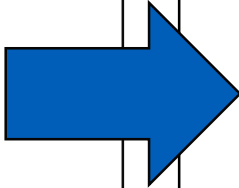


**Rõhkude erinevuse ja ventilatsiooni roll sisekliimaprobleemidega
koolimajade renoveerimisel**

The effects of differential pressure and ventilation in school buildings with perceived indoor air problems

Background and research approach

- Finnish municipal school buildings suffer from significant indoor air problems reported by the occupants
 - Ventilation contributes to most the problematic situations
- 
- Ventilation function and effects of changes in the ventilation was studied by ventilation interventions in two school buildings with occupants' IAQ-related complaints

Aims

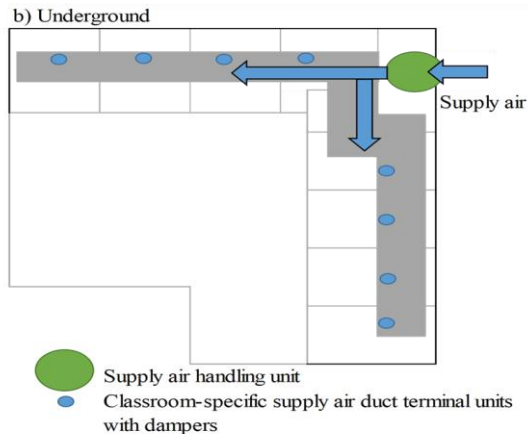
- ✓ To determine the functionality of a hybrid ventilation system in a building part with severe unsolved IAQ related problems.
- ✓ To produce information about the effects and usability of a moderate positive pressure as a temporary solution in a building with prolonged, unsolved IAQ problems.



Ventilation interventions

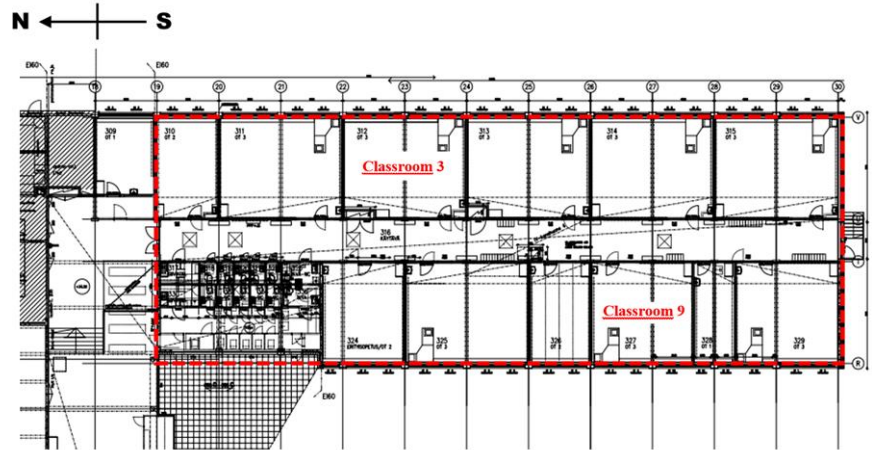
Intervention 1

- Fan assisted natural ventilation (hybrid ventilation) with CO₂ sensors in the classrooms
 - Complete lack of base ventilation was detected
- > improvements to ensure normal ventilation function

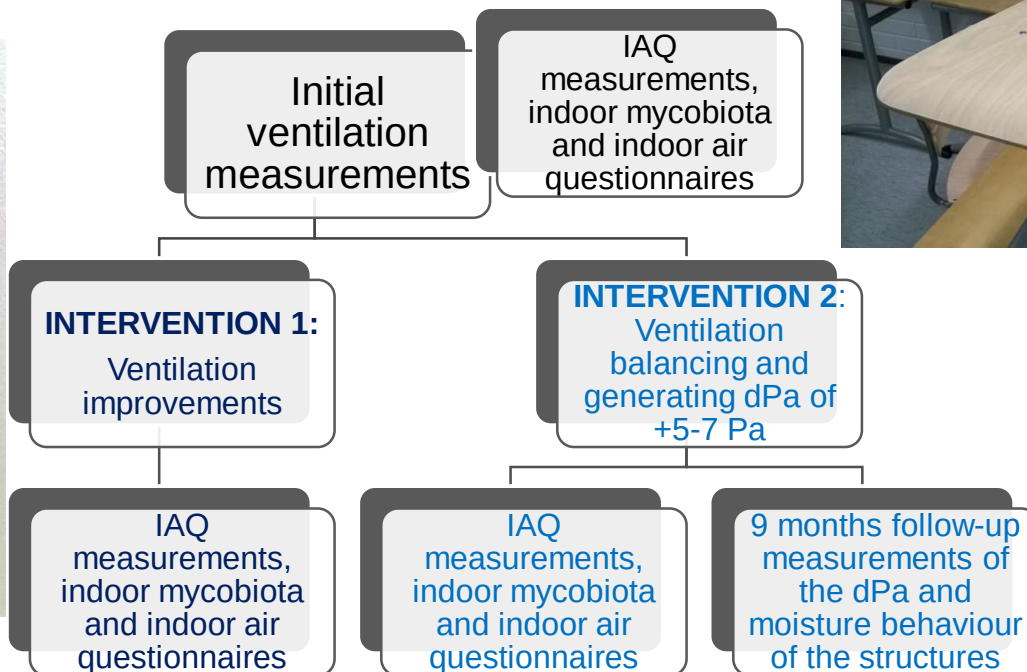


Intervention 2

- Mechanical supply and exhaust ventilation
- High negative pressures and unbalanced air flows in the entire building part
- Positive differential pressure of about 5-7 Pa generated in one building part for 9 months to prevent potential infiltration of harmful agents



Methods



Results

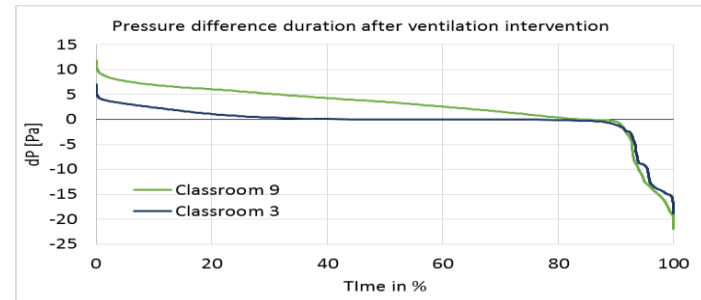
Intervention 1

- CO₂ level was good before and after (average approx. 400 ppm)
- TVOCs and single VOCs: low concentrations before and after (TVOC < 100 µg/m³)
- Decrease in reported perceptions of stuffy air, insufficient ventilation and unpleasant odours
- Toxigenic, potentially mycoparasitic *Trichoderma* sp. colonies found before but not after



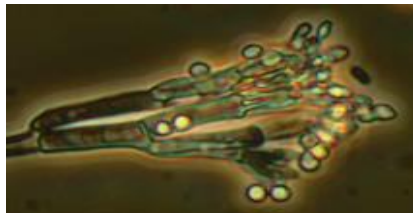
Intervention 2

- Small decrease in TVOC and PM_{2.5} (levels very low in the first place: TVOC ~20 µg/m³, PM ~1,3-1,8 µg/m³)
- Decrease in perceived odours, stuffy air and eye irritation (increased in the other parts of the school)
- Possibly pathogenic *Aspergillus* species and possibly mycoparasitic *T. atroviride* found before but not after
- No moisture condensation inside the structures



Conclusions

- The serviceability of a school building's ventilation system has to be simple
- Adequately designed HV system is able to provide required air flow but is very sensitive for several factors occurring in a real-life circumstances
- Indoor mycobiota showed indicative differences before and after intervention
- Sampling of dust from the exhaust air filter showed potential as an indicator of IAQ problems and could be further improved to increase the applicability
- Positive differential pressure did not cause moisture accumulation inside the structures with any moisture excess values realistic for a school building
- The positive pressure intervention showed potential in terms of improving IAQ, and could be investigated and applied in other contexts in the future



Thank you!

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- Vornanen-Winqvist, Camilla; Järvi, Kati; Toomla, Sander; Ahmed, Kaiser; Andersson, Maria; Mikkola, Raimo; Marik, Tamas; Kredics, László; Salonen, Heidi; Kurnitski, Jarek. 2018. Ventilation positive pressure intervention effect on indoor air quality in a school building with moisture problems. International Journal of Environmental Research and Public Health, 15(2), article no. 230. ISSN 1660-4601. DOI: 10.3390/ijerph15020230.
- Ferrantelli, Andrea; Vornanen-Winqvist, Camilla; Mattila, Milla; Salonen, Heidi; Kurnitski, Jarek. 2019. Positive pressure effect on moisture performance in a school building. Journal of Building Physics, 43(2), 121-142. Online ISSN: 1744-2583. DOI: 10.1177/1744259119837144.
- Vornanen-Winqvist, Camilla; Salonen, Heidi; Järvi, Kati; Andersson, Maria; Mikkola, Raimo; Marik, Tamas; Kredics, László; Kurnitski, Jarek. 2018. Effects of ventilation improvement on measured and perceived indoor air quality in a school building with a hybrid ventilation system. International Journal of Environmental Research and Public Health, 15(7), article no. 1414. ISSN 1660-4601. DOI: 10.3390/ijerph15071414.