hardwood joint
Recall: Kick-off meeting in Helsinki
Joints

Capacity

Structural members made of hardwoods

Joints with hardwoods

hardwood_joint
Primary purpose

Foster high-performance hardwood structures by developing economic, reliable and innovative joint technologies for hardwood members and the design thereof.

HOW?

UNDERSTAND – COMPLETE – OPTIMISE – IMPLEMENT
KICK-OFF: UNDERSTAND…

Contributions to load-carrying capacity of joints
Rope effect in dowelled joints

- Strain gauge
- Smooth surface

Load $F$

$F_{tens}$ ?
Opened specimen after test

Beech LVL with cross layers
Groups of axially loaded screws
## Results

<table>
<thead>
<tr>
<th>Target failure mode with requirements</th>
<th>(\alpha = 0^\circ) end-grain joint</th>
<th>(\alpha = 45^\circ) tension lap joint</th>
<th>(\alpha = 90^\circ) loading perp.-to-grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>beech &amp; birch</td>
<td>Withdrawal, (n_{ef} \sim n) (a_2 \geq 3d, l_{emb} \geq 10d)</td>
<td>withdrawal (a_1 \geq 5d, a_{1,CG} \geq 5d)</td>
<td>withdrawal, (n_{ef} \sim n) (a_1 \geq 7d, a_2 \geq 5d) (EC5) (a_1, a_2, a_{2,CG}) acc. ETAs if (l_{emb} \geq 4d)</td>
</tr>
<tr>
<td>beech LVL</td>
<td>withdrawal (a_{2,\text{tan}} \geq 3d, a_{2,\text{rad}} \geq 4d, l_{emb} \geq 11d)</td>
<td>-</td>
<td>block or row shear, (n_{ef} &lt; n) (a_1, a_2, a_{2,CG}) acc. ETAs</td>
</tr>
</tbody>
</table>

- \(n_{ef}\) = number of effective fibers
- \(a_1\), \(a_2\), \(a_{1,CG}\), \(a_{2,CG}\) = distances in millimeters
- \(l_{emb}\) = embedment length in millimeters

**Notes:**
- ETAs = European Technical Approvals
- EC5 = European Standard
KICK-OFF: …OPTIMISE…

Increase stiffness and capacity
Increase stiffness and capacity  – Rough shear planes
Production

Testing

Milestone 2 ☑
KICK-OFF: …OPTIMISE…

BOF (nonlinear beam-on-foundation) modelling
BOF – Example: Modelling of rope effect

Load in kN

Displacement in mm

27.6 kN

8.6 kN
Test and modelling results

BOF (RF2)

BOF (SF1)

Milestone 1
Thank you!

ForestValue
Project hardwood_joint is supported under the umbrella of ERA-NET Cofund ForestValue by BMLFUW (AT), ADEME (FR), FNR (DE) and Vinnova (SE). ForestValue has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N° 773324.