Radon at work places - concentrations during working hours vs. long term average

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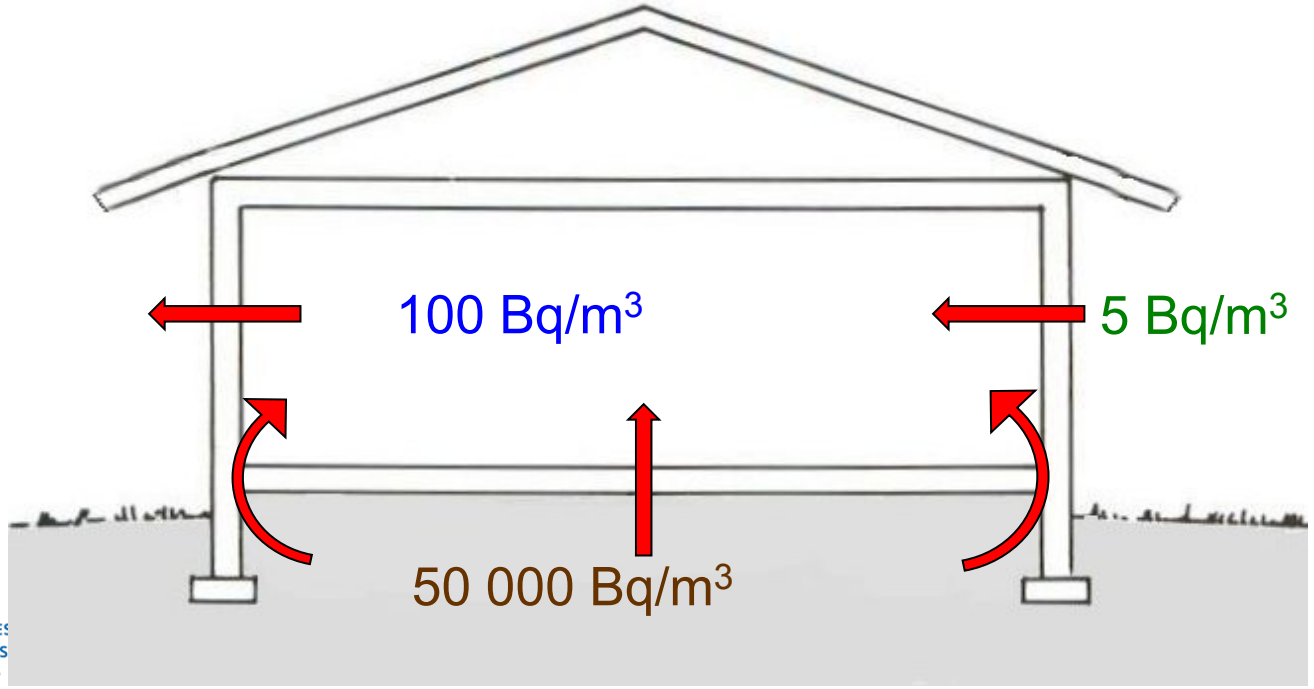
Background

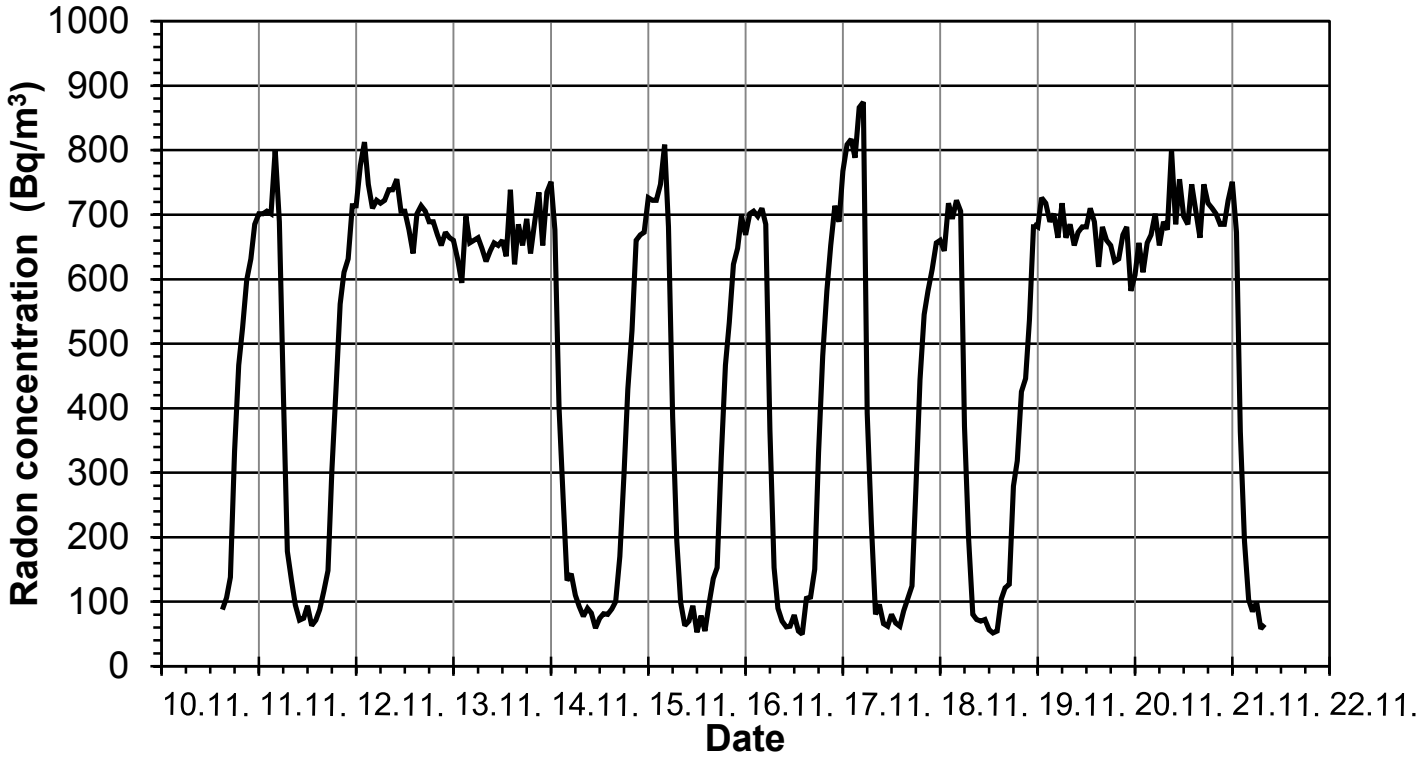
- Radon is accumulated in buildings due to leakage air flows from the ground
- Ventilation removes radon from the building



Characteristics of ventilation at workplaces

- Mechanical ventilation is usually operated at higher power during working hours than at other times
  - Supply and exhaust ventilation or exhaust ventilation only
  - Ventilation is shut down for nights and weekends to save energy (power consumption of fans and heating of the building)
- Separate exhaust ventilation in washrooms & WCs and staircases are usually operated continuously
  - Higher negative pressure in the building during nights and weekends

High variation of radon concentration



- Average during working hours: 80 Bq/m^3
- Average of the whole measurement time (11 days): 480 Bq/m^3
- Long term (> 2 months) average radon concentration: 500 Bq/m^3

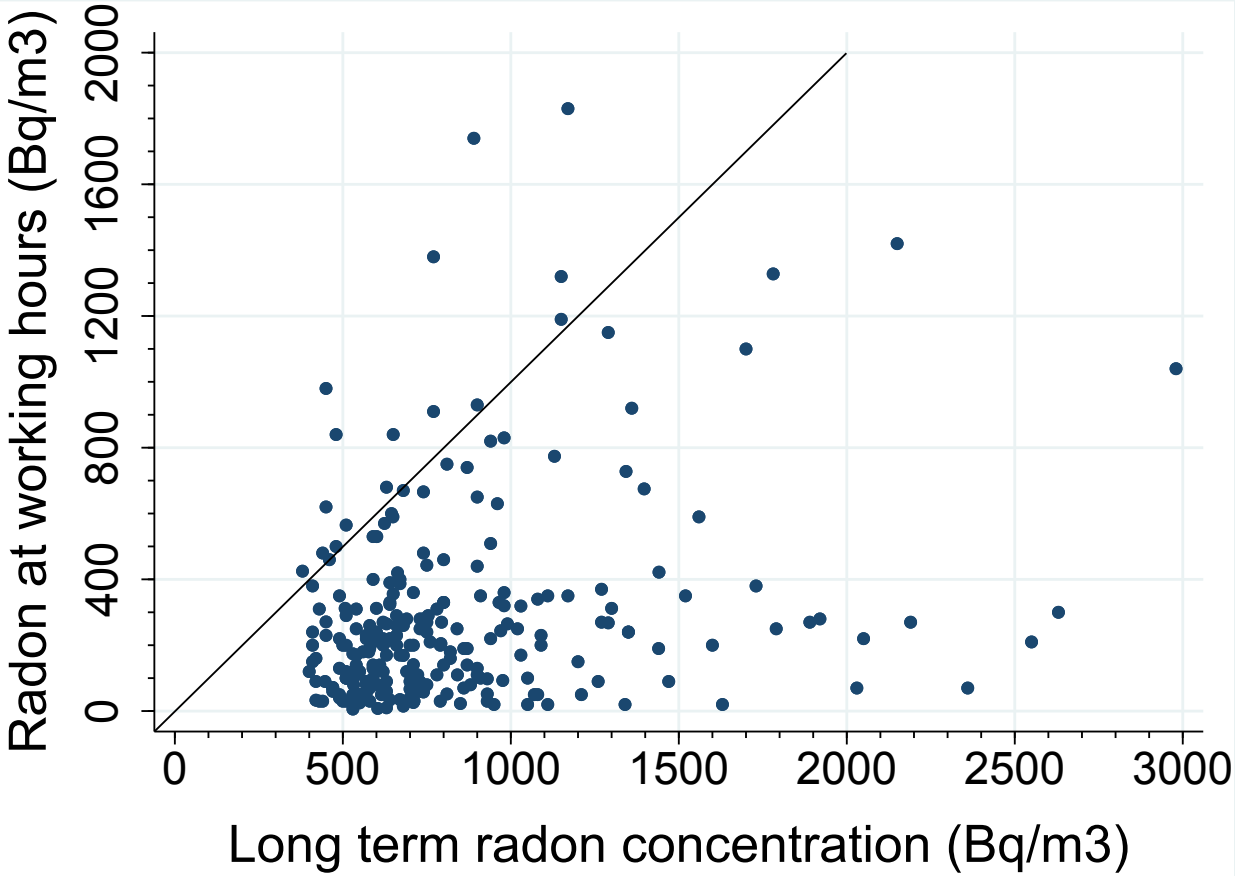
Radon measurements

- At first, radon concentration at a work place is typically measured for two months using an integrating radon detector
  - Easy and cheap measurement but it often overestimates the radon concentration during working hours if there is a scheduled mechanical ventilation at the workplace
  - Nevertheless, it is feasible as a screening measurement
    - With long term measurement one can find those workplaces where radon concentration during working hours may be greater than the reference level
    - Most of the screening measurements are less than the reference level
- Radon concentration during working hours can be determined with a continuous radon measurement
  - Measurement time should be at least seven days

Measurement data

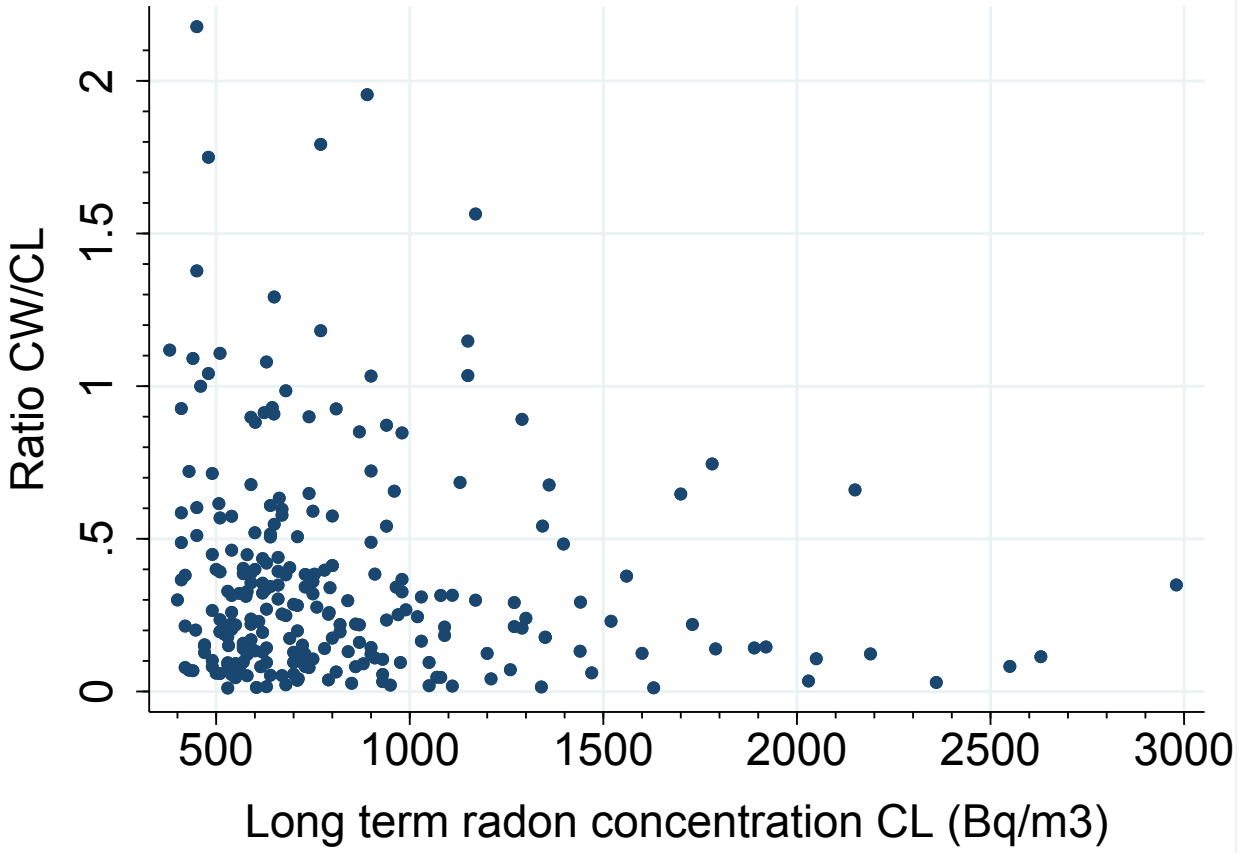
- Data in the national radon measurement database were utilized
- Total of 259 workplaces were found with both long term and continuous measurements carried out
- Measurements were made during measurement season November – April during 2001 – 2017
- Typical duration of the measurements:
  - Long term: typically 60 - 70 days
  - Continuous radon measurement: typically 7 - 9 days

Radon concentration during working hours vs. long term concentration (N=249)



- Ratio of radon during working hours and long term average) > 1 in 16 (6 %) measurement points
- Possible reasons:
  - Unusual week compared to long term measurement with no day-night variation
  - Mechanical exhaust ventilation operated only at working hours with no fresh air vents (high negative pressure)
  - Some other reason

Ratio of radon during working hours (CW) and long term radon concentration (CL)



- N = 249
- Average = 0.37
- Median (P50) = 0.25
- P25 = 0.12
- P75 = 0.49

- Ratio > 1 in 16 (6 %) measurement points

Number of measurement points classified by radon concentration

Radon conc. during working hours	Number of measurement points			
	Long term radon concentration			
	400 - 1000 Bq/m^3	1001 - 2000 Bq/m^3	2001 - 13300 Bq/m^3	Total
0 - 200 Bq/m^3	107	15	3	125 (48 %)
201 - 400 Bq/m^3	57	17	6	80 (31 %)
401 - 600 Bq/m^3	16	2	0	18 (7 %)
601 - 1000 Bq/m^3	15	4	2	21 (8 %)
1001 - 4900 Bq/m^3	2	6	7	15 (6 %)
Total	197 (76 %)	44 (17 %)	18 (7 %)	259

Conclusions

- Ratio of radon concentration during working hours and long term average is typically 0.1 – 0.5
- In about 80 % of the measurements, the radon concentration during the working hours were less than the old reference value of 400 Bq/m^3, although the result of the integrating long measurement were greater than that
- STUK recommends to carry out a continuous radon measurement to determine the radon concentration during working hours in the workplaces having a scheduled mechanical ventilation
- About the future work: STUK is carrying out a survey to obtain more detailed information about the radon concentrations during working hours (variation of the ratio)

Thank you for your attention!