



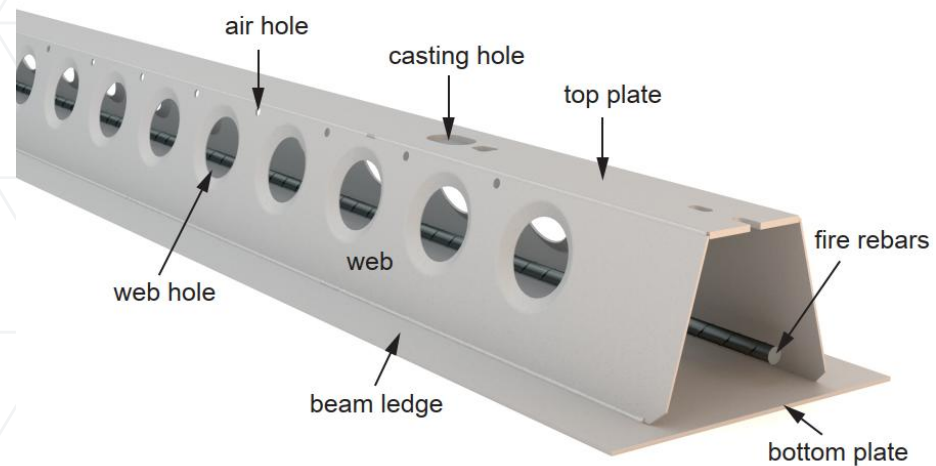
# **LOAD BEARING CAPACITY OF DELTABEAM® WITH TIMBER FLOOR JOINTS**

**Salla-Mari West, R&D Engineer, DELTABEAM®**



# DELTABEAM® COMPOSITE BEAM

## DELTABEAM® parts

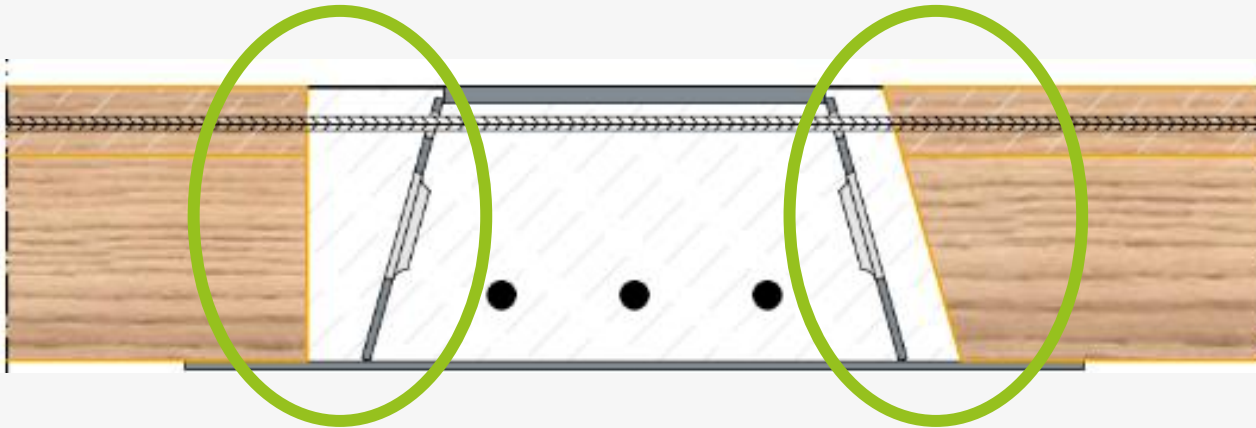


## DELTABEAM® Slim Floor Structure



# THE RESEARCH PROGRAM

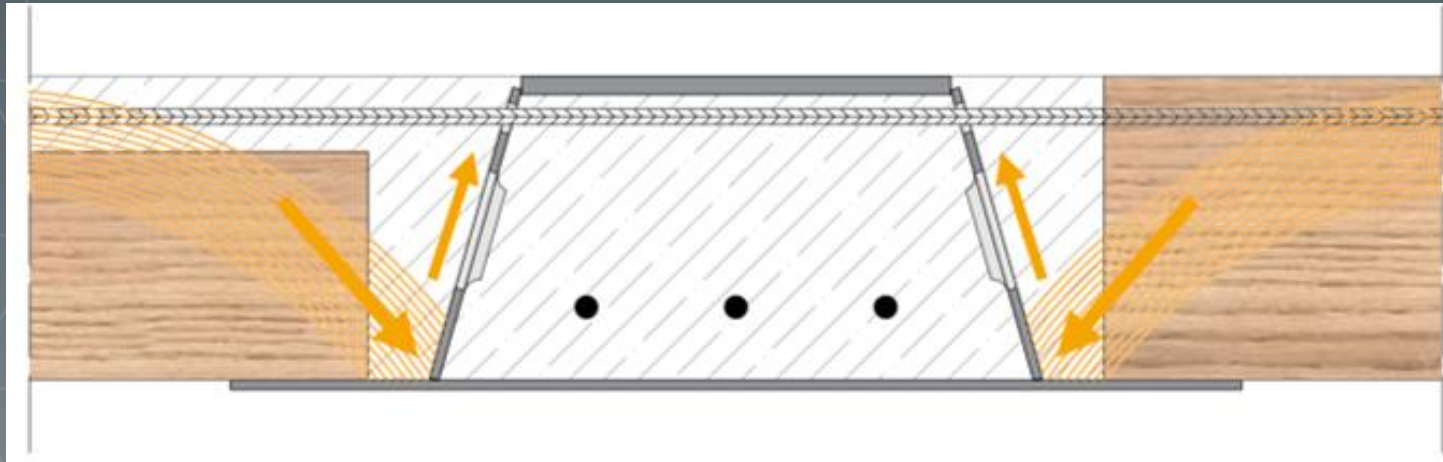
- Why to investigate the performance of the joint between DELTABEAM® and timber slab?
- The combination of timber, concrete and steel is not yet comprehensively standardized



# THE RESEARCH PROGRAM

How the load transfer works in ambient temperature and fire?

- Load transferred to DELTABEAM® through a compression arch against an inclined web
- Transverse rebars tie the beam and slabs together





# THE RESEARCH PROGRAM

## Load transfer tests

- At ambient temperature
- In simulated fire condition
  - Removing the supporting ledge

## 120-minute charring test

- Reduced cross-section method (EN1995-1-2)

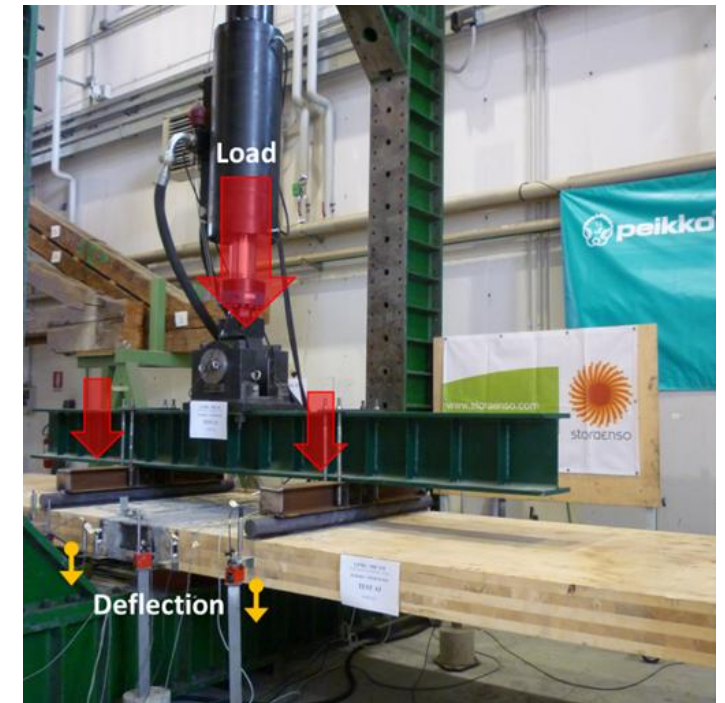
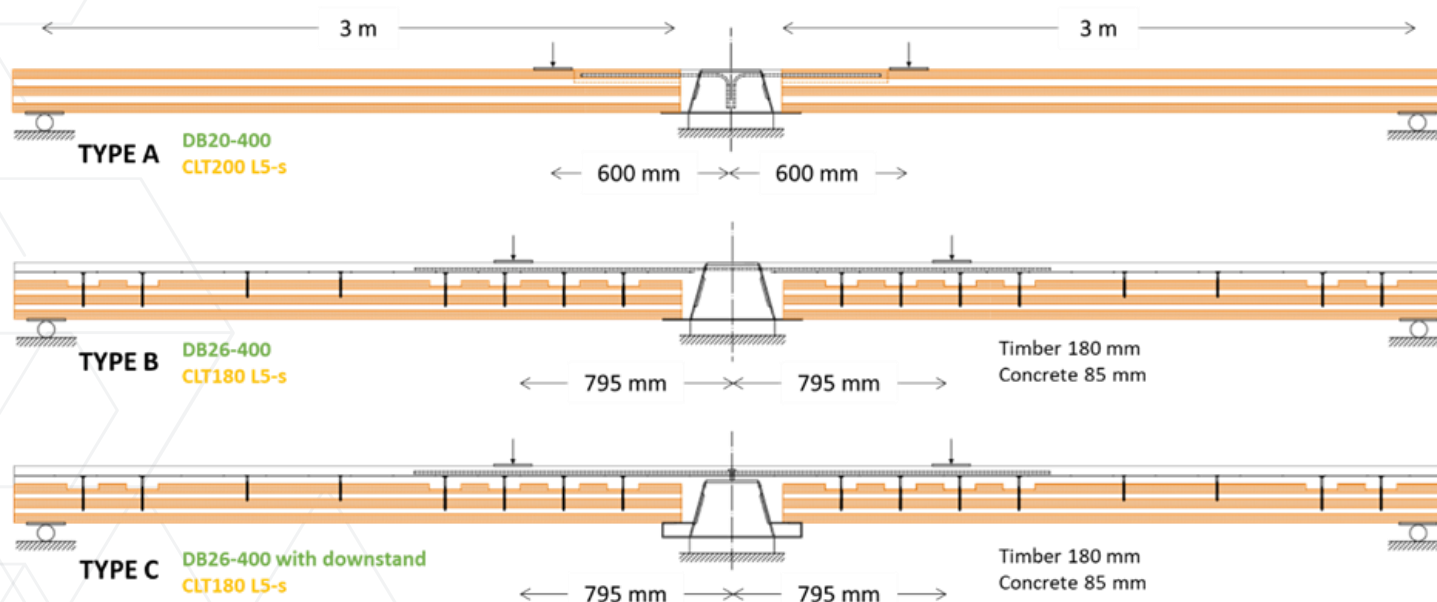
## Loaded 90-minute fire test

- REI requirements

# LOAD TRANSFER TESTS

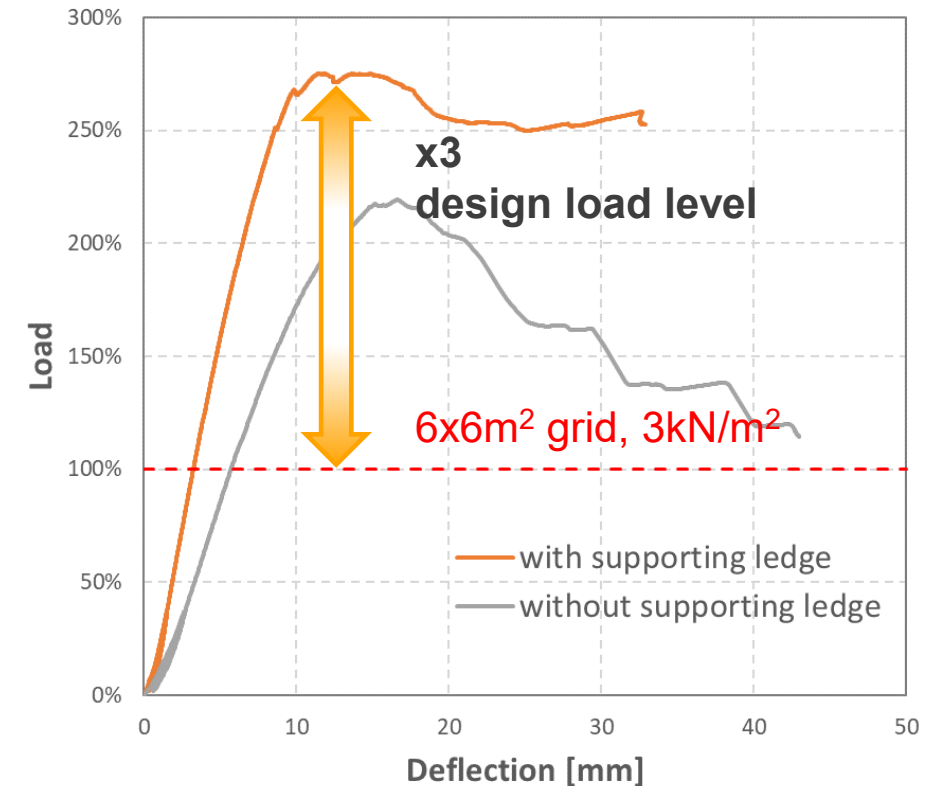
Full-scale specimens of both timber and composite timber slabs supported by DELTABEAM®

- Investigating the load capacity of the floor joint only
- Load level well above the practical loads in projects
- Failure took place in the slab, but not at joint area



# RESULTS OF THE SIMULATED FIRE SITUATION

- Removing the ledge simulates the worst condition
- Proves that the assumed load transfer mechanism is established
- Presence of the ledge is favorable for the confinement of the bottom part of the slab

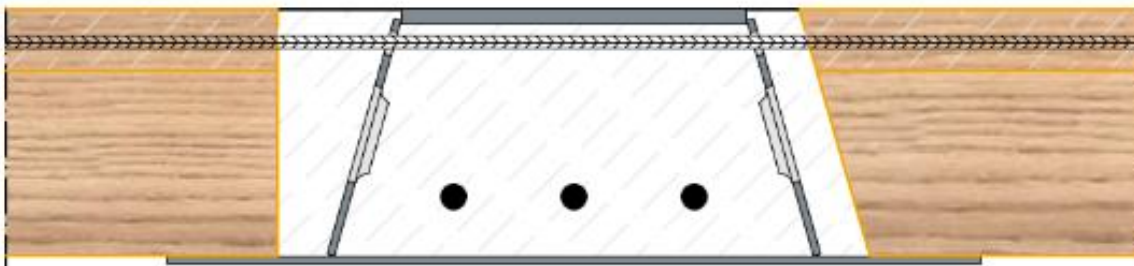




# TWO-HOUR CHARRING TEST

## EN 1995-1-2: Reduced cross-section method

- Seven different details equipped with thermocouples
- DELTABEAM® was not fireproofed in any of the cross-sections
- No loading
- The effective charring depth proves to be less in the joint area than at the midspan of the CLT slab





# 90-MINUTE FIRE TEST WITH LOADING

No additional fire proofing used in DELTABEAM®s nor in CLT slabs

- 200 mm deep DELTABEAM®s and 200 L5s solid CLT slabs had equal depth
- The load arrangement simulated DELTABEAM® and CLT slab structure
  - 8 m CLT span
  - 1.7 kN/m<sup>2</sup> permanent load
  - 5 kN/m<sup>2</sup> live load (congregation/shopping/F traffic areas)
  - Constant load

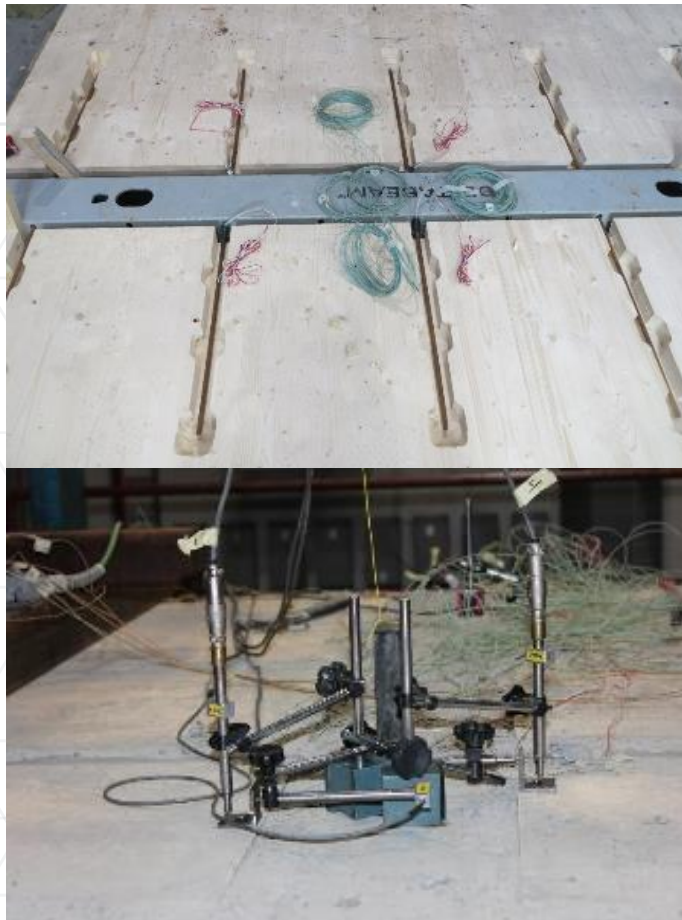


# 90-MINUTE FIRE TEST WITH LOADING

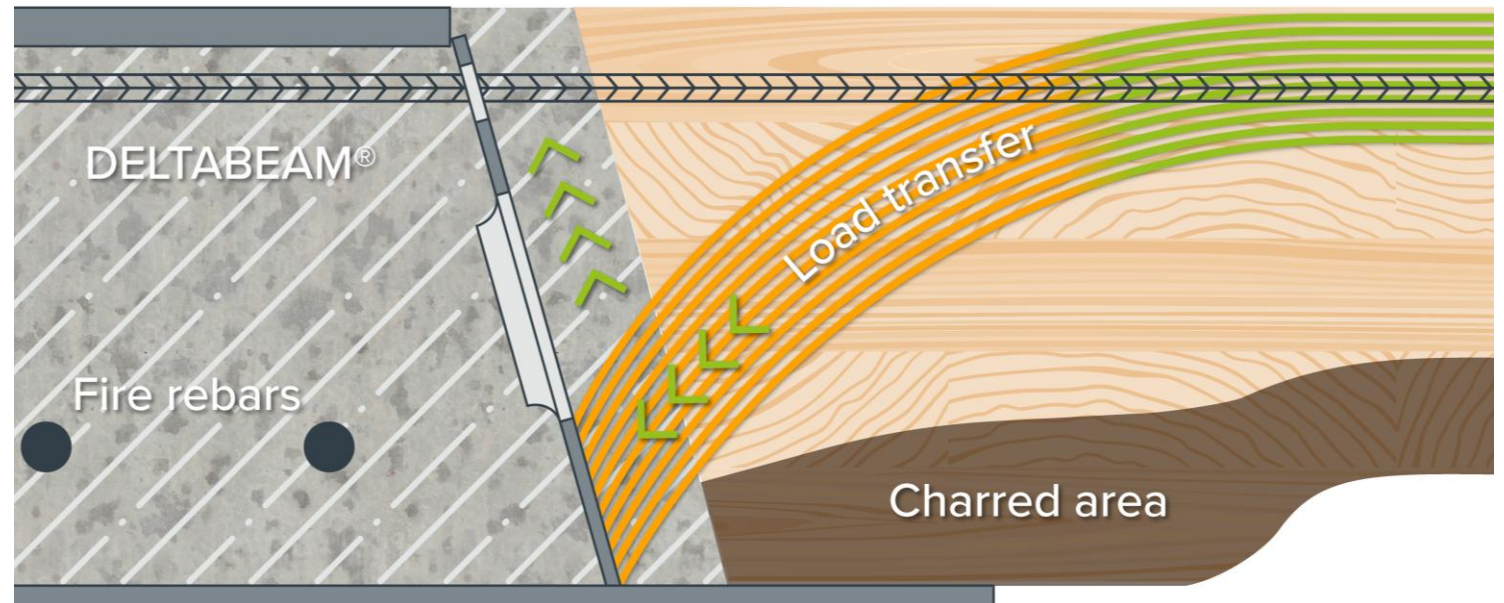
REI90	Test results
Loadbearing capacity R	Deflections 40-50mm and deflection rate under limits
Integrity E	No gaps and no flames
Insulation I	Avarage temperature rise $62^{\circ}\text{C} < 140^{\circ}\text{C}$ and the highest temperature rise $92^{\circ}\text{C} < 180^{\circ}\text{C}$

# LOAD TRANSFER IN FIRE SITUATION

To DELTABEAM® through a compression arch against an inclined web



- Transverse reinforcement secures the load transfer
- The geometry of the CLT slab end doesn't affect to the load transfer capacity





# DEMOLITION: NEXT DAY AFTER REI90 FIRE TEST

Charring depth is smaller in the joint area between DELTABEAM® Composite Beam and CLT slabs

- Protecting effect of the DELTABEAM® ledge and the infill concrete



Charring depth was not as deep in the joint area as in the middle of the CLT span

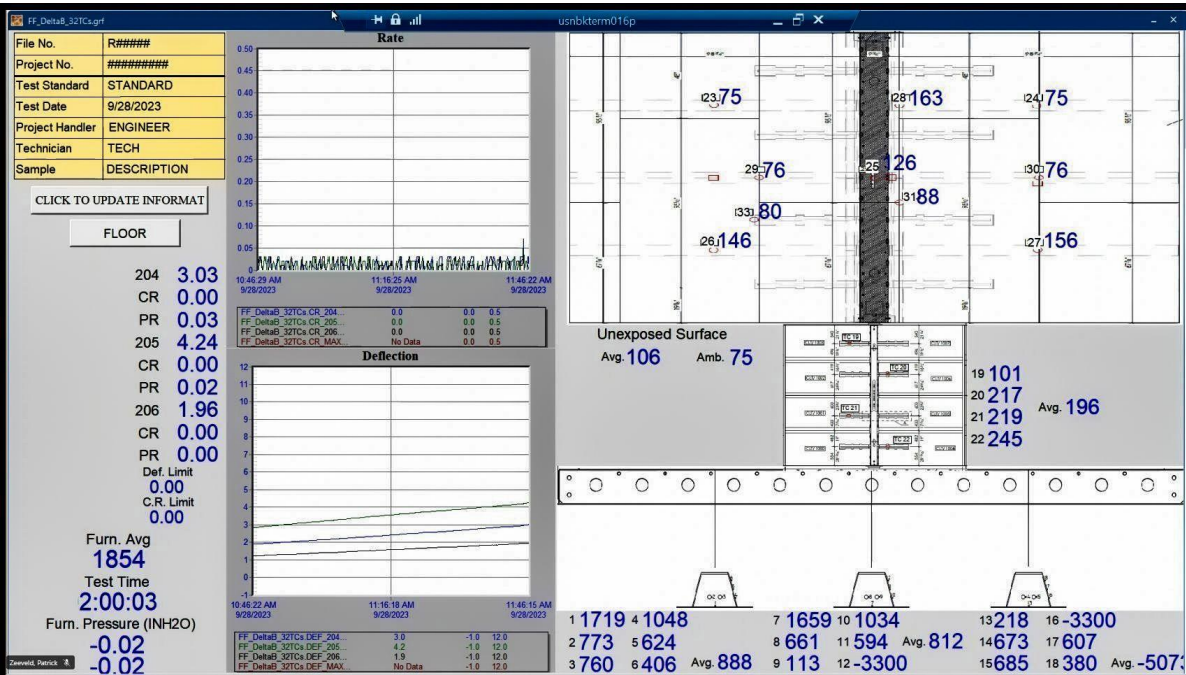
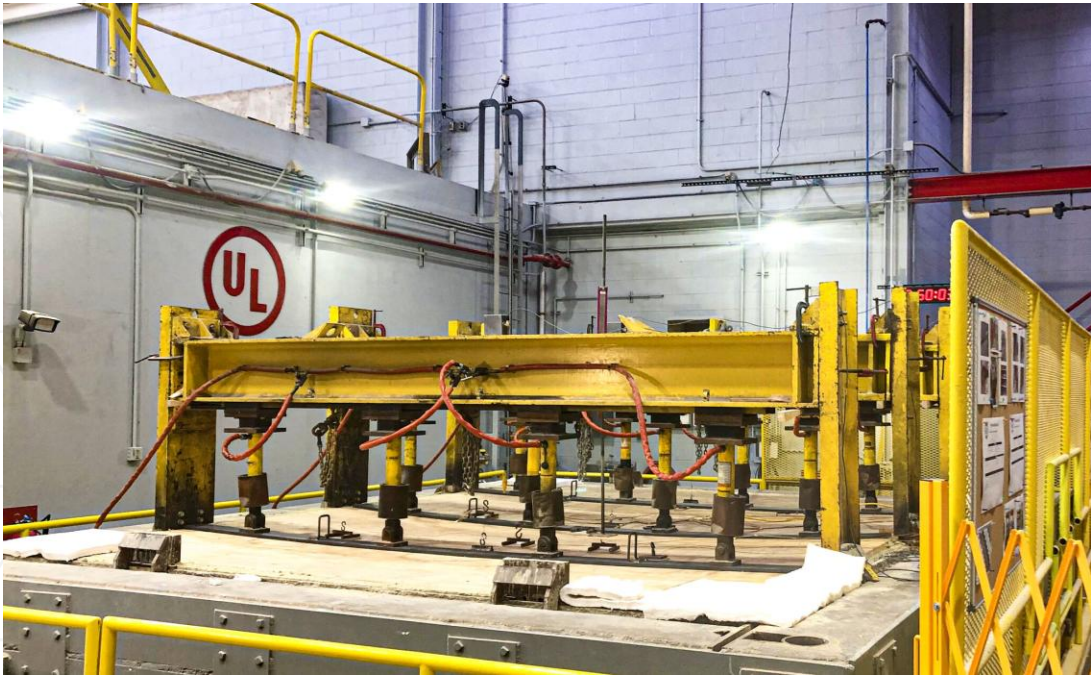
- DELTABEAM® doesn't require any additional fire proofing



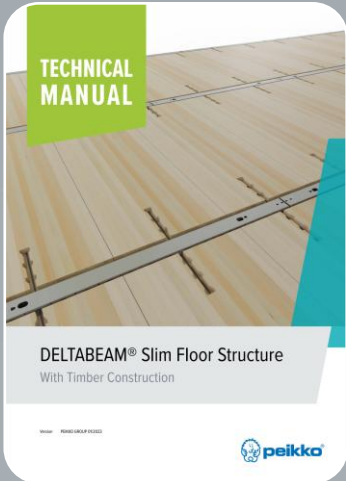


# TWO HOUR LOADED FIRE TEST IN NORTH AMERICA

UL L902 assembly approval for DELTABEAM® Composite Beam with CLT slabs



# WHITE PAPERS OF HYBRID SOLUTIONS



**DELTABEAM<sup>®</sup> technical manual for timber construction**



**High fire performance of DELTABEAM<sup>®</sup> Slim Floor joints with timber slabs**



**DELTABEAM<sup>®</sup> with hybrid timber floors - Load transfer tests**



**Performance DELTABEAM<sup>®</sup>-CLT floors in human-induced vibration**



**Optimizing building life cycle carbon footprint and operational emissions**





**THANK YOU**

[salla-mari.west@peikko.com](mailto:salla-mari.west@peikko.com)