A nationwide radon survey in Finland – prevention in new construction.

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Aim

Exploring the prevalence and efficiency of preventive measures in houses constructed in 2006 - 2008
Background

EU countries

• research on the status of radon prevention is still quite inadequate
• many countries require radon prevention in new construction
• representative surveys on the prevalence and efficiency are lacking

• Reference: RADPAR (Radon Prevention and Remediation, EU DG SANCO) final reports
Radon in Finland

Reference values for radon concentration

- new construction 200 Bq/m³
- existing dwellings 400 Bq/m³

Previous nationwide random sample survey 2006

- 15.1% (204,000) of low-rise residential houses > 200 Bq/m³
- nationwide average
  - all dwellings 96 Bq/m³
  - low-rise houses 121 Bq/m³

Percentage >200 Bq/m³
Entry routes, slab on-ground

- Prevalent type of foundation in Finland
- Gap between foundation wall and floor slab
- Permeable light weight concrete blocks increase air flows
- Non-sealed pipe penetrations
Entry routes

Basement or semi-basement

Light-weight concrete blocks in non-sealed walls promote air-flows
Regulations, key changes in 2003 -2004

**New guide for radon prevention in 2003**
- Use of a strip of bitumen felt for sealing
- Installation of radon piping (as already in the previous 1996 guide)

**New building code for foundations in 2004**
- In the design and construction work, radon risks at the construction site shall be taken into account
- Radon-technical design documents are required
Radon resistant new construction, guideline

Sealing of slab-foundation wall joint and walls in contact with soil

Polyester-reinforced bitumen felt

- cast in direct contact with bitumen felt at least 15 cm

Figures from Guide RT 81-10791
Installation of bitumen felt
Radon resistant new construction, guideline

- Install a passive piping system: discharge open above roof

Install a radon fan when radon concentration

> 200 Bq/m³
New construction survey 2009

Radon concentration was measured in 1561 randomly chosen dwellings (low-rise houses)

- Building permission given in 2006
- Notice of removal before November 2008
- Houses completed in 2006 - 2008
- Single family houses, pair houses, terraced houses
New construction survey 2009

- Original sample 3000 dwellings
- 7% of dwellings in low-rise houses that received building permission in 2006
- Positive reply 62%, received radon dosemeters
- Final participation 52%
- Two months measurements in March - May 2009
New construction survey 2009

• Standard radon measurement questionnaire + special radon prevention questionnaire with figures

Sealing work carried out?  
Radon piping installed?

[Diagram showing sealing work and radon piping installation]
Results, foundation and radon

Slab-on-ground, prevalent type of foundation
• remarkable progress in radon prevention

Highest concentrations
• houses with semi-basement and basement, average 161 Bq/m$^3$ median 97 Bq/m$^3$
• main reason: defective measures for radon prevention in the block walls in contact with soil

Lowest concentrations, rare foundation types
• houses with crawl space, median 29 Bq/m$^3$
• houses with a monolithic floor slab, median 27 Bq/m$^3$
Results

- Preventive measures were taken
  - in 92% of houses in six provinces with highest radon concentration (Area 1)
  - in 38% of houses elsewhere in the country (Area 2)
  - in 54% of houses, whole country

- Average radon concentration 95 Bq/m³, median 58 Bq/m³

- Percentage exceeding 200 Bq/m³
  - 200 Bq/m³ 10.6%, previous nationwide survey 15.8%
  - 400 Bq/m³ 2.1% 3.8%
Results

Radon reduction compared with houses completed in 2000-2005 (previous nationwide survey in 2006)
- 47% in area 1 (high radon provinces)
- 26% in area 2 (elsewhere)
- 33% whole country

Radon reduction compared with houses with no prevention measures (slab-on-ground)
- passive radon piping and sealing 57%
- passive radon piping without sealing 41%
Effect of preventive measures

Radon concentration in houses with slab-on-ground and local reference values.

Regression lines are fitted for houses

- without preventive measures
- with passive radon piping and sealing carried with a strip of bitumen felt
- local reference data is based on the STUK data base, 87,000 low-rise houses
New construction survey 2009


The last bar (2006-2008) represents the results of the new construction study.
Challenges

• Widespread and skilled implementation of preventive measures throughout the country

• Sealing of pipe penetrations

• Sealing measures for block walls in contact with soil

• Increased use of foundation types with typically lower radon concentrations instead of slab-on-ground foundation
Conclusions

• The building code and prevention guidelines were revised in 2003 - 2004

• Nationwide prevention activity increased to 54%

• Reduction in radon concentrations of 33%, in provinces of highest concentration 47%

• The present prevention strategy provides a good basis for further work

• Directed random sample surveys provide an excellent tool for prevention studies
Thank you

Reference


www.stuk.fi   www.radon.fi