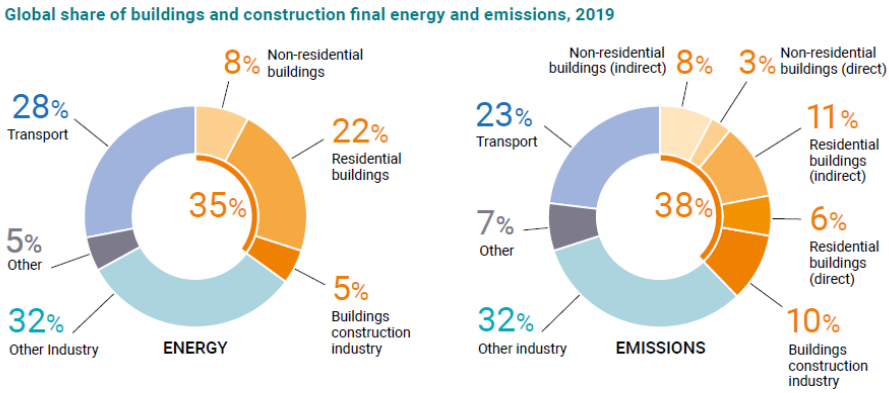
ETH, Institute for Building Materials, Chair of Wood Materials Science
Empa, Cellulose and Wood Materials Laboratory, WoodTec group

Innovative holzbasierte Materialien

Ingo Burgert and Andrea Frangi

SwissForestLab Dialog mit dem Schweizerischen Forstverein
November 10th, 2022

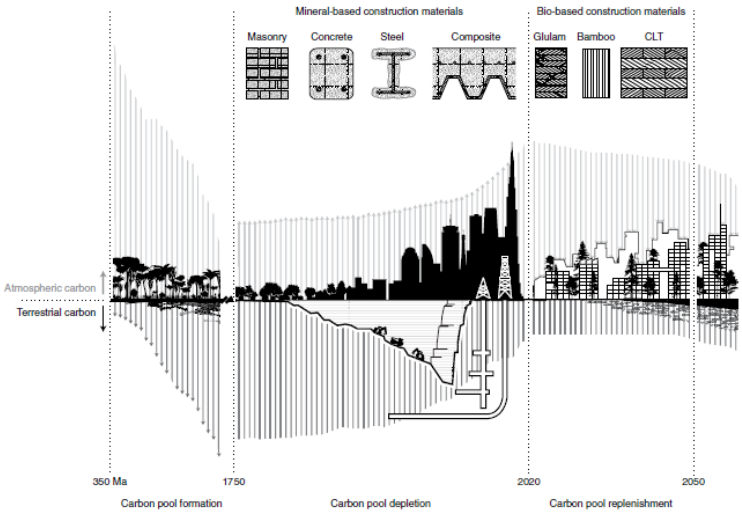
A Grand Challenge



Source: 2020 Global status report for buildings and construction, UN environment program

Wood in construction

Main focus on climate change mitigation and sustainability



Churkina…Schellnhuber (2020) Nature Sustainability

- Contributing to lower or zero emission in the building sector; requires easy and rapid scalability
- Retaining of sustainable forestry and biodiversity
- New and improved wood based products

Research Frangi Group, Timber engineering

Objective
- Enhance use of sustainable timber for structures
- Improve safety and economy of timber structures

Structural Timber and Connections

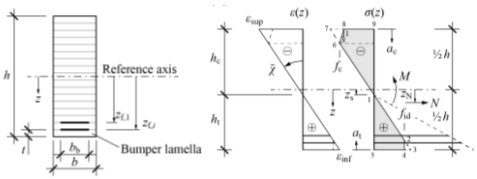
Improve knowledge and reliability of members & connections with regard to safety and economy
Better use of material

Innovative Timber Structures

Improve efficiency and competitiveness of timber
Optimised use of timber in combination with other materials

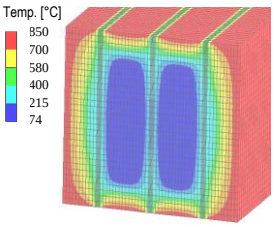
Fire Safety Engineering

Improve fields of application of timber structures based on advanced knowledge with regard to fire safety



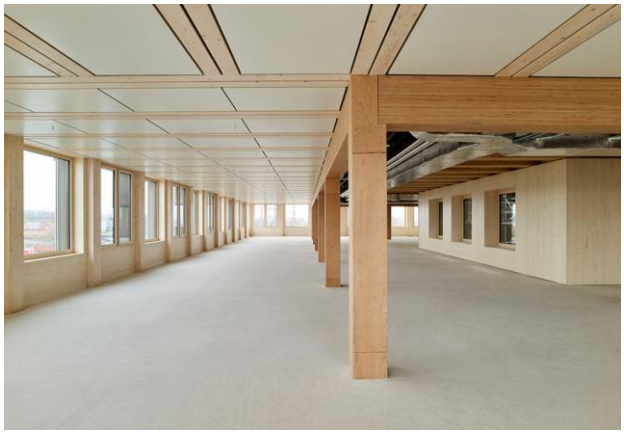
Analytical model for fibre reinforced glulam

ETH House of Natural Resources



FE-thermal analysis of dowel-type connection with slotted-in steel plates

Risch Rotkreuz Suurstoffi S22, 36m

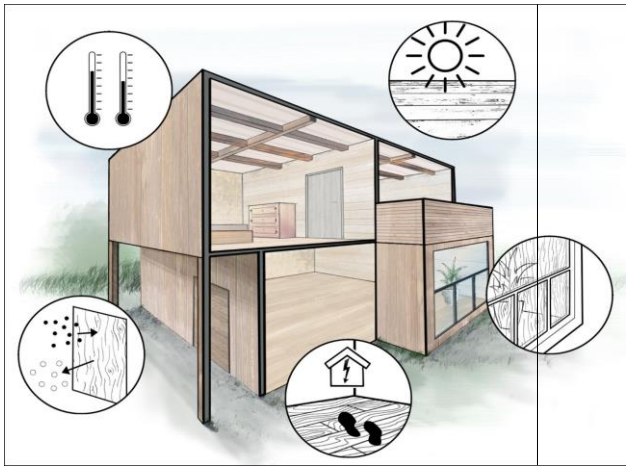


Andrea Frangi

ETH zürich Empa Materials Science and Technology

Wood in building operation

Connection to Smart Building Technologies



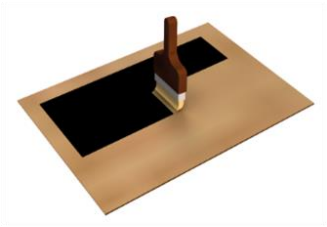
Panzarasa & Burgert (2021) Holzforschung

Sensors
Active/adaptive Materials

- Control of room climate
- Sensing
- Energy harvest / savings
- Light management
- Acoustics
- Self-shaping building elements

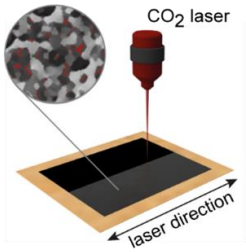
Electric conductivity by laser-induced graphitization of wood

1. Ink deposition



2. Laser treatment for IC-LIG formation

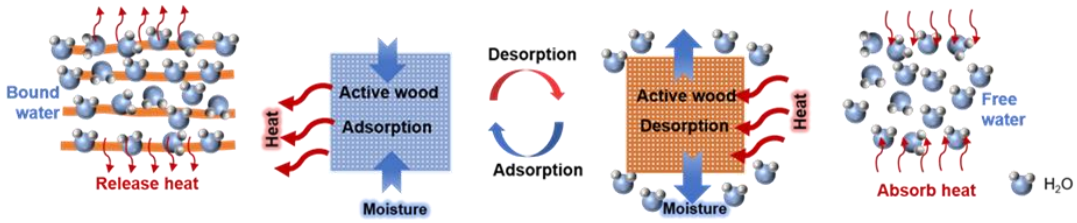
Iron nanostructures in iron-carbon composite

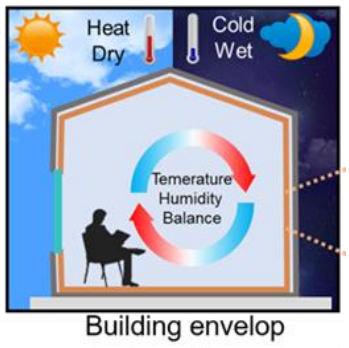


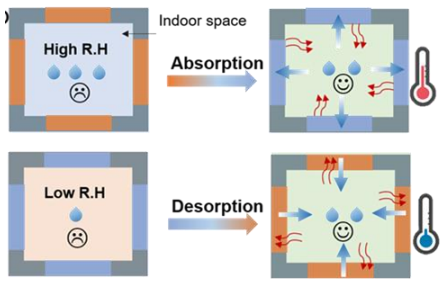
Capacitive touch panel

Dreimol et al. (2022) Nature Communications

Wood for climate regulation in more energy-efficient buildings



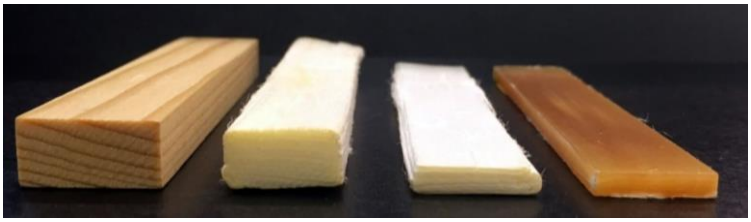




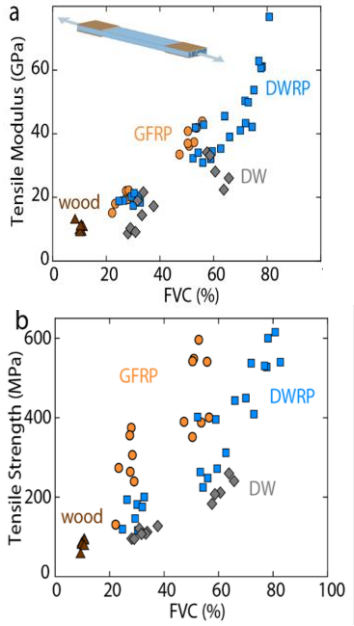
Ding et al. (2022) Materials Horizons

Densified Cellulose Materials

High-strength cellulose composites



Frey et al. (2018) ACS Applied Materials and Interfaces



Frey et al. (2019) ACS Applied Materials and Interfaces

Broaden the perspective

- Currently dominating species could be less available, with consequences for wood processing and wood products.

Research on:

- Green chemistry for wood property improvements / functionalization
- Machine learning techniques to better predict wood properties and handle or even appreciate (bio)diversity of the natural resource
- New separation techniques

Patent application filed:
Rod-based wood materials

Splitting of 1m long rods from hardwood stem segments.

- **High material gains**
- **No cutting of fibers**
- **Elimination of larger knots**
- **Low energy consumption**
- **Low tool wear**