Practical Investigation of Indoor Environmental Parameters Measurements in an Office-Retail Building

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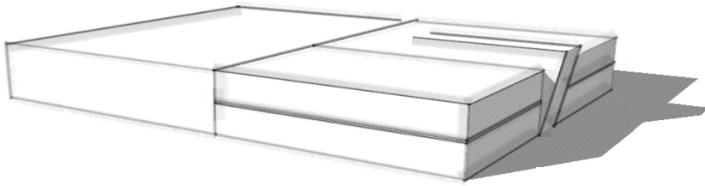
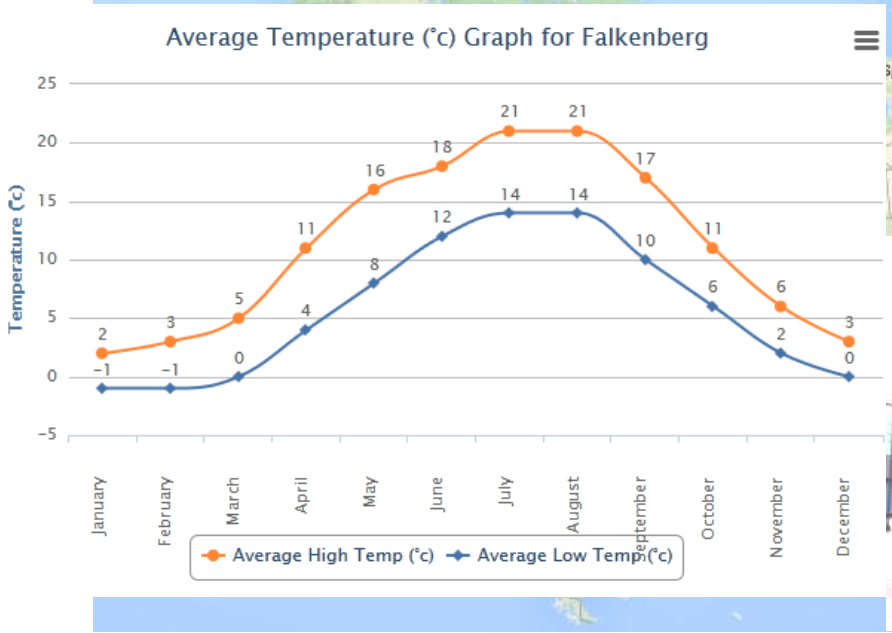


Content

Part of the study: constant air volume (CAV) versus demand controlled ventilation (DCV)

- Building description, HVAC and monitoring systems
- Data complexity and coherence (AHUD and IED)
- Evaluation
  - Air handling unit data (airflow and specific fan power)
  - Indoor environmental parameters (temperature, long-term comfort, building energy classification)
- Summary of results, conclusion and further work

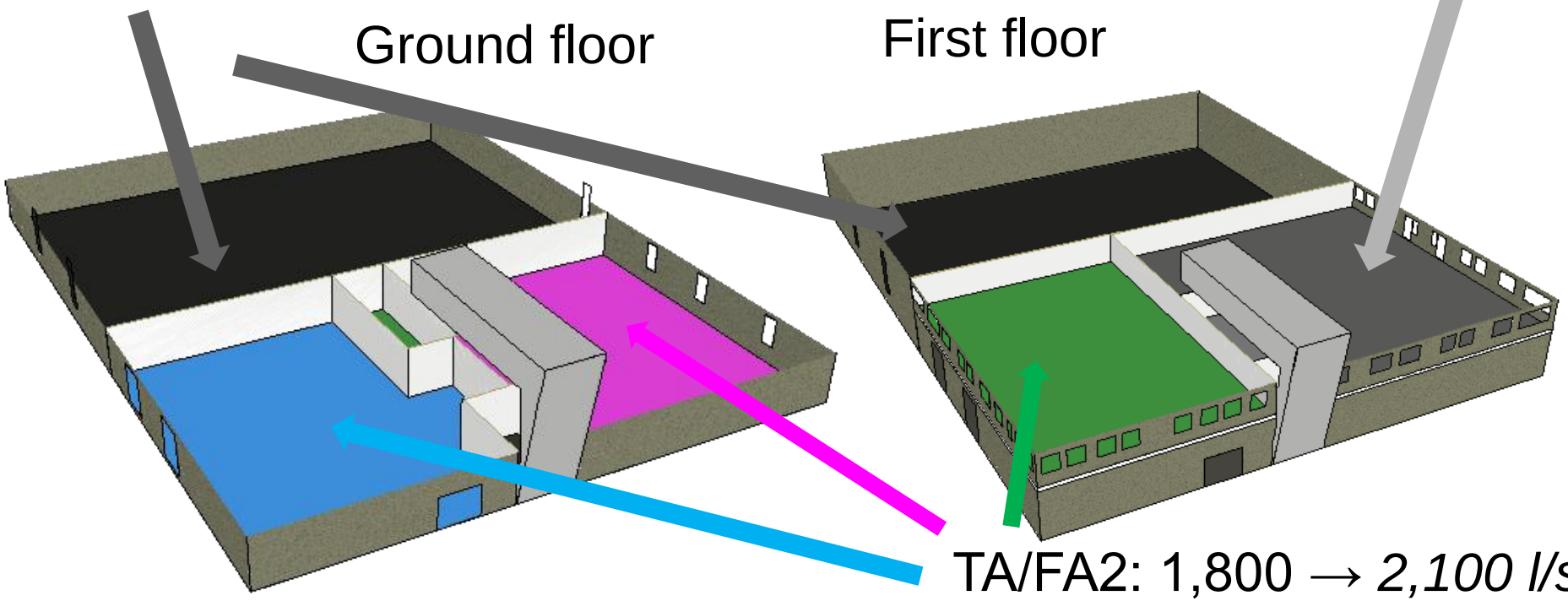
Engelsons in Falkenberg



HVAC system and zones

TA/FA1: 1,000 l/s
warehouse

TA/FA3: 1,200 l/s
rented office



Office (air + water): 725 l/s for 481 m^2

Retail (air + *air water extra*): 900 l/s for 439 m^2

Packing (air + air water + *air water extra*): 175 l/s → 475 l/s for 514 m^2

Monitoring systems

Air handling unit data (AHUD)

Oct 2011 – Feb 2013

Integrated monitoring system

Time step 30 min

Temperature, RH, pressure, airflows, *calculated SFP & recovery efficiency*

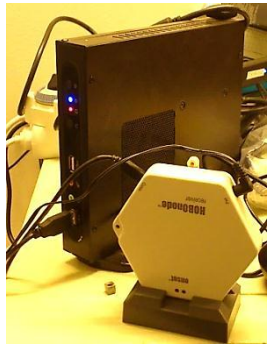
Indoor environment data (IED)

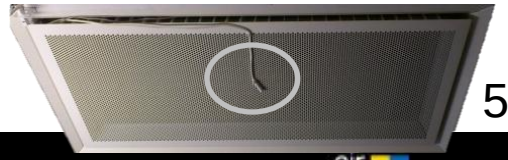
Apr 2011 – Nov 2013

Hobo loggers, remote access

Time step 6 min

Temperature, RH





Data coherence & complexity

Coherence with same data (temp and RH).

The most complex data are in year 2012.

IED (temperature, RH)

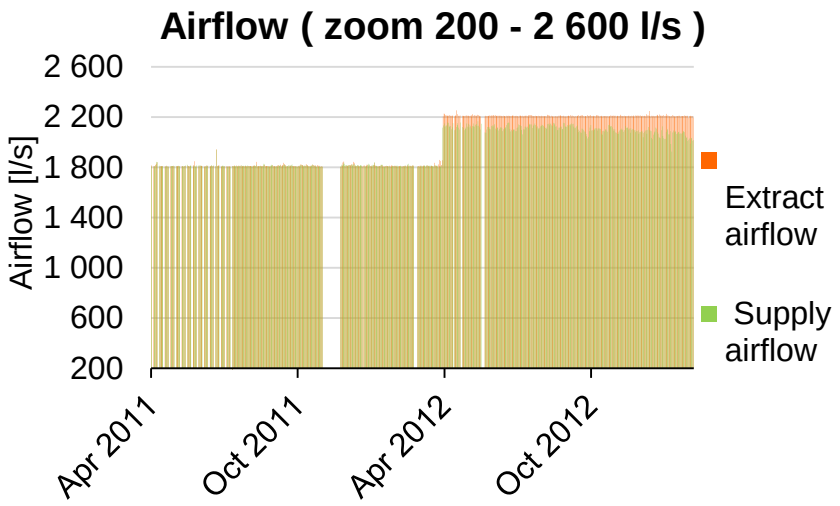
- 100% for office rooms 2110, 2109 and 2108
- 99,0% and 98,6% for retail 111 and packing 101 (malfunctioning of probes)

AHUD (temp, RH, airflow, pressure)

- 96% for temperature and airflow in TA/FA2

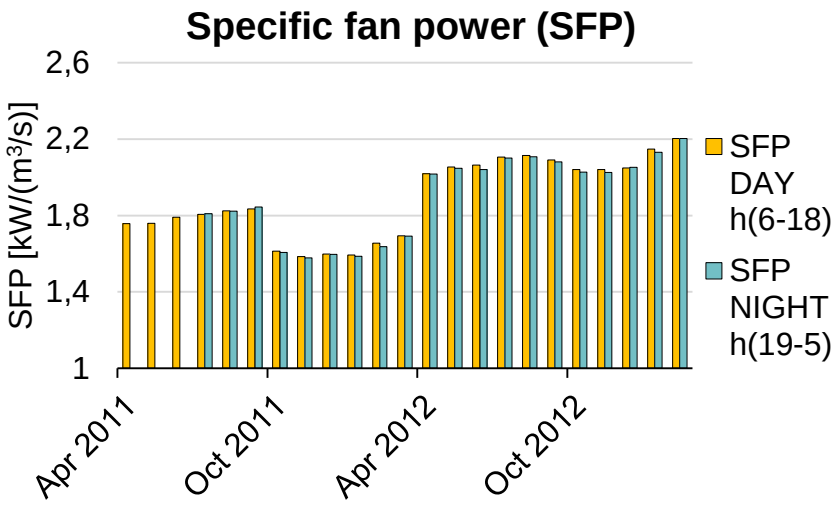
AHU data

Airflow



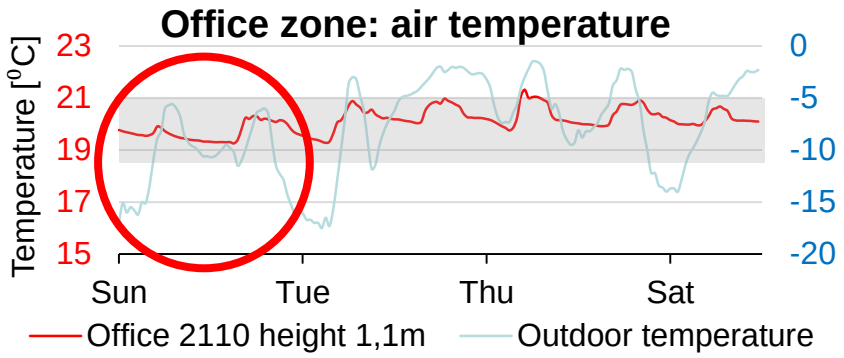
- CAV
- Missing data
- Airflow increase

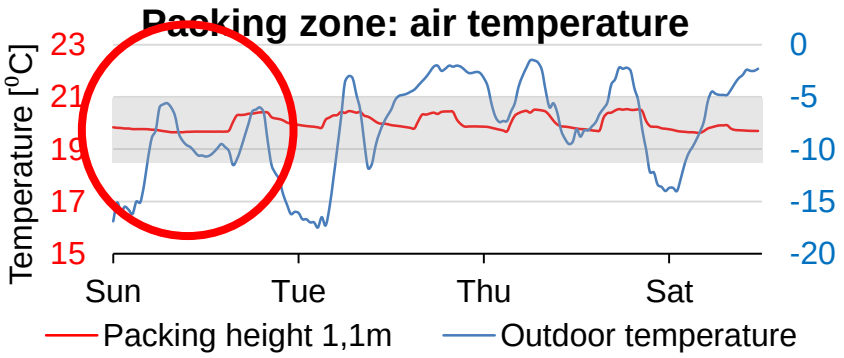
Night (unoccupied) mode

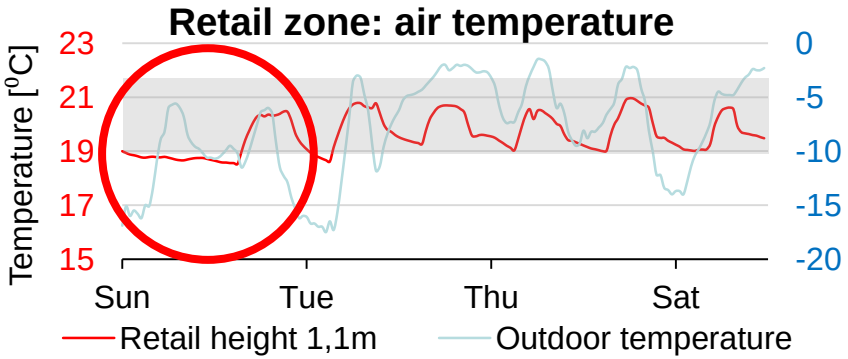


- No reduction in SFP/airflow but..

Indoor temperature in $T_{outdoor, min, weekly}$





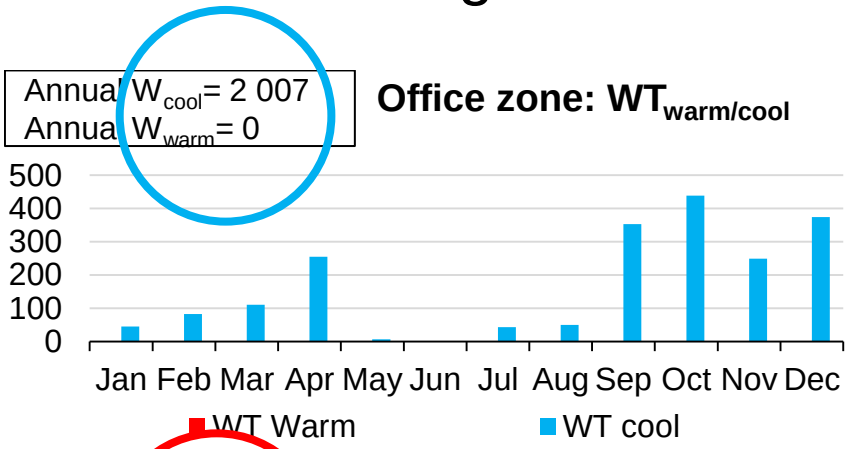


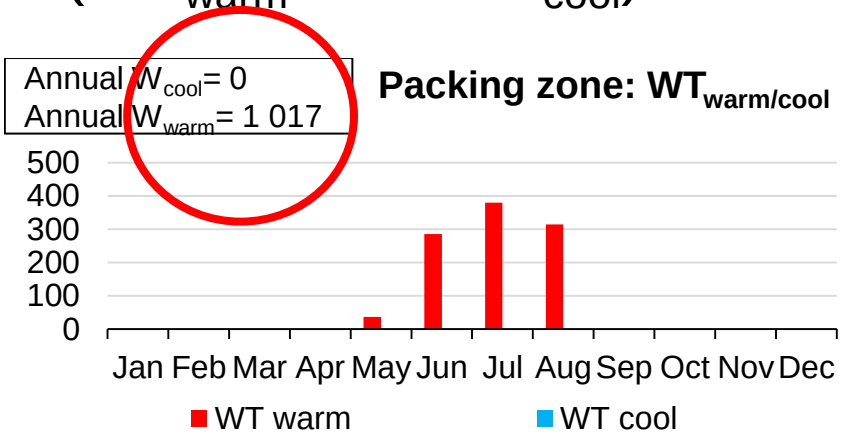
Temp drop in weekends and night time

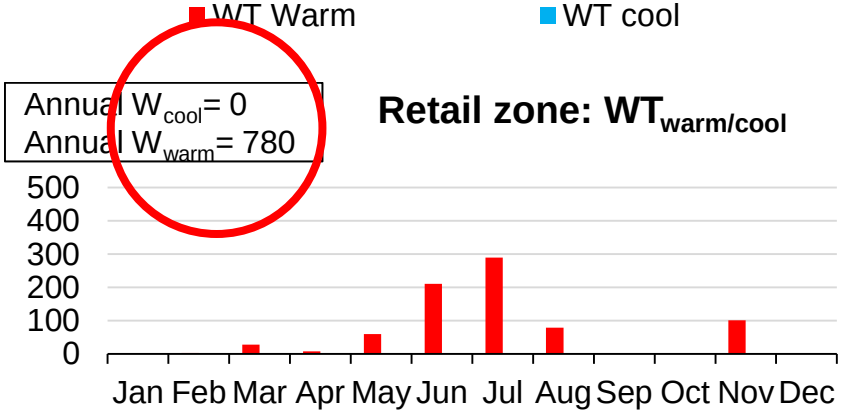
Office: min Temp 19-21ºC (*class 3 – class 1*)

Long-term comfort

- Based on (PPD) & (PMV) with *clo* and *activity*
- Sum of weighted time factors (WT_{warm} and WT_{cool})







Office → cool discomfort

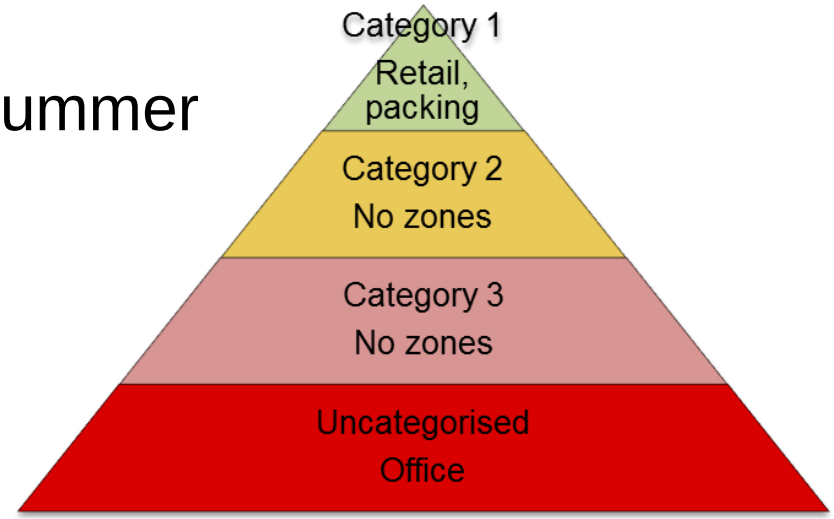
Packing → warm discomfort

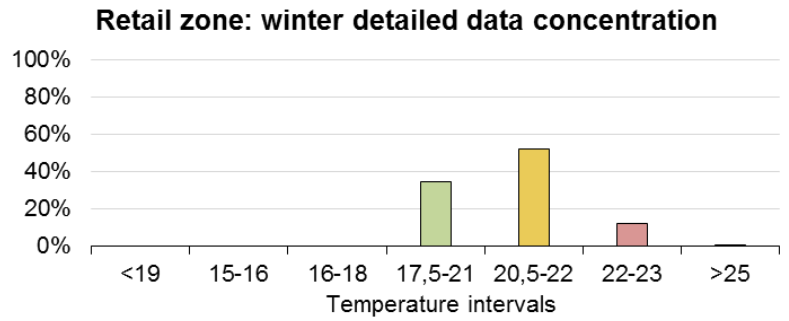
Retail → warm discomfort

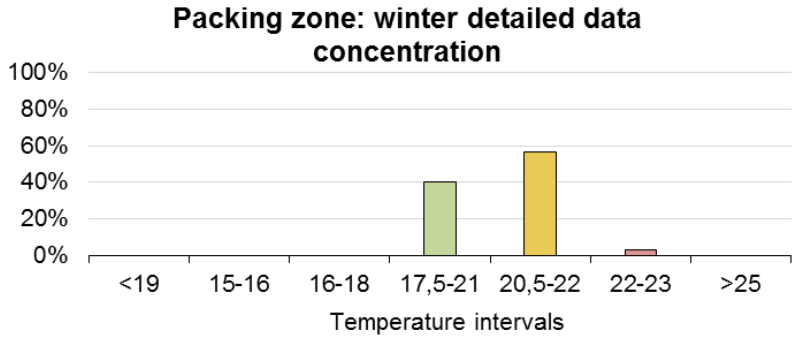
Building energy category

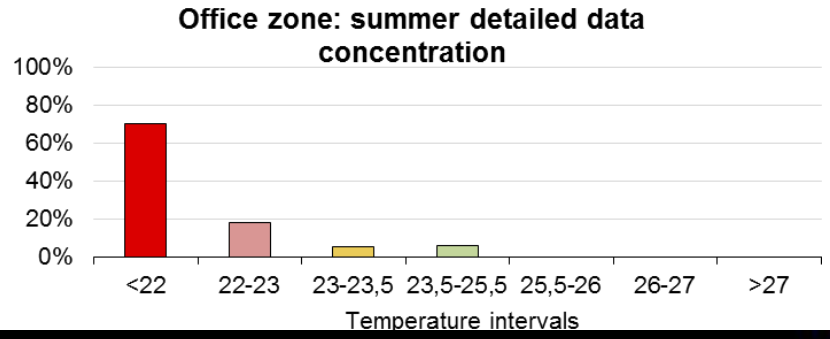
Winter

Summer









Results

- Problem with increase of airflow resulting in unbalanced system and higher under-pressure → influences efficiency of HVAC system
- Night mode regulation does not seem to be effective → lowering of SPF/airflow although temperature drop during unoccupied period
- Cool discomfort in office rooms, and warm discomfort in retail and packing zones → post installation of two fan coils in the retail area and a split unit in the packing
- Energy classification in winter *class 1* for offices and *class 2* for retail with packing area, office in summer falls outside *class 3* → possibility for better regulation

Conclusion

More careful regulation of HVAC system would reduce energy consumption and increase the energy class & deliver a better indoor environment.

Solution in proper documentation, monitoring, evaluation and regulation of HVAC system (a repeated cycle).

Further work: CAV versus DCV (Francesco Errico´s thesis)

Thank you.

Dennis Johansson, Lund University, Sweden
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John Woollett, Swegon, Sweden