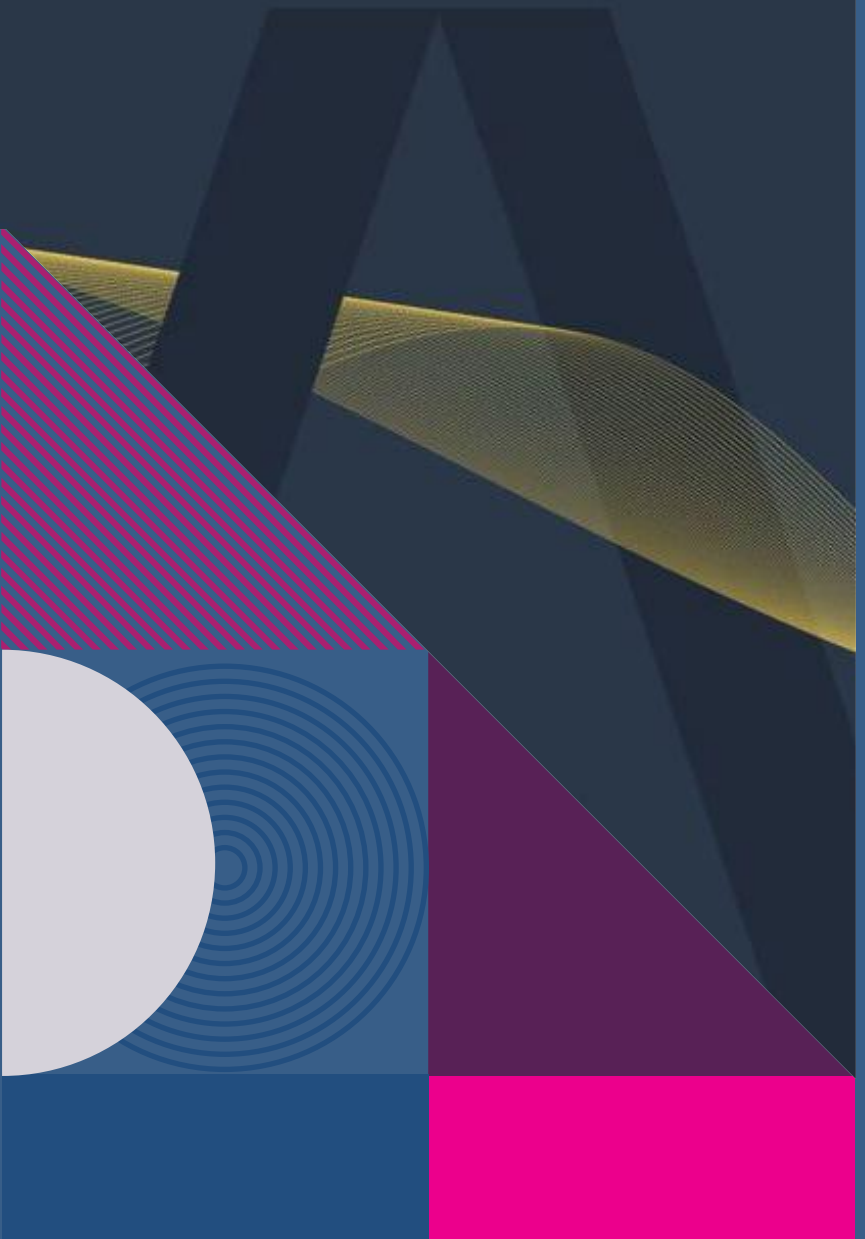


MASTER WITH AIRMASTER

THE TEAM

William Jensen

Jonas Spanggaard

TITLE: MITIGATING VERTICAL TEMPERATURE GRADIENTS FOR OPTIMAL THERMAL COMFORT IN AIR-HEATED SPACES

GOAL

To demonstrate the effectiveness of air movement in a heating scenario using the AMX4 from Airmaster. The project will focus on how to ensure that the supplied air, whether fresh or recirculated, is mixed, when heating, to prevent stratification and promote uniform thermal comfort throughout the space.

THE AMX4

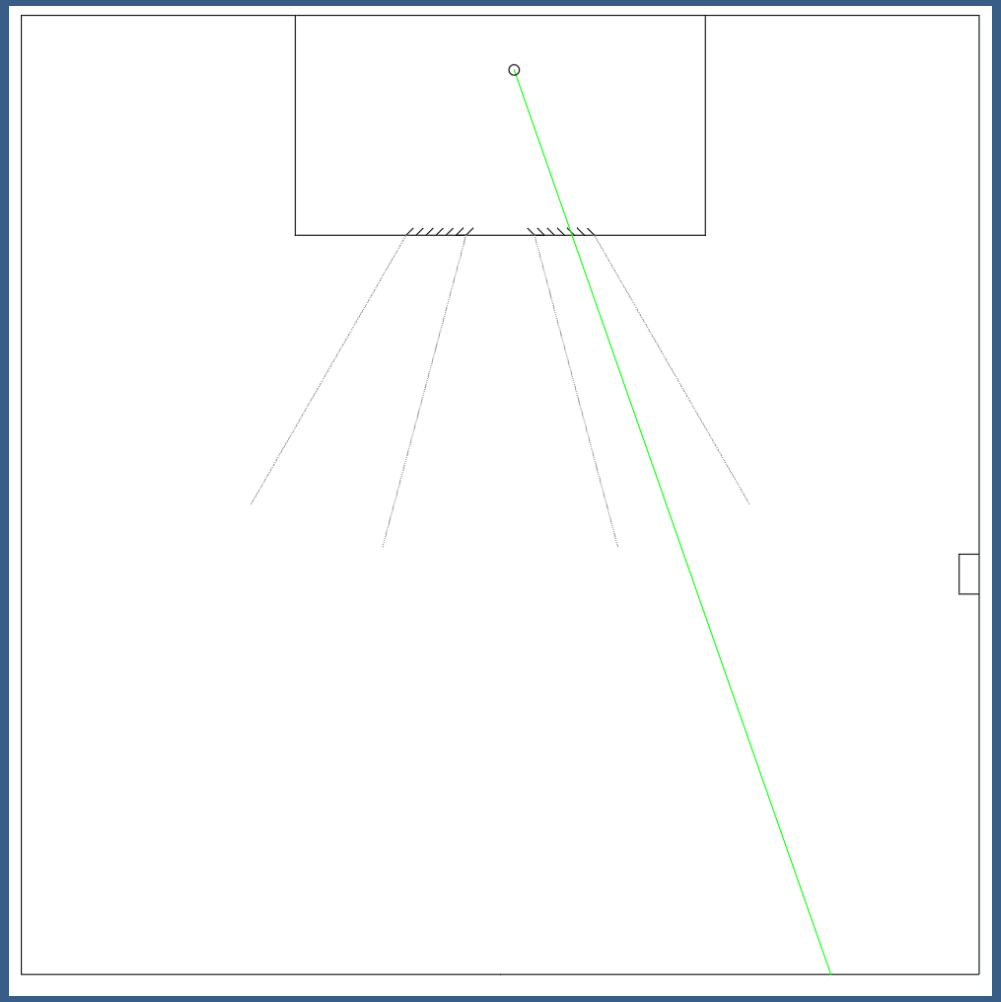
- Smart ventilation unit
- User Only Sets a Room Temperature
- Automatic Adjustable Blades
- Fresh/Recirculated Air
- Build-in Reversible Heat Pump
- Two Electric Comfort Heaters

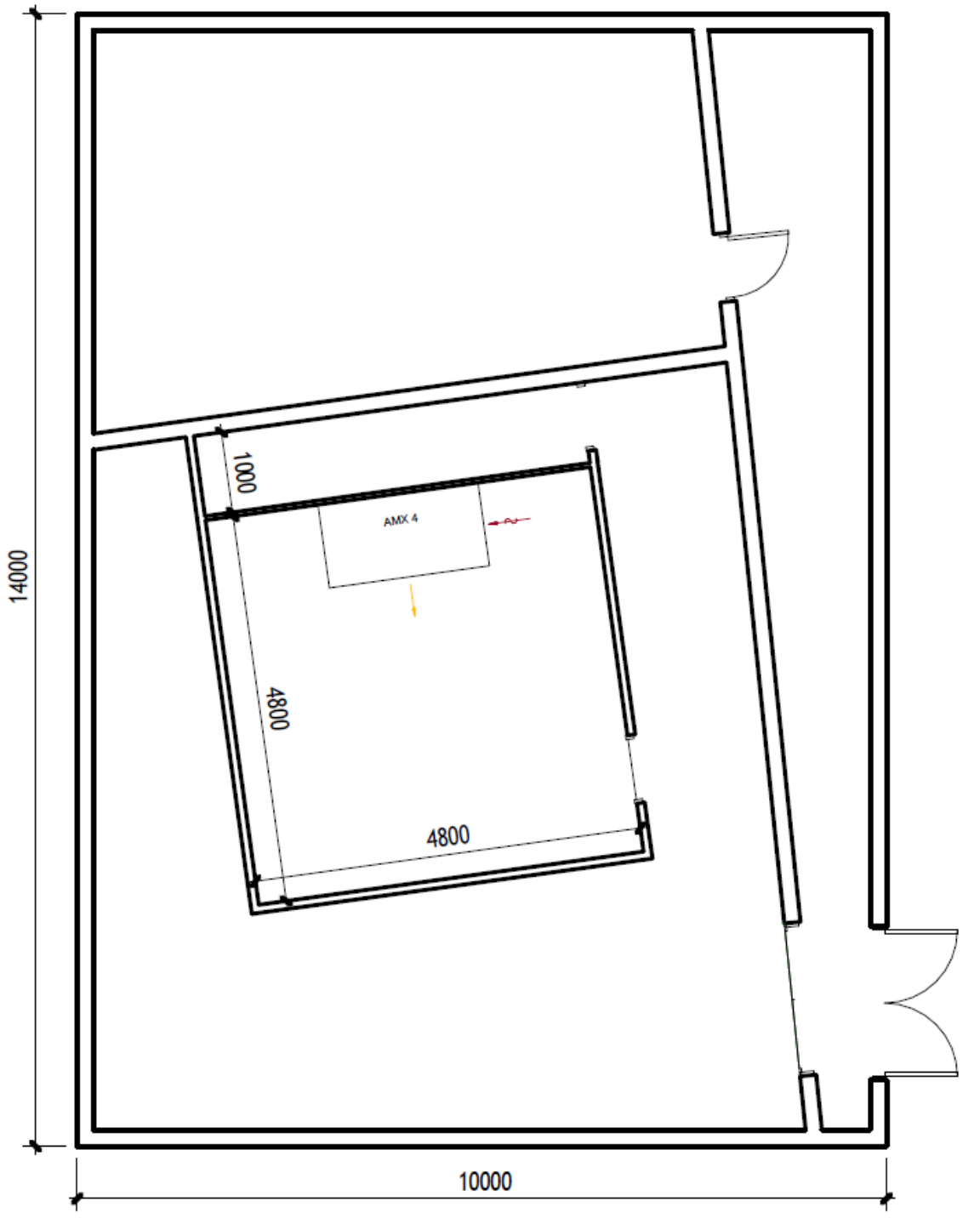
LABORATORY

At Airmaster

TEST SETUP

At Airmaster

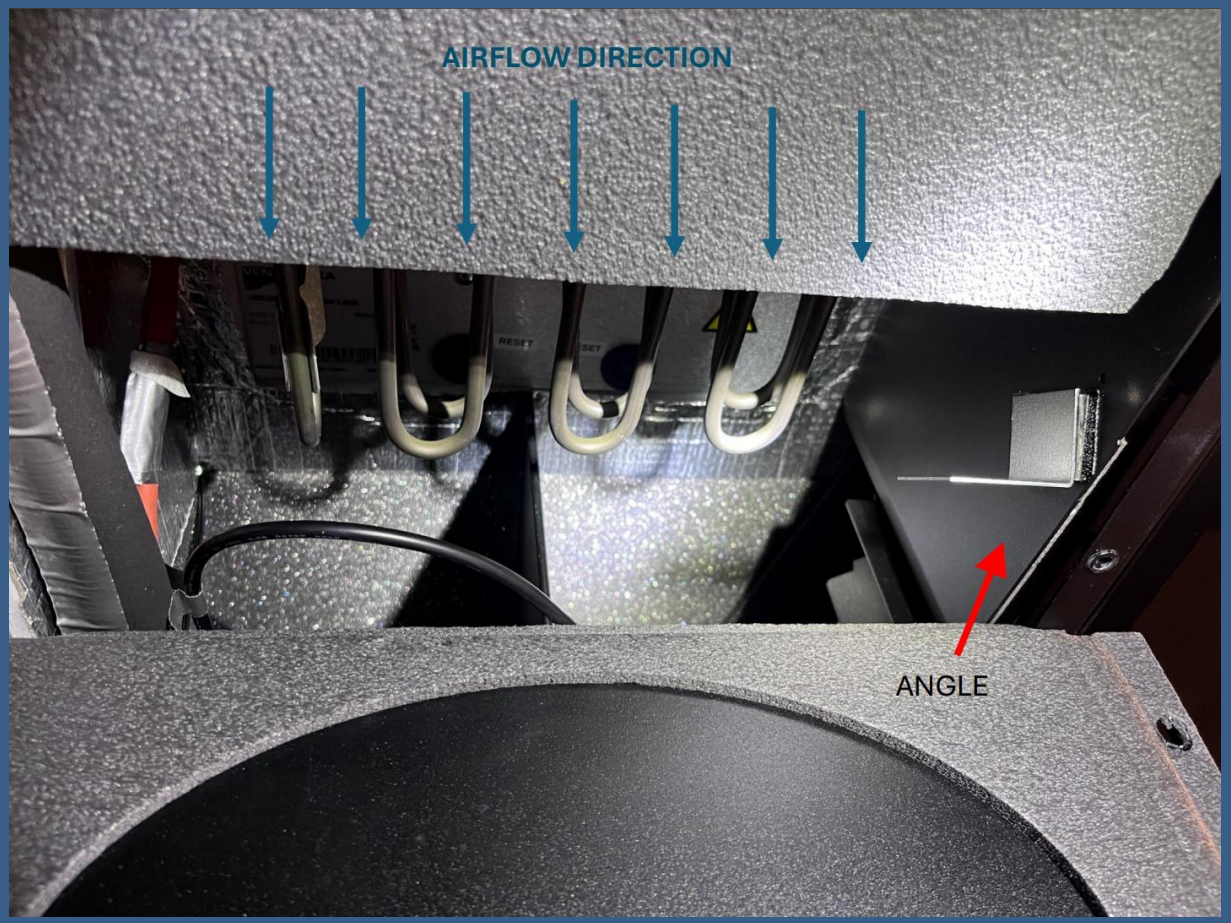


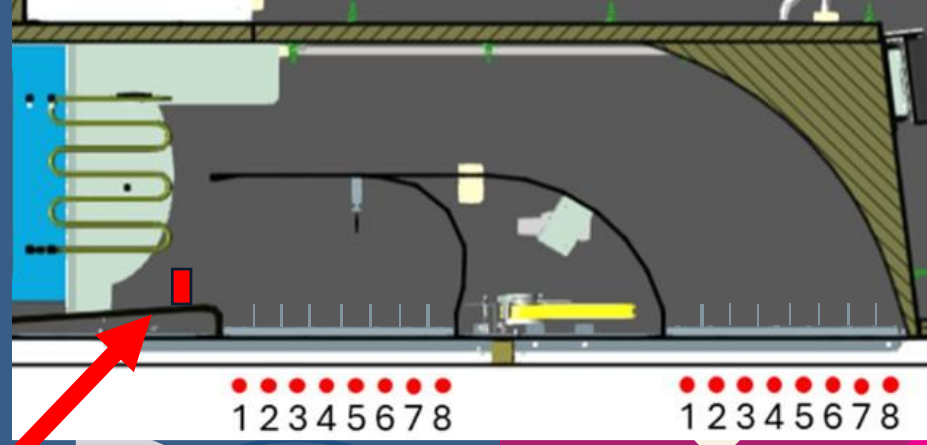


TEST SETUP

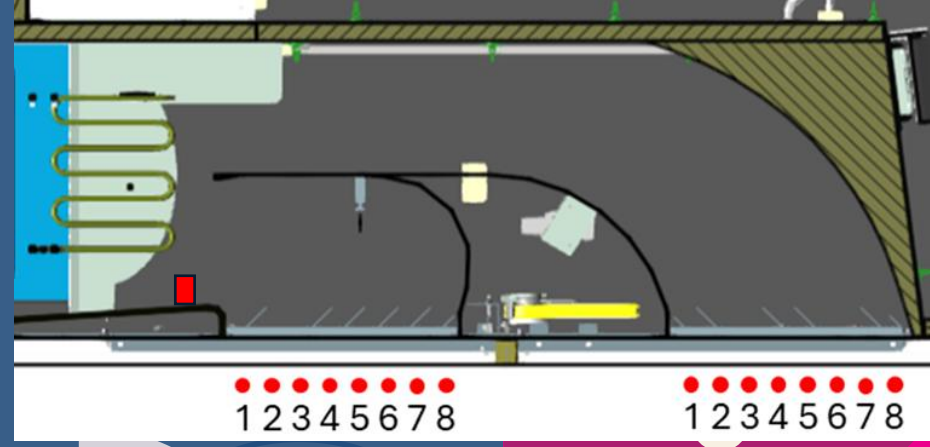
At Airmaster

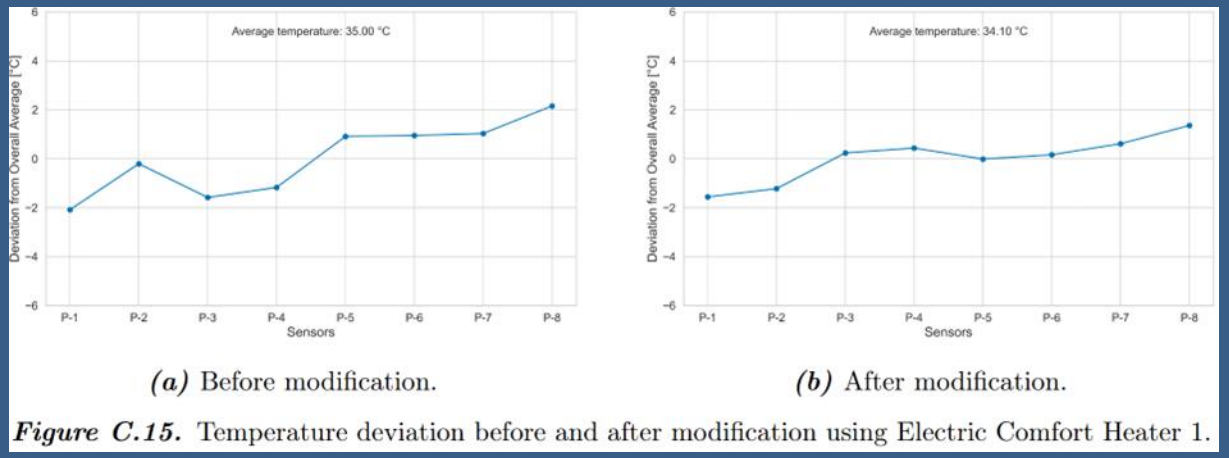
TEMPERATURE DIFFERENCE - IMPROVEMENT





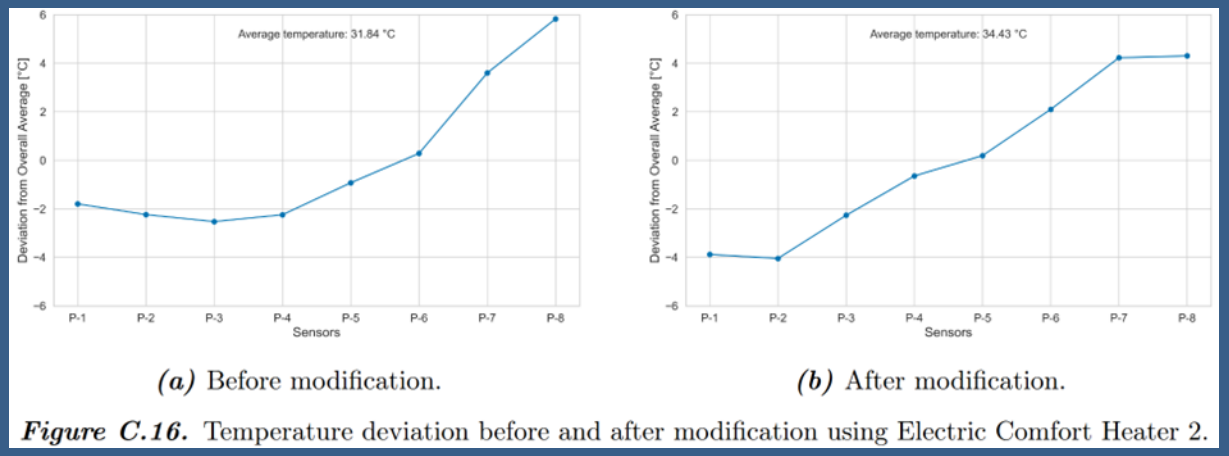
INITIAL INVESTIGATIONS - TEMPERATURE





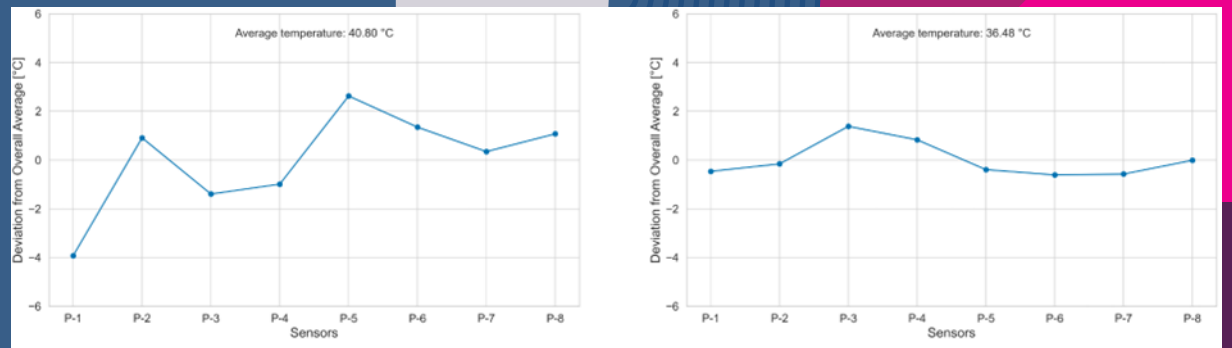
(a) Before modification. *(b)* After modification.

Figure C.15. Temperature deviation before and after modification using Electric Comfort Heater 1.



(a) Before modification. *(b)* After modification.

Figure C.16. Temperature deviation before and after modification using Electric Comfort Heater 2.



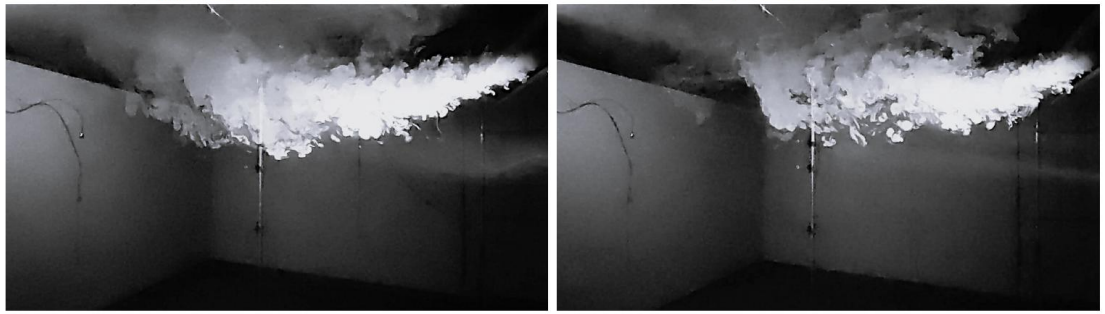
(a) Before modification. *(b)* After modification.

Figure C.17. Temperature deviation before and after modification using the Heat Pump.

SMOKE TESTS

The effect of increasing inlet temperature with constant inlet angle and flowrate.

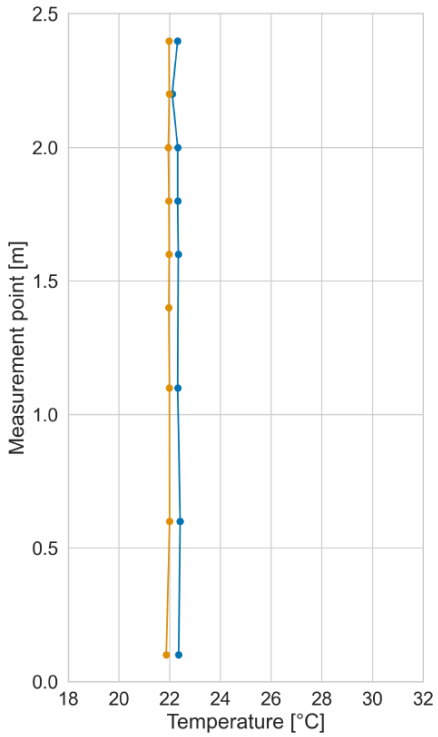
(a) Case 67: $\Delta t = 0.2$ *(b)* Case 38: $\Delta t = 4.3$



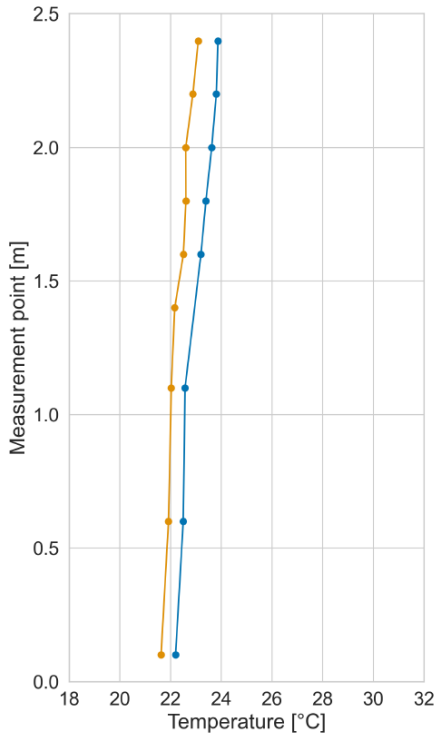
(c) Case 26: $\Delta t = 8.3$ *(d)* Case 42: $\Delta t = 11.2$

(e) Case 17: $\Delta t = 19.5$

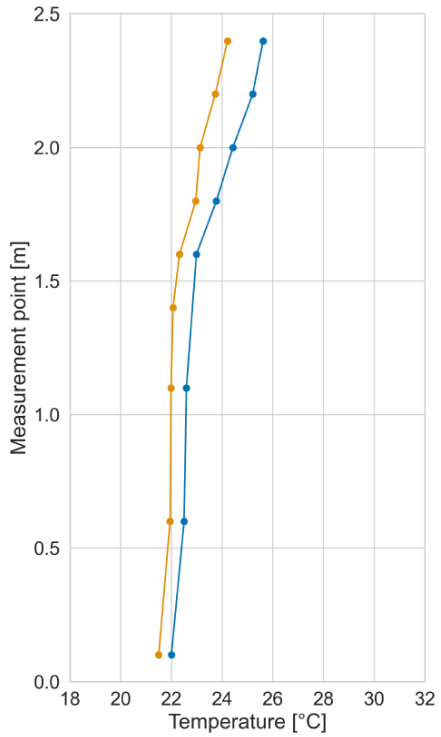
TEMPERATURE GRADIENTS RESULTS



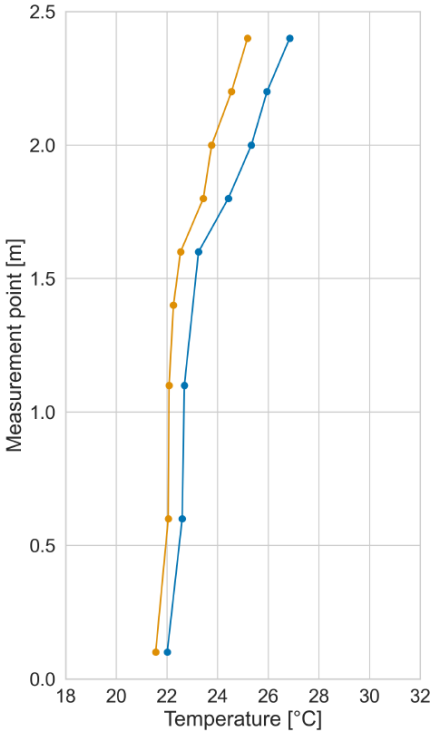
(a) Case 67: $\Delta t = 0.2$



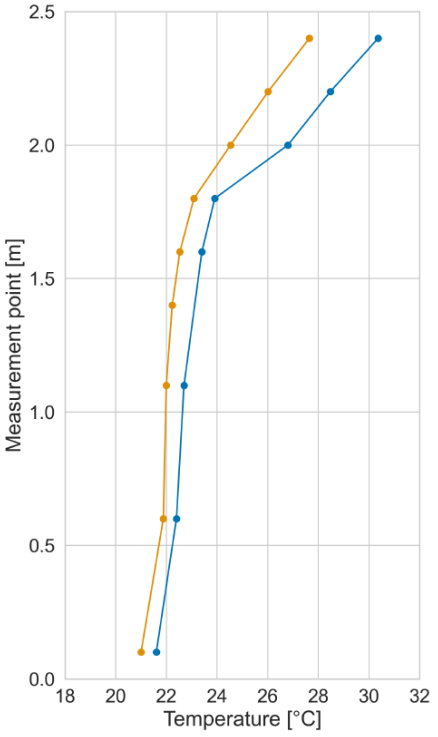
(b) Case 38: $\Delta t = 4.3$



(c) Case 26: $\Delta t = 8.3$



(d) Case 42:$\Delta t = 11.2$

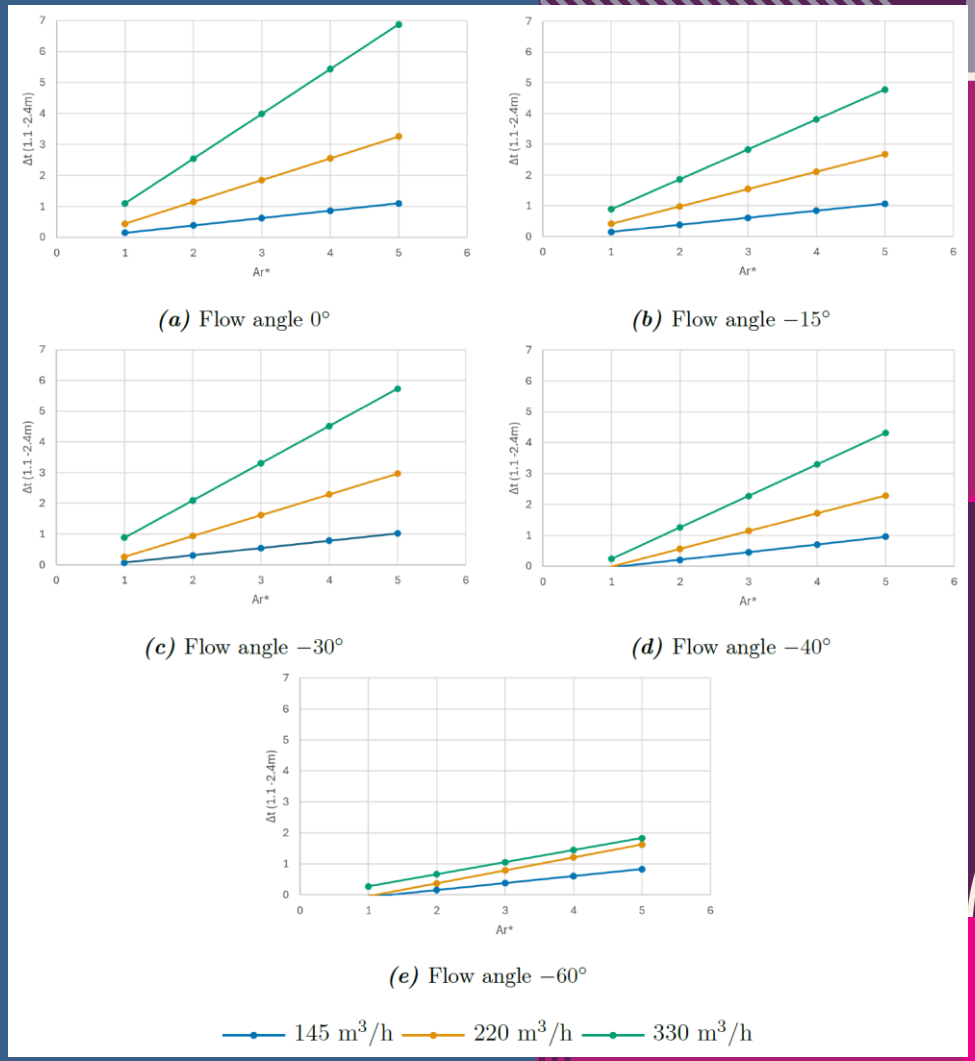


(e) Case 17: $\Delta t = 19.5$

PT100 Anemometer

SOLUTION TO IMPLEMENT IN THE CONTROL

- Linear relation.
- Temperature in 1.1m can be measured at outlet.

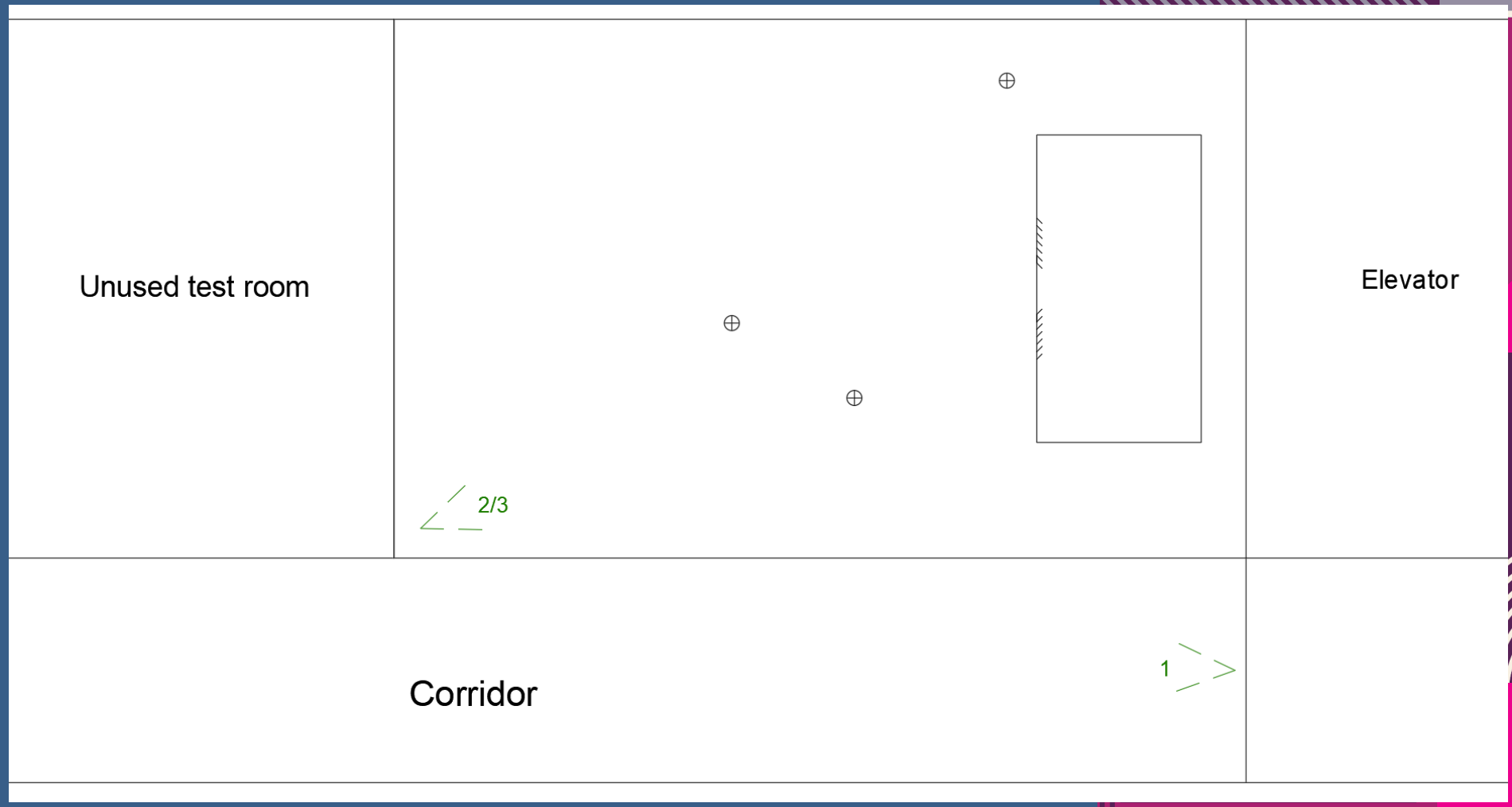


LABORATORY

At AAU

TEST SETUP

At AAU



TEST SETUP

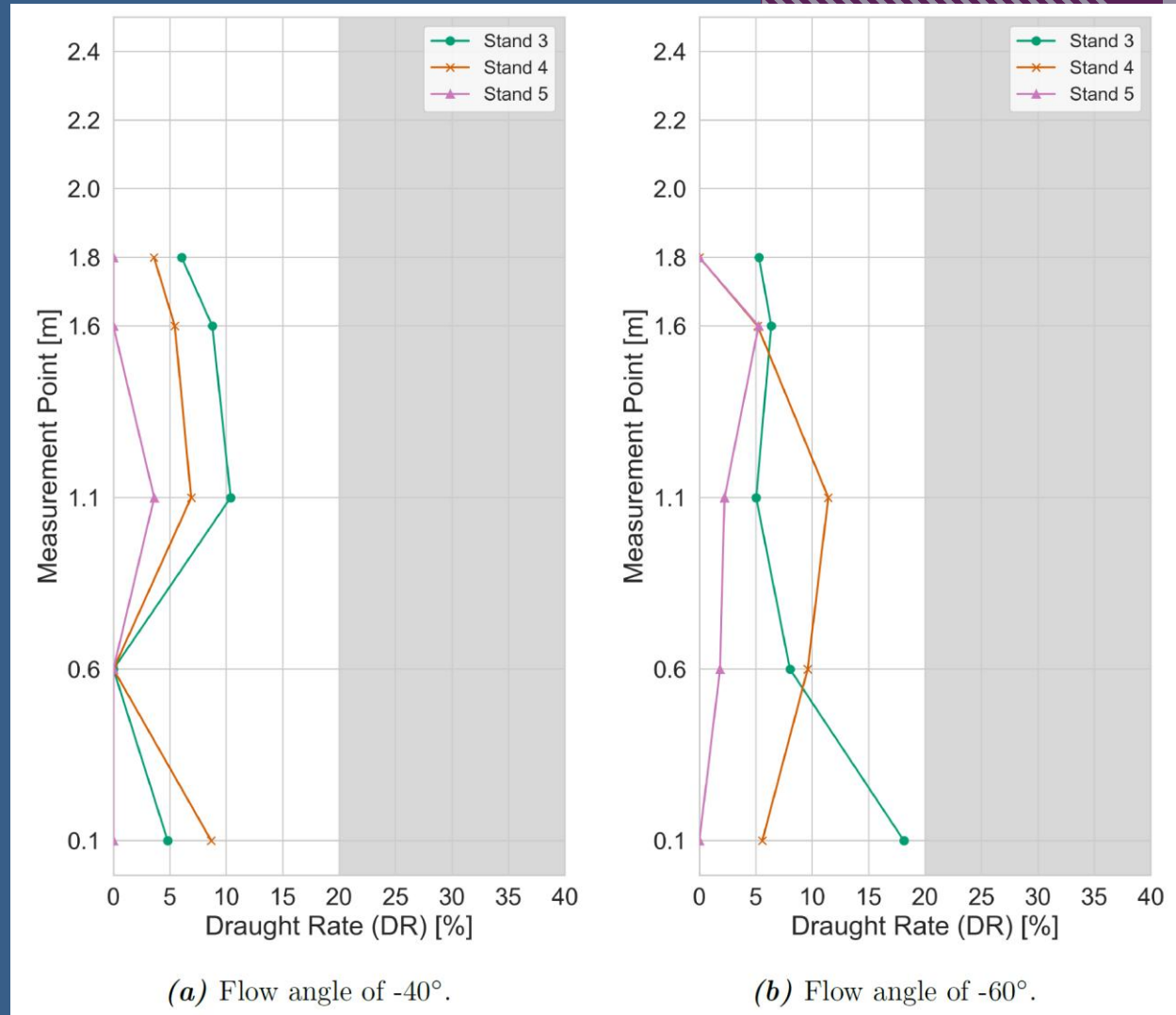
At AAU

Comparison of results:

- Depending on room geometry (Airmaster vs AAU test room)
- With and without occupant load
- Ventilation effectiveness (CO_2)
- Draught risk

DRAUGHT RISK

- No draught risk according to results.
- 20% limit according to standards.

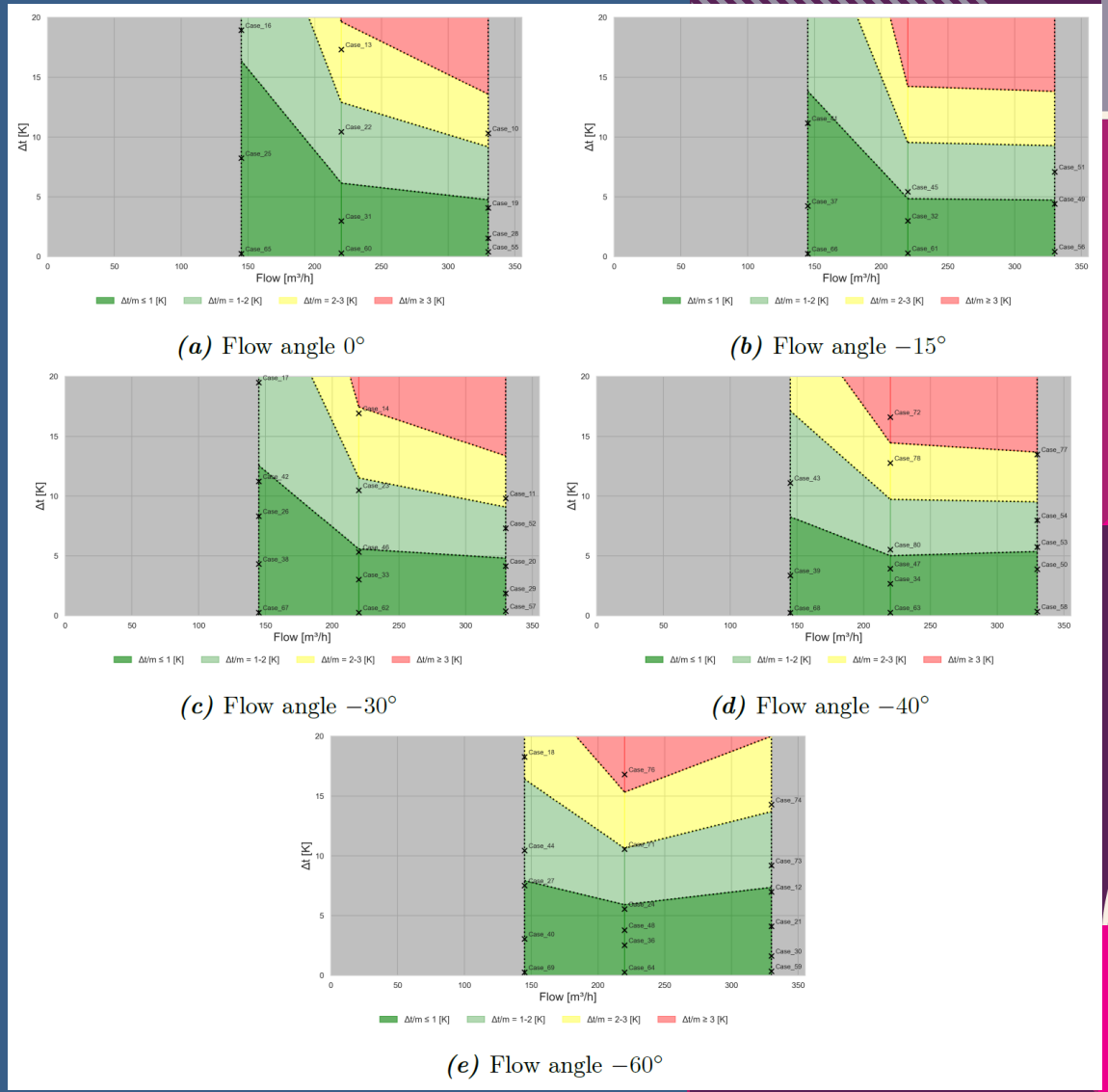


(a) Flow angle of -40°.

(b) Flow angle of -60°.

INVESTIGATION OF COMFORT

- Chart for standing persons.
- Dependent of flow angle.



(a) Flow angle 0°

(b) Flow angle −15°

(c) Flow angle −30°

(d) Flow angle −40°

(e) Flow angle −60°

QUESTIONS?