

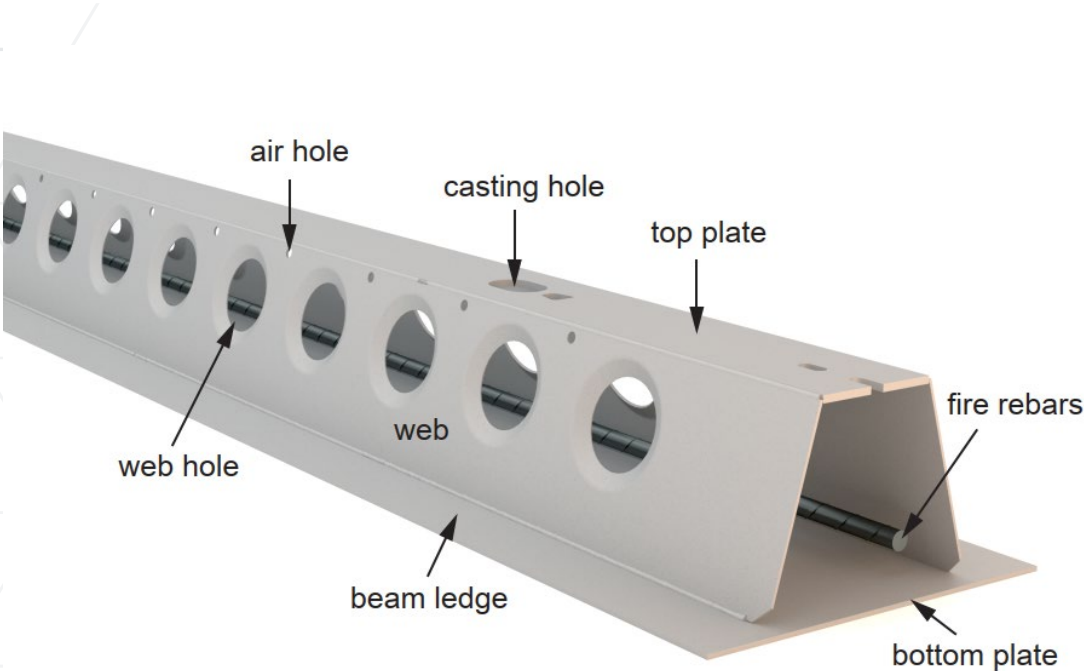


STEEL HYBRID SOLUTION IN FIRE SITUATION

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

DELTABEAM® COMPOSITE BEAM

DELTABEAM® parts



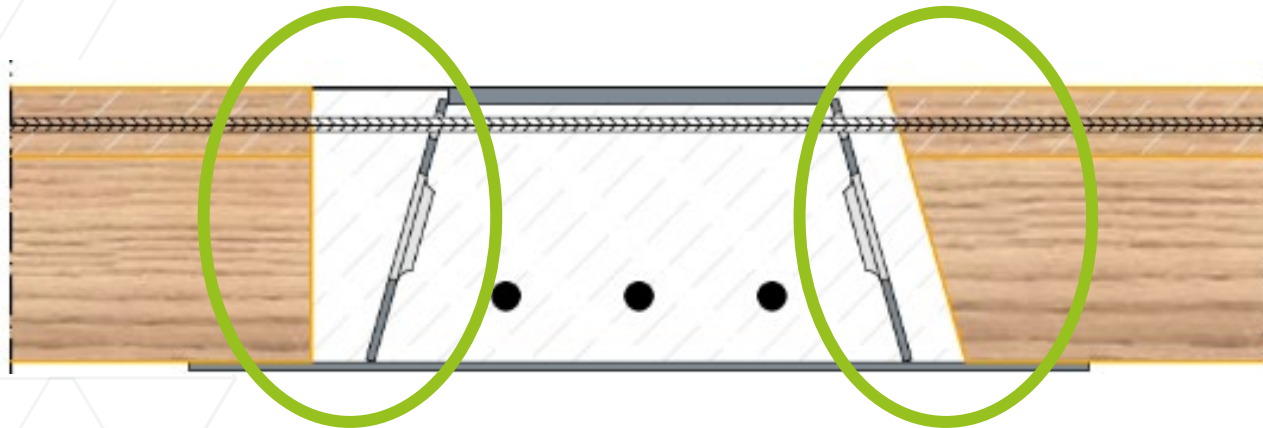
DELTABEAM® Slim Floor Structure



THE RESEARCH PROGRAM

Why to investigate the performance of the joint between DELTABEAM® and timber slab?

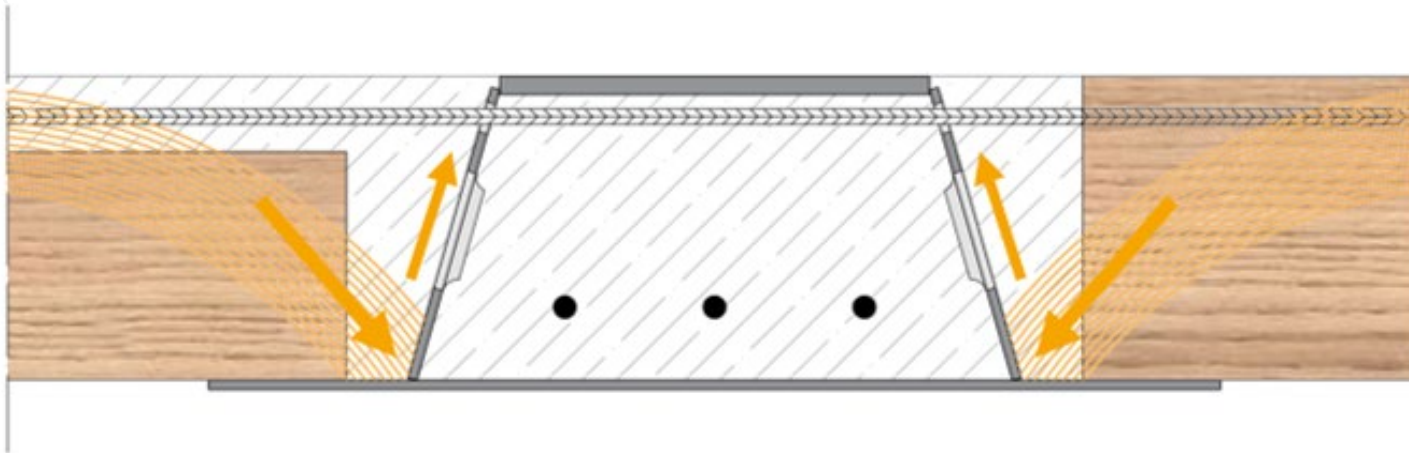
- The combination of timber, concrete and steel is not yet comprehensively standardized



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

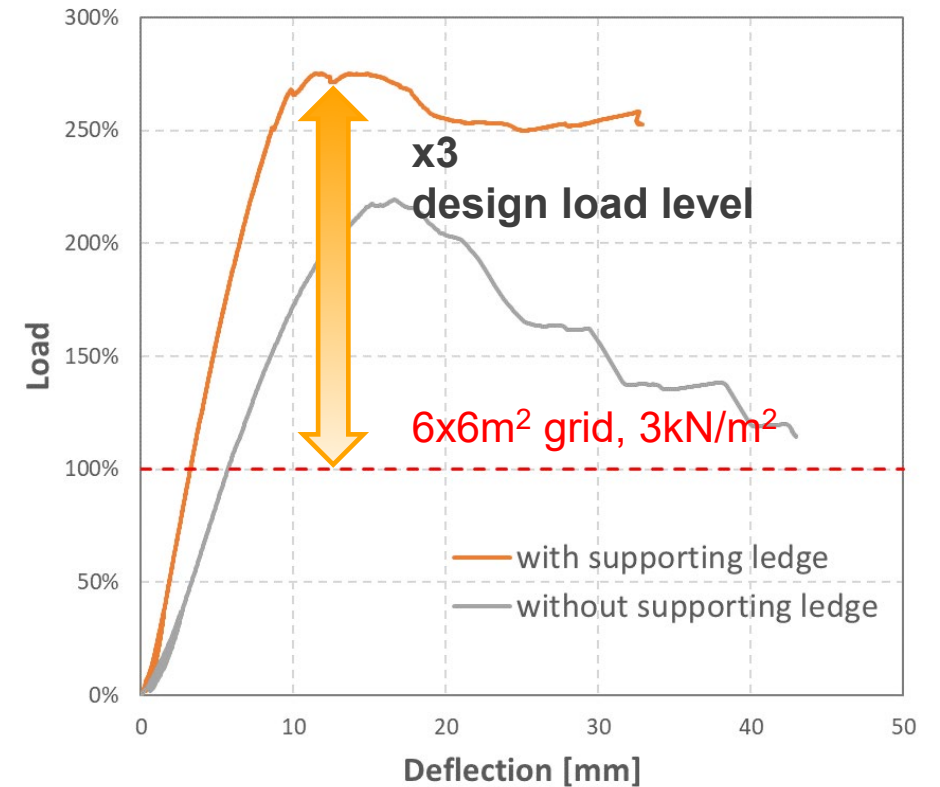
- Reduced cross-section method (EN1995-1-2)

Loaded 90-minute fire test

- REI requirements

RESULTS OF THE SIMULATED FIRE SITUATION

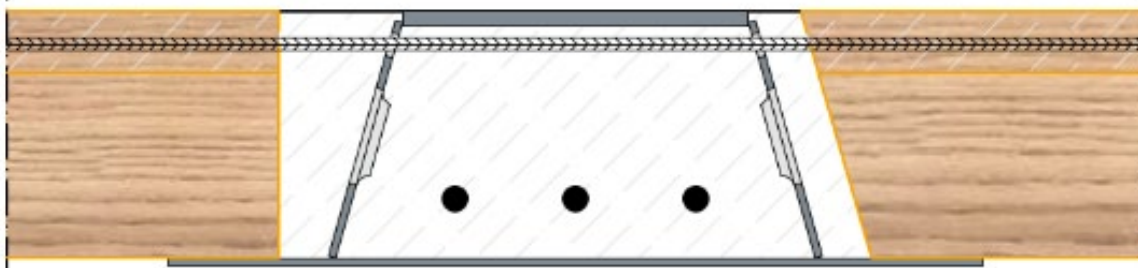
- Removing the ledge simulates the worst condition
- Proves that the assumed load transfer mechanism is established
- Presence of the ledge is favorable for the confinement of the bottom part of the slab



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/m² permanent load
 - 5 kN/m² live load (congregation/shopping/F traffic areas)
 - Constant load



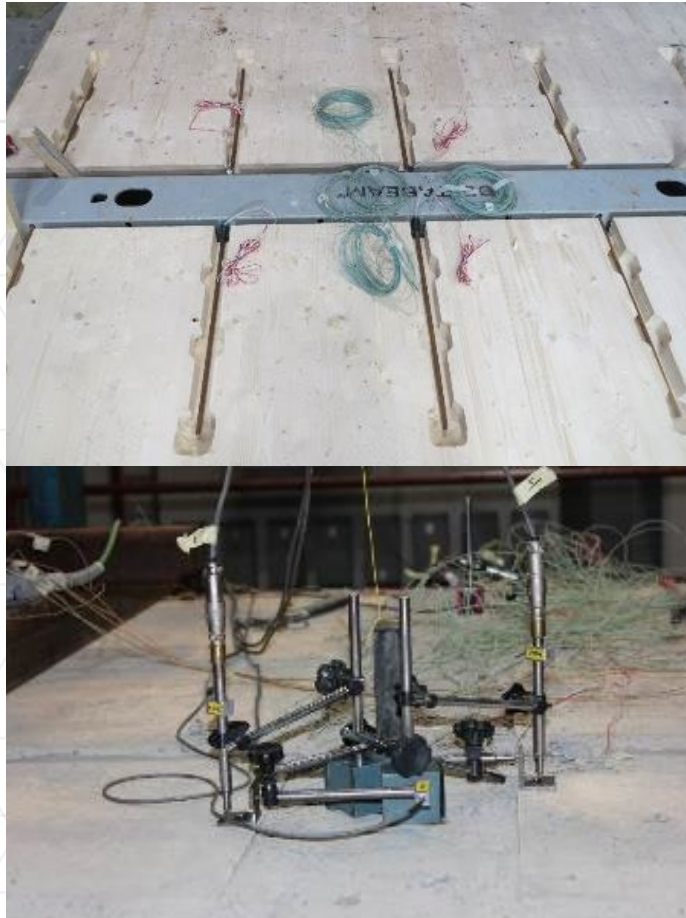
90-MINUTE FIRE TEST WITH LOADING

All REI90 requirements were met

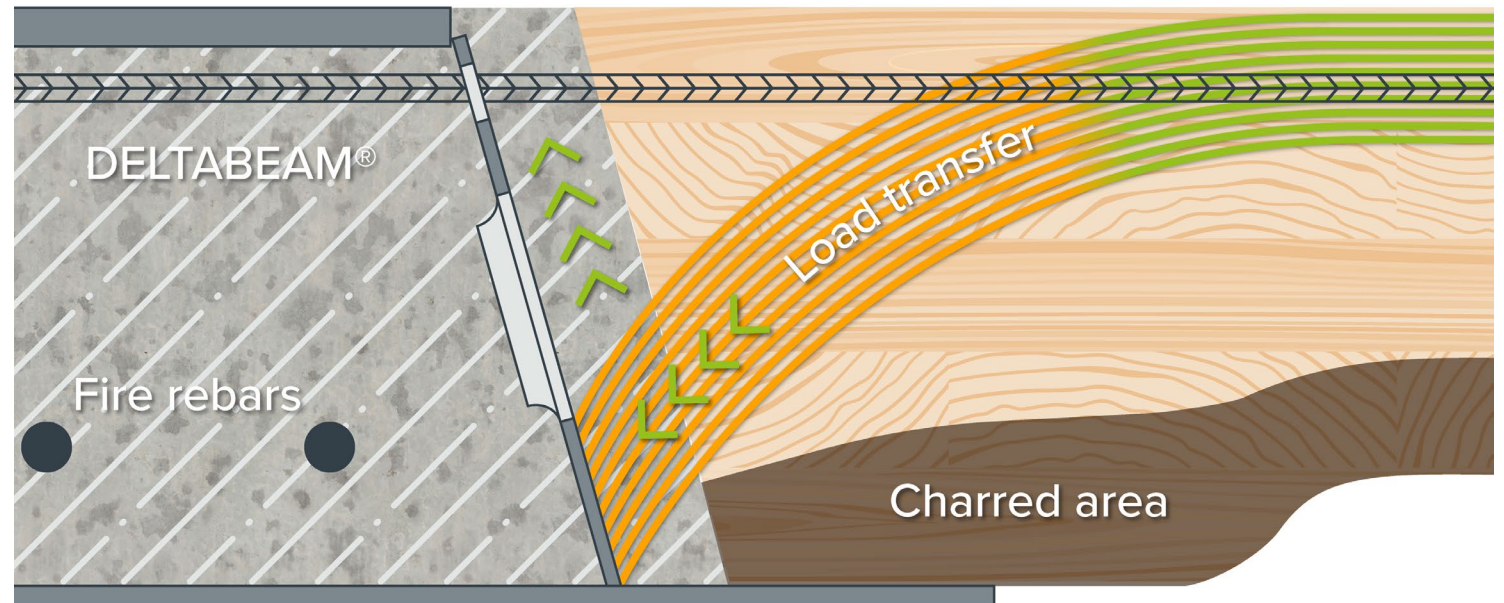
REI90	Test results
Loadbearing capacity R	Deflections 40-50mm and deflection rate under limits
Integrity E	No gaps and no flames
Insulation I	Avarage temperature rise $62^{\circ}\text{C} < 140^{\circ}\text{C}$ and the highest temperature rise $92^{\circ}\text{C} < 180^{\circ}\text{C}$

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

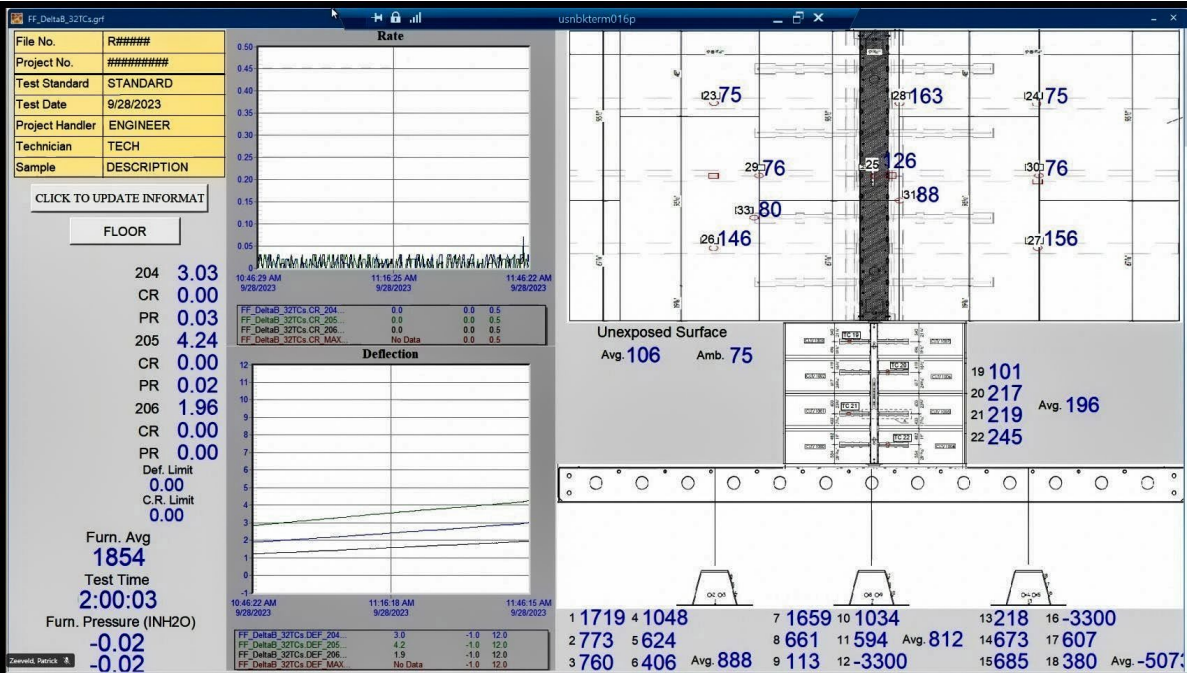
Charring depth is smaller in the joint area between DELTABEAM® Composite Beam and CLT slabs

- 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

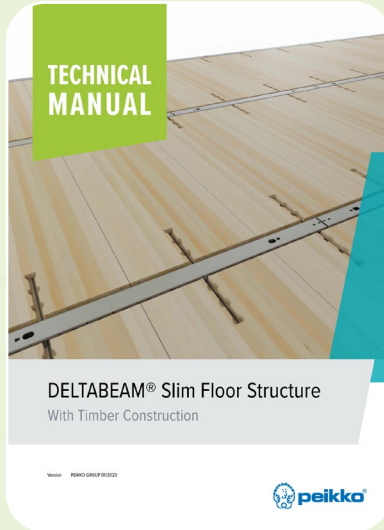


TWO HOUR LOADED FIRE TEST IN NORTH AMERICA

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



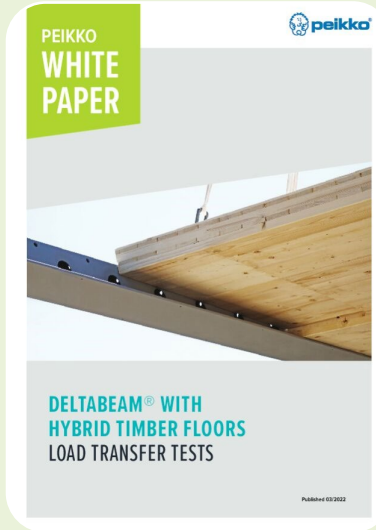
WHITE PAPERS OF HYBRID SOLUTIONS



DELTABEAM®
technical
manual for
timber
construction



High fire
performance of
DELTABEAM®
Slim Floor
joints with
timber slabs



DELTABEAM®
with hybrid
timber floors -
Load transfer
tests



Performance
DELTABEAM® -
CLT floors in
human-
induced
vibration



Optimizing
building life
cycle carbon
footprint and
operational
emissions



ANY QUESTIONS?

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