Airtightness Measurements of Wood Frame Low Energy Row Houses

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Outline

- Background and building information
- Methods
- Results
  - Achieved airtightness
  - Challenging / costly details
- Conclusions
Jåtten Øst – Background

- "Hothouse", April Arkitekter wins.
- 73 row houses.
- Total ca 11,000 m².
Jåtten Øst – background - owner effort

Foundations built by 73 future home-owners, led by Stavanger Municipality

Photo: Stavanger Kommune

Photo: April Arkitekter
Jåtten Øst - Background - Accessibility
Jåtten Øst – Background – Energy Ambitions

- Introduced LATE in the process
- Net energy demand: <106 kWh/m² (152 kWh/m² “normal”)
- n₅₀<1.0 h⁻¹ (<4.0 h⁻¹ mandatory) n₅₀=air changes per hour at 50 Pa pressure difference.
- “1,0 was a nice, round number, and we knew that it had been achieved by another company”
Methods

- Examination of leakage test results
  - Each apartments individually tested with blower-door twice:
    - After completing wind barrier.
    - Just before take-over.

- Interviews:
  - commissioner *(Stavanger municipality)*,
  - architect *(1)*,
  - carpentry contractor *(4)*,
  - electrical contractor *(1)* and
  - airtightness surveyor *(1)*
Starting point for airtightness work

- Architect: No experience in designing air tightness.
- Carpenter: No prior experience with measurement of airtightness, but "experienced in tightening against driving rain."
- Electrician and plumber: no prior airtightness experience.
- Specifications: double windbarrier, radon-barrier, 3-hour seminar and mandatory measurement. Penetrations not well described (detail and responsibility).
- Ad-hoc solutions by carpenter / leakage tester.
Construction layers:
- 12 mm plasterboard
- 50 mm insulation
- Vapor barrier
- 198 mm insulation
- 9 mm plasterboard
- Wind barrier
- 36 mm airgap
- 19 mm wood cladding
“Not really suitable for do-it-yourselves – but they managed in the end..”
Ad hoc solutions for uneven foundation / bottom sill and retaining wall / foundation

- Double sill with foam
- Retaining wall cut to give room for wind barrier
Penetrations were not planned for airtightness..
Airtightness / Accessibility

- Another ad-hoc solution involving expanding foam
Airtightness results
Airtightness: labor and costs

- Architect: more work adopting plans to insulation thickness than airtightness.

- Carpenter: Airtightness: 2-3 extra hours per apartment. Considerable more work installing the extra insulation.

- Rough cost estimate 1,600-2,000 USD / apartment, including testing. (Double WB, Radonstop and balanced ventilation present for other purposes)

- ECM value index = 0.40 $/kWh*y saved (assuming balanced ventilation with 70 % heat recovery)
Lessons learned

- 1.0 h⁻¹ at 50 Pa achievable in a “normal” project.
- Wind-barrier alone can give sufficient air tightness. Testing at this phase has several benefits.
- Testing is important. Finished house with vapor barrier may be more or less tight.
- Ad-hoc solutions to improve air tightness may conflict with environmental considerations.
- Measuring individual apartments overestimates leakiness.
- More air tightness focus in design phase could lead to lower costs and/or better airtightness.
Where to go

- Predicting airtightness from materials, components and solutions.
- Optimizing airtightness requirements.
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