Radon Measurements on Higher Floors in Swedish Multi-Family Houses

- Measurements included in the statistical analysis
- Swedish and US measurement protocols for multi-family houses
- Differences between different floors
- Number of multi-family where radon levels above the reference level are found only on floors above the ground floor
- Dependences on ventilation type and building year
- Are measurements on higher floors needed?

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Measurement statistics from Swedish multi-family houses

- Radonova has made more than 400’000 measurements in Swedish apartments (about 18 % of all apartments
- Data from buildings with 5 and more measurements performed during 2017-2020 were selected, which gave 5559 multi-family buildings and 3347 workplaces.

The analysis of this data and also detailed analysis of measurements in single-family houses and workplaces have been published in a research report by the Swedish Radiation Authority (SSM):
https://www.stralsakerhetsmyndigheten.se/en/publications/reports/radiation-protection/2021/202128/

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In order to study measurements on higher floors in more detail, a new analysis of data (also in buildings with 5 or more measured apartments) was made from measurements performed during 2014-2021 based on buildings without “blue concrete” building material and with at least one apartment above 200 Bq/m^3 (5.4 pCi/l) on ground floor or higher and with measurements on both ground floor and higher floors (some buildings might not have apartments on the ground floor).

Radon measurement protocols for Multi-Family houses

(Comparison between Sweden and US)

Parameter	US (ANSI/AARST)	SWEDEN (SSM)
Measure in every building	YES	YES
Measure on every floor with apartments	YES	YES
Apartments on floor with ground contact	ALL	ALL
Apartments above non-measured basement	ALL	> 20 %
Apartments on higher floors	> 10 %	> 20 %
Detectors per apartment (minimum)	1	2

Swedish MULTI-FAMILY HOUSES (no “Blue Concrete”)– different floors

(Radon measurements with 5 or more APPARTMENTS – analyzed by Radonova 2014-2021)

Type of floor	Number of measure-ments	Measure points per floor measurement	Average Median value (pCi/l)	Average (pCi/l) & (Spreading - 1 sd)	Some value above 5.4 pCi/l (200 Bq/m^3)
Ground floor – slab on grade	656	8.2	1.4	1.7 (66 %)	17 %
Basement – basement	80	3.0	2.4	2.5 (86 %)	18 %
No ground contact – slab on grade	679	10.6	0.8	0.9 (50 %)	5 %
No ground contact – basement	1503	12.3	1.2	1.3 (57 %)	13 %

Differences between floors in the same building

(Radon measurements with 5 or more measurements in the same building – analyzed by Radonova 2018-2022

(*) At least one measurement on ground floor and at least one measurement on higher floor and at least one measure point above 5.4 pCi/l on ground floor or higher. (**) (Multi-family data from 2014-2021). Only multi-family houses which had answered that they had no blue concrete were included in the analysis.

Floor type comparison	Number (Multi-family houses) (**)	Higher floors with higher average values	Number (Workplaces)	Higher floors with higher average values
No ground contact / Ground contact (Slab on grade) (*)	110	11 %	194	20 %
No ground contact / Ground contact (Slab on grade)	568	18 %	888	26 %
No ground contact: not Ground Floor / Ground Floor (*)	164	28 %	404	28 %
No ground contact: not Ground Floor / Ground Floor	1288	30 %	1645	36 %

The amount of higher floor with higher values than the ground floor is smaller for buildings with higher radon levels.
A questions is: How many multi-family buildings with radon levels would not be found if measurements only were performed on the ground floor?

Differences between floors in the same building

(Radon measurements with 5 or more measurements in the same building – analyzed by Radonova 2014-2021

At least one measurement on ground floor and at least one measurement on higher floor and at least one measure point above 200 on ground floor or higher.

Foundation type	Number of multi-family buildings	Only values above 200 Bq/m³ (5.4 pCi/l) on floors above the ground floor	Only values above 200 Bq/m³ (5.4 pCi/l) on the ground floor
All	326	17 %	64 %
Basement	169	20 %	58 %
Basement (5 or more measurements on ground floor	63	16 %	60 %
Slab on grade	124	7 %	71 %

About 15-20 % of multi-family houses with basement and with values above the reference level would not have been found if no measurements were made on floors above the ground floor. For workplaces, the corresponding number was 17 %.

A questions is: Would some of these houses been found if more apartments had been measured on the ground floor?

Differences between floors in the same building

(Radon measurements with 5 or more measurements in the same building – analyzed by Radonova 2014-2021

At least one measurement on ground floor and at least one measurement on higher floor and at least one measure point above 200 on ground floor or higher.

Foundation type	Values above 200 Bq/m³ (5.4 pCi/l)	Average number of measured apartments on ground floor	Average number of measured apartments on higher floors
Basement	Only on higher floors	4.3	10.6
Basement	Only on ground floor	7.5	10.1
Slab on grade	Only on higher floors	12.1	22.1
Slab on grade	Only on ground floor	12.3	11.1

Part of the buildings where levels above the reference level only were found on higher floors might be explained with a smaller number of measurements on the ground floor.

However, for multi-family houses with slab on grade, the measurement protocol require measurements in all apartments on the ground floor.

Differences between floors in the same building

(Radon measurements with 5 or more measurements in the same building – analyzed by Radonova 2014-2021

At least one measurement on ground floor and at least one measurement on higher floor and at least one measure point above 200 on ground floor or higher.

Ventilation type	Number of buildings	Only values above 200 Bq/m³ (5.4 pCi/l) on floors above the ground floor	Only values above 200 Bq/m³ on the ground floor
All	326	17 %	64 %
Natural ventilation	81	25 %	50 %
Mechanical exhaust	192	12 %	67 %
Balanced ventilation with heat recovery	37	16 %	68 %

Buildings with only too high values on higher floors are more frequent in buildings with natural ventilation.

Differences between floors in the same building

(Radon measurements with 5 or more measurements in the same building – analyzed by Radonova 2014-2021

At least one measurement on ground floor and at least one measurement on higher floor and at least one measure point above 200 on ground floor or higher.

Building year period	Number of buildings	Only values above 200 Bq/m³ (5.4 pCi/l) on floors above the ground floor	Only values above 200 Bq/m³ on the ground floor
All	326	17 %	64 %
-1959	108	27 %	44 %
1960-1979	58	10 %	67 %
1980-1999	84	11 %	77 %
2000-2022	67	13 %	79 %

Buildings with only too high values on higher floors are more frequent in older buildings.

In 55 % of the houses built before 1960, the ventilation type is natural ventilation compared to 26 % for all building periods.

Are measurements on higher floors needed?

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01 About 15-20 % of Swedish multi-family houses (without “blue concrete”) with basement and with values above the reference level would not have been found if no measurements were made on floors above the ground floor.

02 About 5-10 % of Swedish multi-family houses (without “blue concrete”) with slab on grade and with values above the reference level would not have been found if no measurements were made on floors above the ground floor.

03 Only values above the reference levels are more common in older buildings and in buildings with natural ventilation

04 For people living in a multi-family house, it is also a value in knowing that radon levels are low.

THANK YOU !!

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