

BRANDSKYDDSLAGET

Comparison of numerical simulations and compartment fire
experiments with the ventilation supply
positioned adjacent to the floor

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Agenda

- Background
- Description of fire experiments
- FDS-simulations – setup
- FDS-simulations – results and comparison
- Conclusions

Different protection measures in the ventilation system

Common internationally

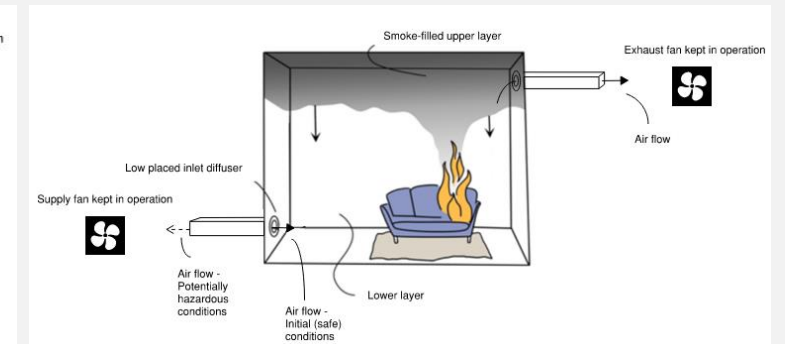
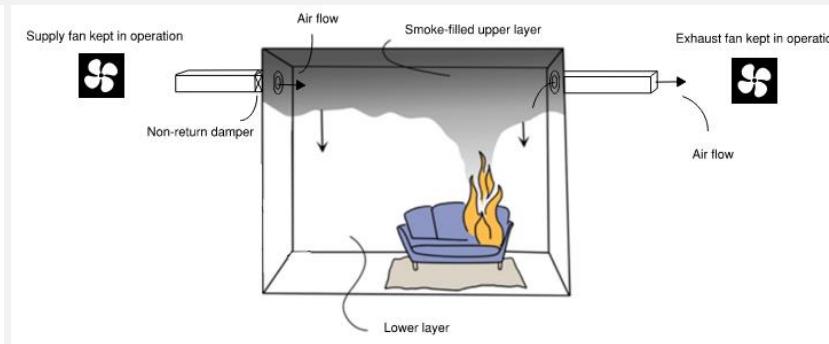
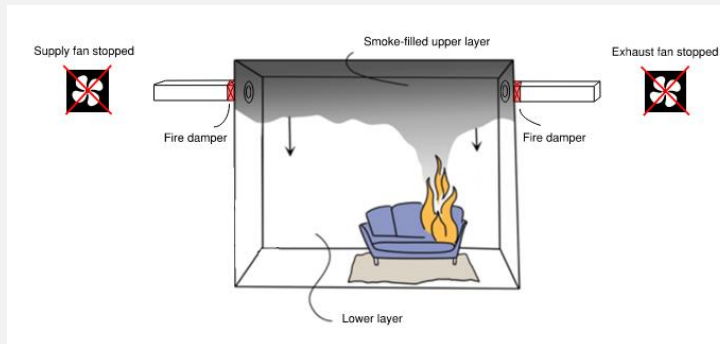
- Stopped fans
- Closed fire dampers

Common in Sweden

- Fans kept in operation
- Non-return dampers on the supply side
- Limited amount of fire dampers

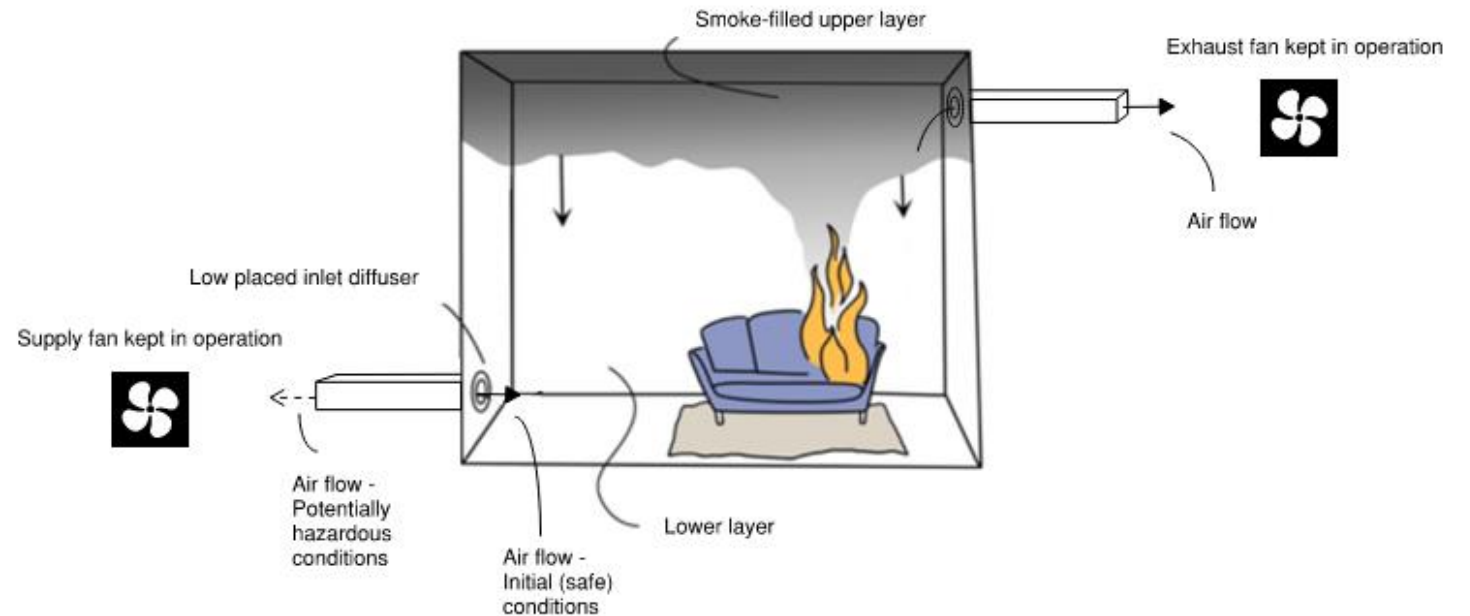
Alternate approach

- Fans kept in operation
- Low placed inlet diffusers instead of non-return dampers

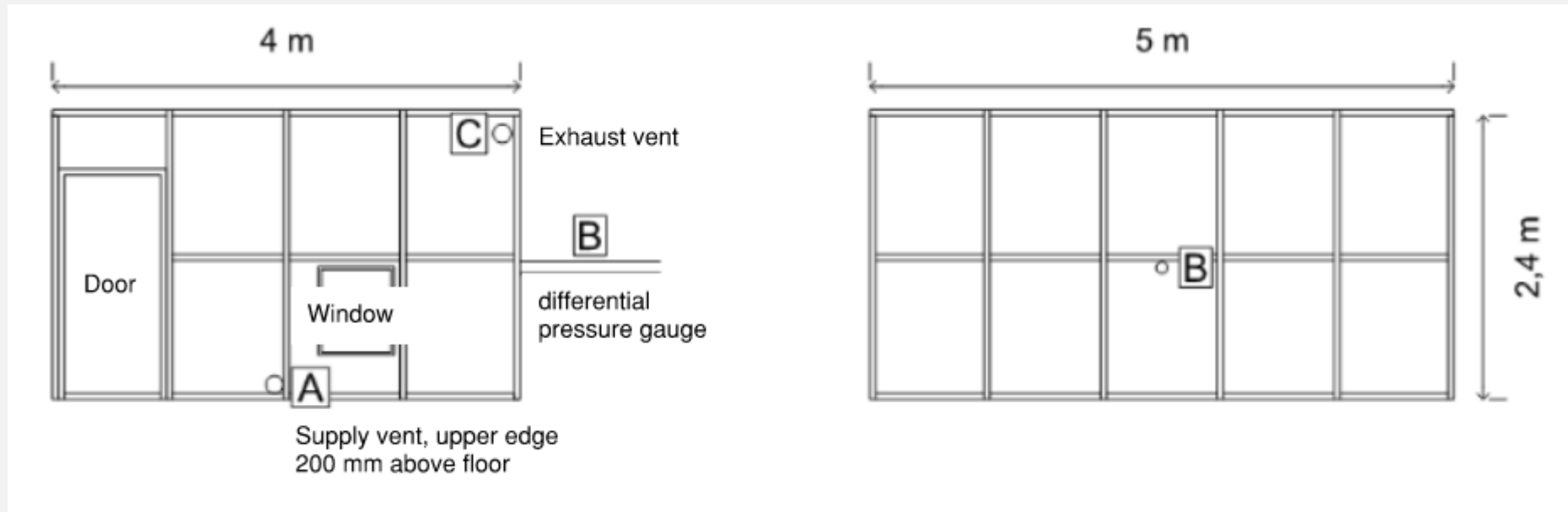


Low placed inlet diffusers

- Ventilation supply close to the floor is sometimes a possible solution
- Initial state critical
- Smoke stratification leads to quite clean air volumes being pressed out
- Full scale tests from 2021 the basis for my work



Description of the compartment fire experiments

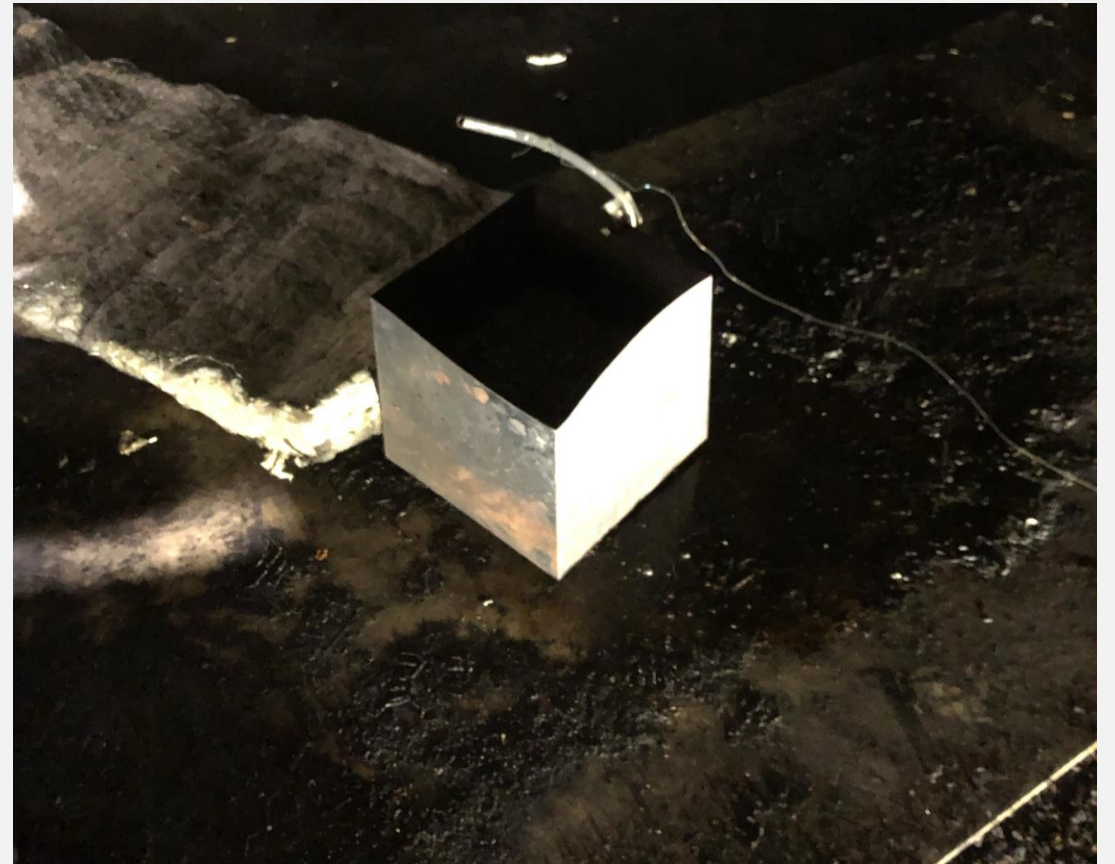


Description of the compartment fire experiments



Description of the compartment fire experiments

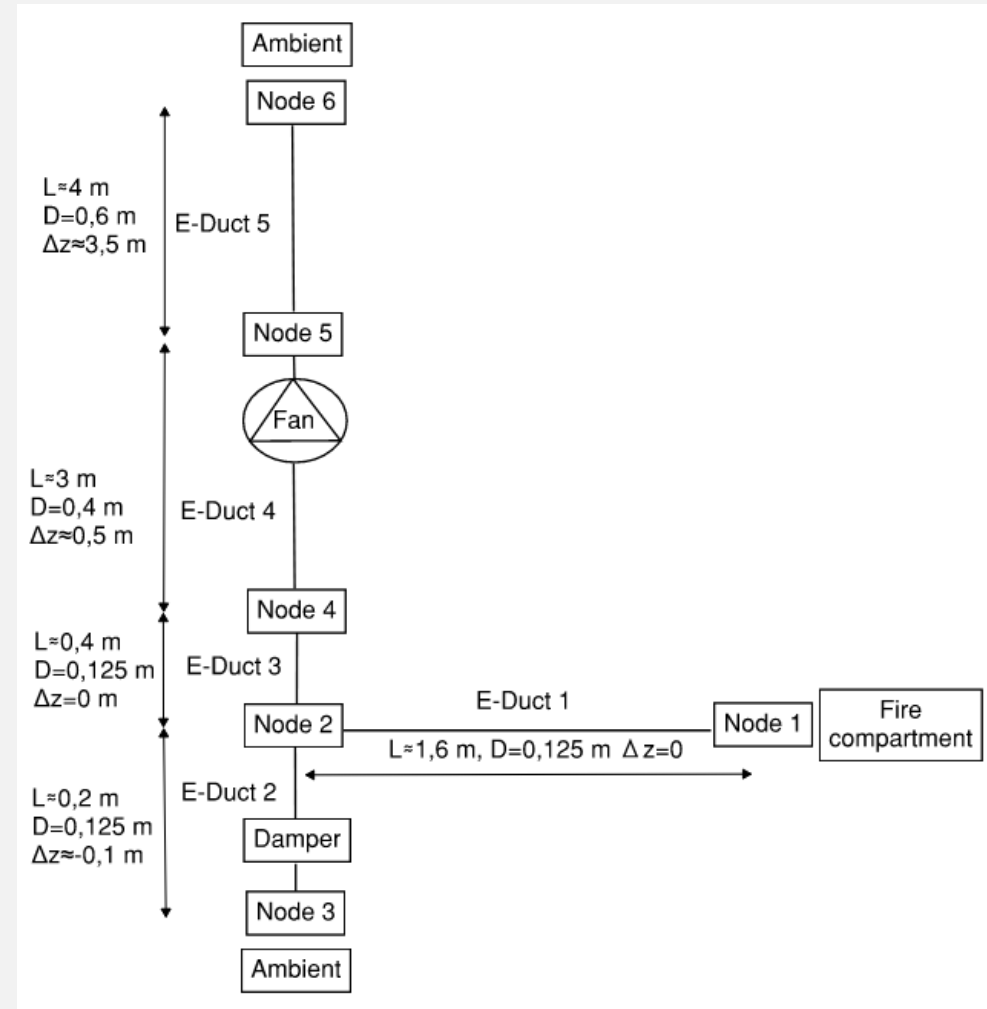
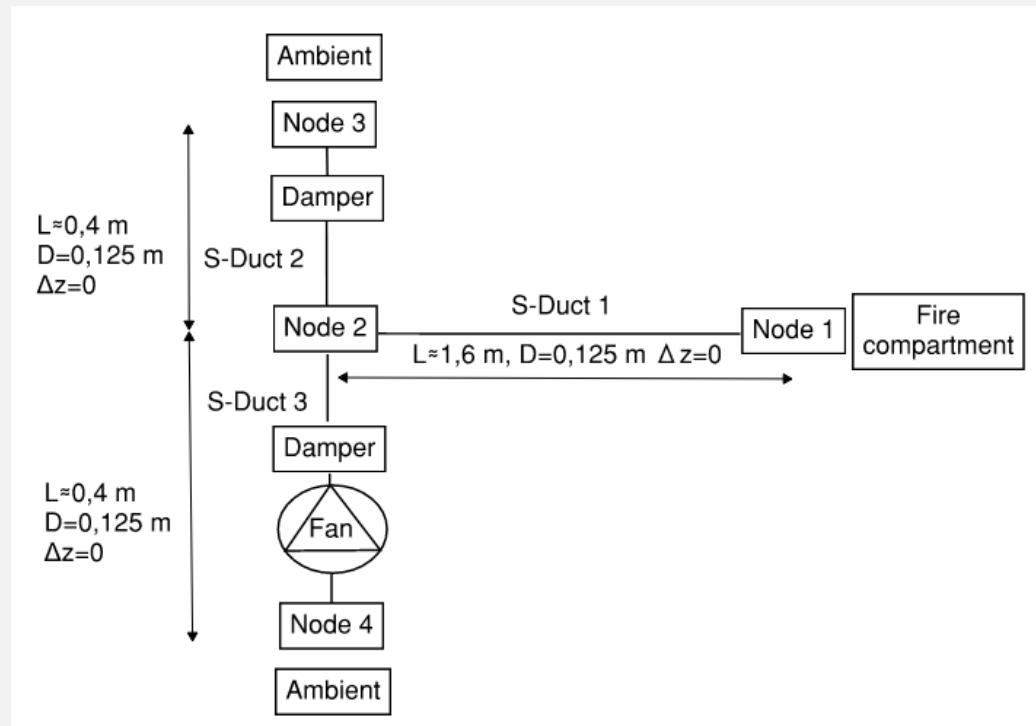
- Three different kind of fires
 - "Prison fires"
 - "Natural fires"
 - T-squared fires (95 % propane)
- Different ventilation conditions
 - No ventilation (open ducts)
 - Mechanical ventilation
- In total 18 tests



FDS-simulations – setup

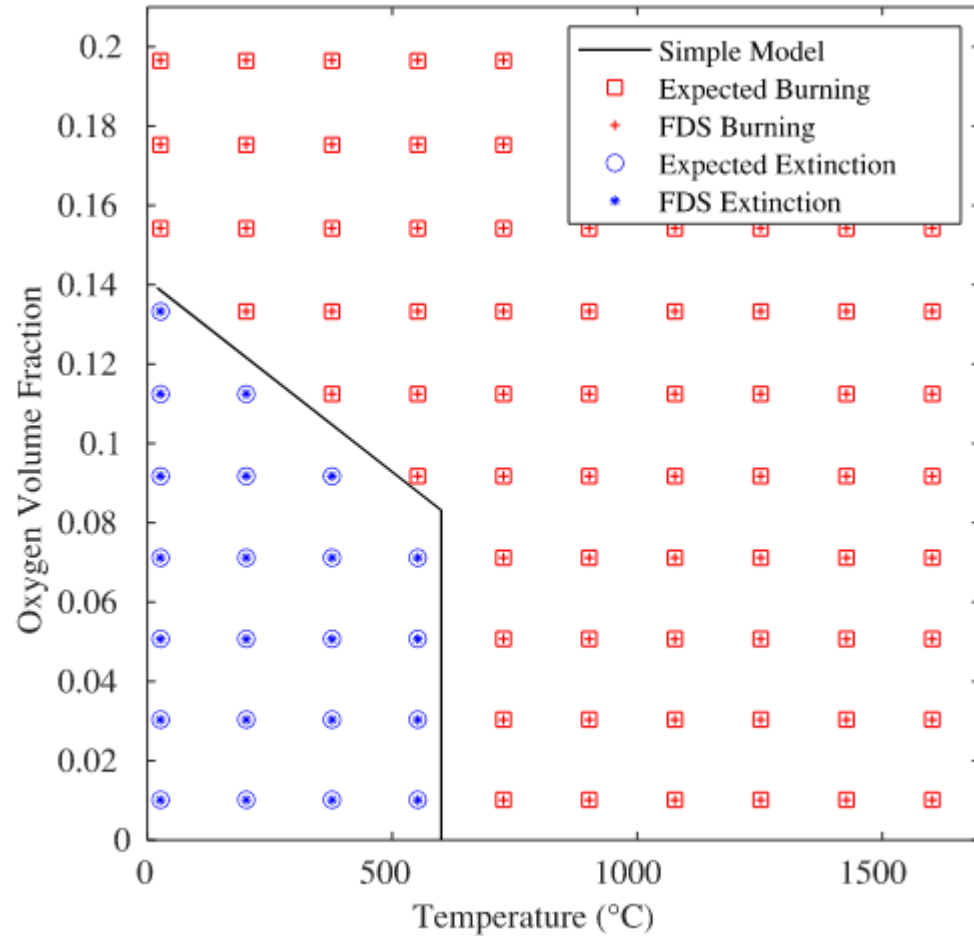
- FDS version 6.7.9
- 5 cm grid, one mesh.
- Propane as a fuel.
- HRR input known from experiment (slow, medium, fast)
- HVAC-model to simulate the ventilation system

FDS-simulations – setup

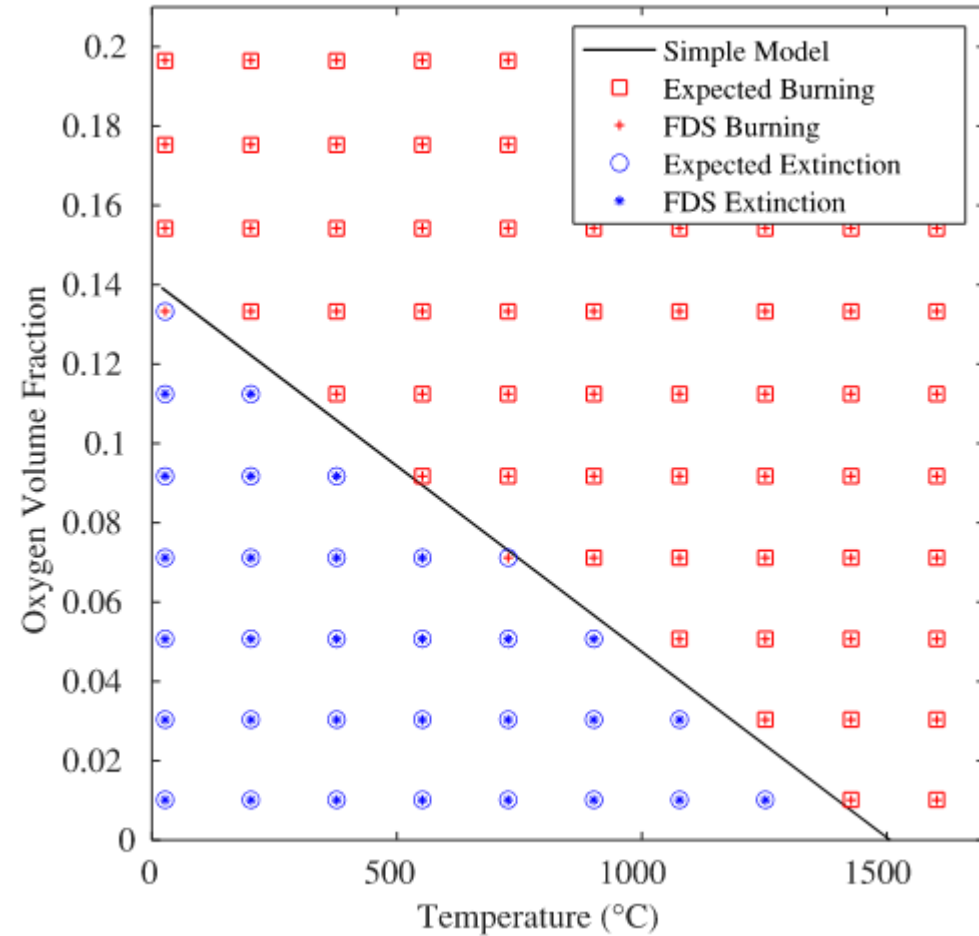


FDS-simulations – setup

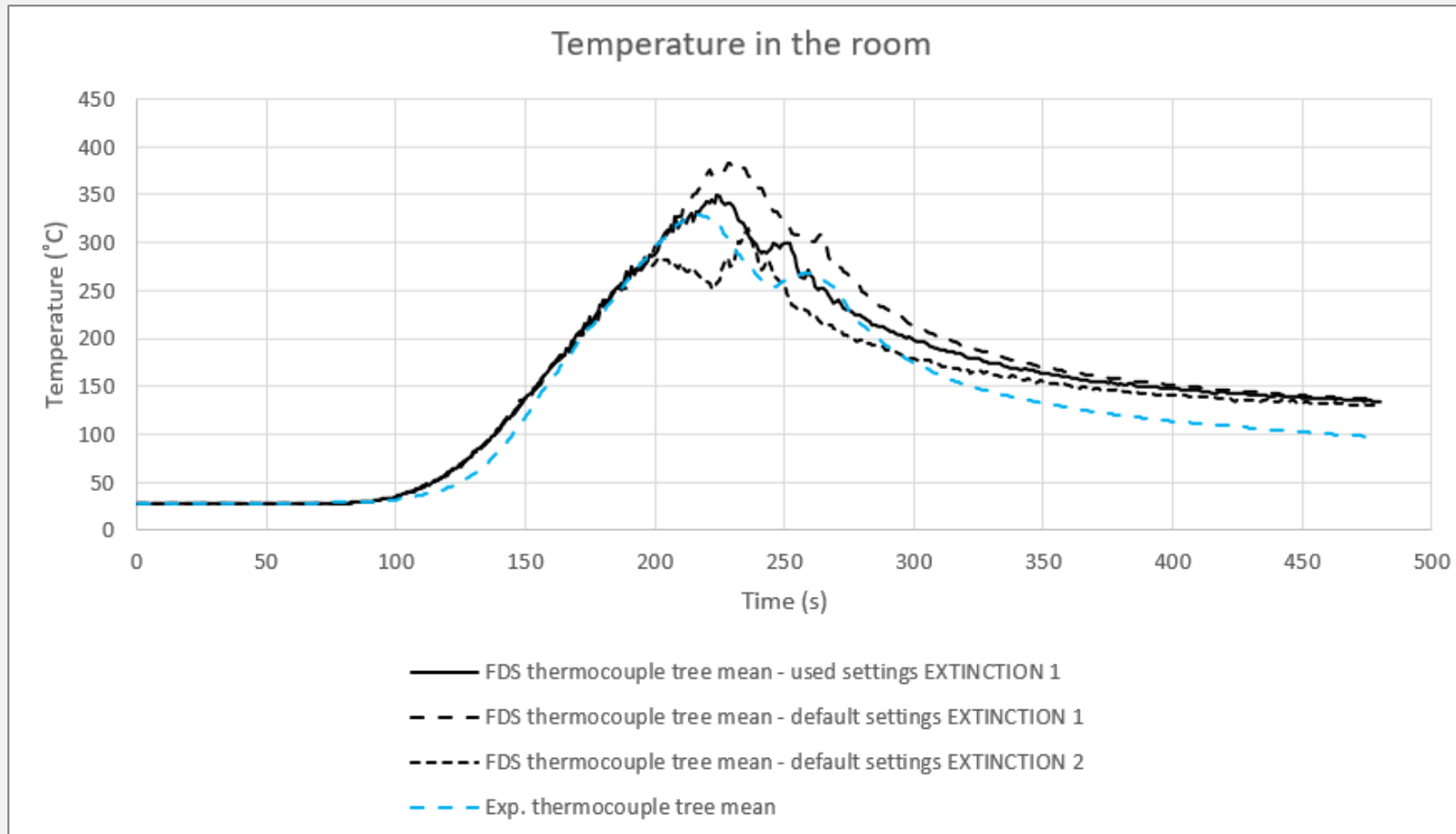
Extinction model 1



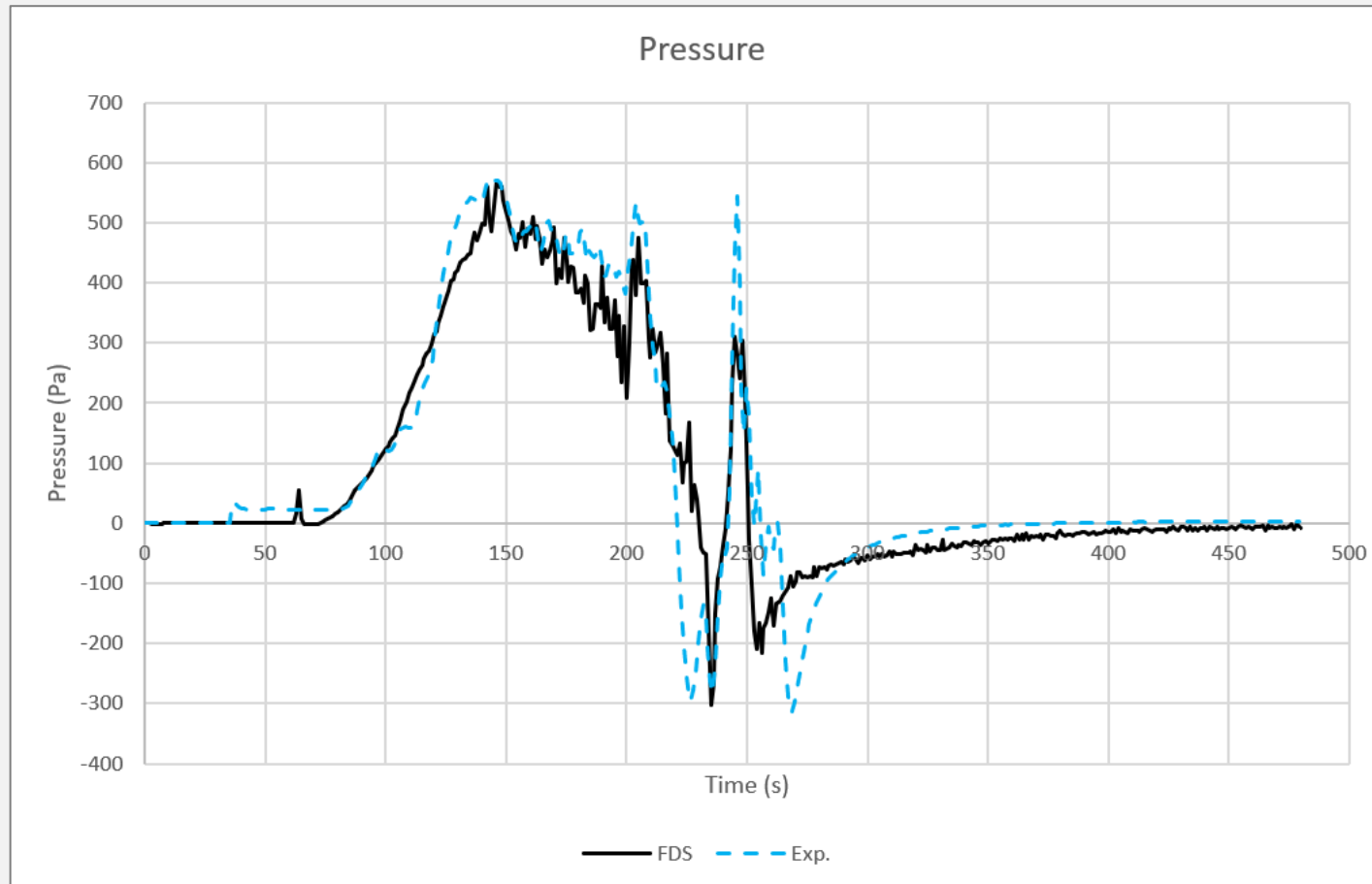
Extinction model 2



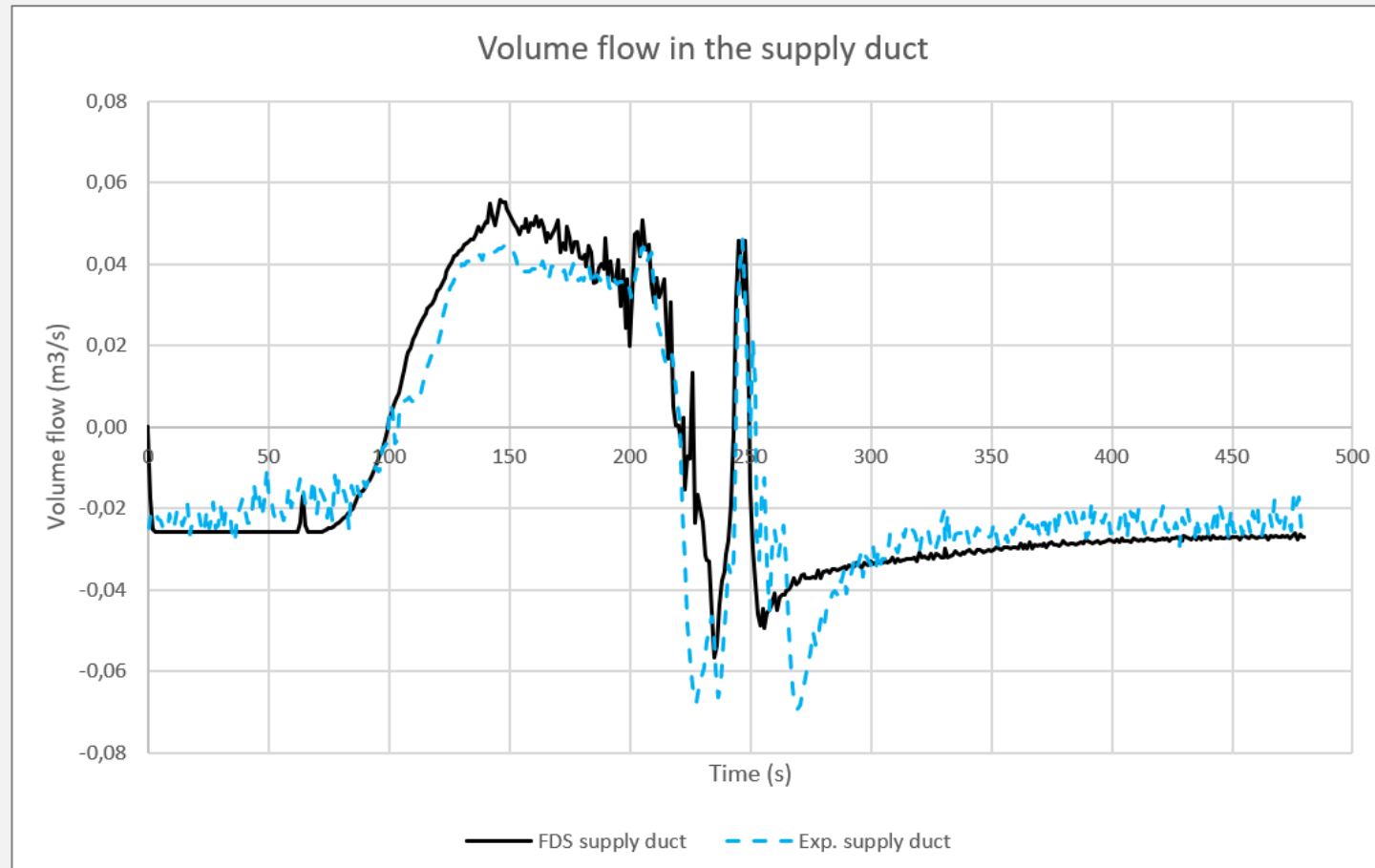
Results – temperature in the room



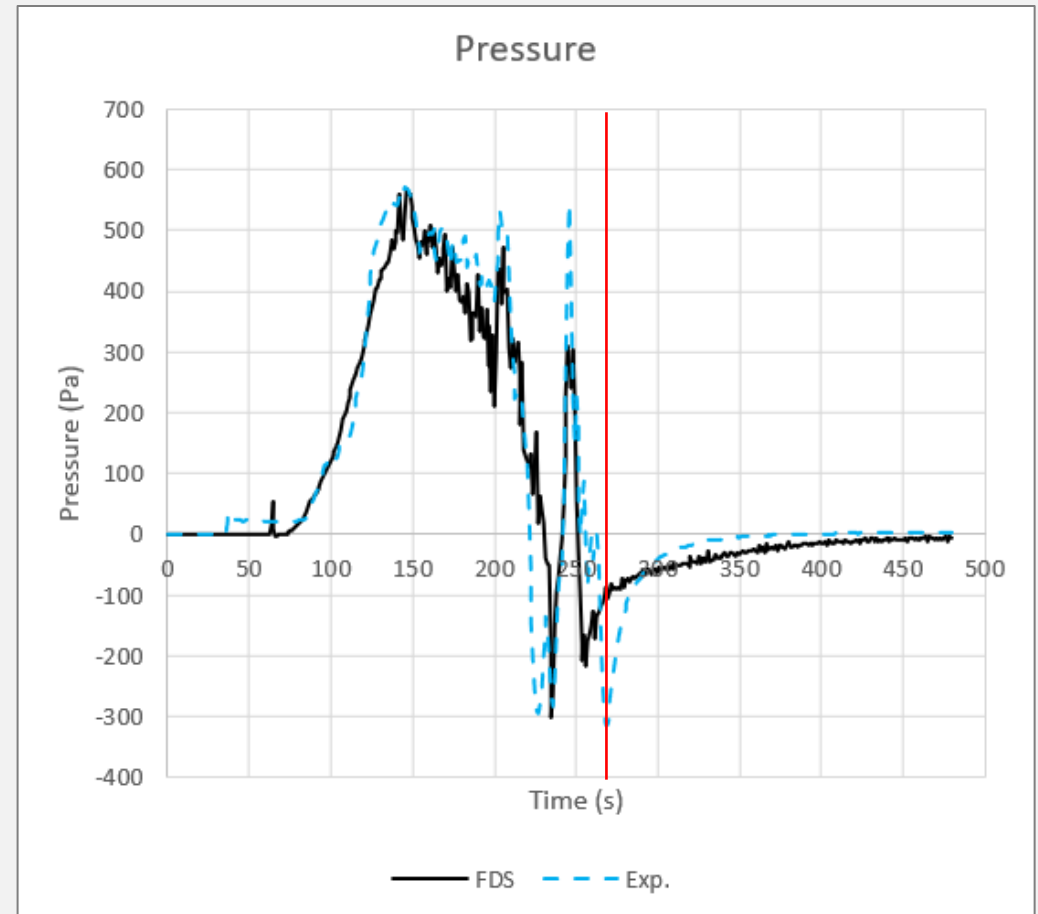
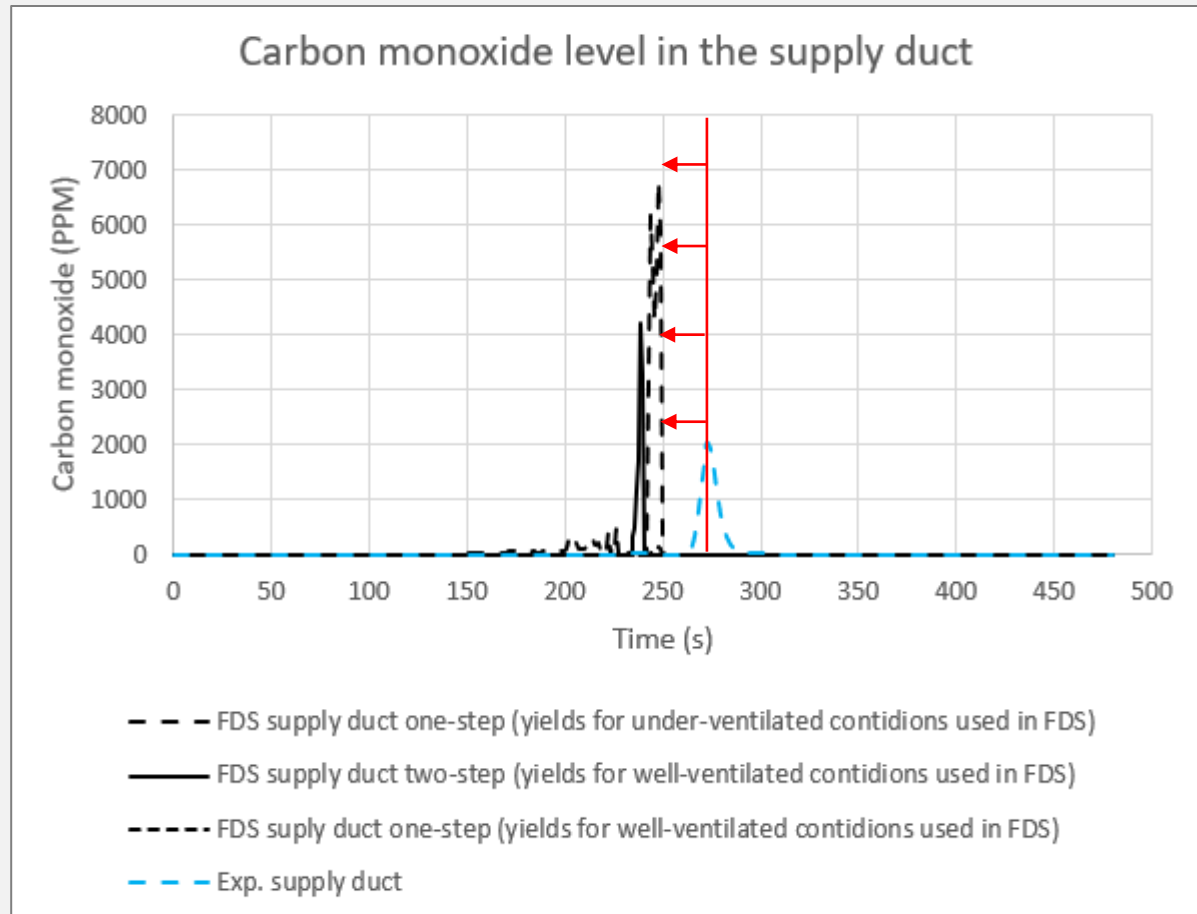
Results – pressure



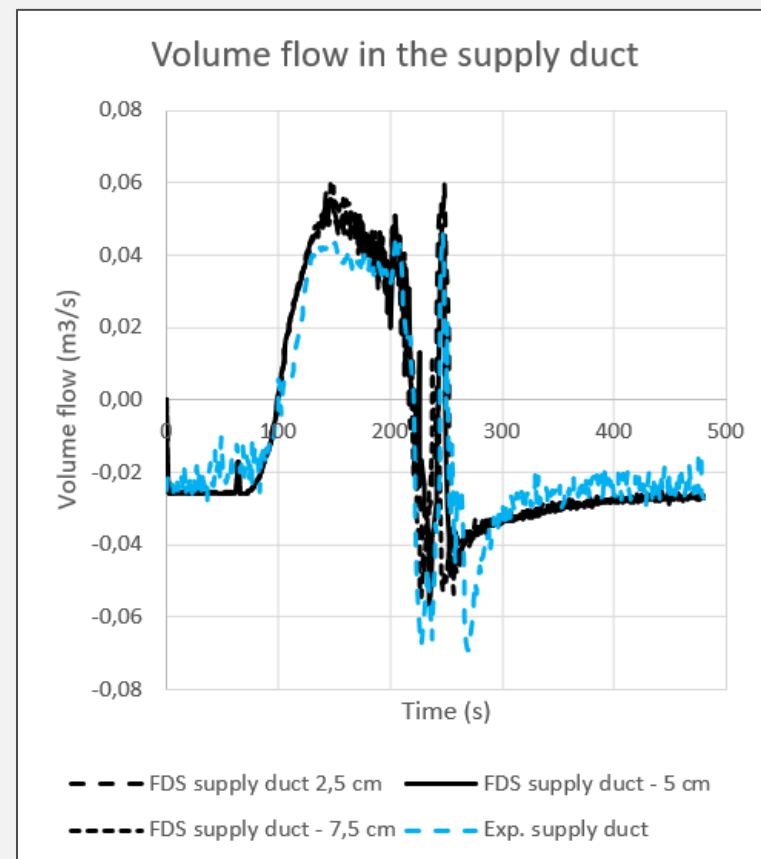
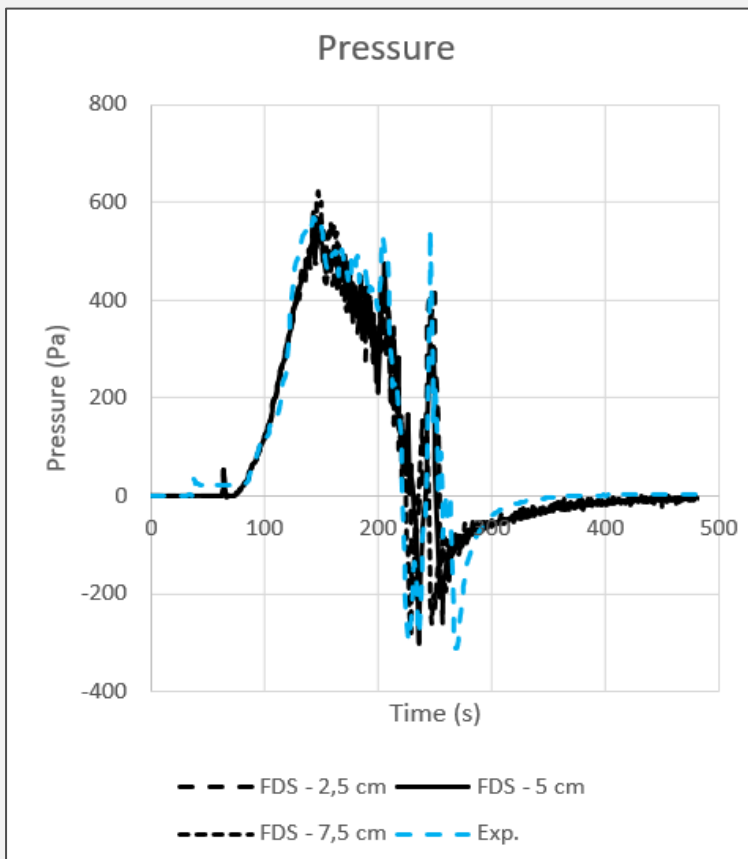
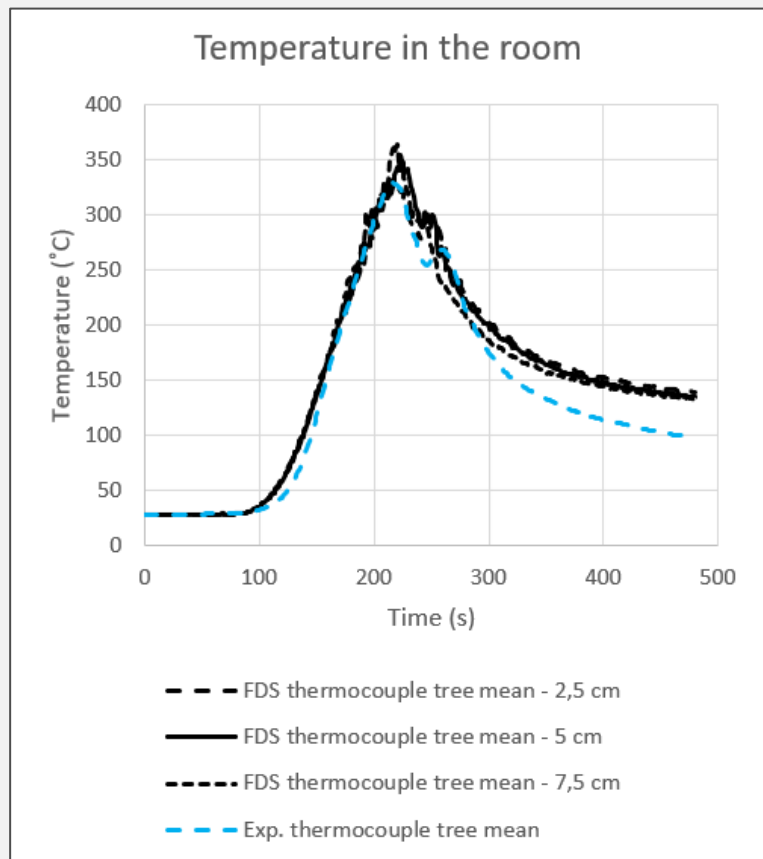
Results – volume flow in the supply duct



Results – CO level in the supply duct



Grid resolution study



Conclusions

- FDS can simulate scenarios as the described with low placed supply vents.
- Temperature, pressure and volume flow to a high degree matches the experiment.
- Careful considerations needs to be made regarding, amongst others, the extinction model.
- Increased levels of soot and CO when the fire becomes under-ventilated is a challenge. Two-step simple chemistry works but seems do not fully capture the effects.

Thank you!

Questions?