

COMSOL CONFERENCE 2018 LAUSANNE



Heat and moisture in wooden bearings of monumental buildings (continued)

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Built Environment, BPS

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3 Heat and moisture in wooden bearings of monumental buildings

Wooden beams in walls



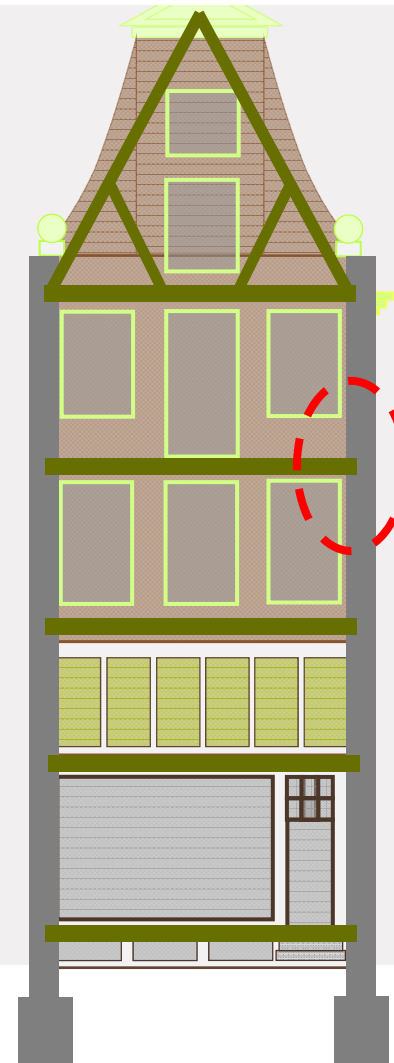


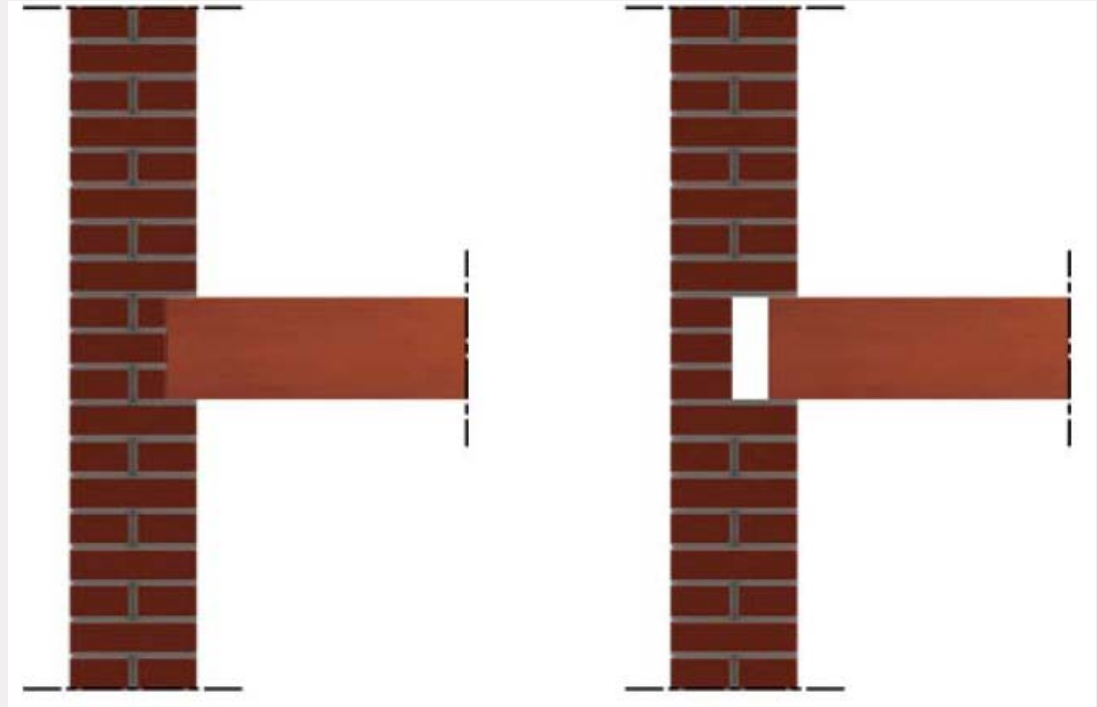
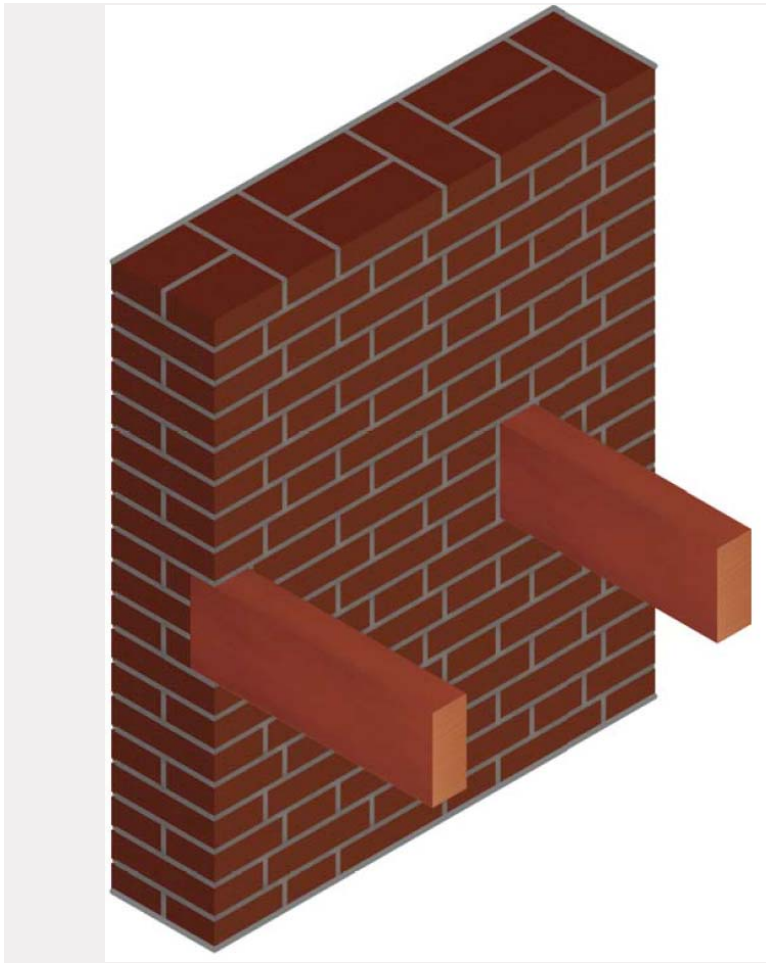


Wooden beams in buildings

Typical construction

- Masonry walls
- Wooden floors
- Wooden truss





Wooden beams in buildings

Risks typical construction

- High wind driven rain load
- Leakages
- Cracks



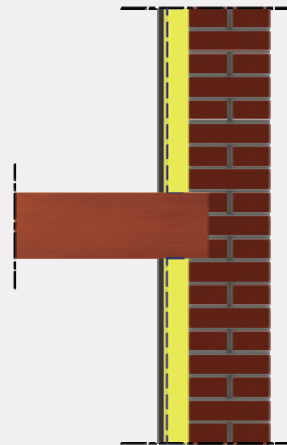
Wooden beams in buildings

Interior insulation risks

- Moisture buildup in materials
- Mould growth
- Deterioration of wood

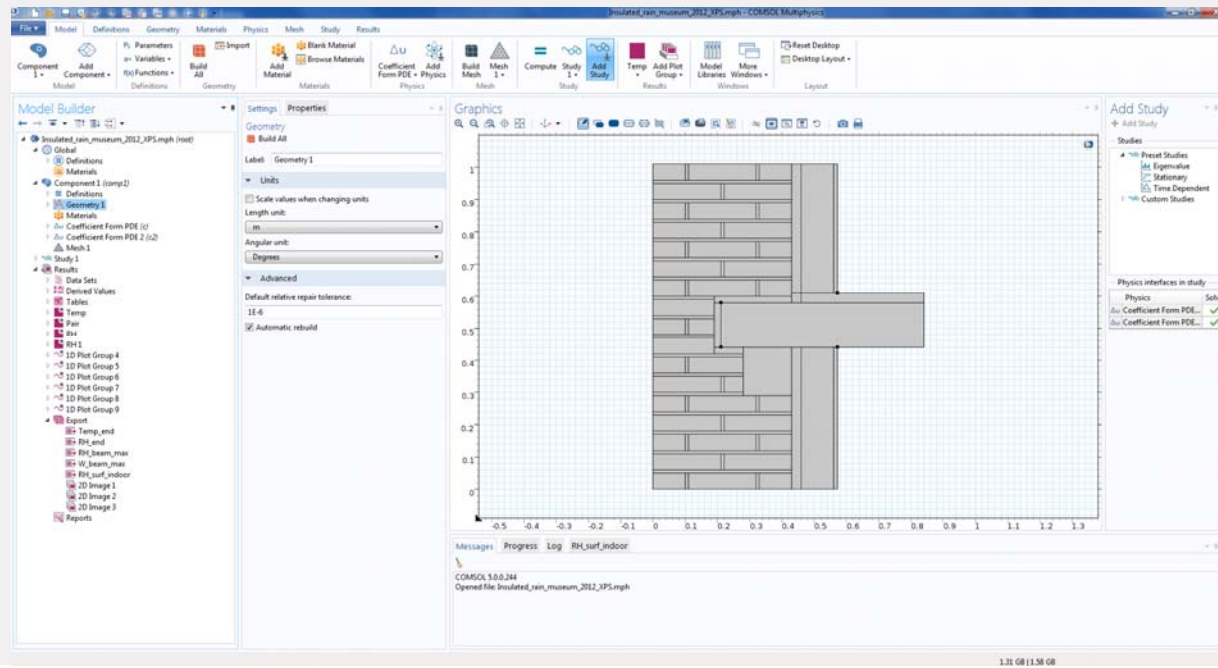
Area of concern

- Air permeability of construction
- Connection vapour barrier



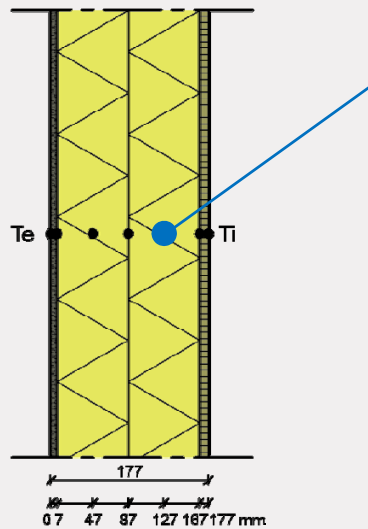
HAM Simulations

Heat, Air and Moisture

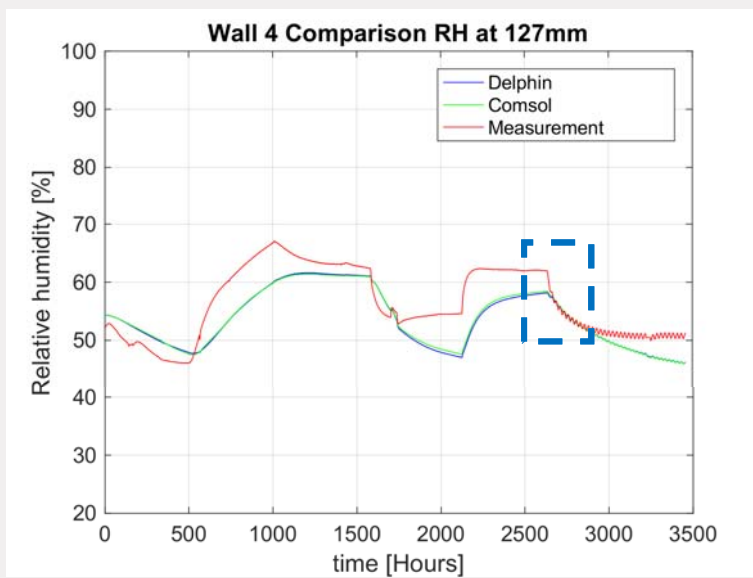


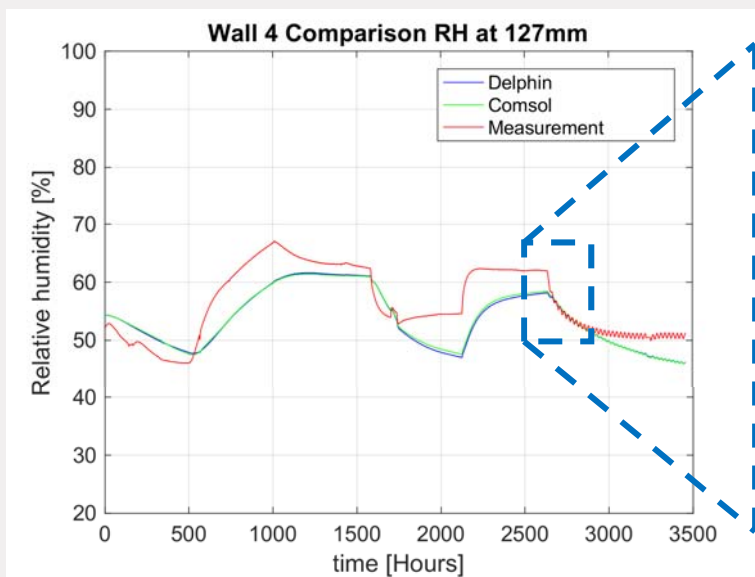
Comparison with Delphin

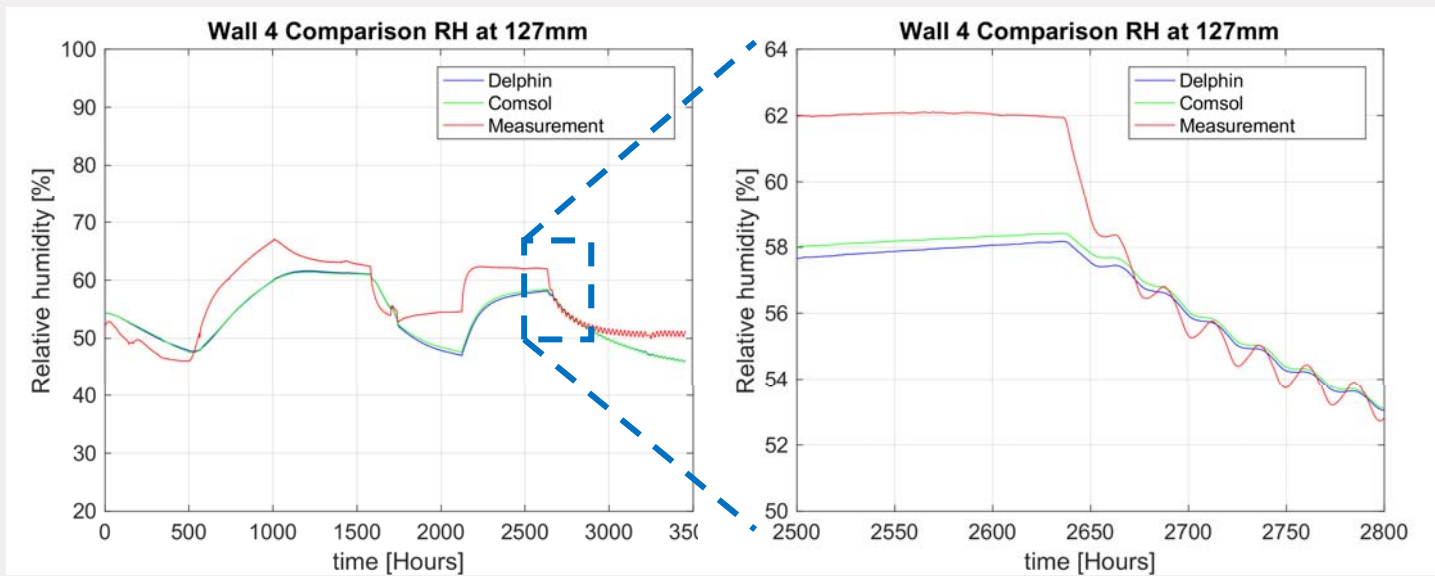
- Materials from Delphin
- Boundary conditions [Rafidiarison, et al. 2015]
- Comsol model based at Goesten, S. [2016]

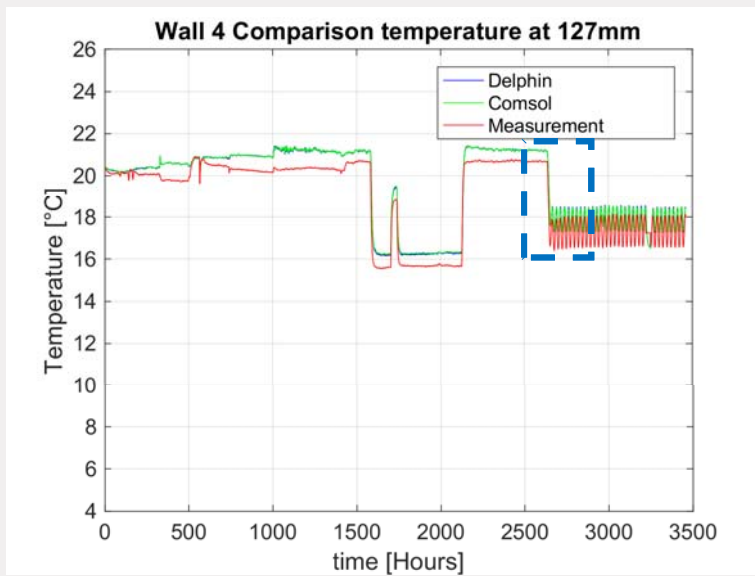


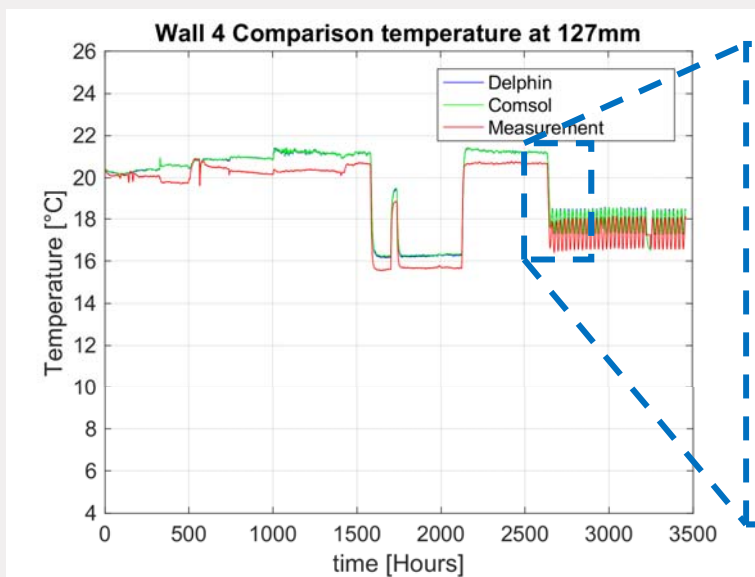
Position 127mm

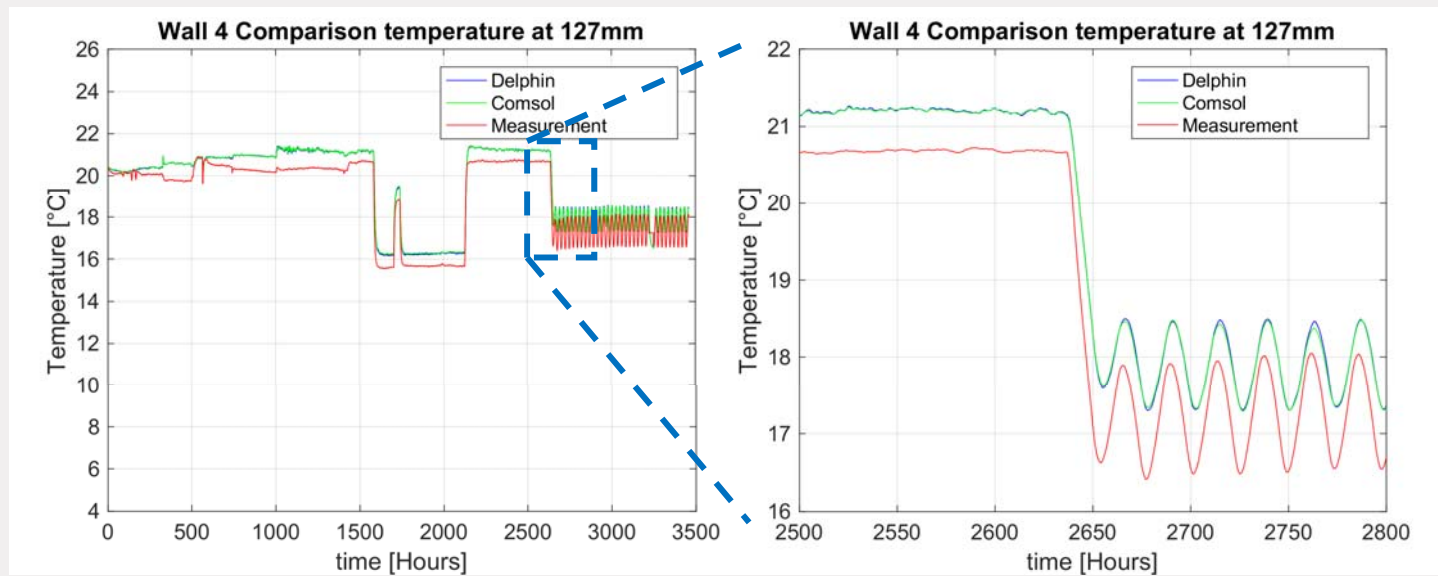












Case study

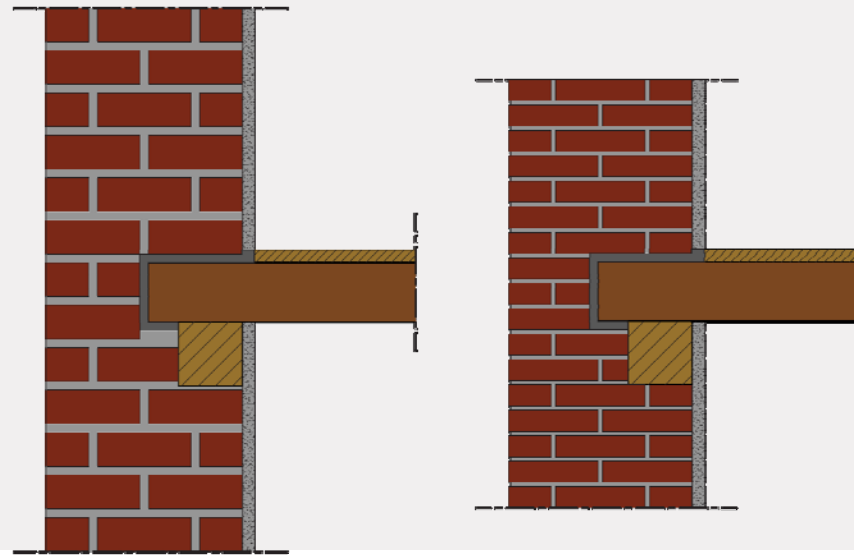
Harrestrup, M. [2016]

Reproduction with COMSOL

Adapted to Dutch sizes

Usage of Dutch climate

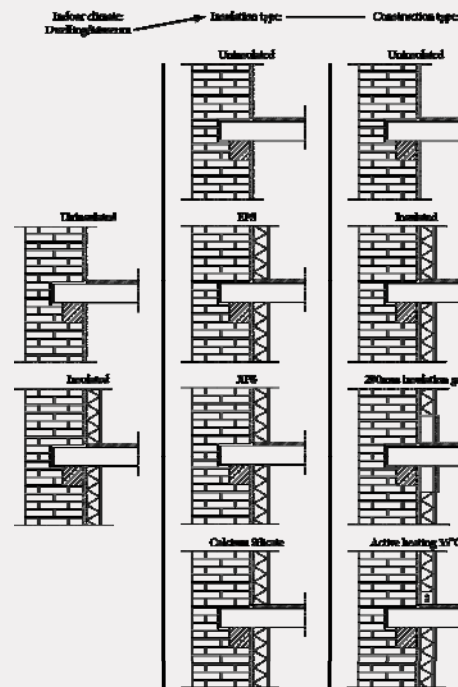
Year 2012 (average)



Case study

Different categories

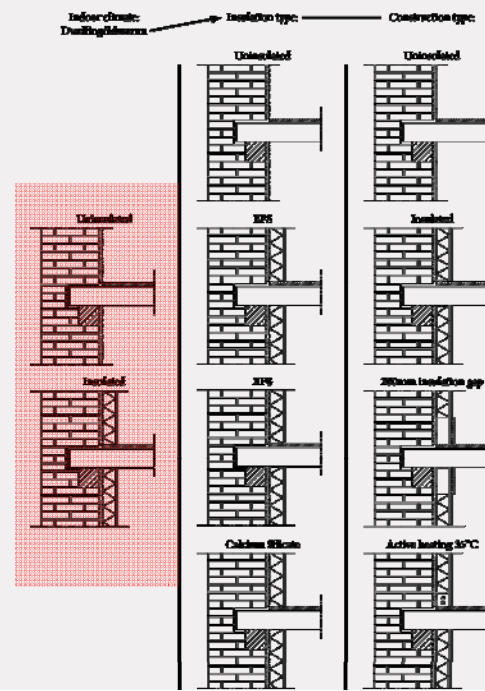
- Indoor climate
- Insulation type
- Construction type



Case study

Different categories

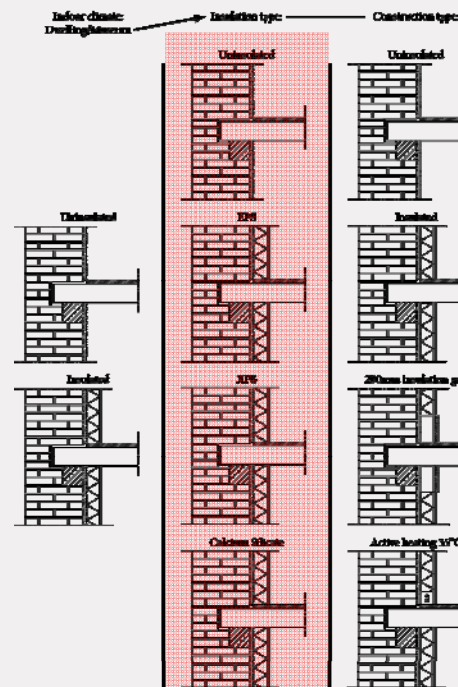
- Indoor climate
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- Construction type



Case study

Different categories

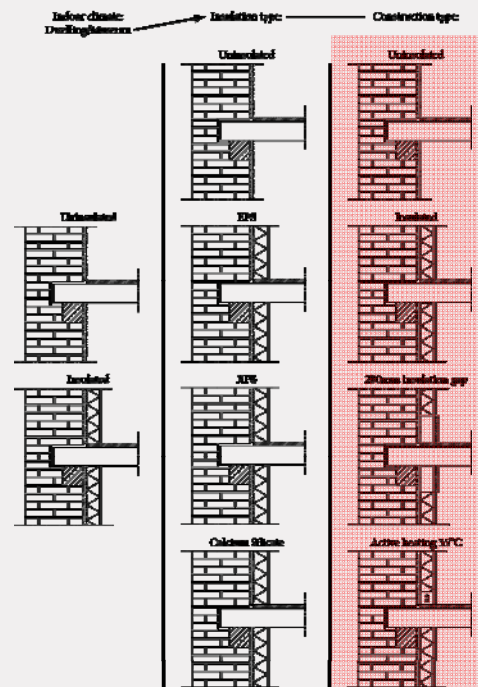
- Indoor climate
- Insulation type**
- Construction type



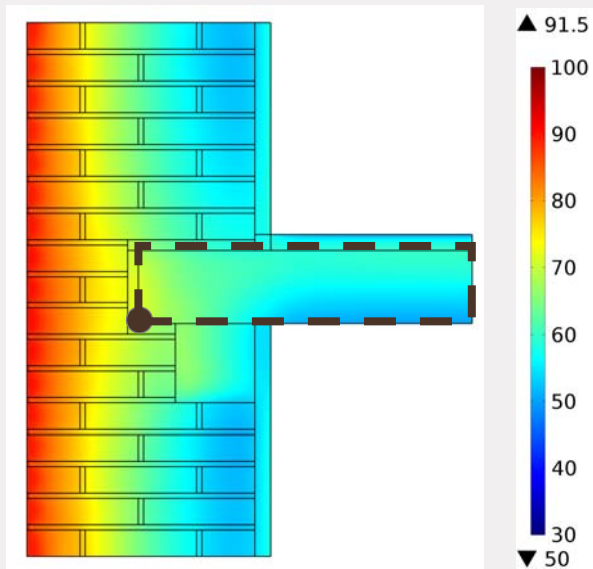
Case study

Different categories

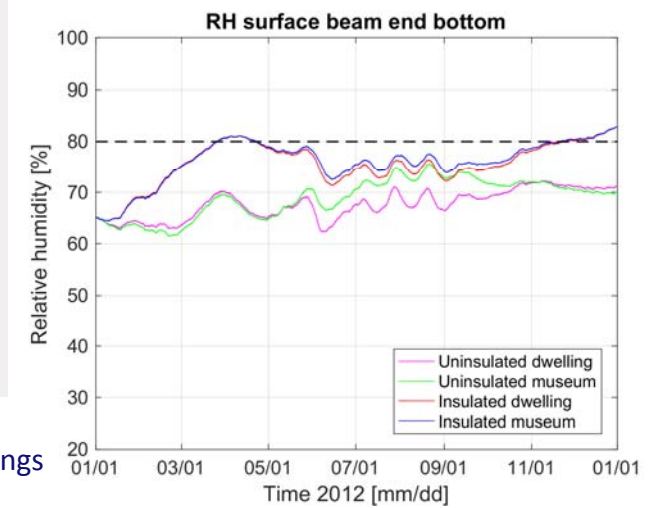
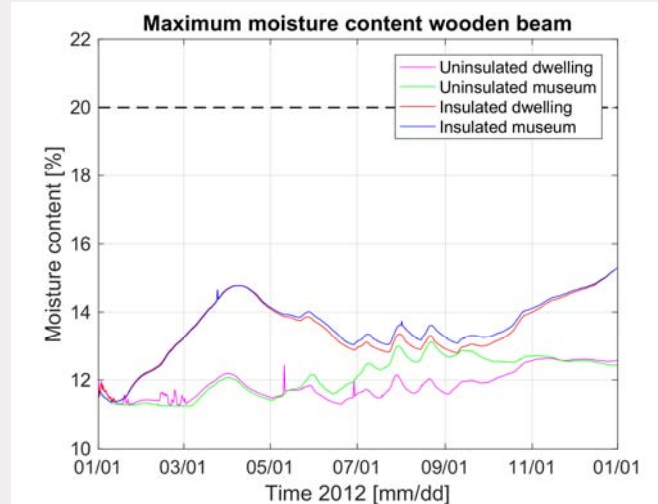
- Indoor climate
- Insulation type
- Construction type**



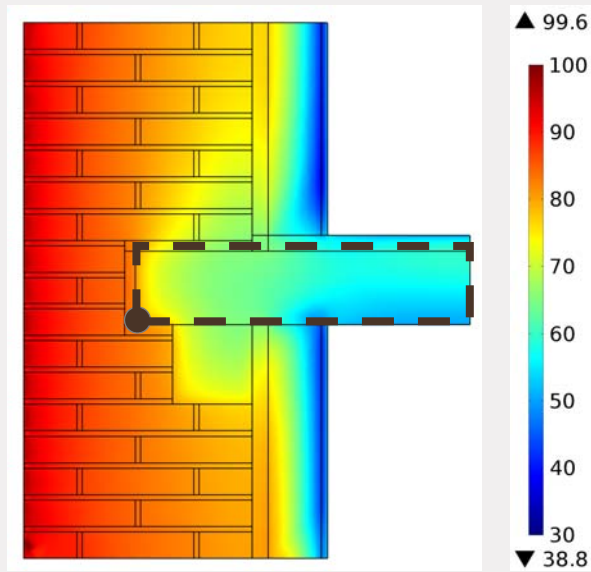
Indoor climate:



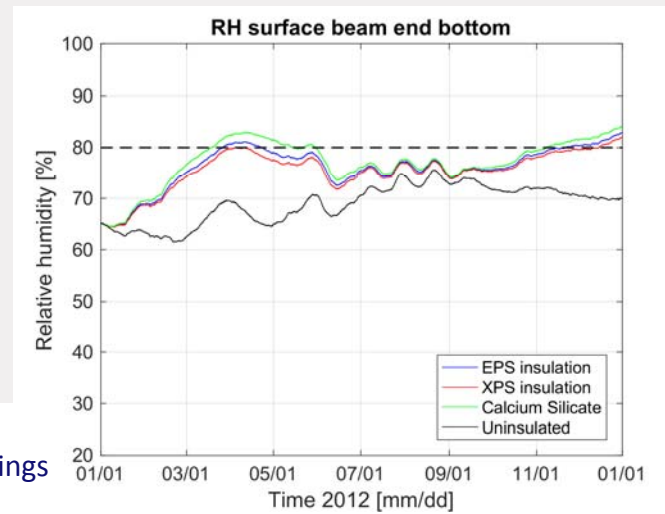
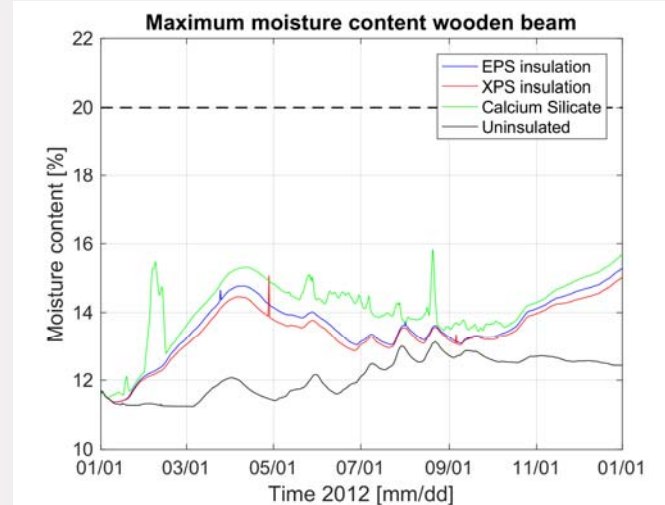
RH at 30-12-2012



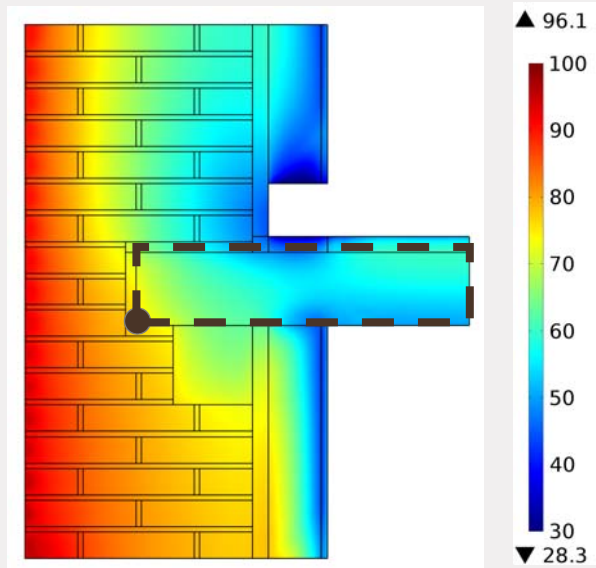
Insulation material:



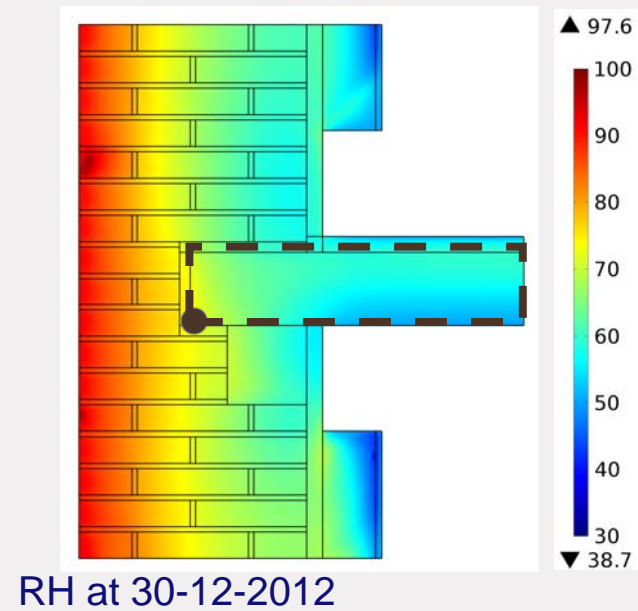
RH at 30-12-2012



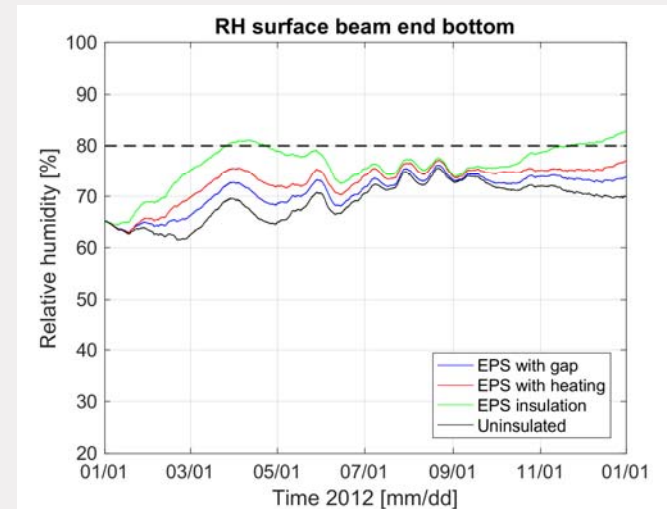
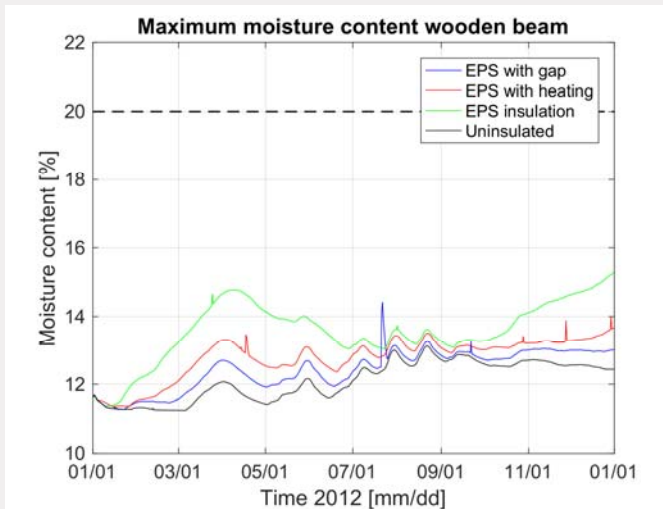
Active heating 35°C



200 mm gap



Construction:



Conclusion

Interior insulation possible

- Museum indoor climate (worst case)
- Moisture buildup
- Risk of mould growth at surface

Effective measures

- Active heating
- Insulation gap of 200mm

Recommendations

Improvement simulation model

- Solar radiation
- Wind/rain climate (measured or with CFD)
- Simulation multiple years
- 3D models

Questions?