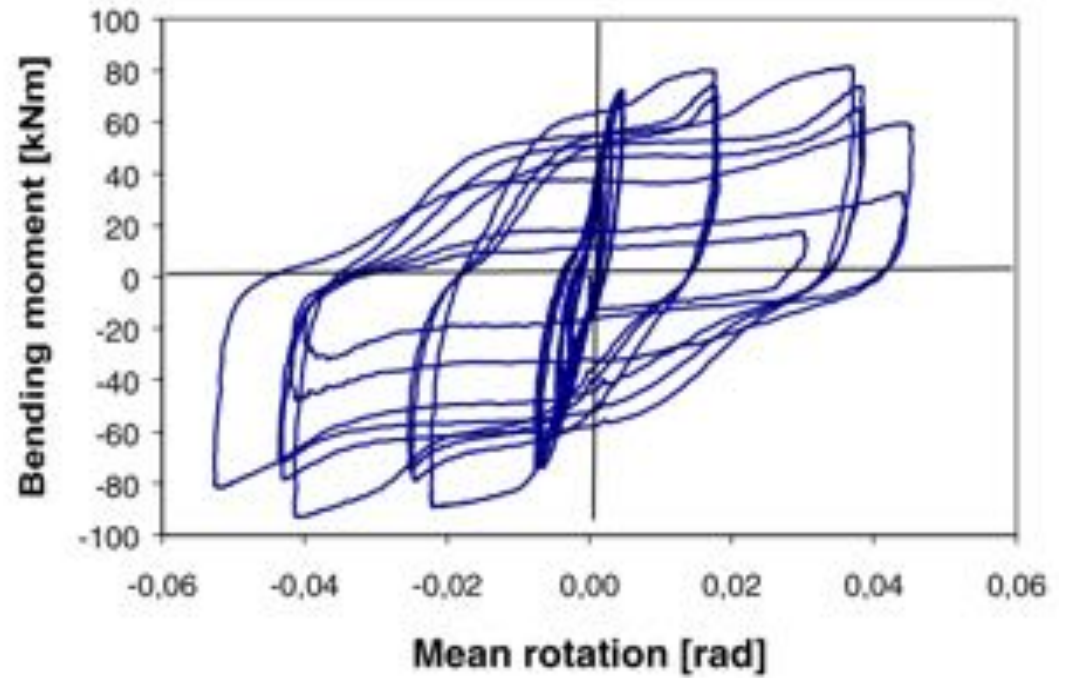
# With densified layer



# Connection with tube

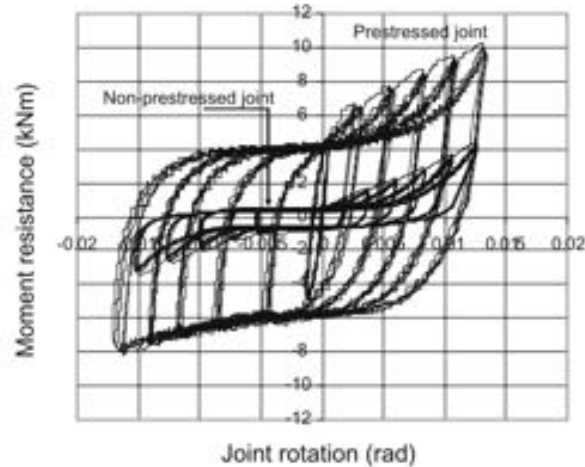
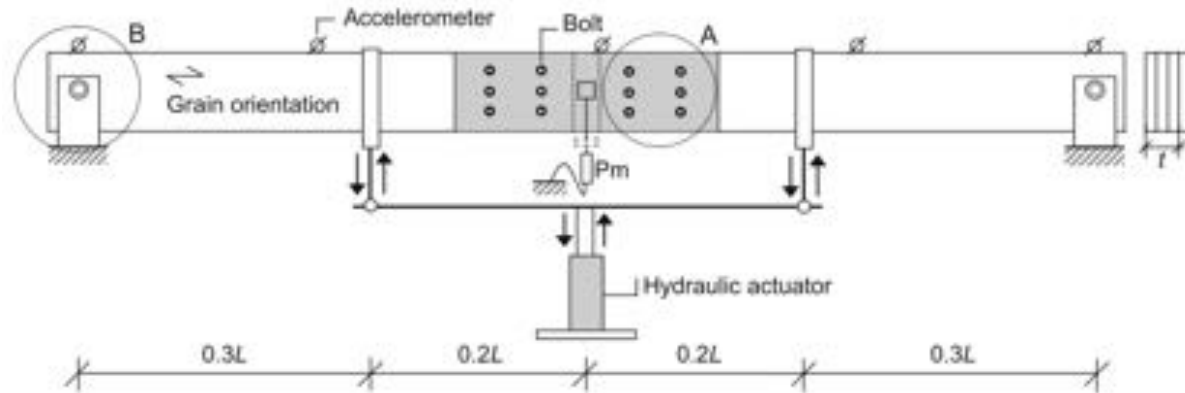


Reversed cyclic test results

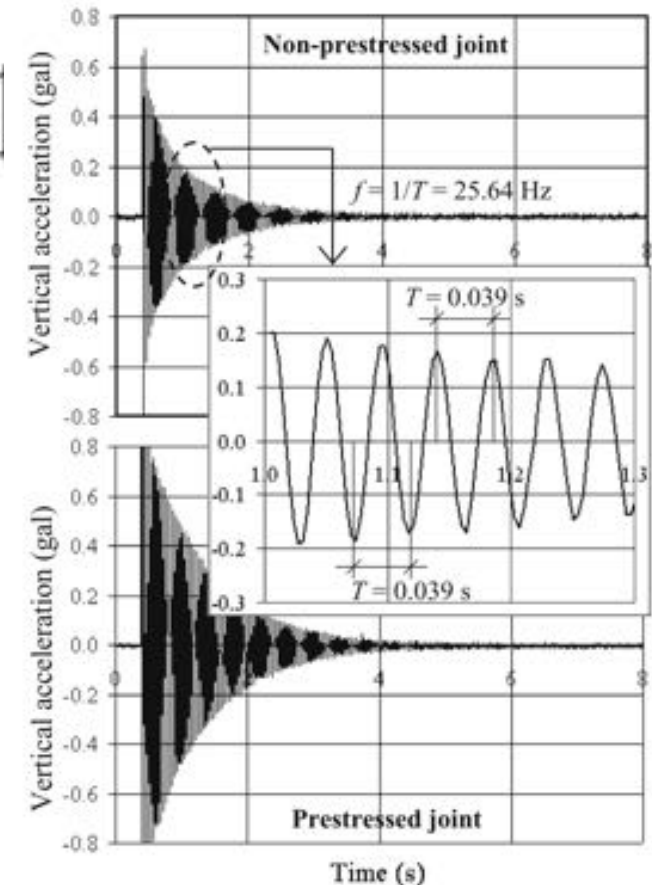




# Pre-tensioned bolts vs normal bolts



A large increase of initial stiffness due to bolt pretensioning was followed by increases in ultimate resistance, ductility coefficient, and natural frequency.

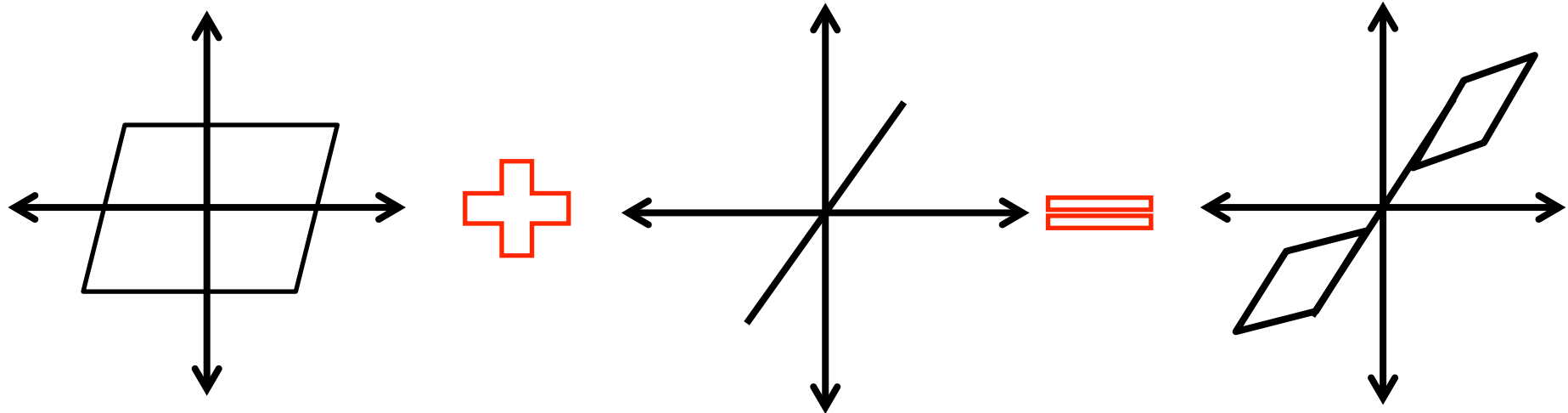


# Post-tensioned connection

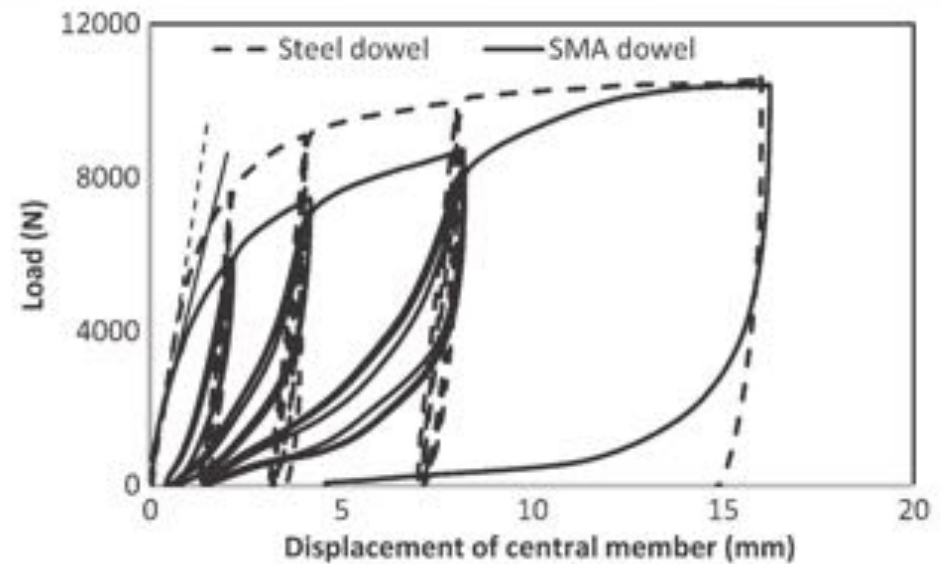
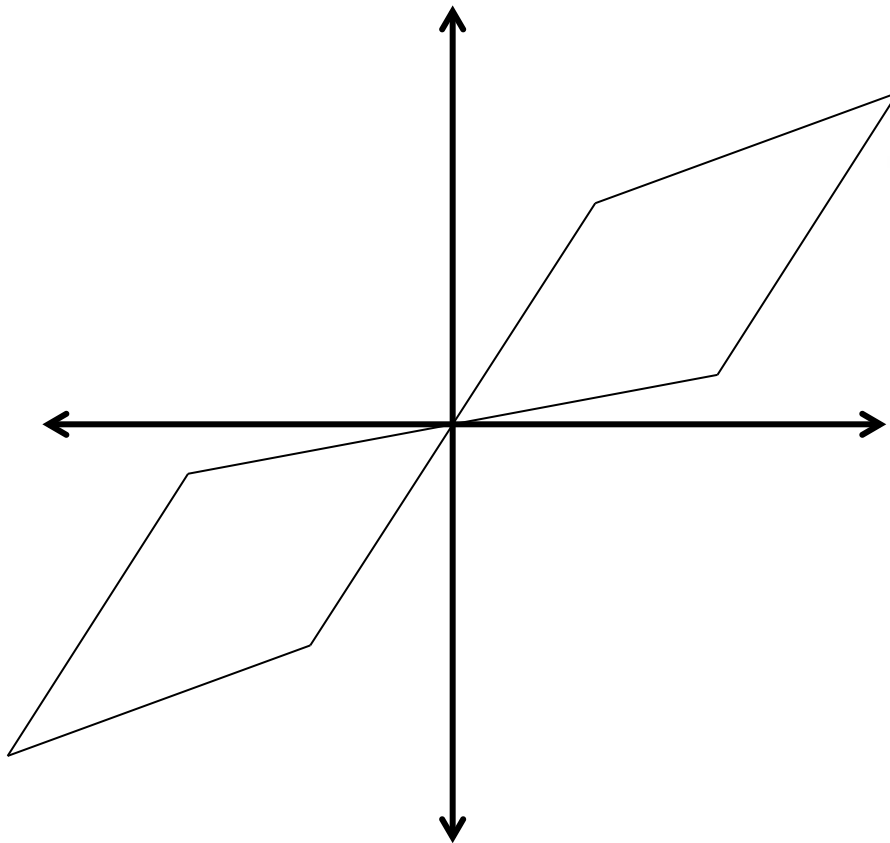




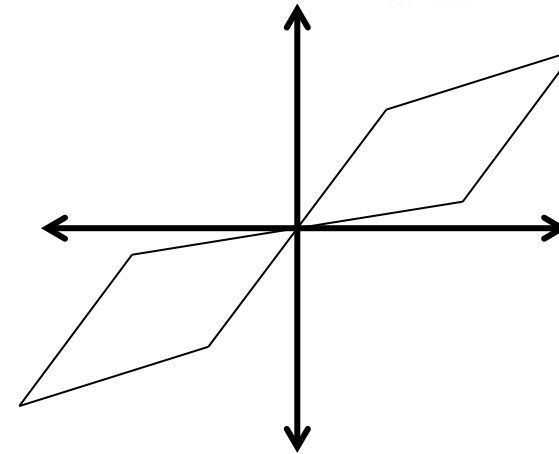
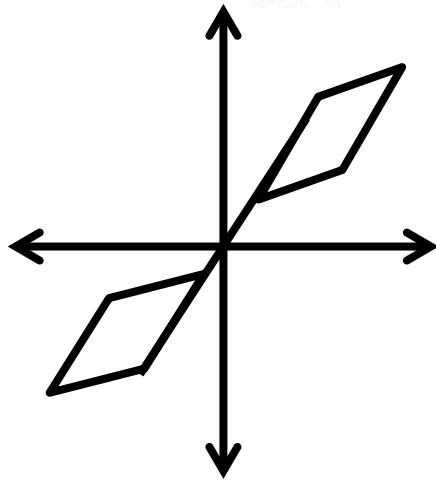
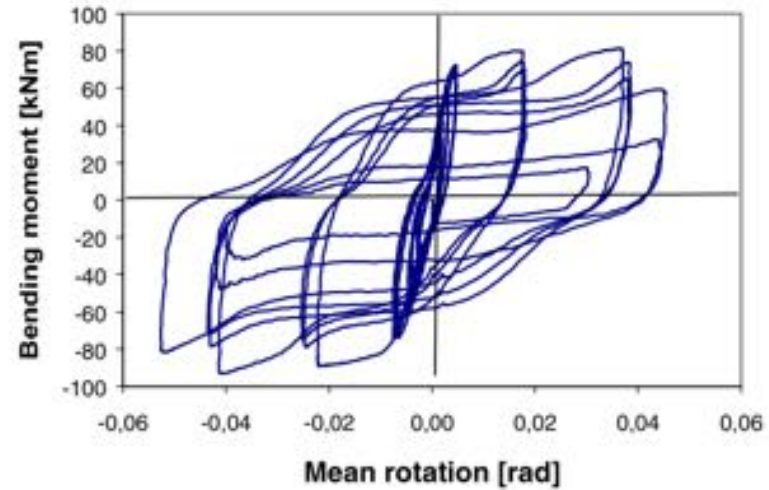
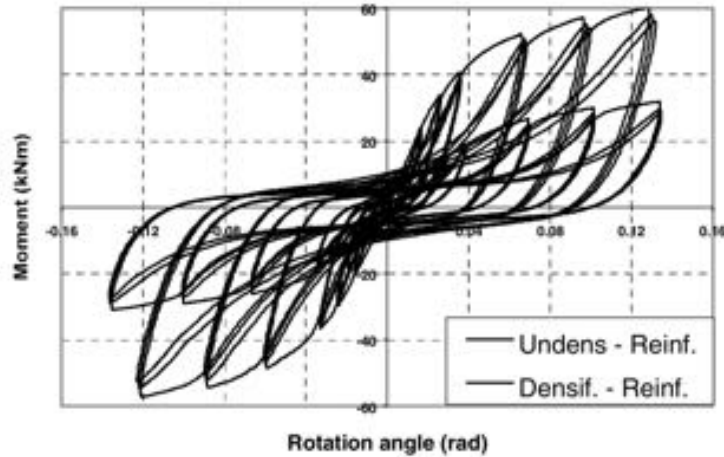
# Post-tensioned connection



# Connection with smart material



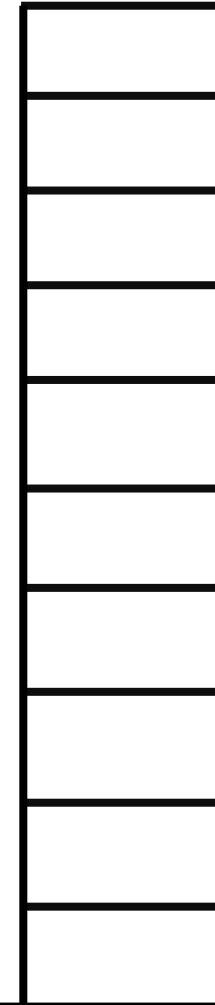
# Connection with different hysteretic loop



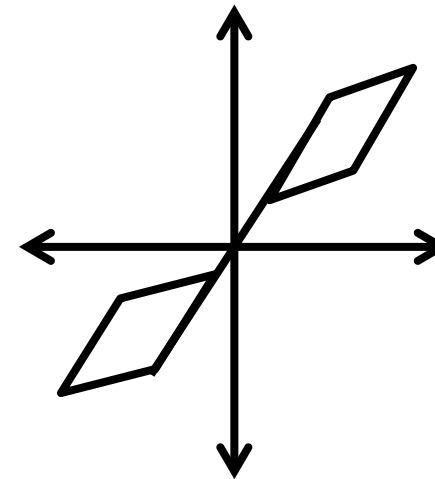
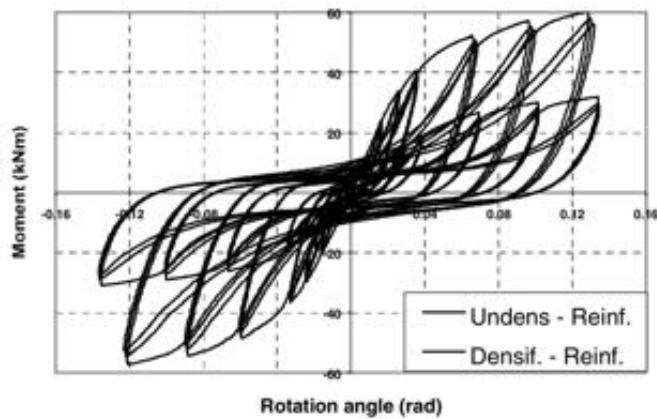
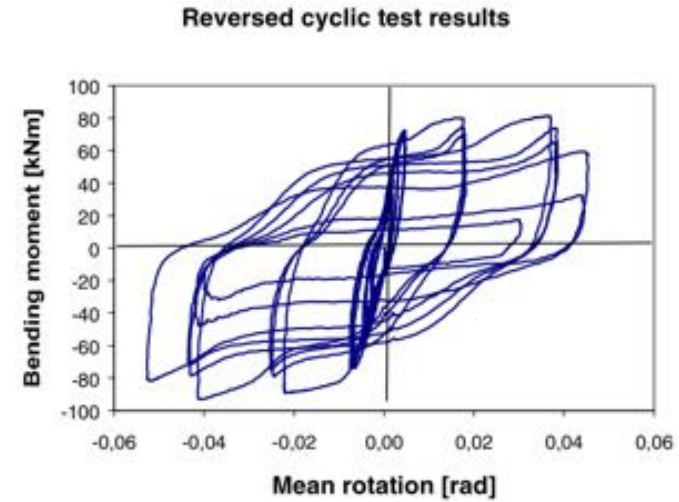
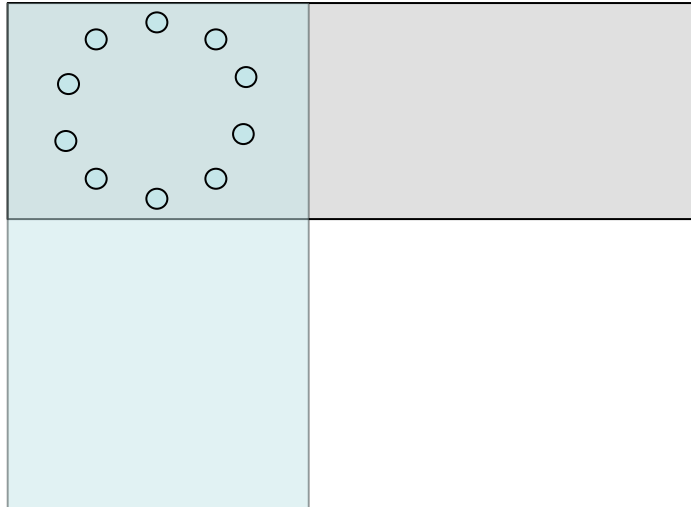
# Comparison of different hysteretic loop



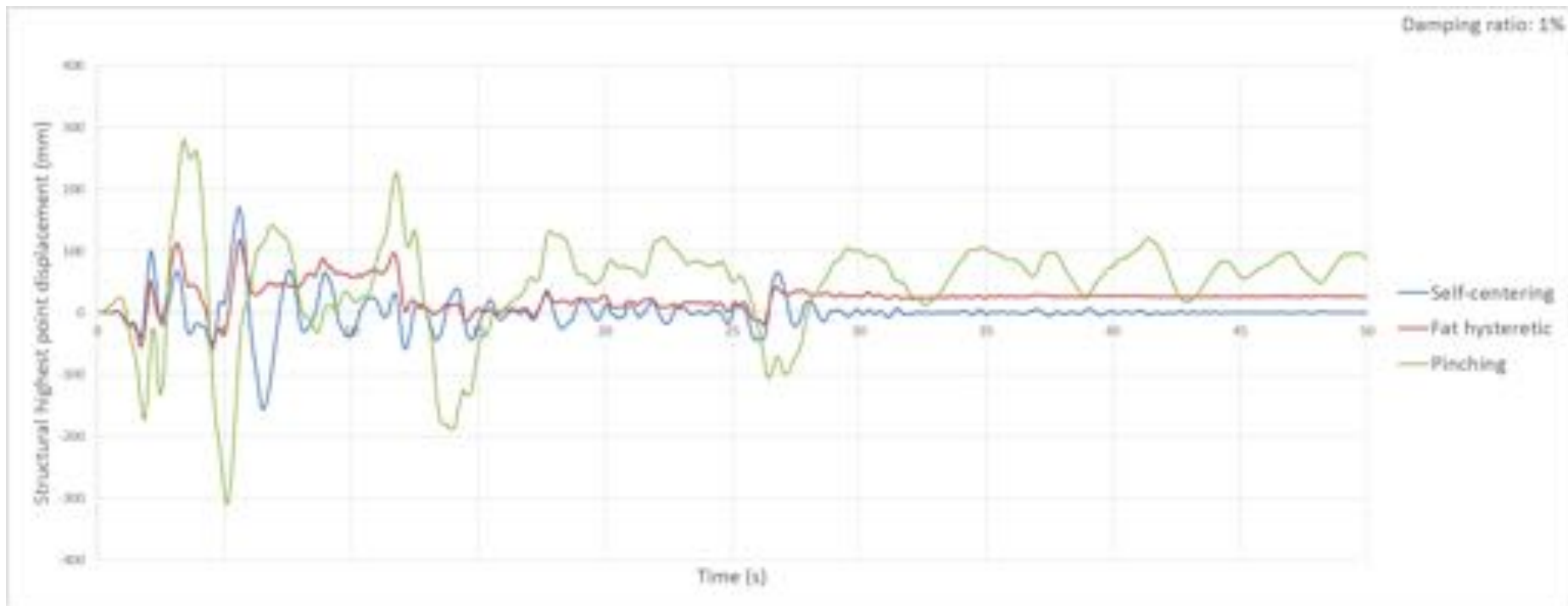
- Four models of 10-storey timber framed unbraced structures, 6x6 metres in plan.
- Three different damping ratios 1%, 3% and 5%
- Connections with different types of hysteretic loops
  - Fat hysteretic loop
  - Pinched hysteretic loop
  - Recentering hysteretic loop
- Use El Centro earthquake ground motion data
- Analysed using OpenSees



# Comparison of different hysteretic loop

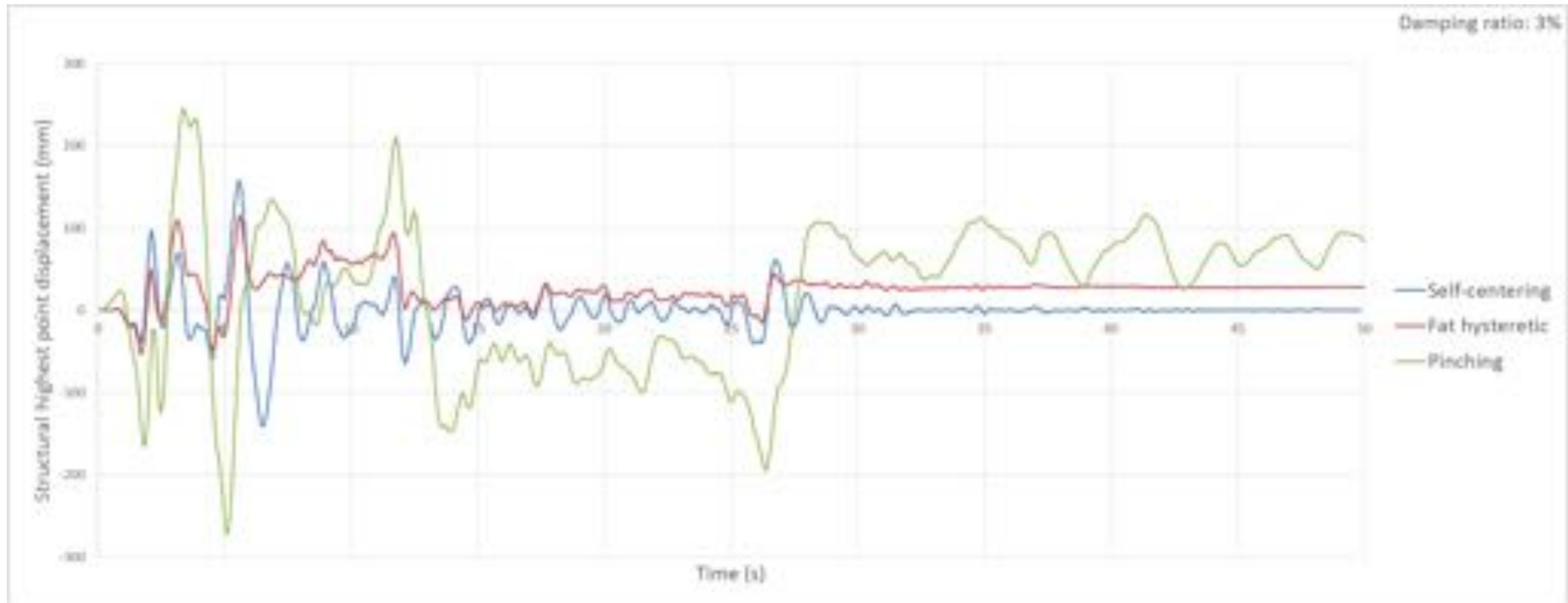


# Comparison of different hysteretic loop

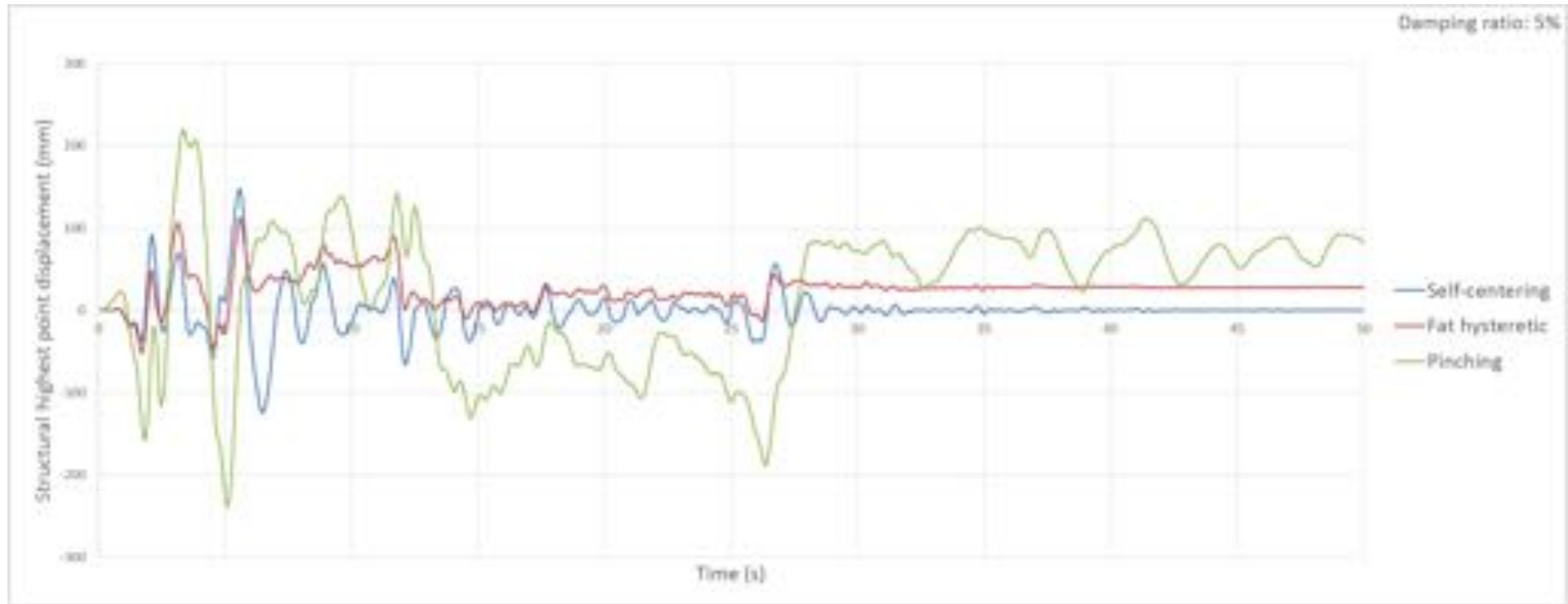




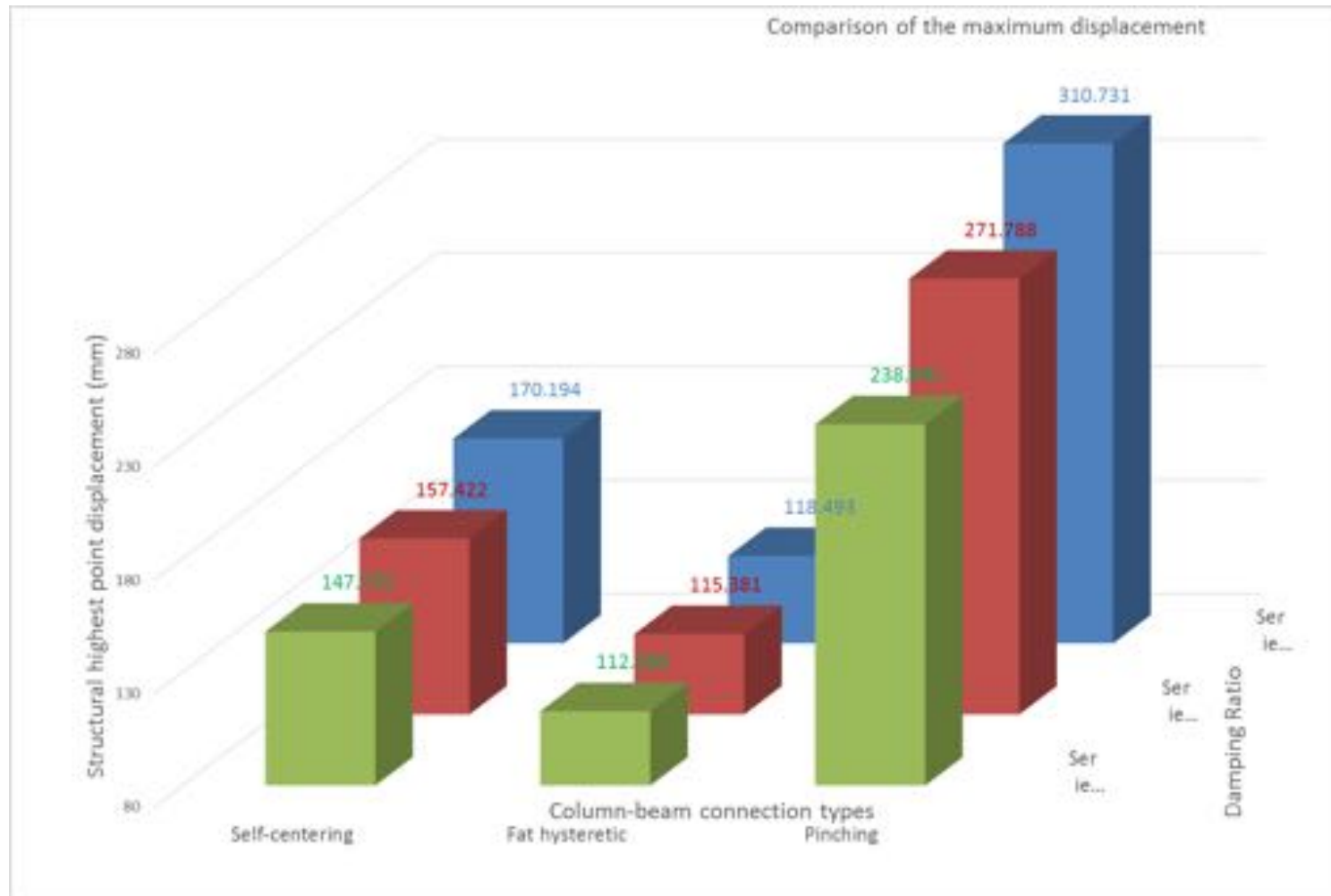
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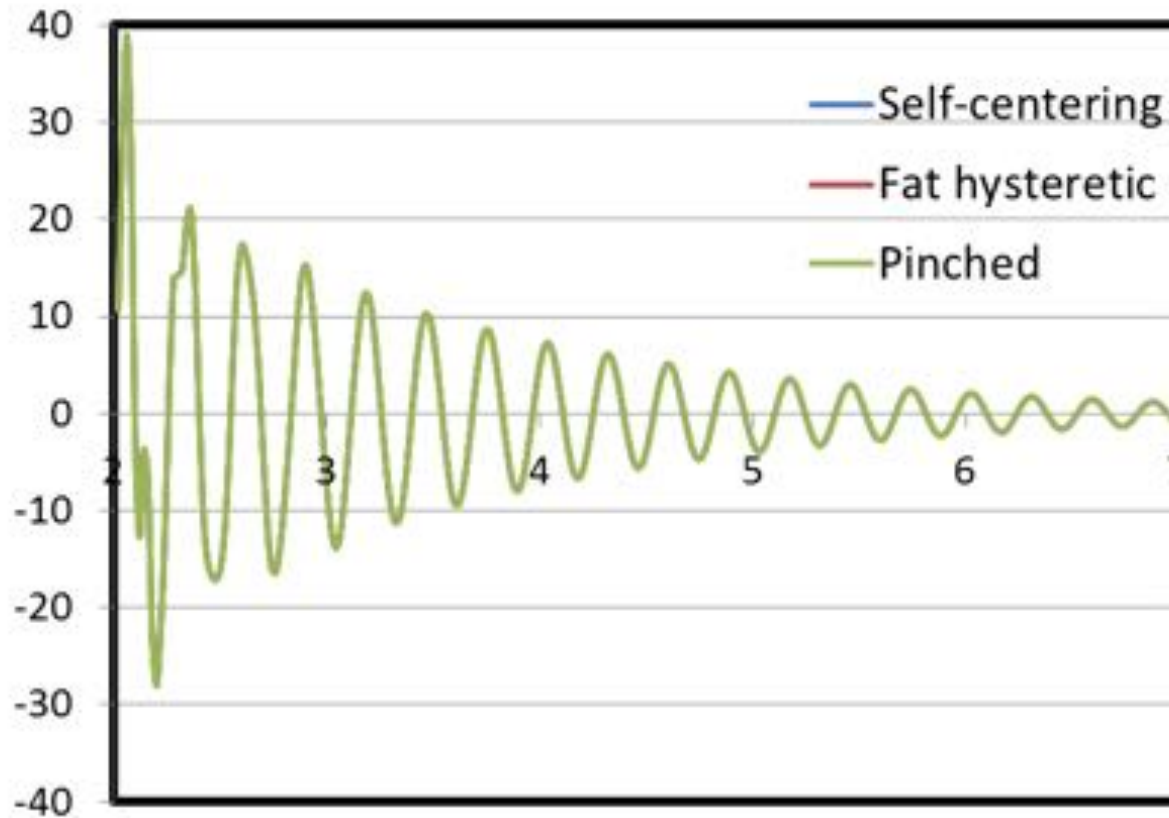
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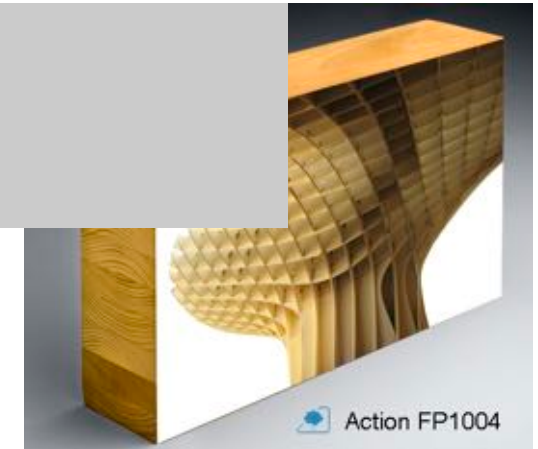


0.05 g impulse

# Conclusions



- The connections with different forms of hysteretic loop will influence the dynamic behaviour of timber structures in earthquake.
- It does not necessarily influence dynamic behaviour under small loads (eq. wind-induced vibration)
- The structure with fat hysteretic loop connection have smaller displacement in earthquake as the connections will dissipate more energy.
- Those with Re-centered capacity exhibit larger displacement but have smaller residual deformation.



Thank you for your attention, question?