Applicability of Cross Laminated Timber in Bridges

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CLT as a construction material

• Buildings
  ▪ Floors
  ▪ Roofs
  ▪ Walls

• Bridge
  ▪ Decks
Applicability of CLT in bridges

• Small span bridges
  - In theory all parts in CLT
  - Differently oriented

• Long span bridges
  - Deck
  - CLT long beams too weak against bending
Experiments: Small scale test

• Deck representation
  - Rolling shear failure (50kN)
Experiments: Full scale CLT-beam test

- Main girder representation
  - Bending failure (72kN)
Numerical Analysis

• LUSAS finite element model
  - 3D Solid composite model
    - 16 noded solid elements (HX16L)
  - 2D Thick shell composite model
    - 8 noded thick shell elements (QTS8)
Numerical Analysis: Small scale test

3D Solid composite model  
2D Thick shell composite model

<table>
<thead>
<tr>
<th>Load [kN]</th>
<th>Solid model</th>
<th>Thick shell</th>
<th>Experiment</th>
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<td>3mm</td>
<td>5mm</td>
<td>3mm</td>
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<tr>
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<td>5mm</td>
<td>9mm</td>
<td>5mm</td>
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<td>50</td>
<td>7mm</td>
<td>13mm</td>
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Identical deflection

3D model needed even for preliminary studies on CLT decks
Numerical Analysis : Full scale beam test

3D Solid composite model

2D Thick shell composite model

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Identical deflection

Accuracy of 90%

Simple 2D composite model seems accurate enough for preliminary studies on CLT beams
From CLT beams to DLT beams

• Cross Laminated Timber beam
  ▪ 90° angle orientation difference
  ▪ Low bending stiffness if too long

• Diagonal Laminated Timber beam
  ▪ $\alpha$ angle orientation difference
  ▪ Optimizable angle
    ➢ Depending on the configuration of the bridge

¹ designation used in Bejtka I., *Cross (CLT) and diagonal (DLT) laminated timber as innovative material for beam elements*. KIT Scientific Publishing, Karlsruhe, Germany. 2011. 134 p.
Conclusion

• Cross Laminated Timber is being used for decks

• Small span all-CLT bridges possible
  Preliminary studies of CLT beams easily obtainable

• Longer span CLT bridges possible with Diagonal Laminated Timber beams

• DLT beams analysis and improvement needed
  Preliminary studies easily obtainable
Thanks for your attention!