Influence of the joint ultimate deformation in the behaviour of timber-concrete beams

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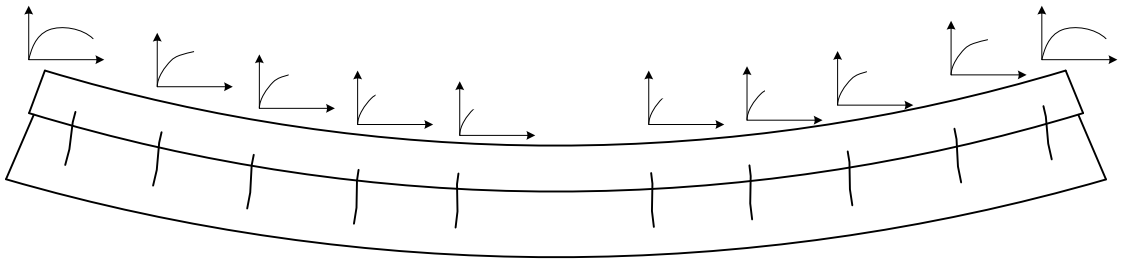
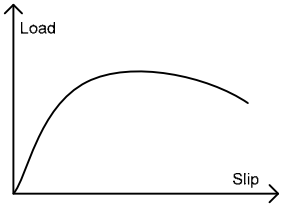
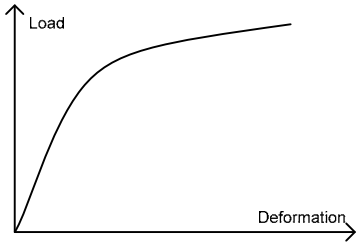
Importance of the joints ultimate slip in timber-concrete beams







Composite beam

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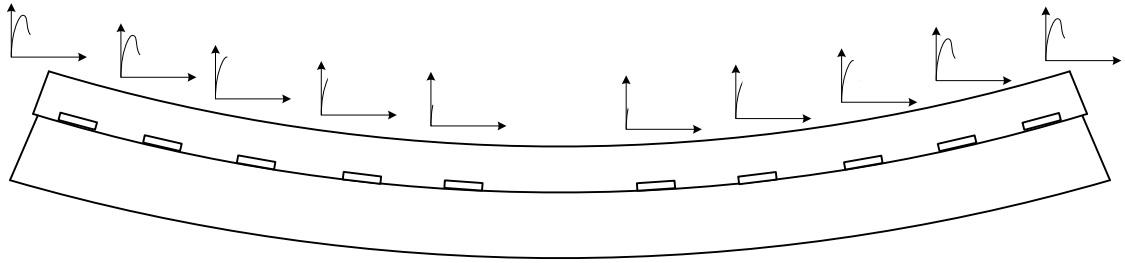

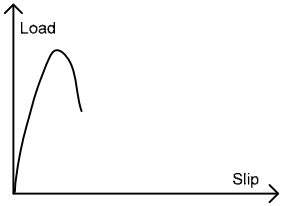

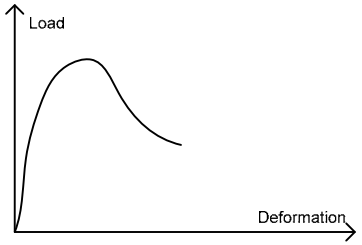

Composite beam

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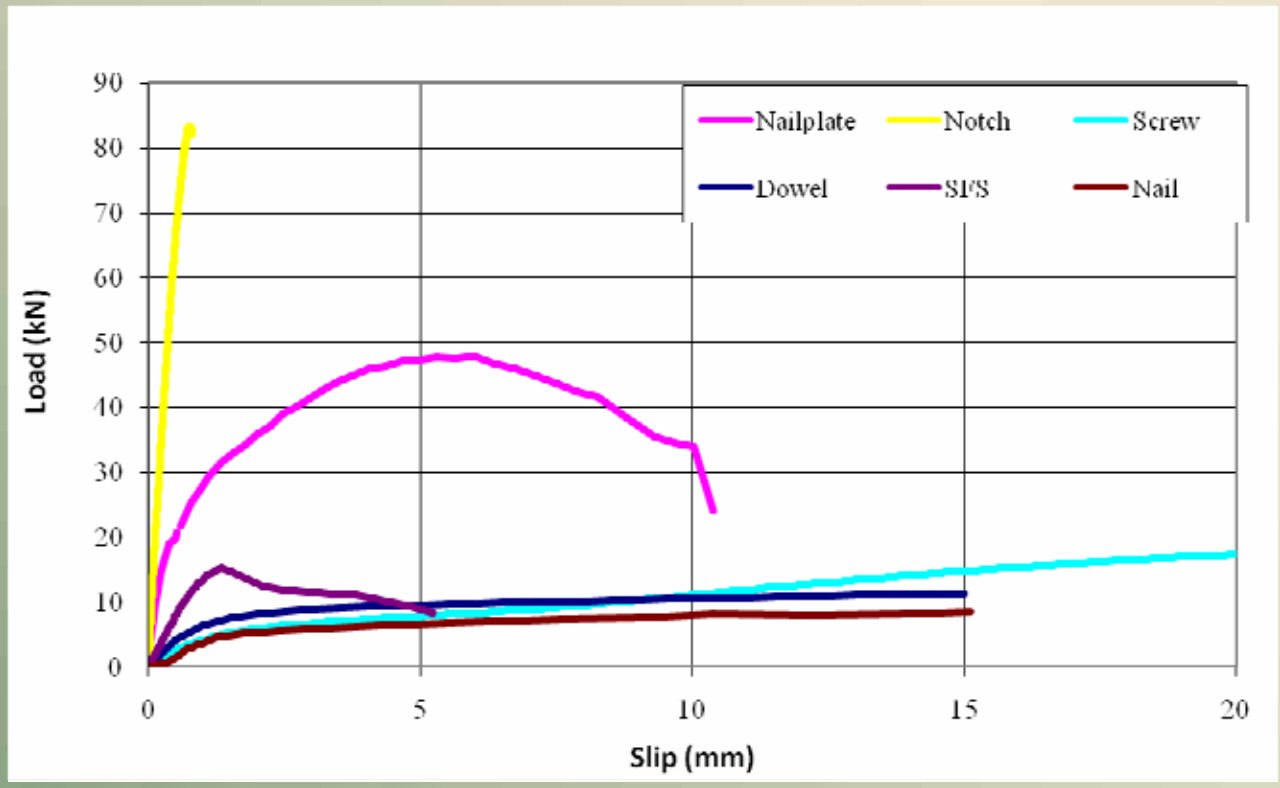
Ultimate slip of timber-concrete joints



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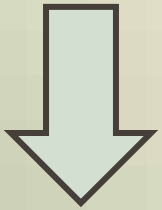
Objectives of the analysis

- Evaluate the importance of the joints ultimate slip in the performance of timber-concrete beams



- Calculation of the slip at the beam ends
- Comparison with the ultimate deformation of the joints

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Numerical modelling

1. Two independent beam elements

2. Partial interaction model given in EC5

Assumptions

1. **Two independent beam elements**
   - Load with uniform distribution
   - No interaction in the longitudinal direction
2. **Partial interaction model given in EC5**
   - Load with sinusoidal distribution
   - Elastic stiffness given by $K_u = 2/3K_s$
   - Maximum spacing (minimum stiffness) equal to 5 times the minimum spacing defined in accordance with EC5 and joint geometry

Assumptions

- Simple supported beams
- Linear elastic behaviour for materials and joints
- No friction between timber and concrete
- Maximum strain allowed on timber 0.35% or 0.70%
- Cross sections calculated for a maximum composite gain (E_{max}/E_{min} =4)
- Maximum mid span deflection of L/500 for a full rigid joint

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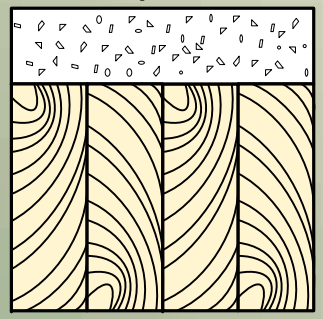
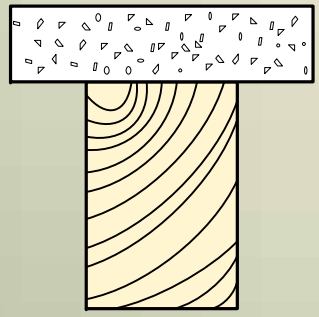
Assumptions

- Various cross section configuration used

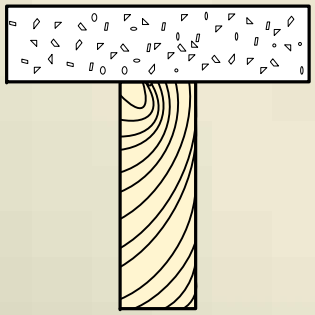
C_P=3



C_P=6

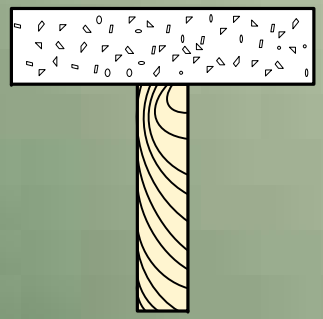


C_P=12

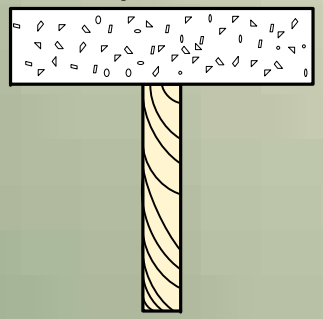


$$C_P = \frac{E_c}{E_t} \times \frac{b_c}{b_t}$$

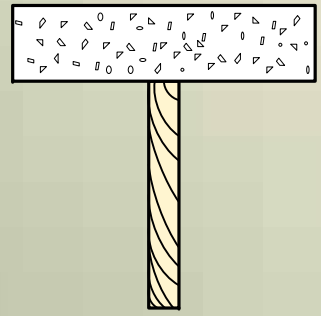
C_P=18



C_P=24



C_P=30



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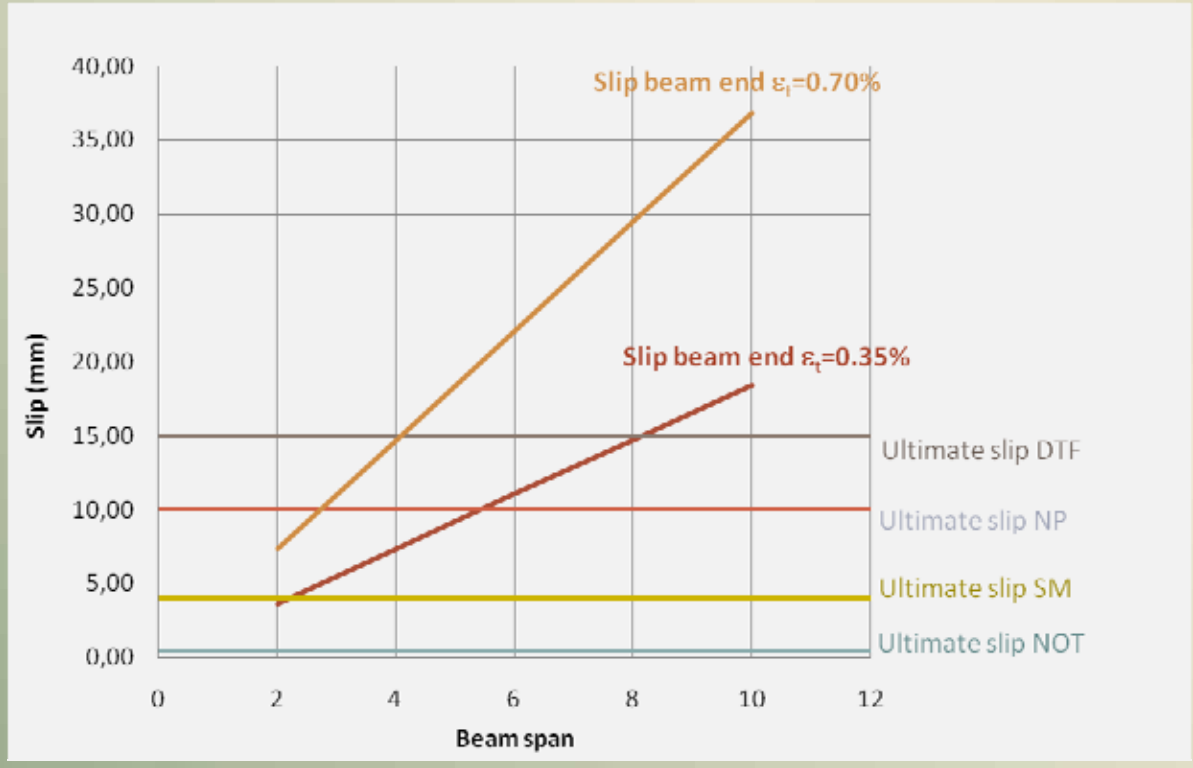
Test results

Slip at the beam end for a joint with zero stiffness



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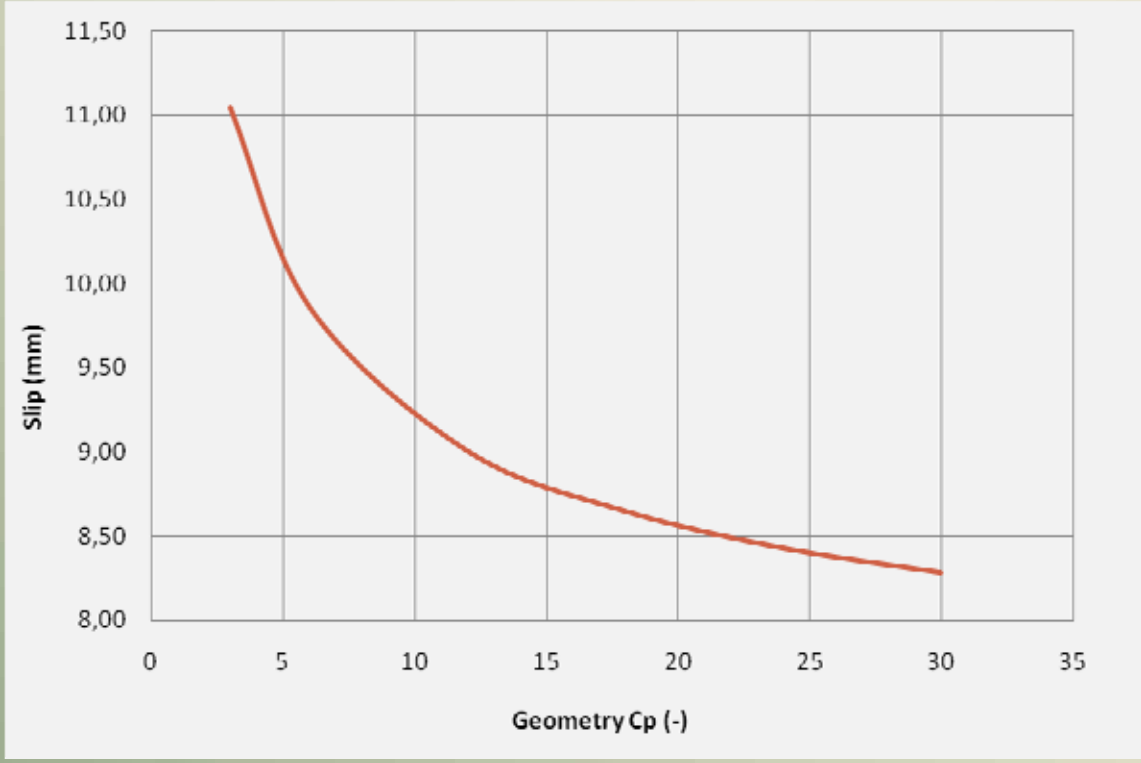
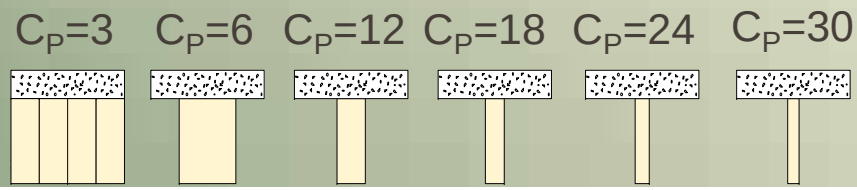
Test results

Variation of the slip at the beam end with the geometry of the cross section





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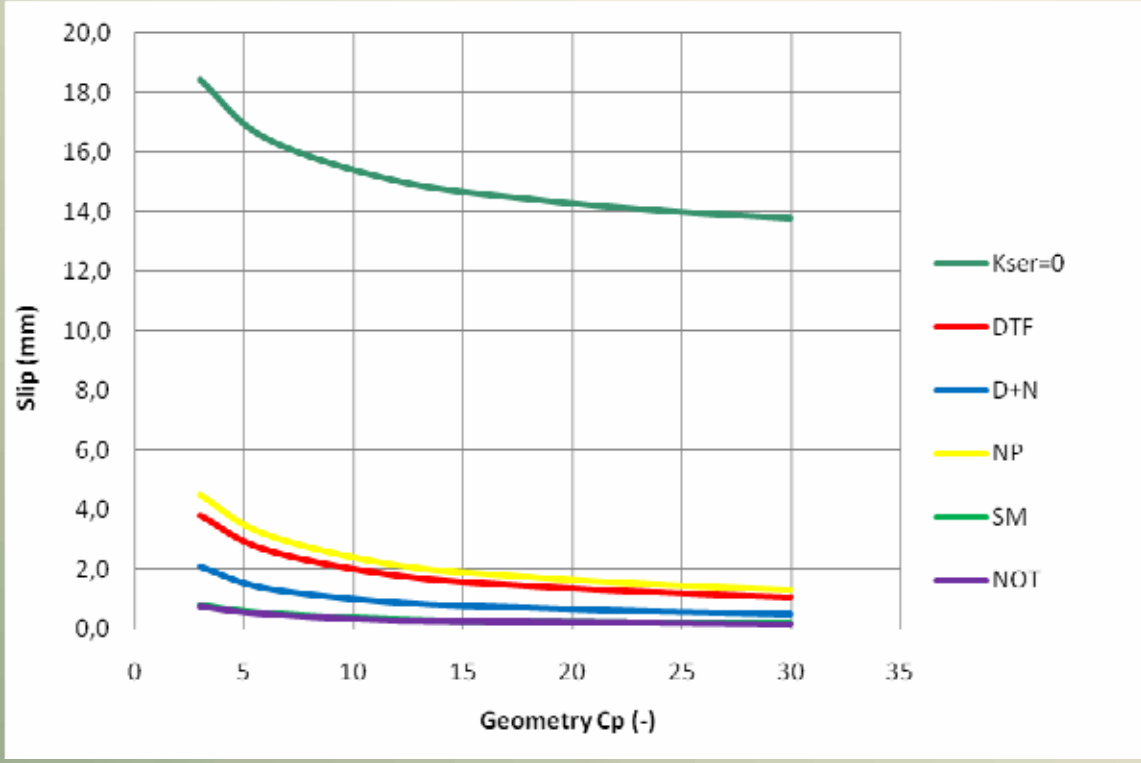
Test results

Slip at the beam end for various joints



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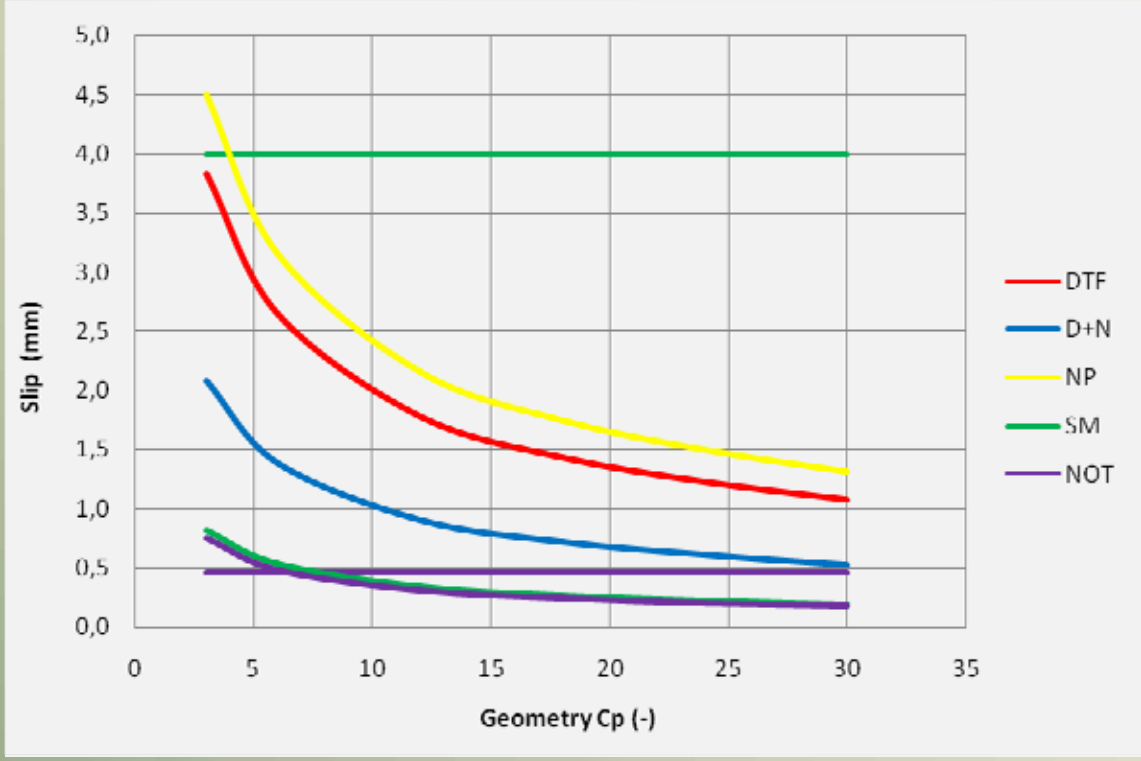
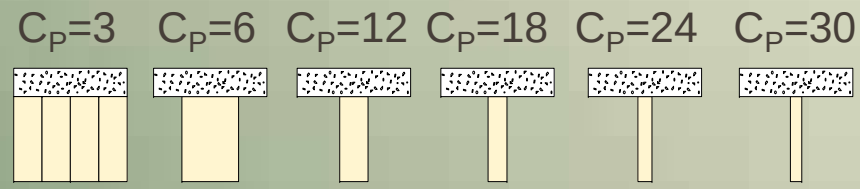
Test results

Slip at the beam end for a maximum strain on timber equal to 0.35%





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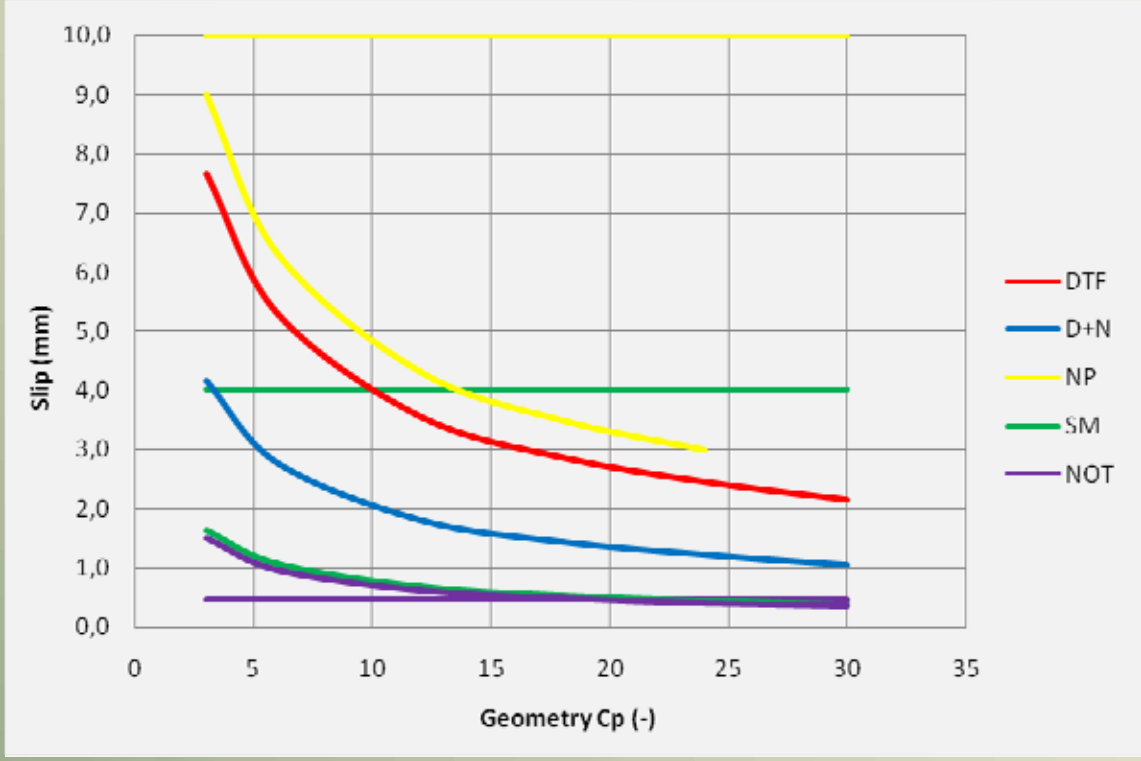
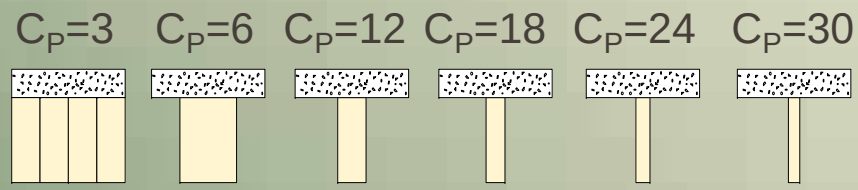
Test results

Slip at the beam end for a maximum strain on timber equal to 0.70%





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Conclusions

- The joint stiffness decreases the slip at the beam ends by a factor higher than four
- For a 0.35% strain on timber restrict number of cases with a slip in the composite beam larger than the joint ultimate deformation
- For a 0.70% strain on timber higher number of cases with a slip in the composite beam larger than the joint ultimate deformation

Conclusions – Future developments

- Materials and joint stiffness degradation as well as friction were not considered in the model
- Other types of joints and other load situations shall be considered

Further analysis shall be done using more powerful models

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