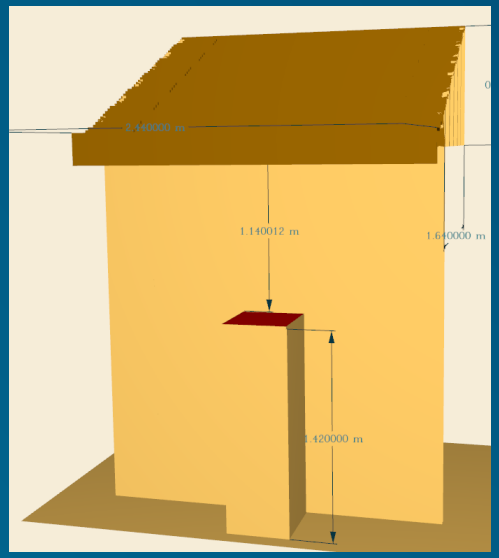
FDS simulations of heat exposure and flow conditions at the eave and in the attic

NIST WUI Fire Days 2022

Xareni Sanchez Monroy



07/13/2022

Motivation

Indoor Shed Burn Experiments with Target Structure

Evaluation of target structure performance:

- Window failure
- Eave ignition
- Vent performance

1B-SVSh0-5

1B-SVSh0-5-R1

plenum exhaust fan fail

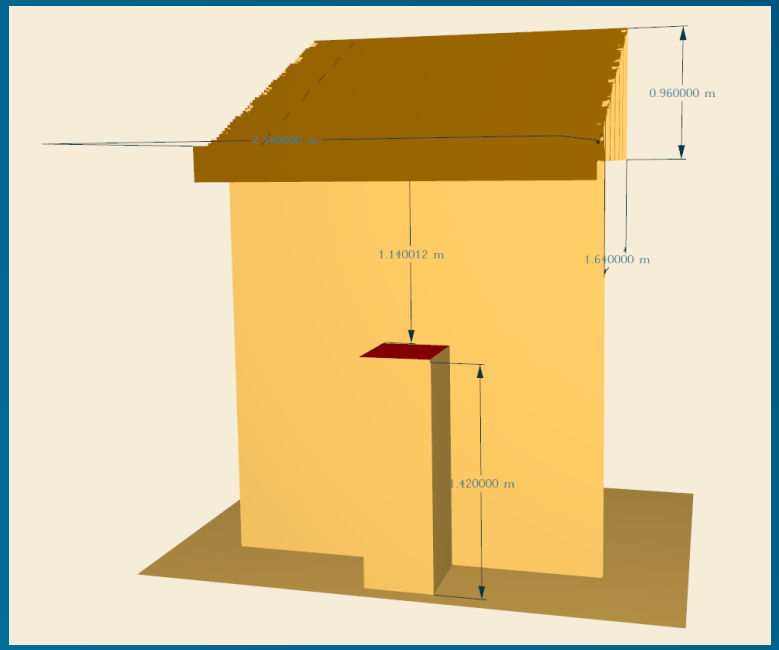
↓

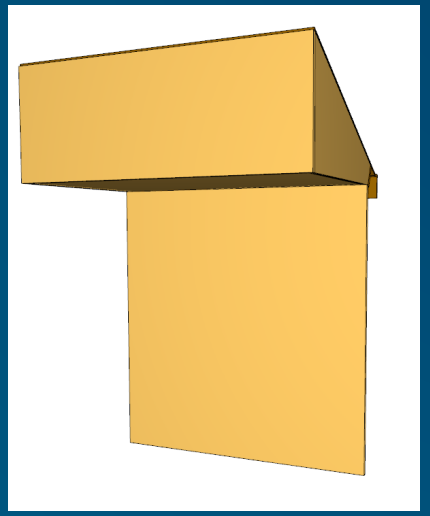
Delay of ~ 3 min

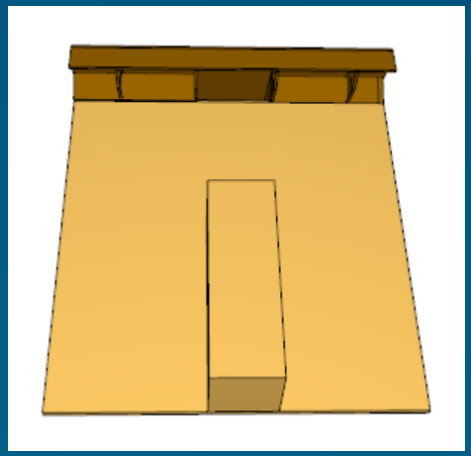
Understand if/how the flow through the eave vent impacts eave ignition

Objectives

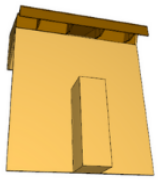
- How eave vent flow impacts eaves ignition
- Guide experimental designed to characterize eave vent performance for different thermal exposures

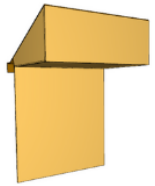






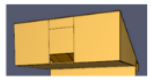
Methodology

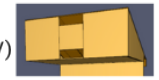


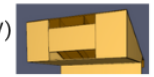


Eave vent
- **Close (CEV)**
- Open (OEV)

Back vent
- **Close ( )**
- 1 Vent size (1BV)
- 2 Vent size (2BV)
- 4 Vent size (4BV)







Vents

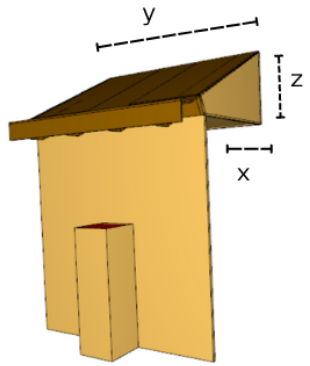
Base case

Size

Deep (x)
- **Sx**
- Mx
- Lx

Wide (y)
- **Sy**
- My
- Ly

High (z)
- **Sz**
- Mz
- Lz



200 kW
300 kW
to define

Sorce intensity

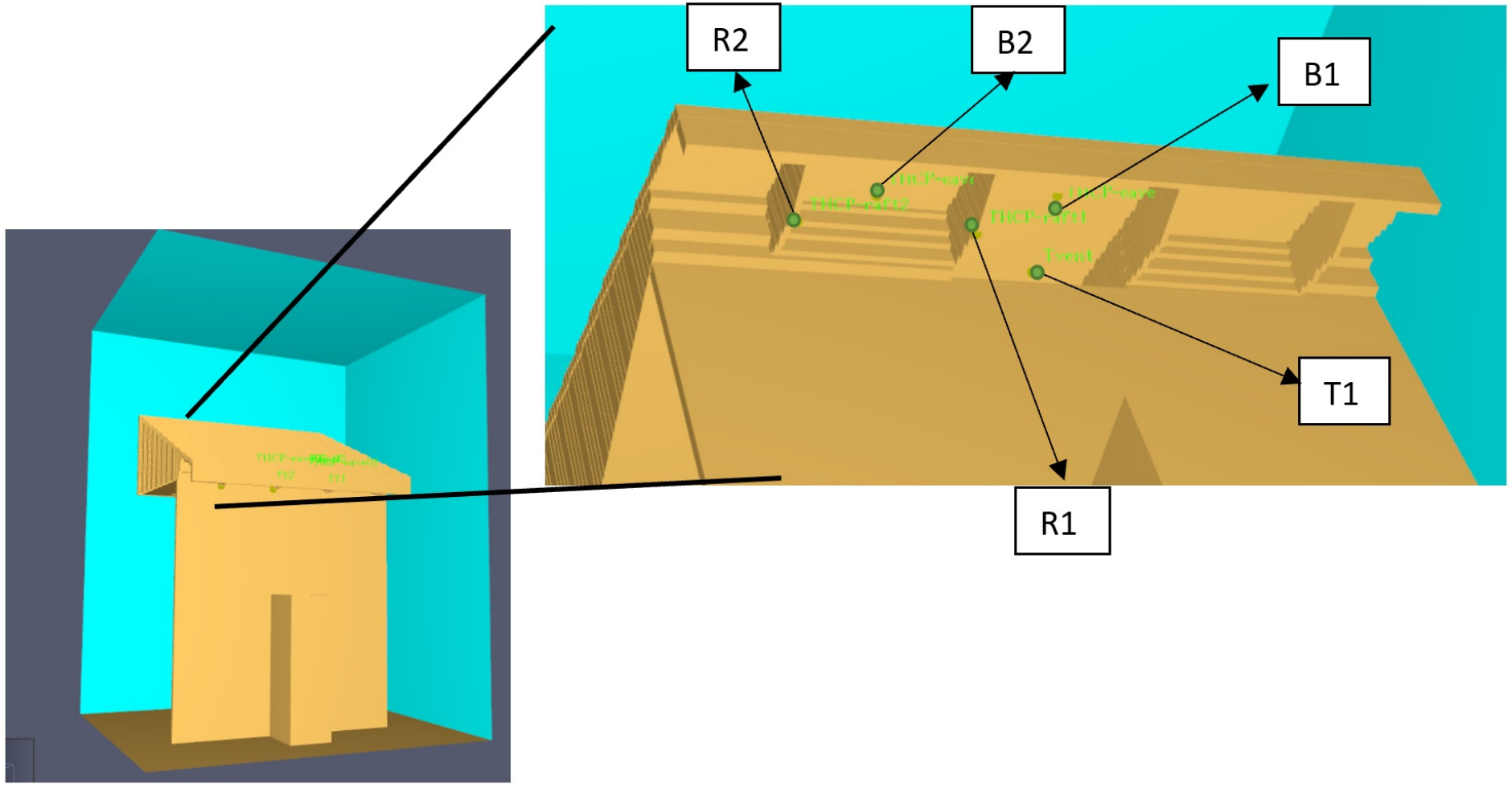
- Close eave vent
- Close back
- SxSySz
- Above ground leve

Burner Location

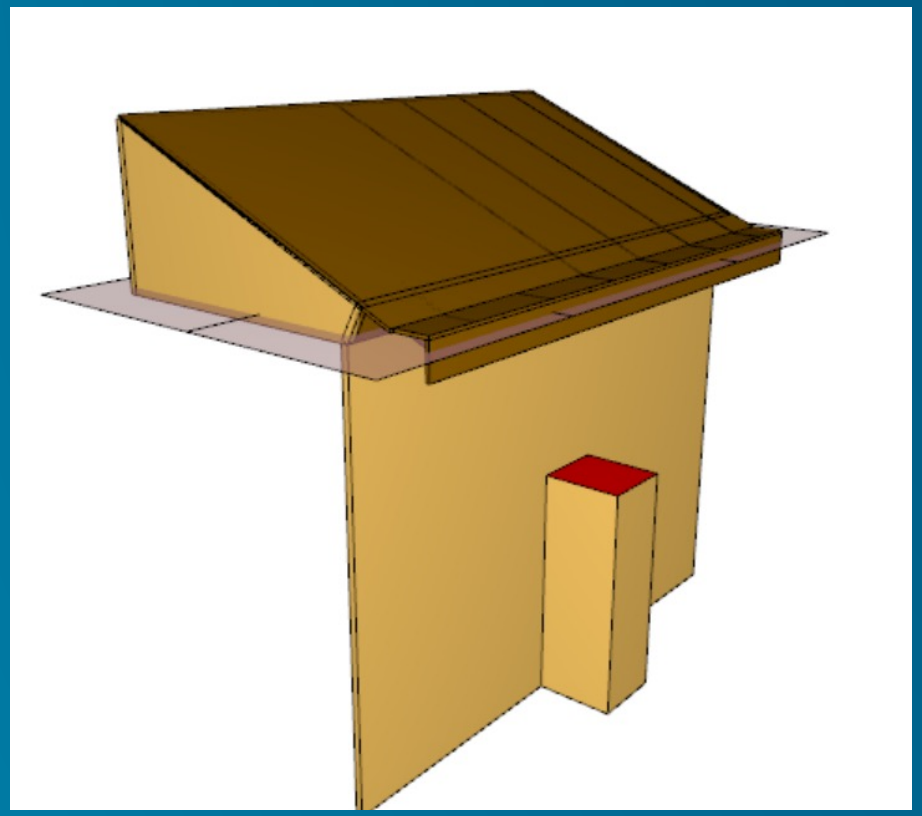
Attache to the structure
- **Above ground level (AGL)**
- Groud level (GL)

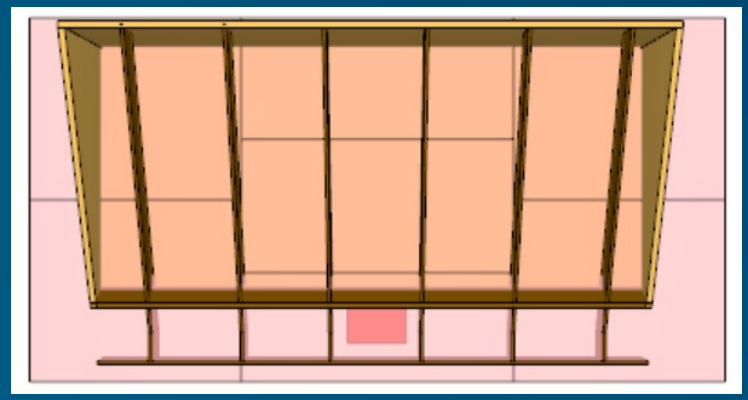
Separate from the structure
- to define ...

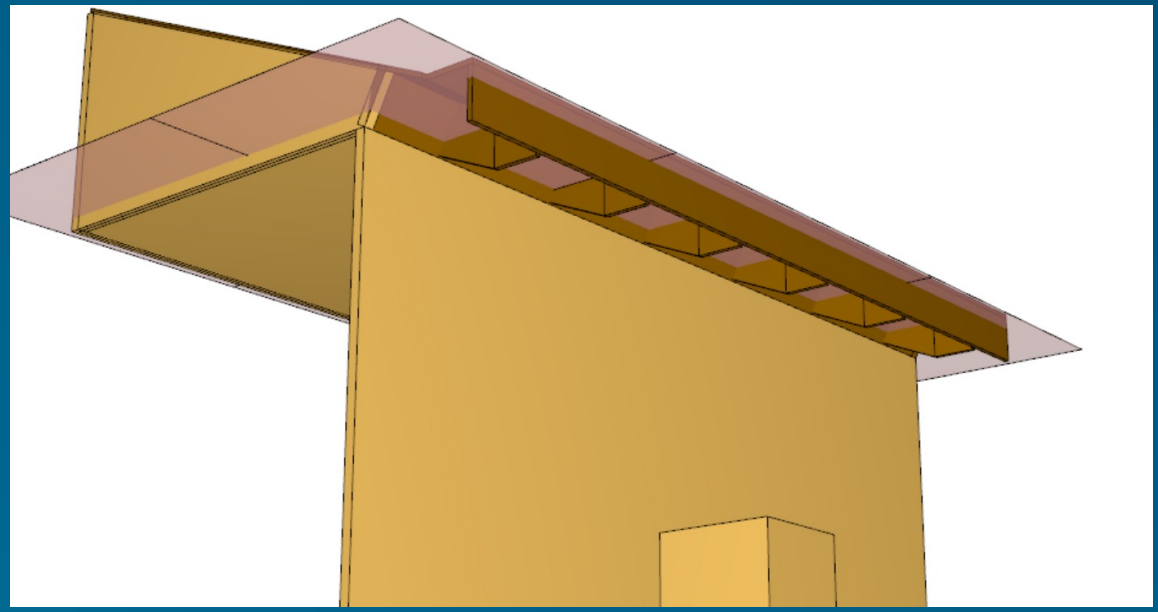
Devices: temperature & oxygen fraction



Slice: temperature & oxygen fraction

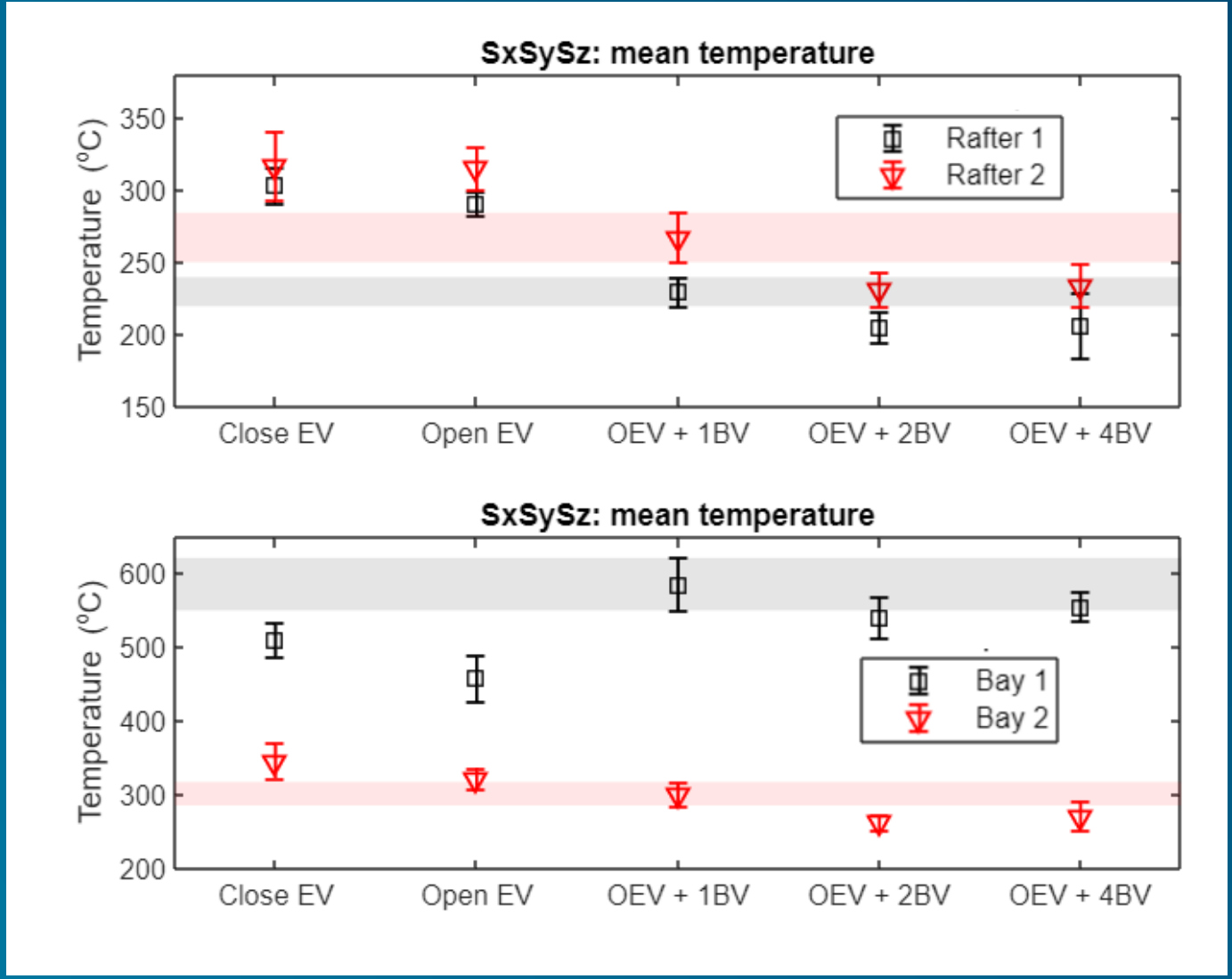




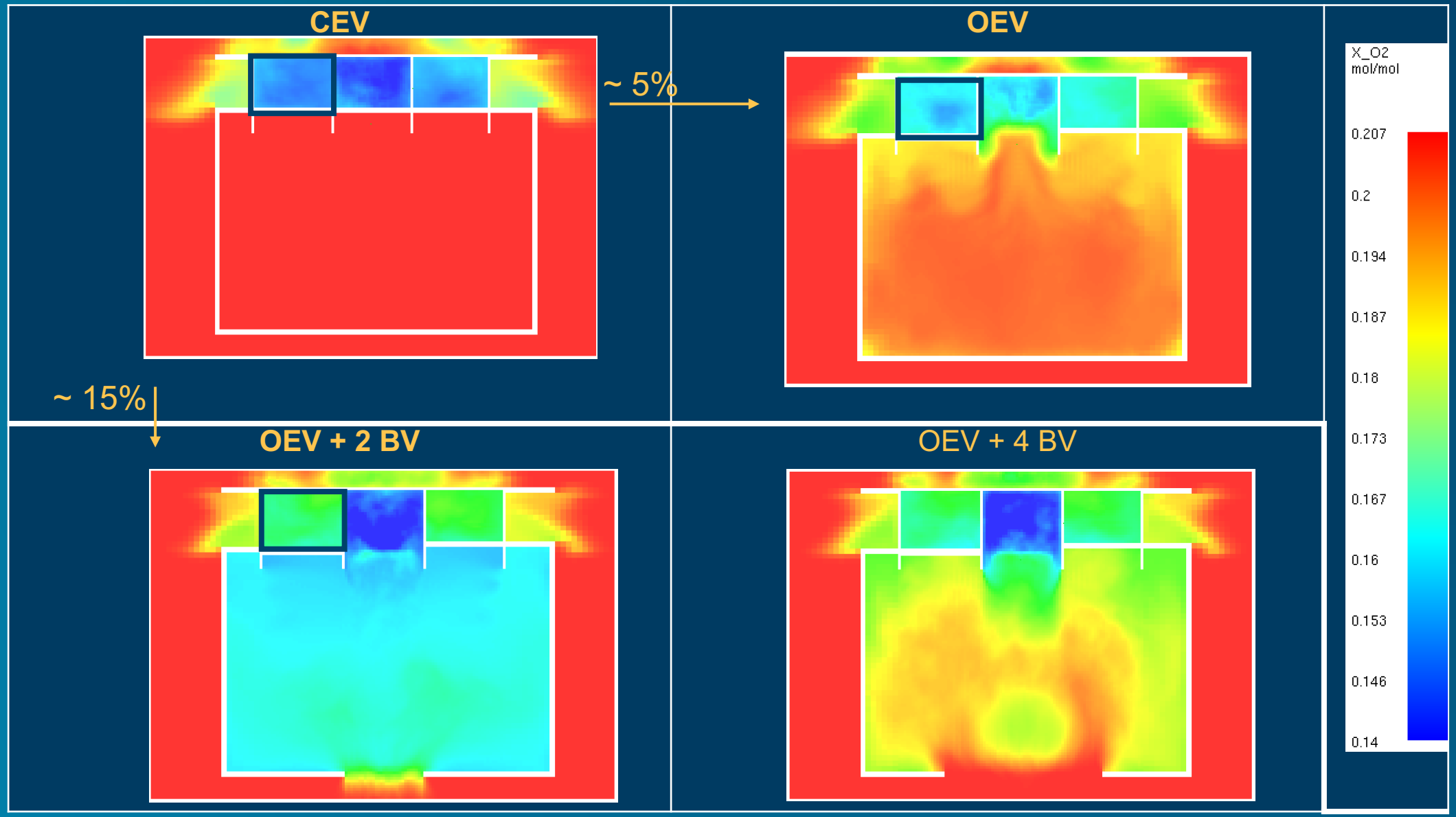


Results

Vents

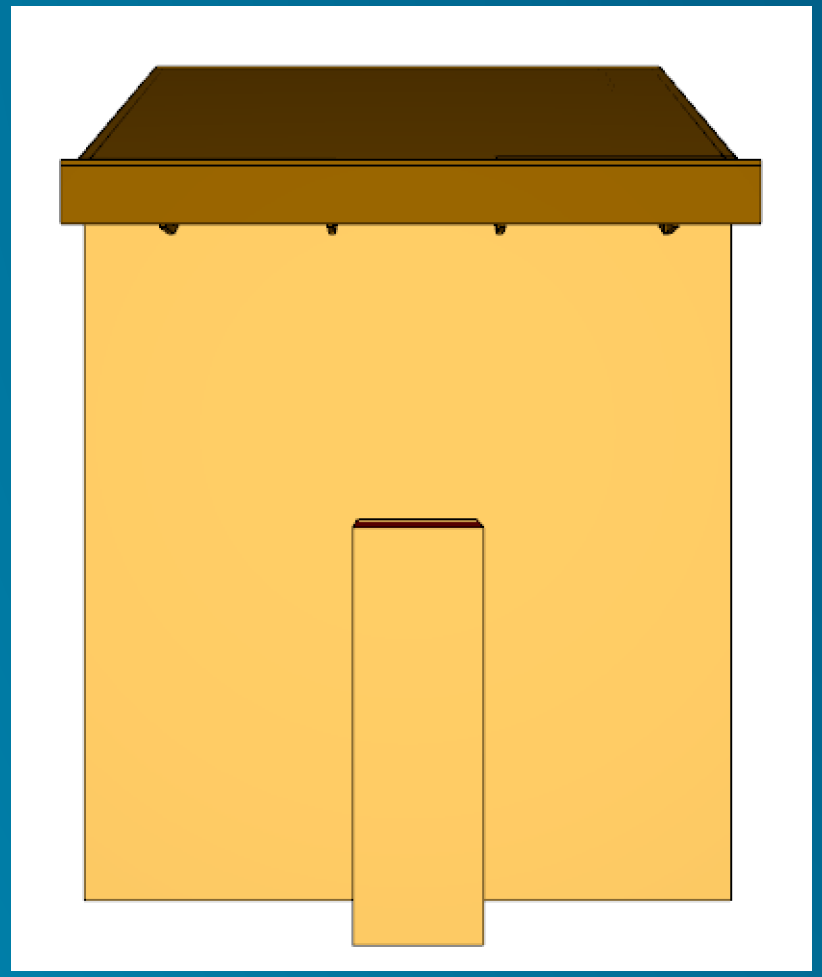


Mean oxygen fraction



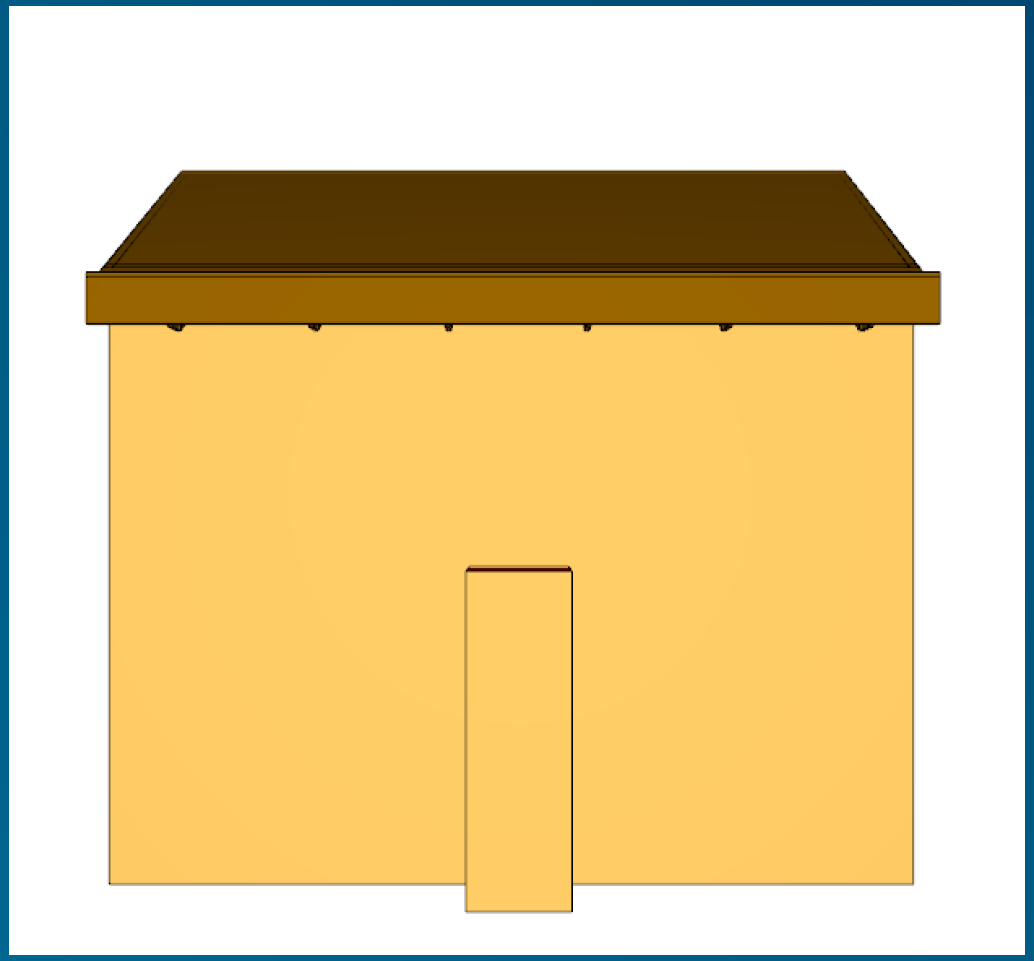
SxSySz

2.4 m

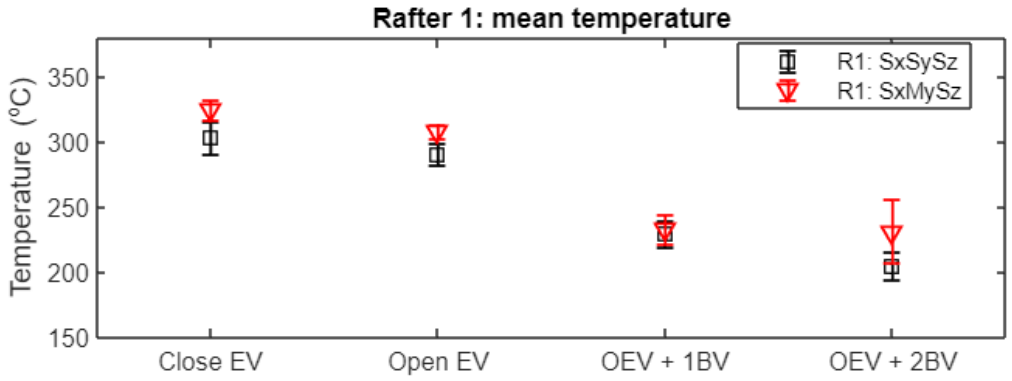


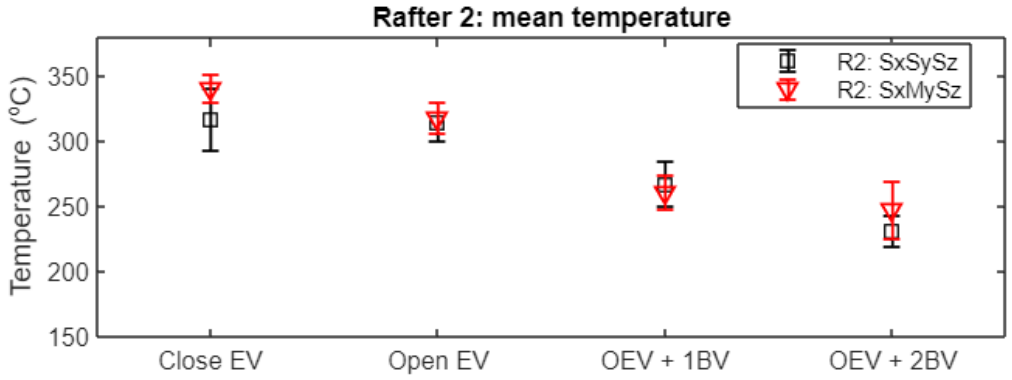
SxMySz

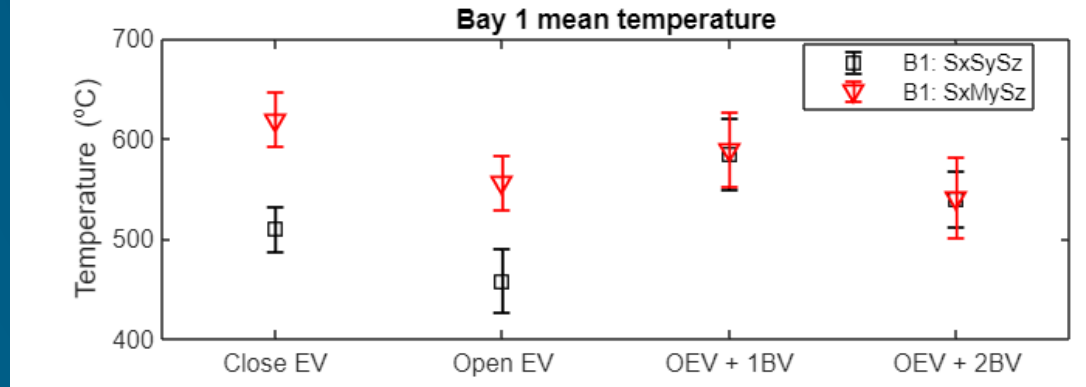
3.6 m

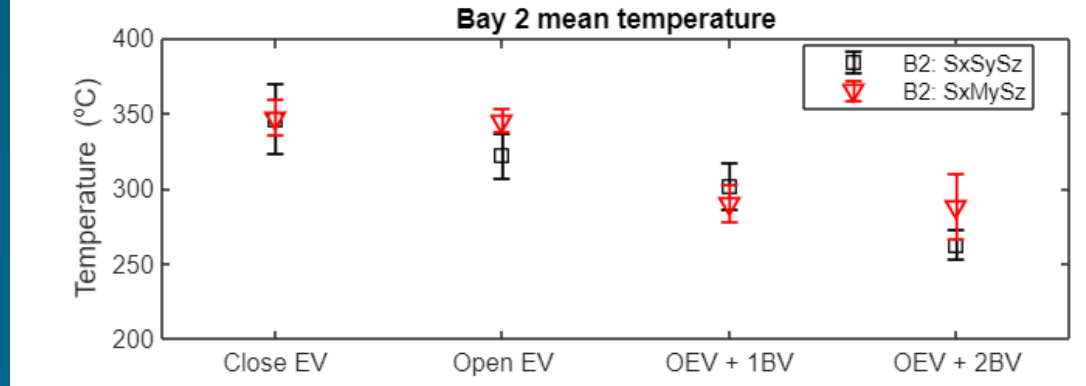


Mean temperature

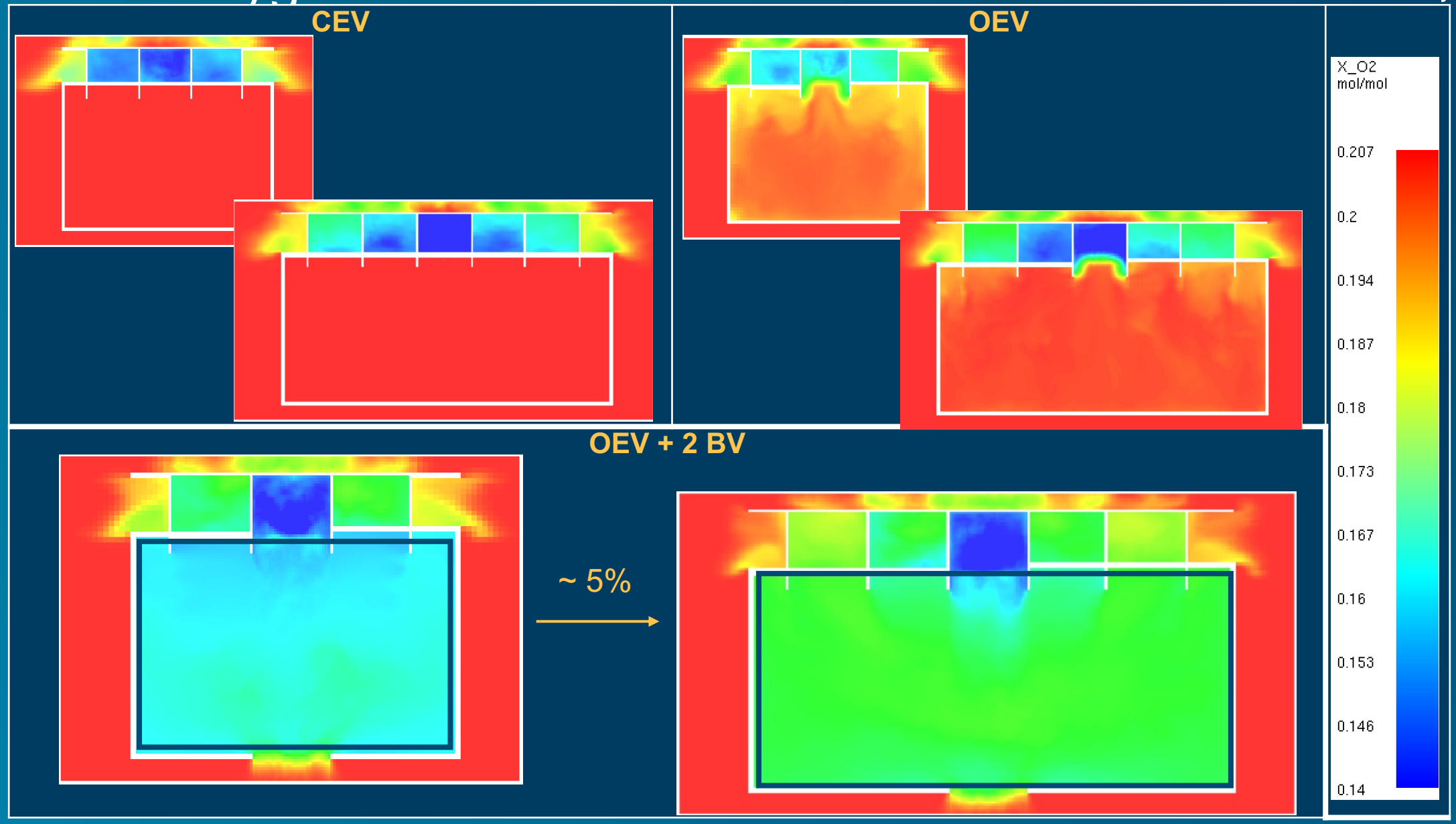








Mean oxygen fraction



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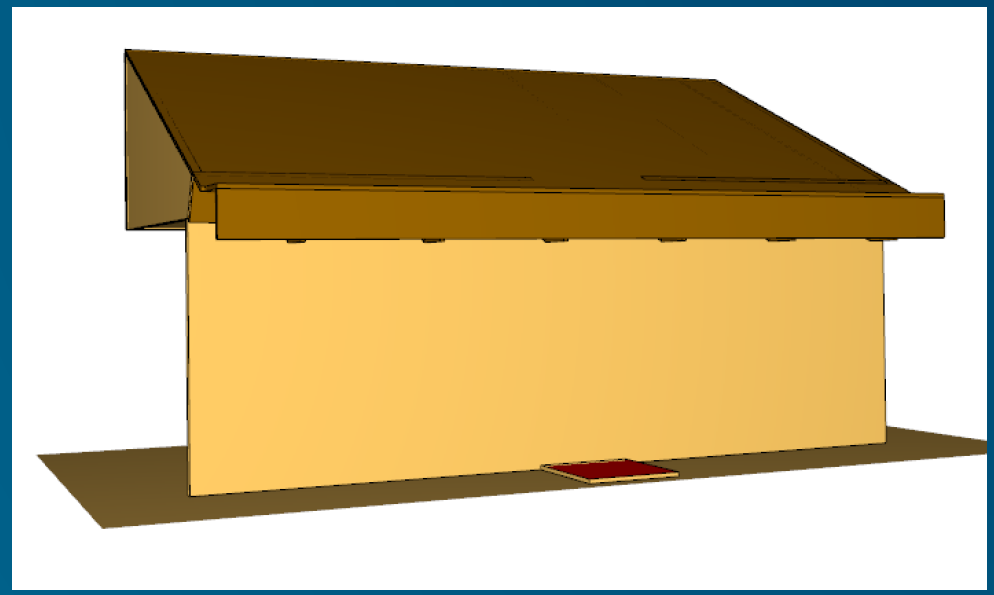
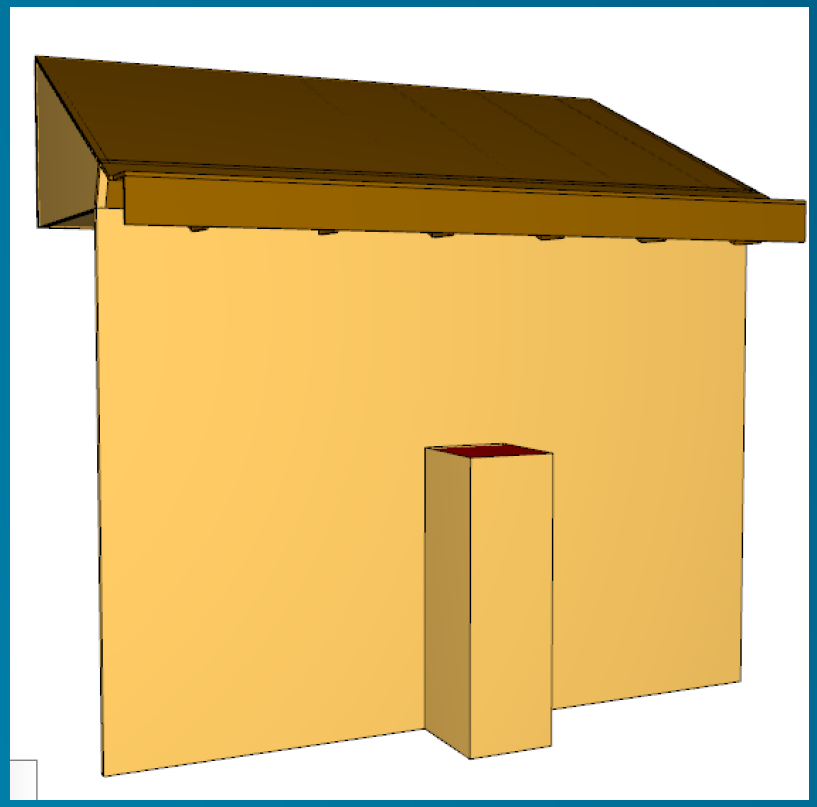
GL

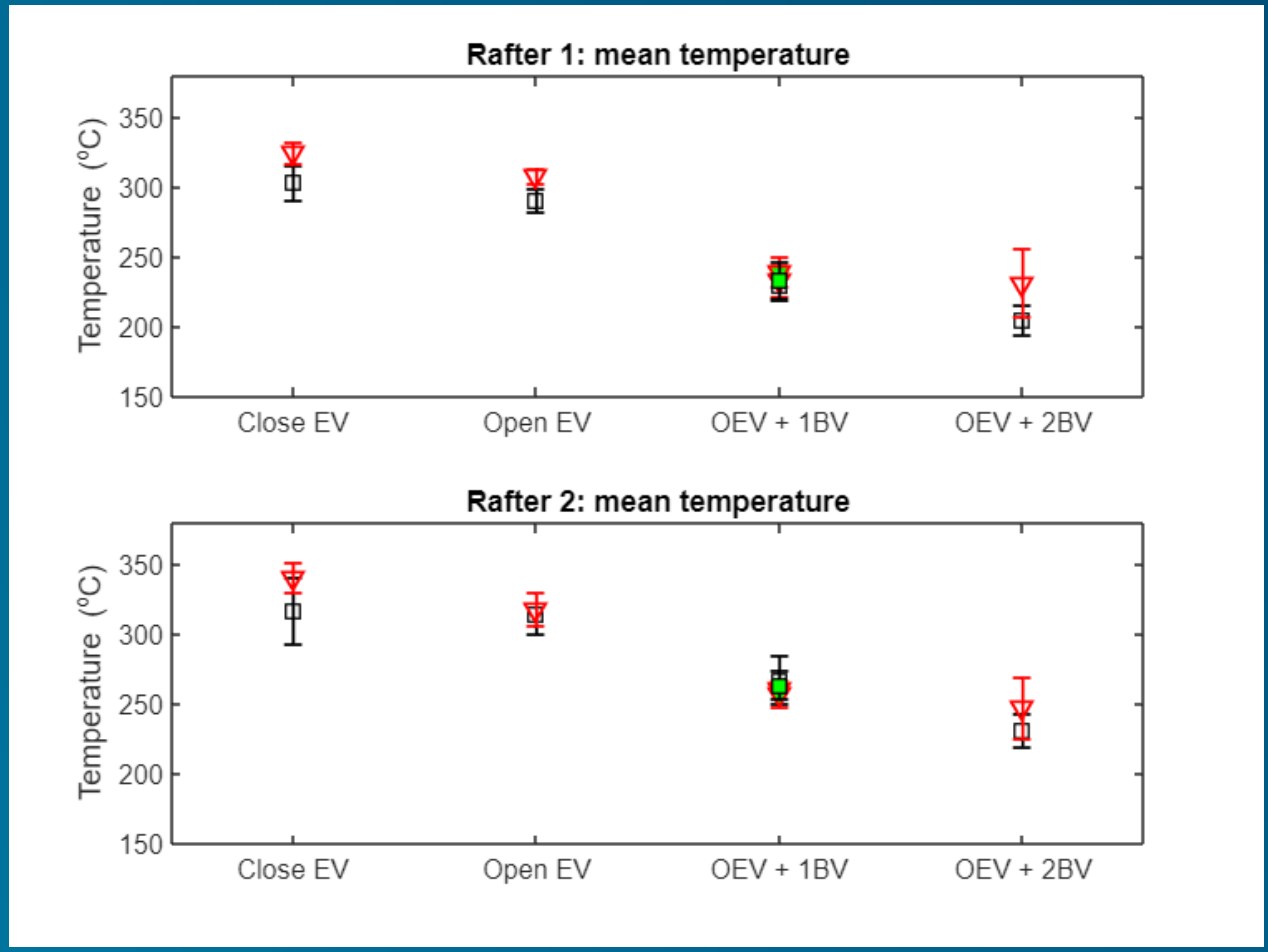


AGL

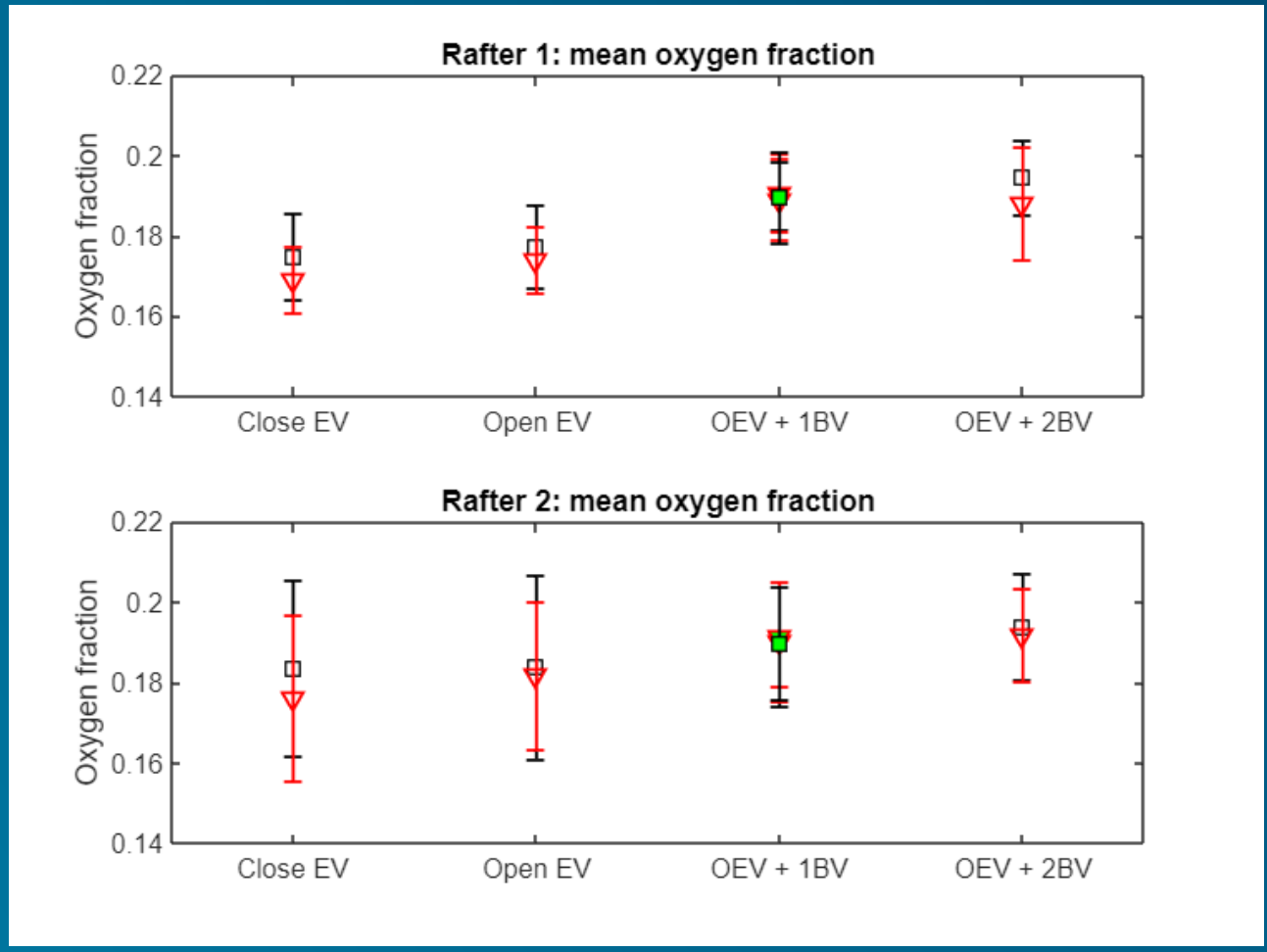


SxSySz: EV + 1 BV
SxMySz: EV + 1 BV

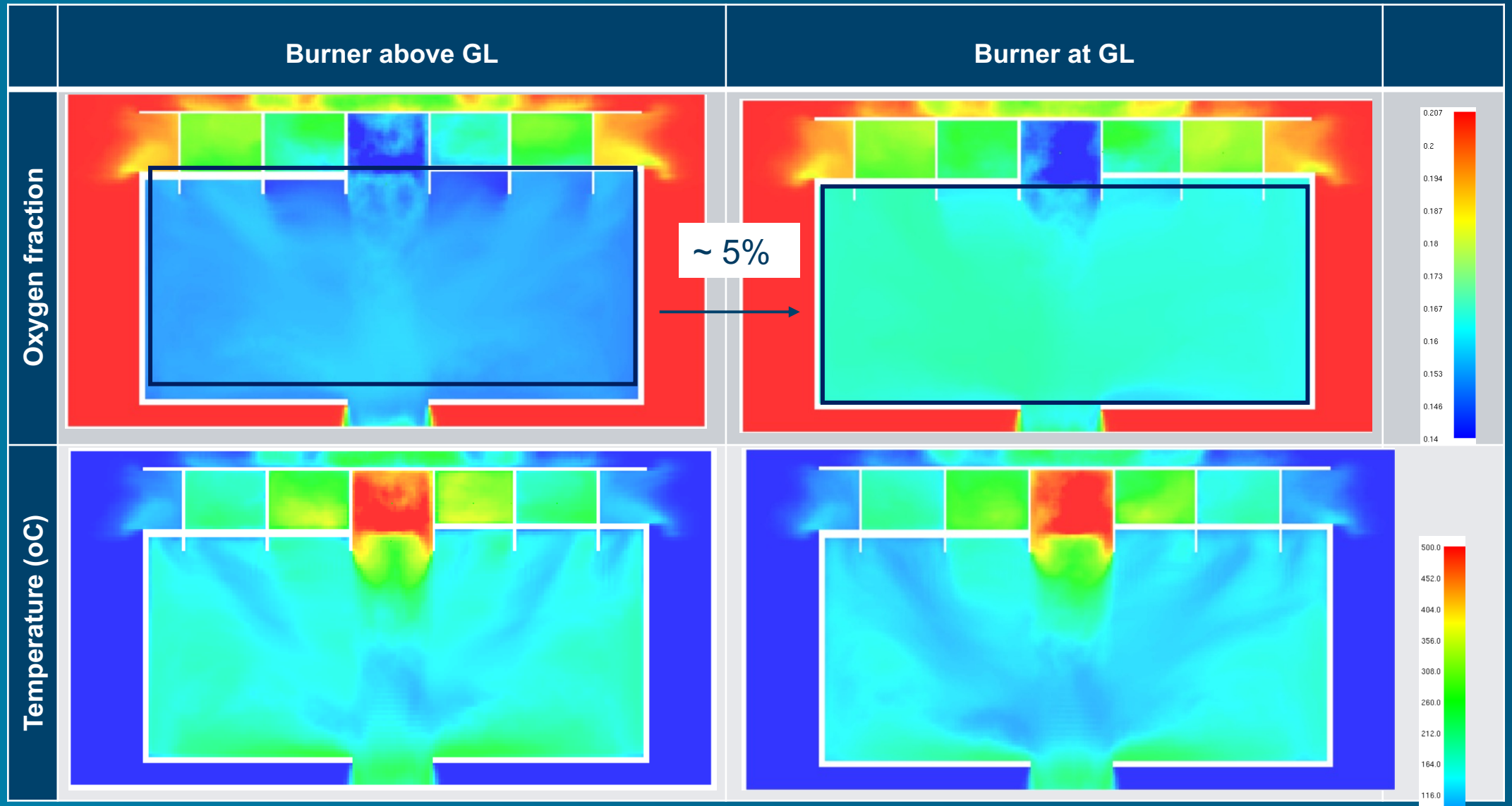
AGL vs GL:
Mean temperature



AGL vs GL:
Mean oxygen fraction



SxMySz


Burner above GL
Burner at GL
Oxygen fraction
Temperature (oC)
~ 5%
0.207
0.2
0.194
0.187
0.18
0.173
0.167
0.16
0.153
0.146
0.14
500.0
452.0
404.0
356.0
308.0
260.0
212.0
164.0
116.0
68.0
20.0

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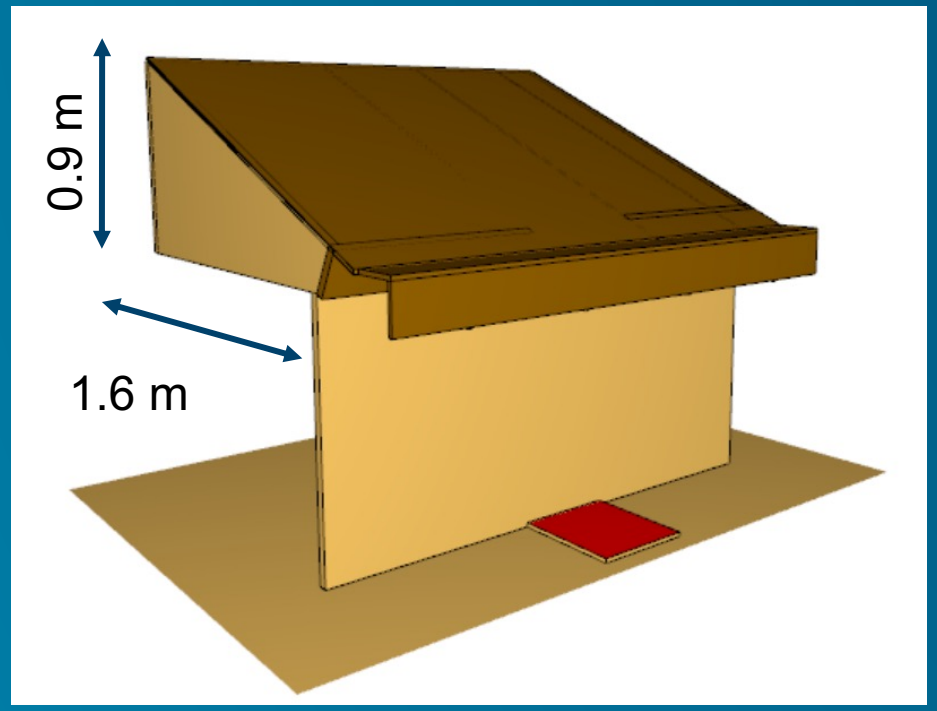
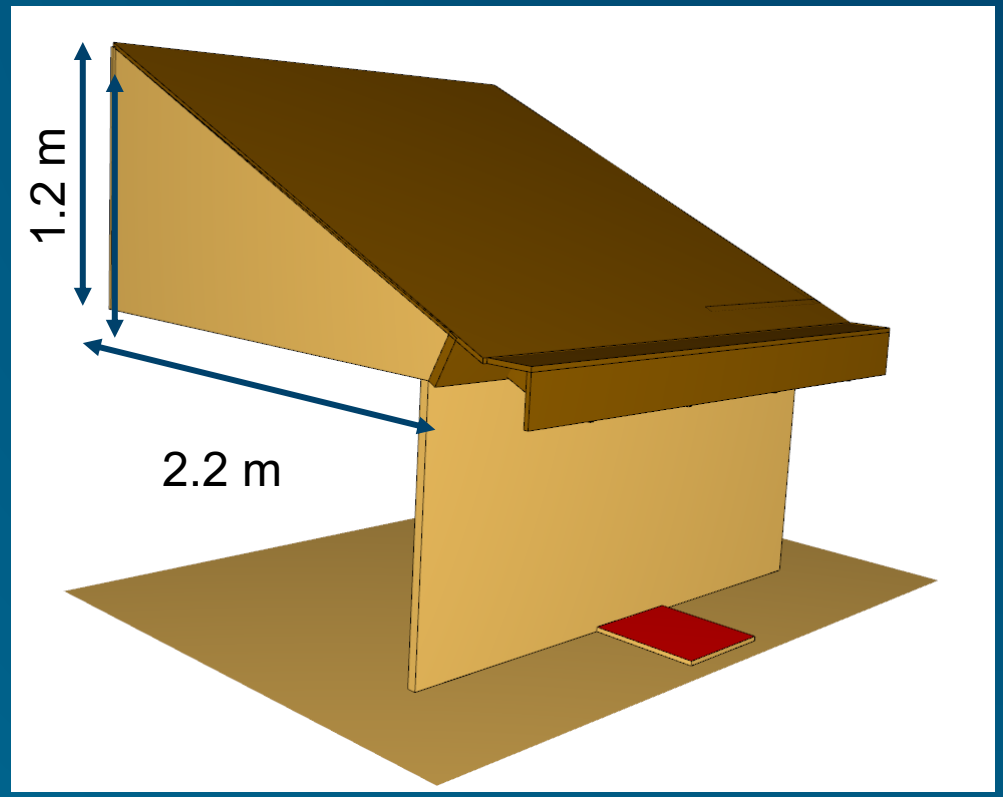
SxSySz



MxSyMz



Summary & Conslusions

- We have explored the impact of several variable on the heat exposure and flow condition on the eave and in the attic
  - Several vent location and sizes
  - Different size attic size
  - Heat source location
- According to the simulations:
  - Close eave vent -> less oxygen fraction (15%)
  - There is no significant difference having 2 BV or 4 BV (eave area)
  - No significant difference by making the attic wider
- To do…
  - Evaluation of longer periods of time
  - Continue analyzing the impact of the attic size
  - Modified the heat source and the SSD

Use the simulation results to guide the experimental design