FIRENWOOD

IMPROVED FIRE DESIGN OF ENGINEERED WOOD SYSTEMS IN BUILDINGS

https://risefr.com/services/research-and-assessments/firenwood

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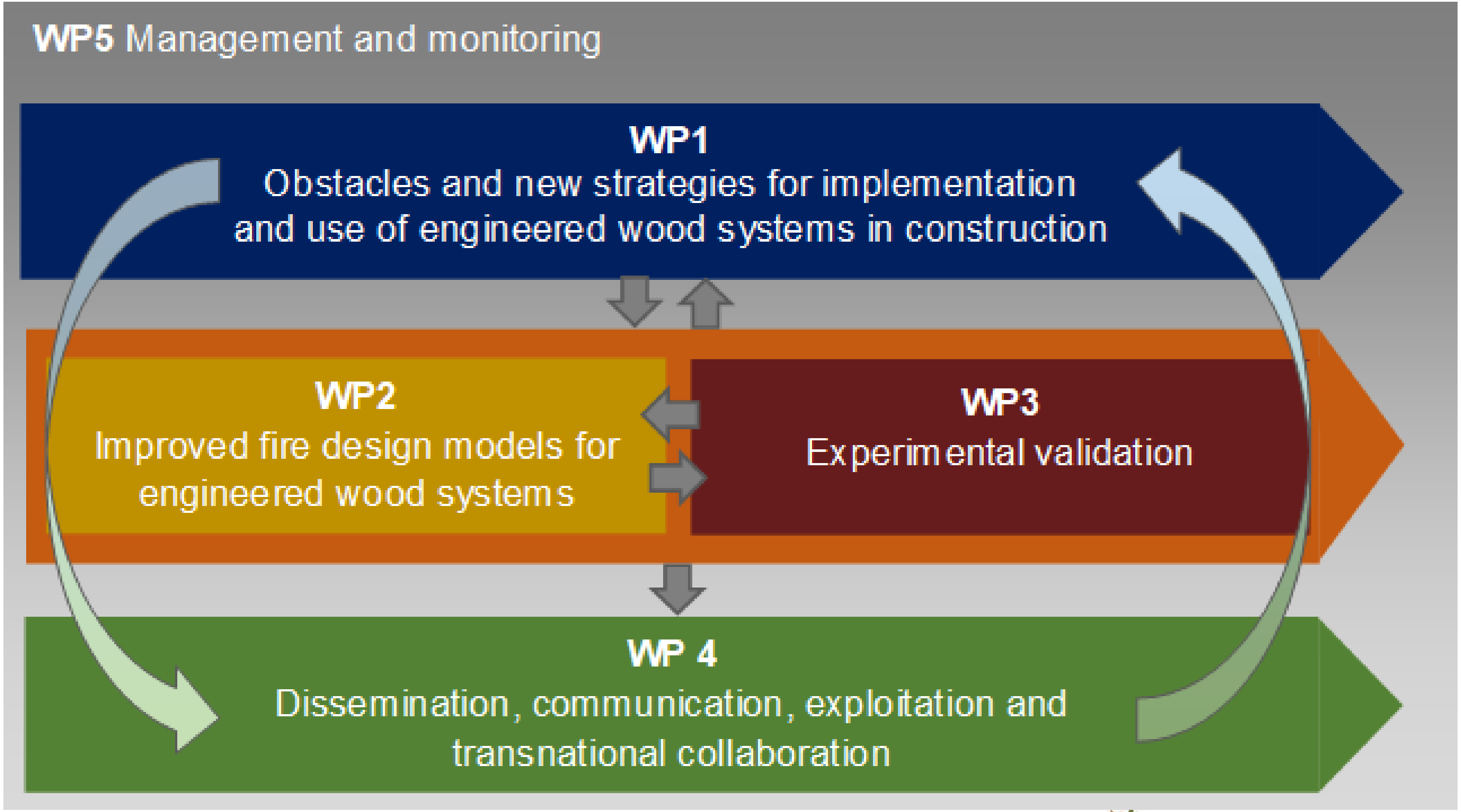
ForestValue


WP5 Management and monitoring
WP1
Obstacles and new strategies for implementation and use of engineered wood systems in construction
WP2
Improved fire design models for engineered wood systems
WP3
Experimental validation
WP 4
Dissemination, communication, exploitation and transnational collaboration

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WP1 Obstacles/new strategies, engineered wood systems

Objective:

Gathering of knowledge about societal and political obstacles in different countries and development of new strategies for fire design and optimization of wood systems and wood structures related to fire behavior.

- review of European building regulations
- survey and workshop with different stakeholders to gather country specific information

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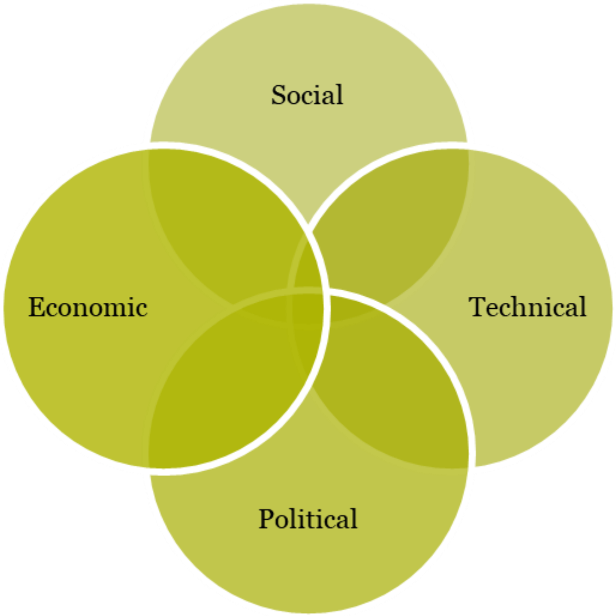
WP1 Obstacles of engineered wood systems

Main obstacles:

- lack of knowledge
- fire protection
- economic disadvantages
- construction products and their certification
- restrictions in building regulations



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WP2 Improved fire design models

Objective:

Develop relevant and validated fire design models that will support and streamline the building design process.

- **Specific input values** in existing models related to adhesive behavior at elevated temperatures **will be defined**.
- **Design models** for CLT walls and floors, timber-to-timber connections with glued-in steel rods and walls and floors with I-joists will be **developed and/or improved**

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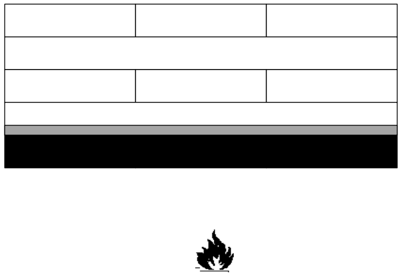
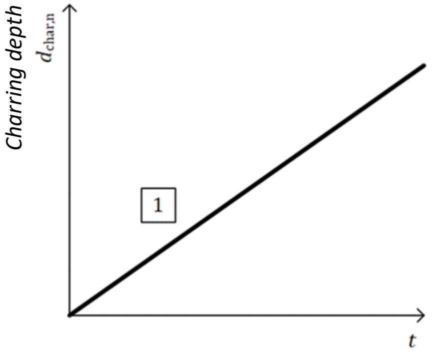
Design models proposed for EN 1995-1-2

Bondline integrity maintained





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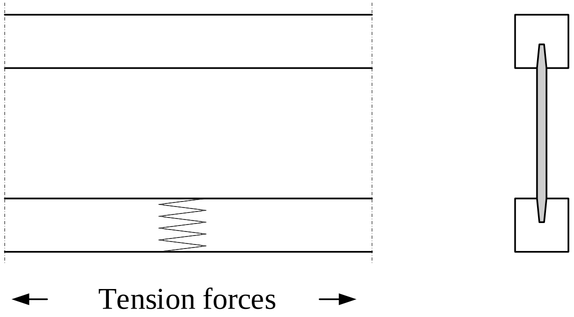

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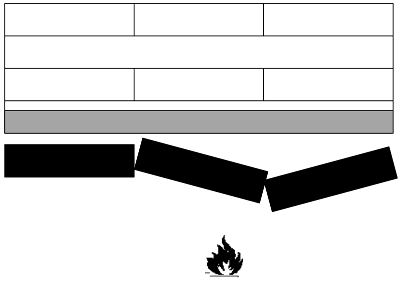

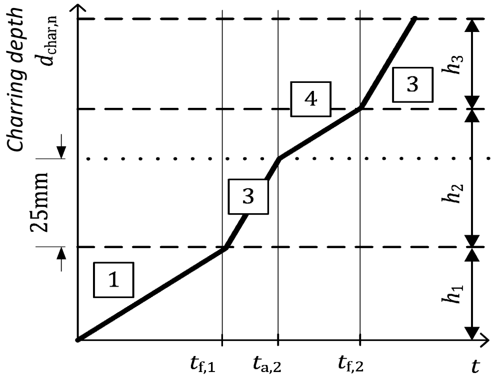

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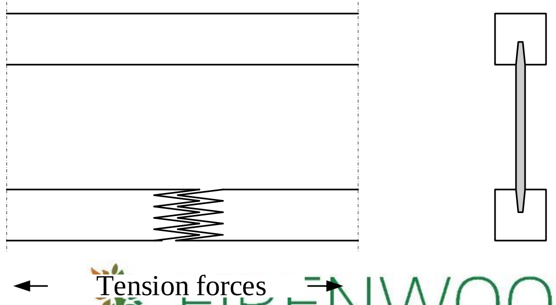

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Design models proposed for EN 1995-1-2

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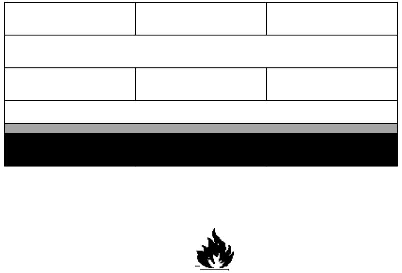

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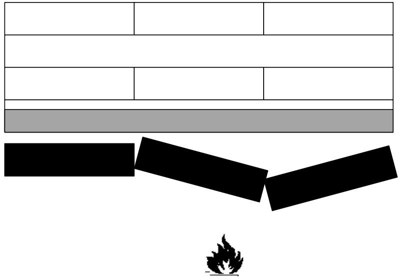

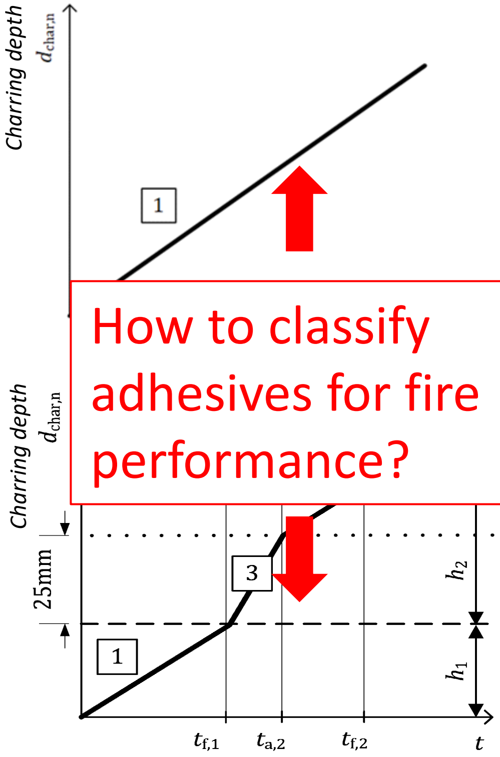

How to classify adhesives for fire performance?

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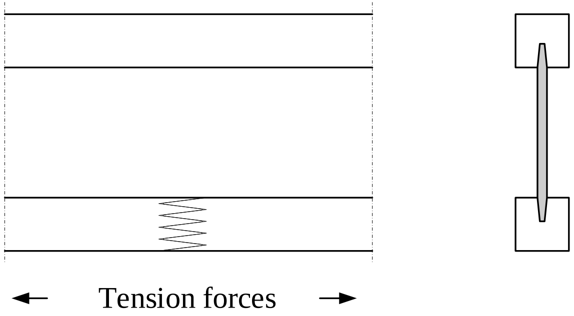

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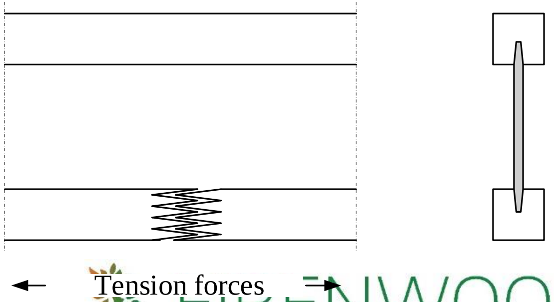
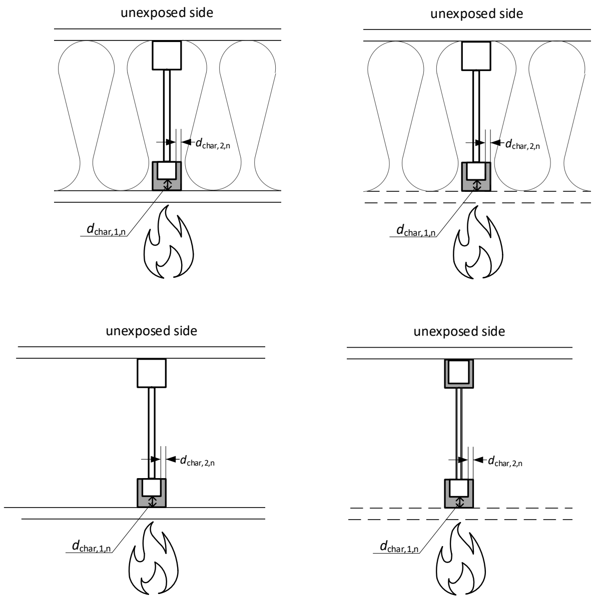
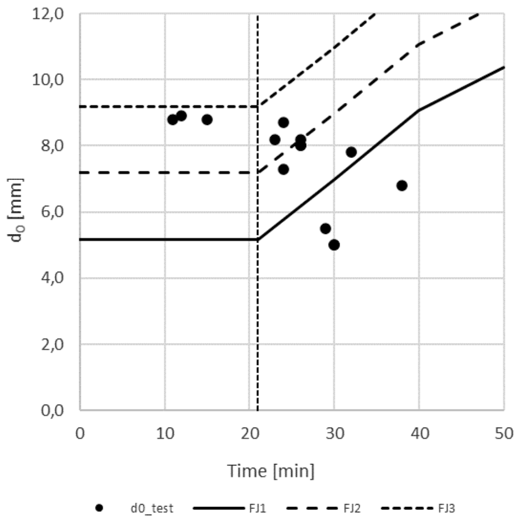


Light timber frame assemblies with I-joists

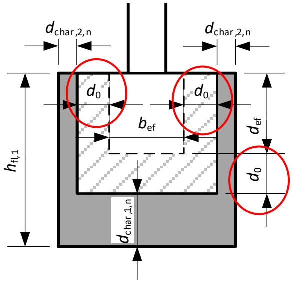


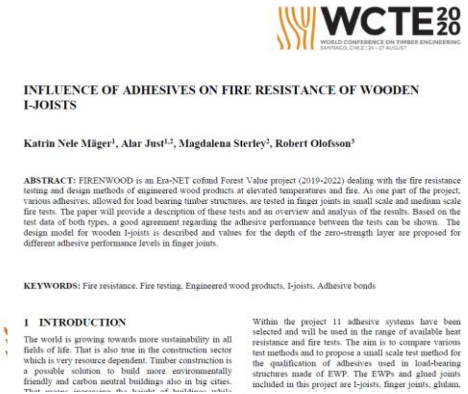
EN 1995-1-2:2025



d_0 – zero strength layer to compensate strength reduction because of heating

Different adhesive classes for finger joints FJ1, FJ2, FJ3

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INFLUENCE OF ADHESIVES ON FIRE RESISTANCE OF WOODEN I-JOISTS

Katrin Nele Mäger[1], Alar Just[1,2], Magdalena Sterley[2], Robert Olofsson[3]

ABSTRACT: FIRENWOOD is an Era-NET cofund Forest Value project (2019-2022) dealing with the fire resistance testing and design methods of engineered wood products at elevated temperatures and fire. As one part of the project, various adhesives, allowed for load bearing timber structures, are tested in finger joints in small scale and medium scale fire tests. The paper will provide a description of these tests and an overview and analysis of the results. Based on the test data of both types, a good agreement regarding the adhesive performance between the tests can be shown. The design model for wooden I-joists is described and values for the depth of the zero-strength layer are proposed for different adhesive performance levels in finger joints.

KEYWORDS: Fire resistance, Fire testing, Engineered wood products, I-joists, Adhesive bonds

1 INTRODUCTION

The world is growing towards more sustainability in all fields of life. That is also true in the construction sector which is very resource dependent. Timber construction is a possible solution to build more environmentally friendly and carbon neutral buildings also in big cities.

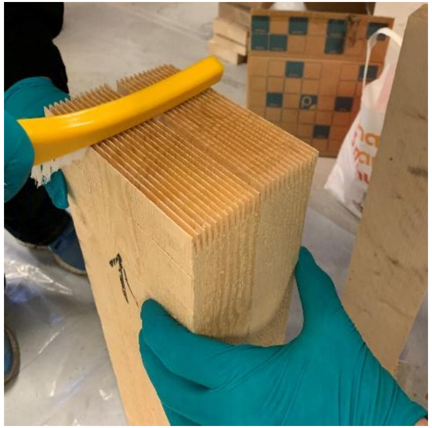
Within the project 11 adhesive systems have been selected and will be used in the range of available heat resistance and fire tests. The aim is to compare various test methods and to propose a small scale test method for the qualification of adhesives used in load-bearing structures made of EWP. The EWPs and glued joints included in this project are I-joists, finger joints, glulam,

WP3 Experimental validation

Objective:

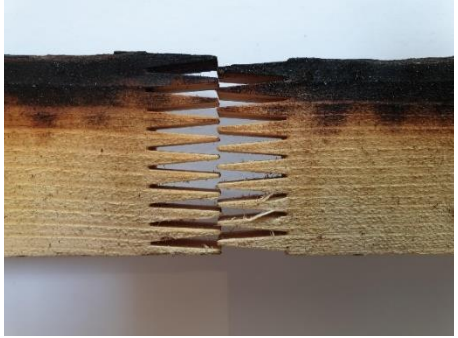
Gain new insight by testing fire development and fire properties, as well as mechanical properties at elevated temperatures, of the selected adhesives and bond types of the engineered wood.

- Different investigated **test procedures** with adhesive bonds.
- **Reproducibility**.
- **Development** and **validation** of the fire design models in WP2



Cone heater tests of finger joints

Adhesive name	TTF (min)	Residual strength (MPa)	Failure description
A	25,93 (0,38)	5,78 (0,19)	Adhesive
B	30,63 (1,48)	7,81 (0,67)	Wood/adhesive
C	27,39 (1,2)	6,59 (0,37)	Adhesive/wood
D	30,48 (2,79)	7,23 (0,75)	Adhesive/wood
E	23,71 (0,66)	5,43 (0,17)	Adhesive
F	31,49 (0,63)	7,59 (0,49)	Wood/adhesive
G	27,55 (0,99)	6,56 (0,37)	Adhesive/wood
H	26,21 (0,42)	6,16 (0,19)	Adhesive/wood
I	31,66 (0,81)	7,93 (0,69)	Wood/adhesive
J	32,28 (1,67)	8,55 (0,62)	Wood
K	26,63 (1,12)	6,05 (0,12)	Adhesive/wood



11 adhesives

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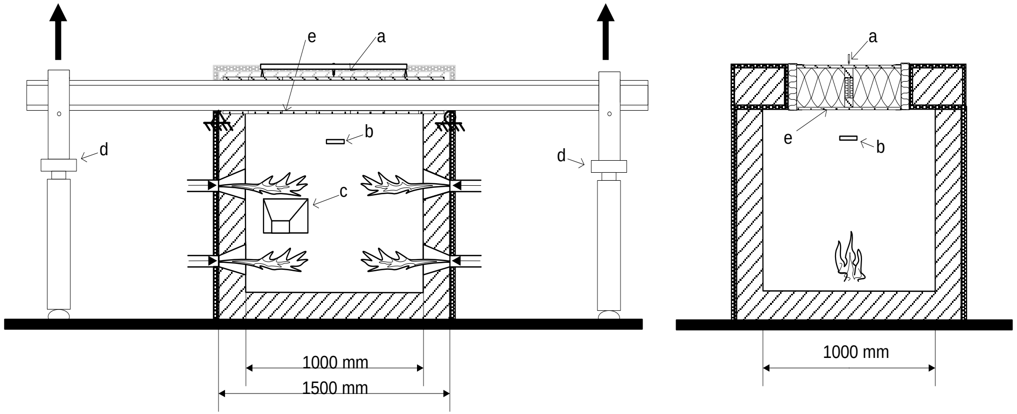
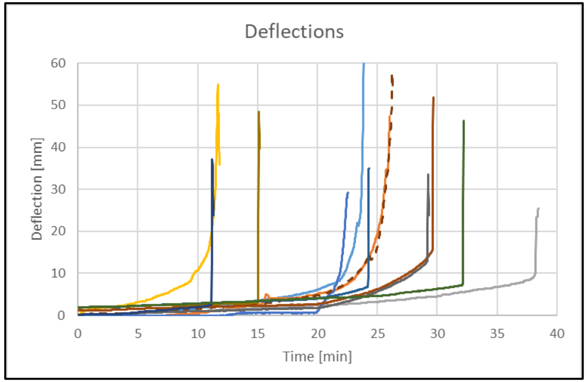
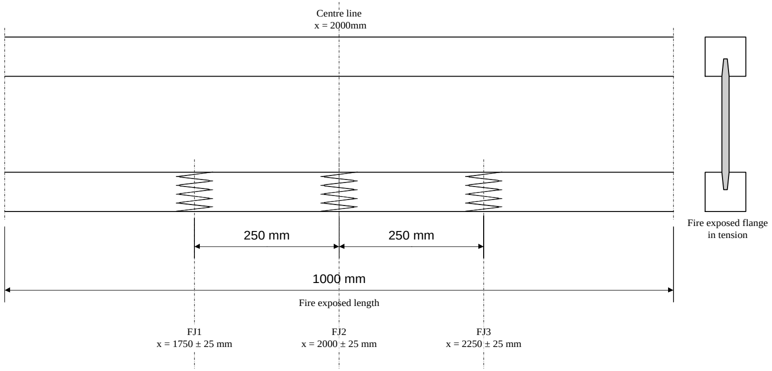
Model scale tests with finger jointed flanges





11 adhesives



Load level
40% of bending strength

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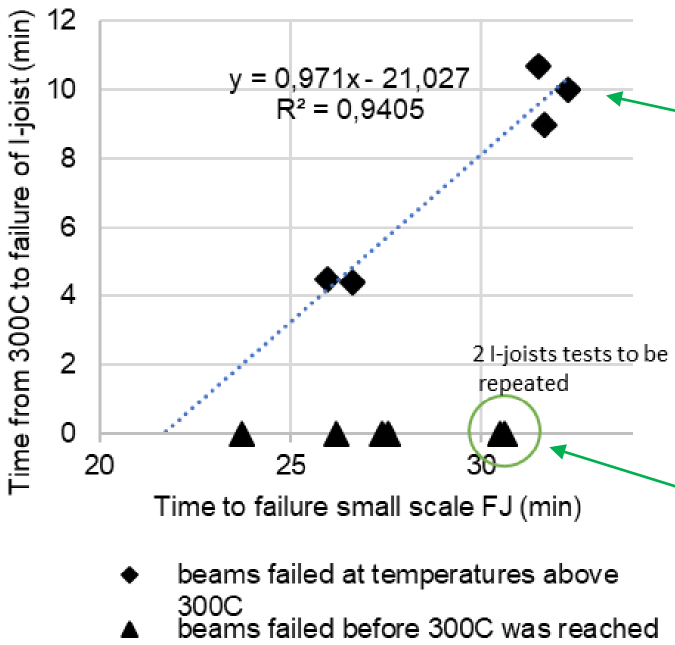
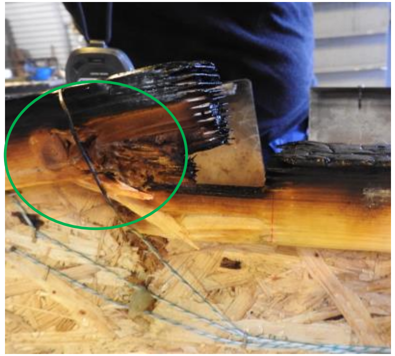
Furnace tests vs cone tests



No bondline failure

knot



Good correlation!
2 I-joists failed due to knots (will be repeated)

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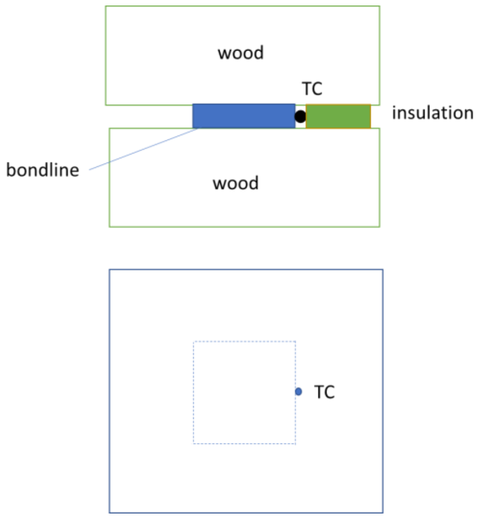
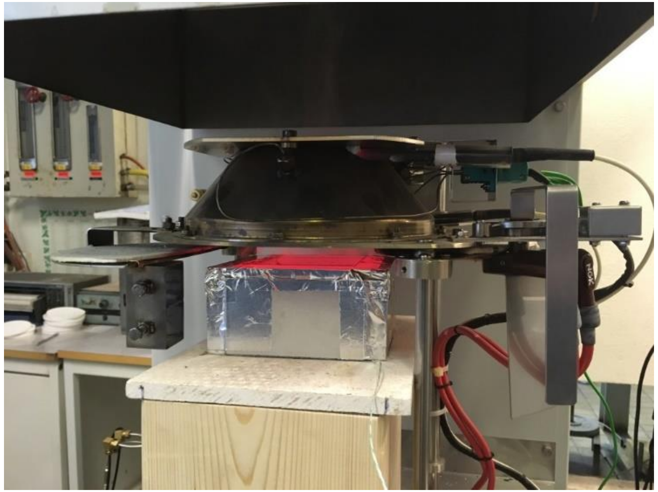
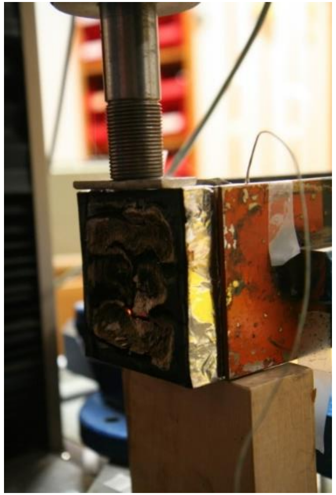
Cone calorimeter tests of CLT and GLT







Shear test

11 adhesives

CLT and GLT
Exposed lamellas 20 and 40 mm

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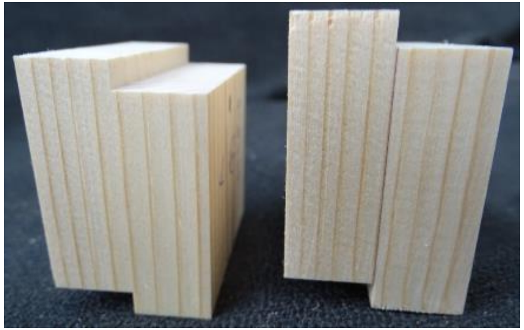
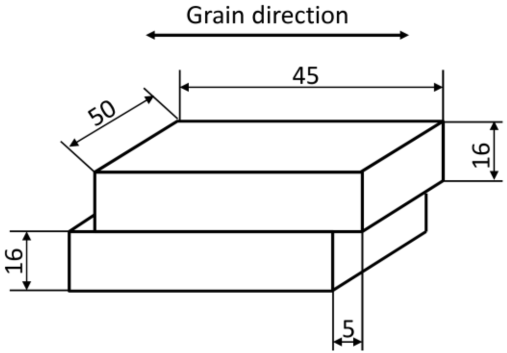
Single lap compression shear tests

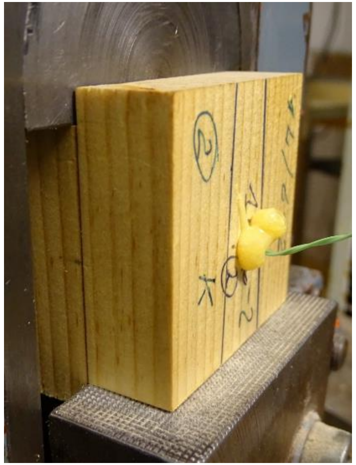
Single lap compression shear tests at elevated temperatures following EN 17224

- **12 Adhesives** (1 Adhesive national project)
- **Temperatures:**
  - 20°C
  - 70°C
  - 100°C
  - 130°C
  - 160°C
  - 180°C
  - 200°C
  - 220°C
  - 232°C (450°F)
  - 250°C (testing ongoing)

(70°C – 160°C: only 3 adhesives)







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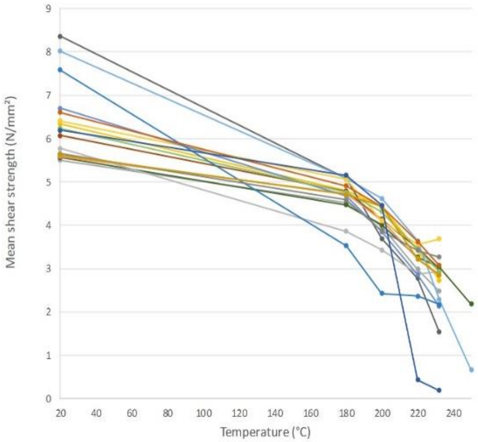
Single lap compression shear tests

Target temperature 232°C



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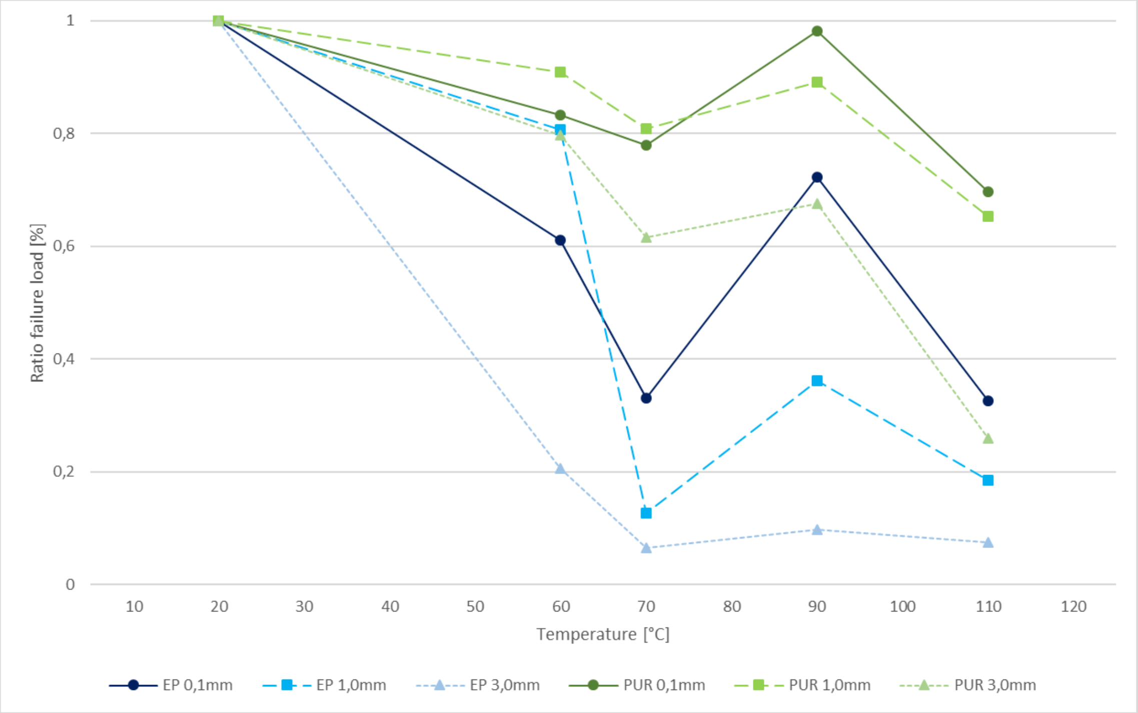
Tension shear tests at elevated temperatures

- 5 Temperatures
- 3 different gluelines
- 2 adhesives



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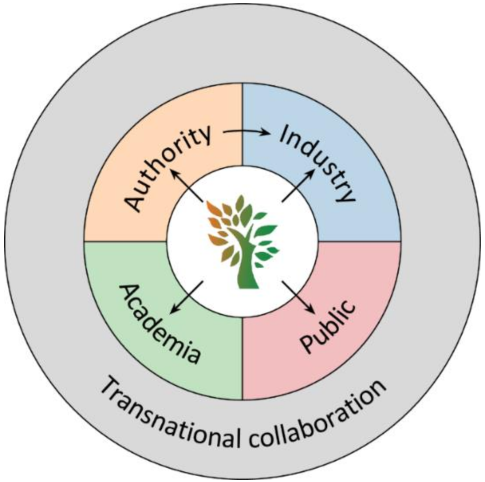
WP4 Dissemination, communication, exploitation and transnational collaboration

A strong focus is on:

- Presenting proposed strategies and design approaches
- Implementation tests for classification of adhesives with regards to elevated temperature and fire behavior
  - CEN/TC 193 /SC1 Adhesives for wood and derived timber products
  - CEN/TC 250 /SC5 Eurocode 5, Part 1-2: General rules



Dissemination and communication framework

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