



Thermo-Mechanical Setup for Real-Time Multiphysics Hybrid Simulation

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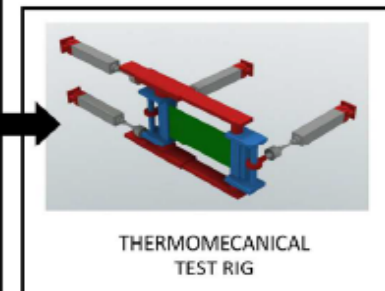
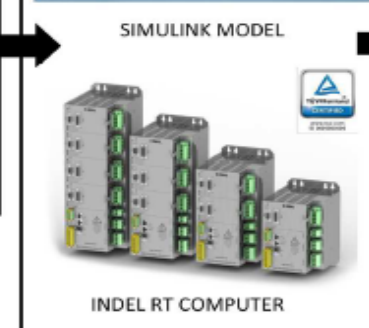
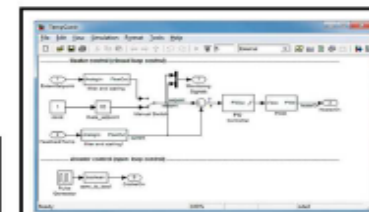
Outline

- Motivation
- The Thermo-Mechanical Test Rig
- Projects
- Conclusions

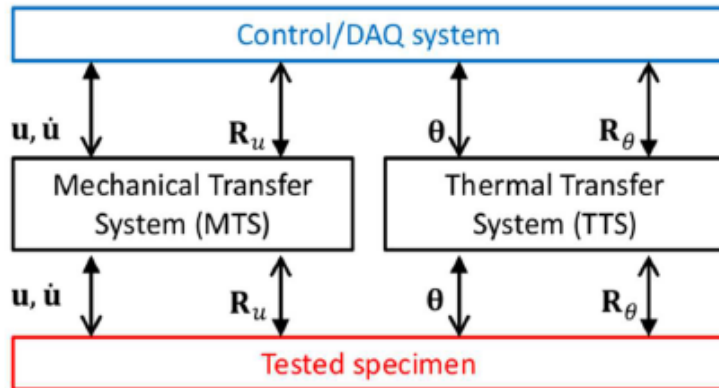
Motivation

- Why Hybrid Simulation?
 - flexibility and cost-effectiveness of computer simulation
 - realism of experimental testing
 - no need to model the “more complex” parts → physically tested
- Why Multiphysics Simulation?
 - more than one simultaneously occurring physical fields
 - displacements with thermal loading conflicts the overall response

Thermo-Mechanical Test Rig



Thermo-Mechanical Test Rig



Architecture of the TM-TR.

■ Mechanical Transfer System (MTS)

- Actuator



- Load Cell



- Laser



- LVDT



■ Thermal Transfer System (TTS)

- IR Lamp



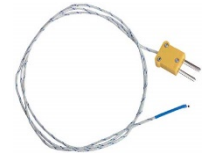
- Peltier module

- Heat sink

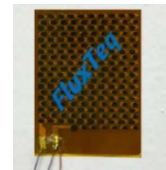
- Fan



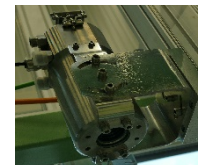
- Thermocouple



- Heat flux gauge



- IR camera



Thermo-Mechanical Test Rig

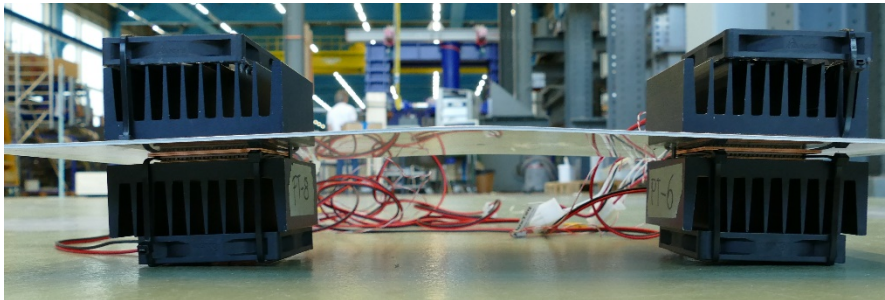


Physical substructure: Plate
Numerical substructure: BCs

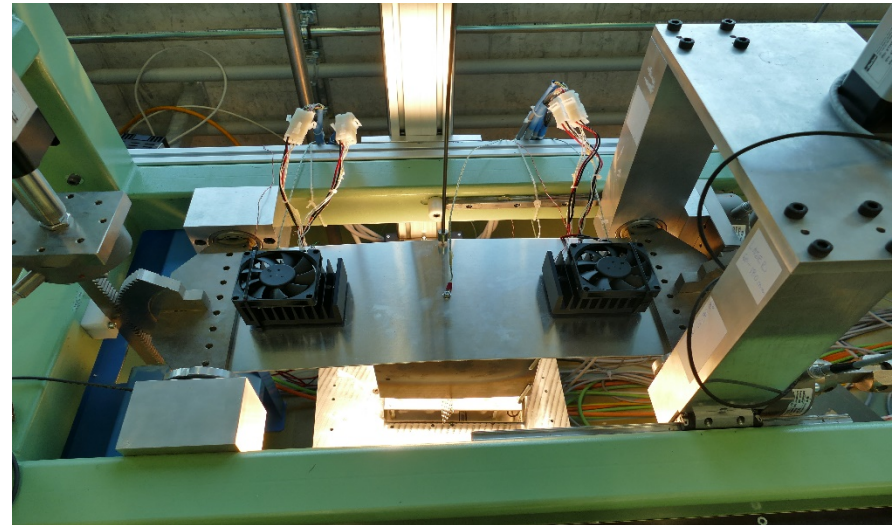


Project: Thermo-Mechanical RTHS

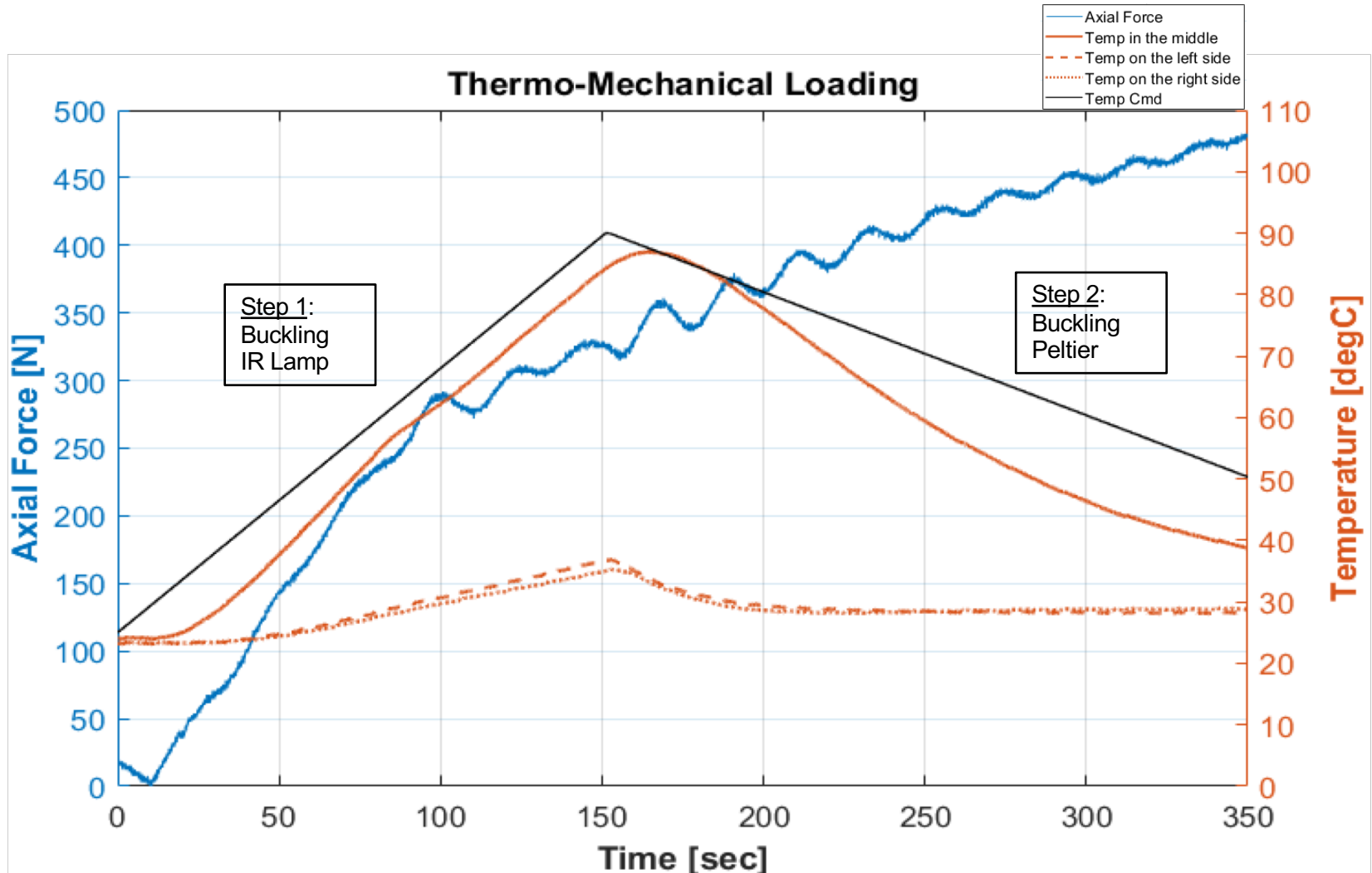
- Mechanical loading: Hybrid Simulation
 - Physical substructure: Aluminium plate
 - Numerical substructure: BCs - Free clamps at both edges
 - Axial target displacement: 30 mm out-of-plane
- Thermal loading: Time History
 - Heating: 23-90 °C, 0-151 sec
 - Cooling: 90-28 °C, 152-350 sec
- Runtime: ~350 sec



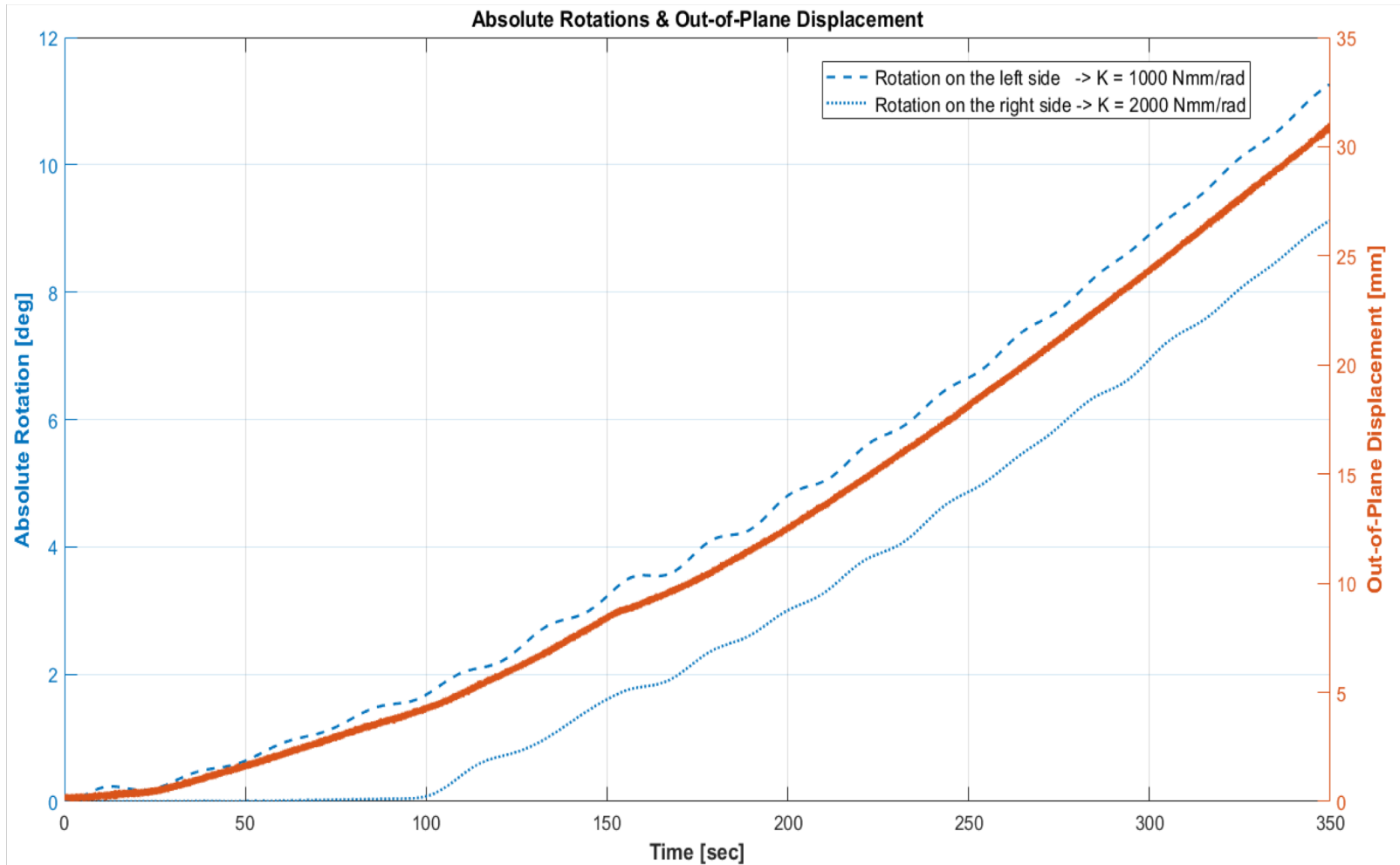
500x200x1 mm



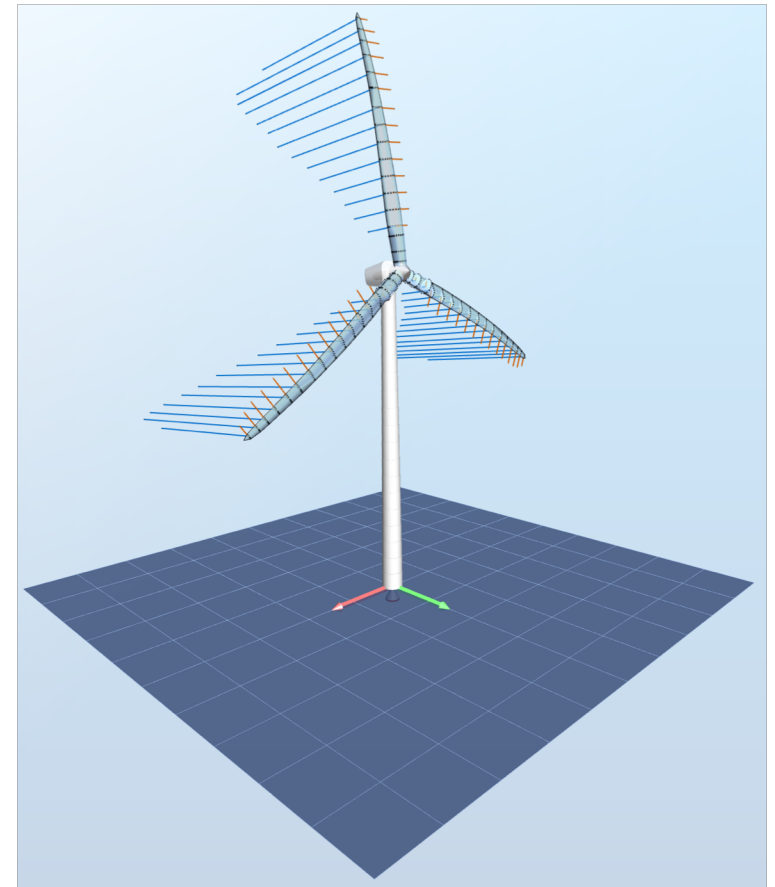
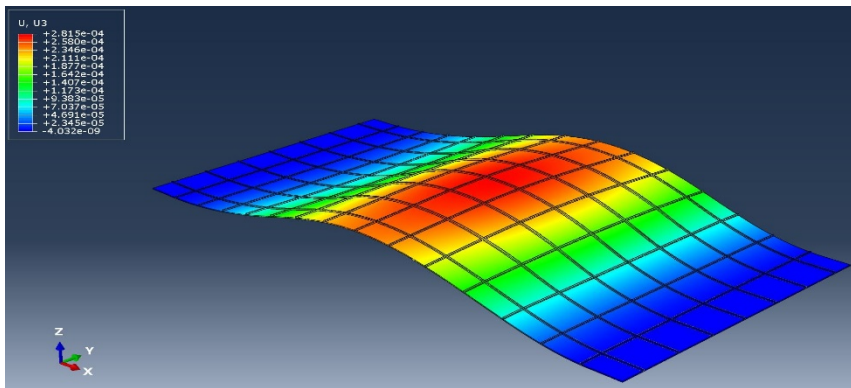
Project: Thermo-Mechanical RTHS



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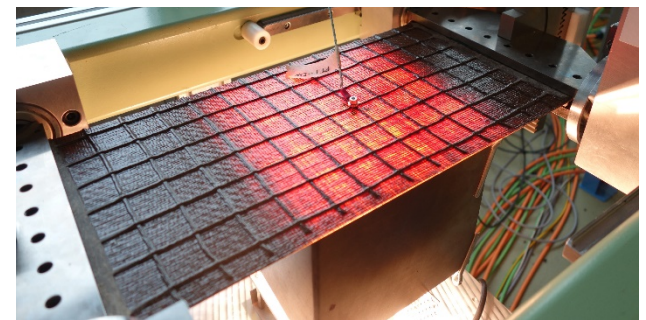
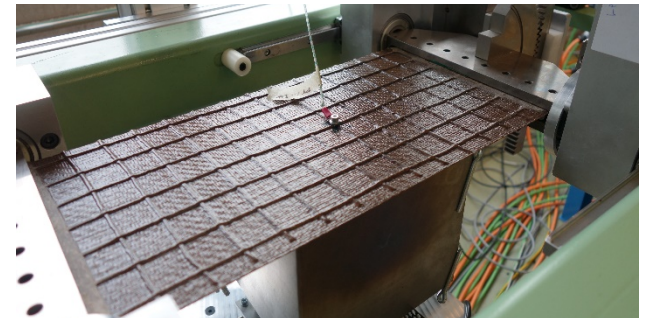
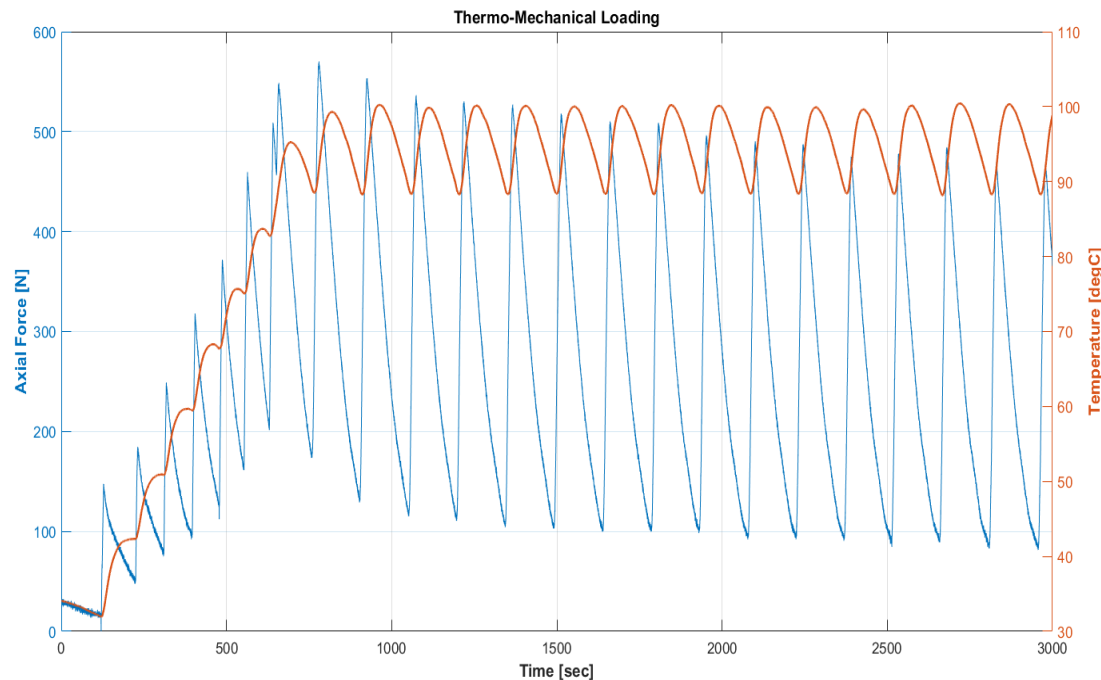


Project: Composite PowerRib Plate



Project: Composite PowerRib Plate

- Mechanical BCs: Fixed clamps at both edges
- Thermal loading: Temperature ramp $23 \div 90$ °C
- Runtime: 50 min

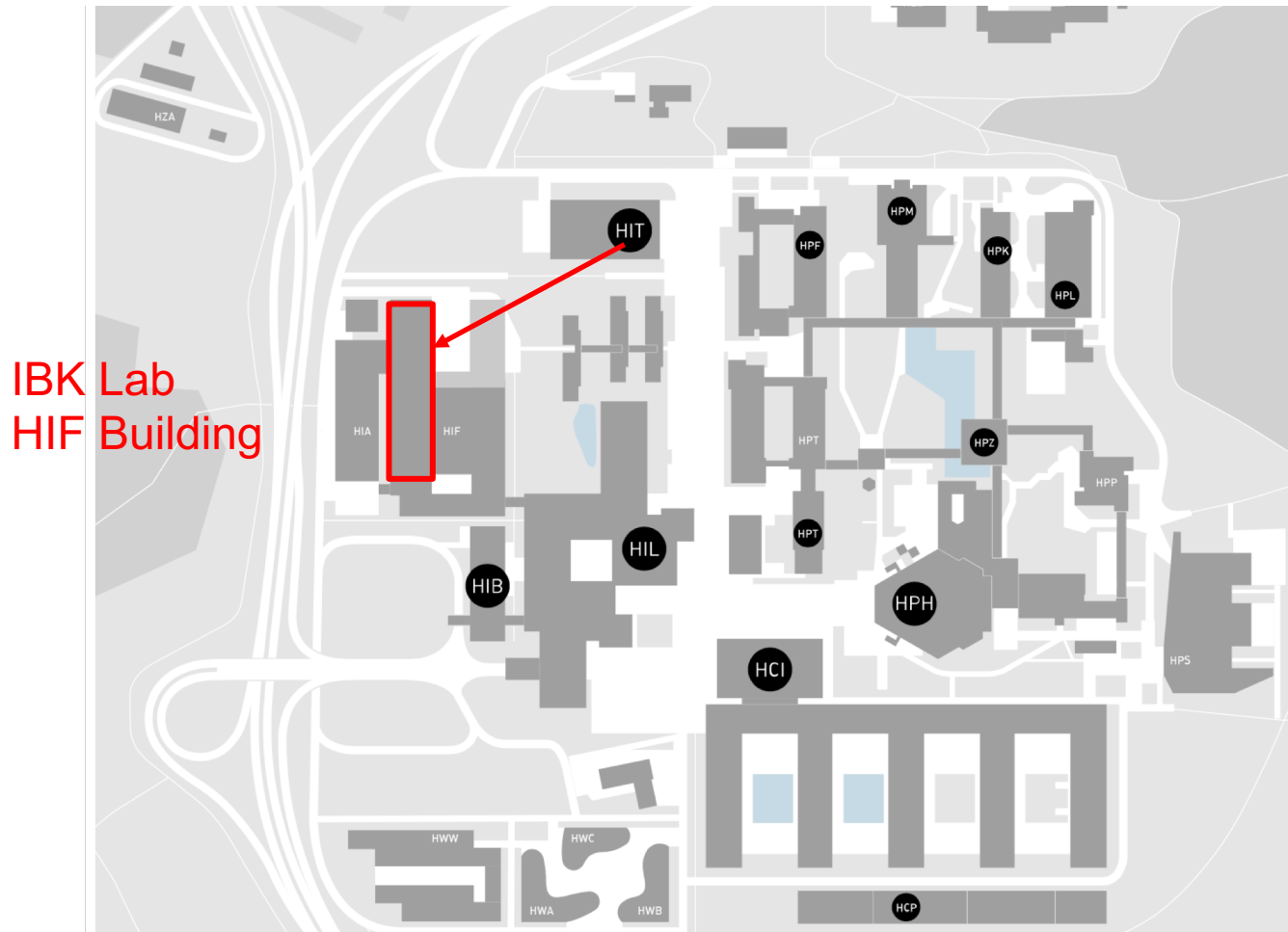


420x200x2 mm

Conclusions

- Validation of the setup
- Accurate thermo-mechanical control of the specimen
- Observe how mechanical & thermal loading interact to generate the overall response
- Ability to conduct complex testing – modular system

ETH IBK Structural Testing Laboratory



Thank you!

Questions?