

Methods for Investigation of Technical Status Before Renovation and Evaluation of Renovation Measures for the Building Envelope



Kristina Mjörnell and Thorbjörn Gustavsson, SP,
Angela Sasic, Chalmers University of Technology



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Milparena project – “Million Homes Program” arena

- Platform for knowledge transfer between experts and researchers at Chalmers and SP and building owners in West of Sweden.
- The aim is to create the necessary conditions to decrease energy use in buildings without increasing the risk of damage.
- Based on a number of ongoing renovation projects.
- The current project deals with methods for upgrading the building envelope (additional insulation and air tightness) and methods of working with evaluation and follow up of renovation measures.



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Working methods used in the renovation projects

Investigation prior renovation

- Moisture investigations
- Thermography
- Measurements of air tightness

Simulation of hygro thermal conditions

- Ventilated constructions (crawl space and attics)
- Additional insulated exterior wall and facade

Evaluation through testing, measurements and observations

- Laboratory testing
- Moisture inspections at building sites



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Katjas gata in Backa

Before renovation:

- Prefabricated concrete facade elements
- Carbonation and leakage
- Air leakage, draught from infill walls
- Thermal bridges and cold floors
- Energy use: 178 kWh/m², year



After renovation:

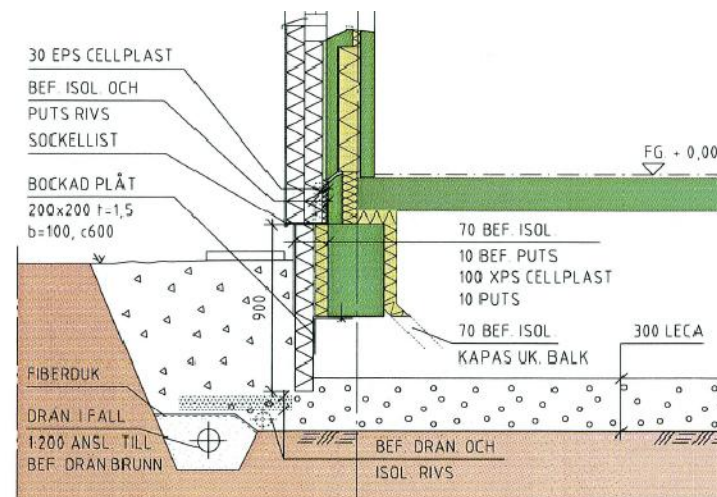
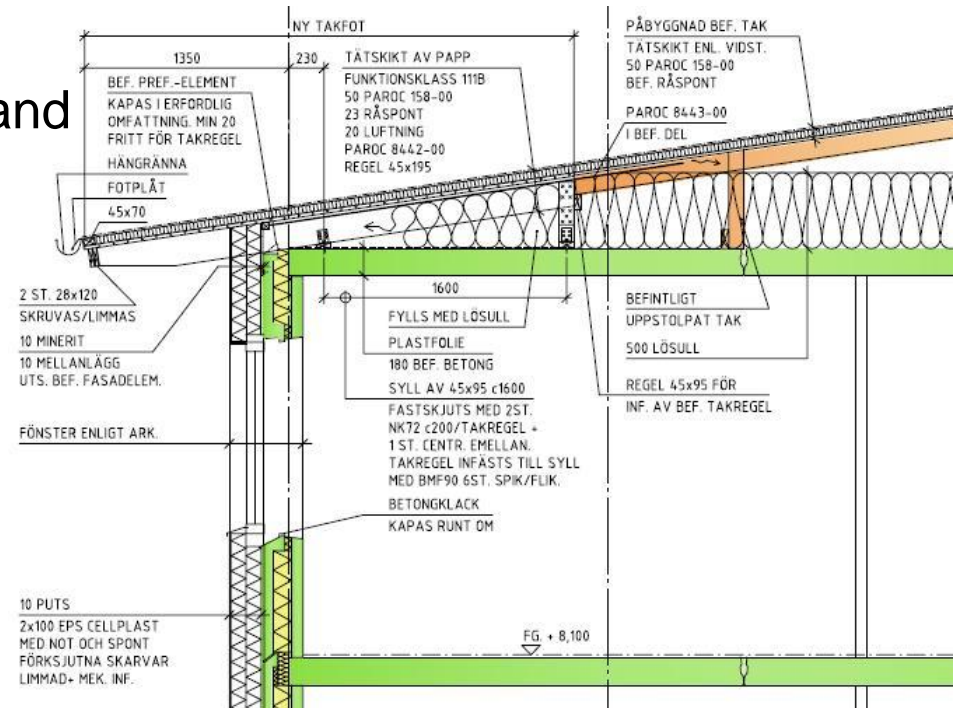
- Additional insulation of 200 mm cellular plastic boards and rendering
- Air tightness through sealings
- New 3-pane windows, solar control
- Insulation on attic and in crawl space
- Energy use: 60 kWh/m², year



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Simulation of hygro-thermal conditions

- Hygro thermal analyses of attic and crawl space using HAM-Tools.



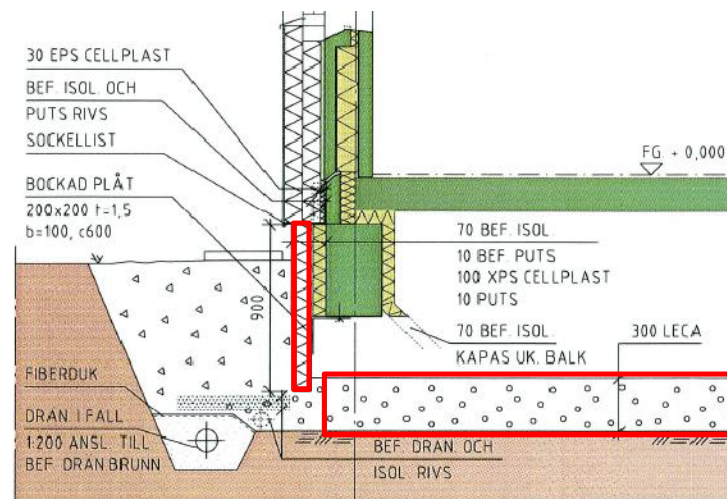
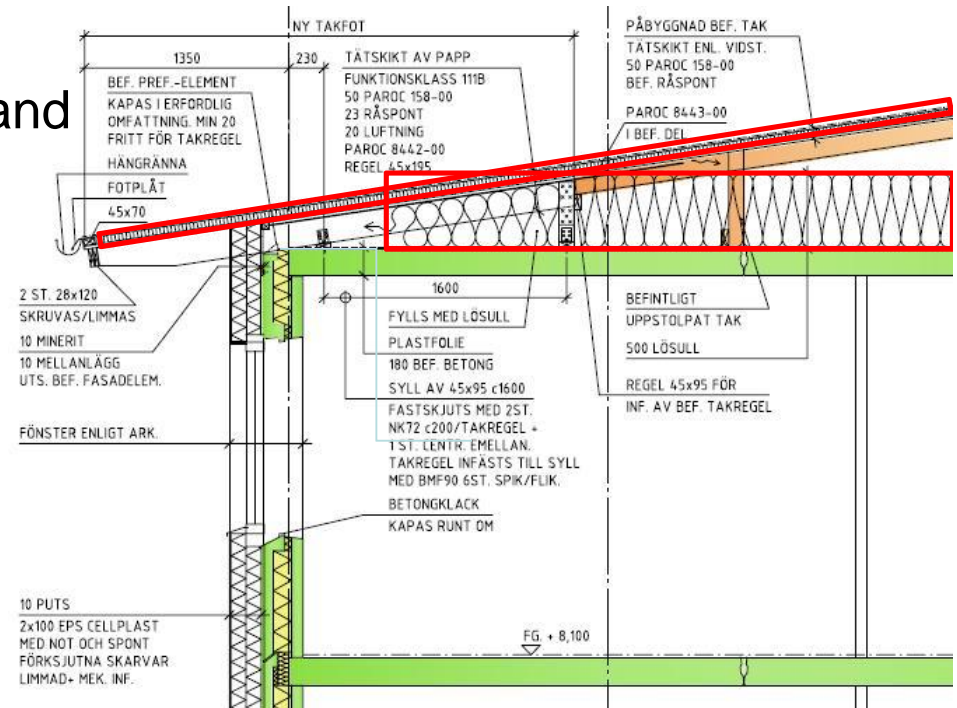
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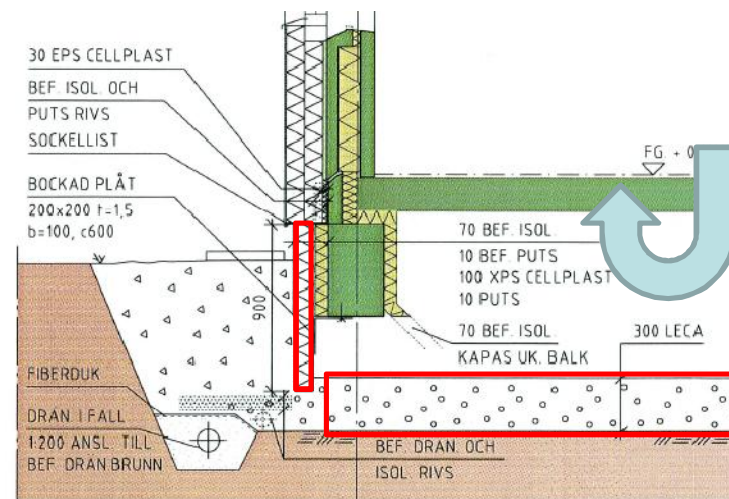
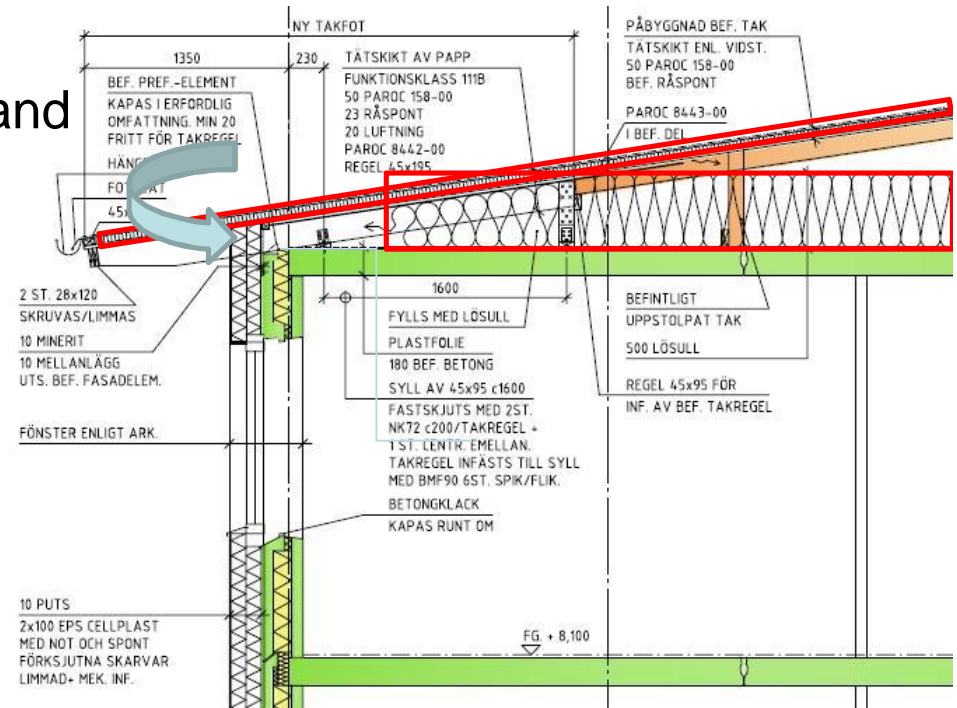


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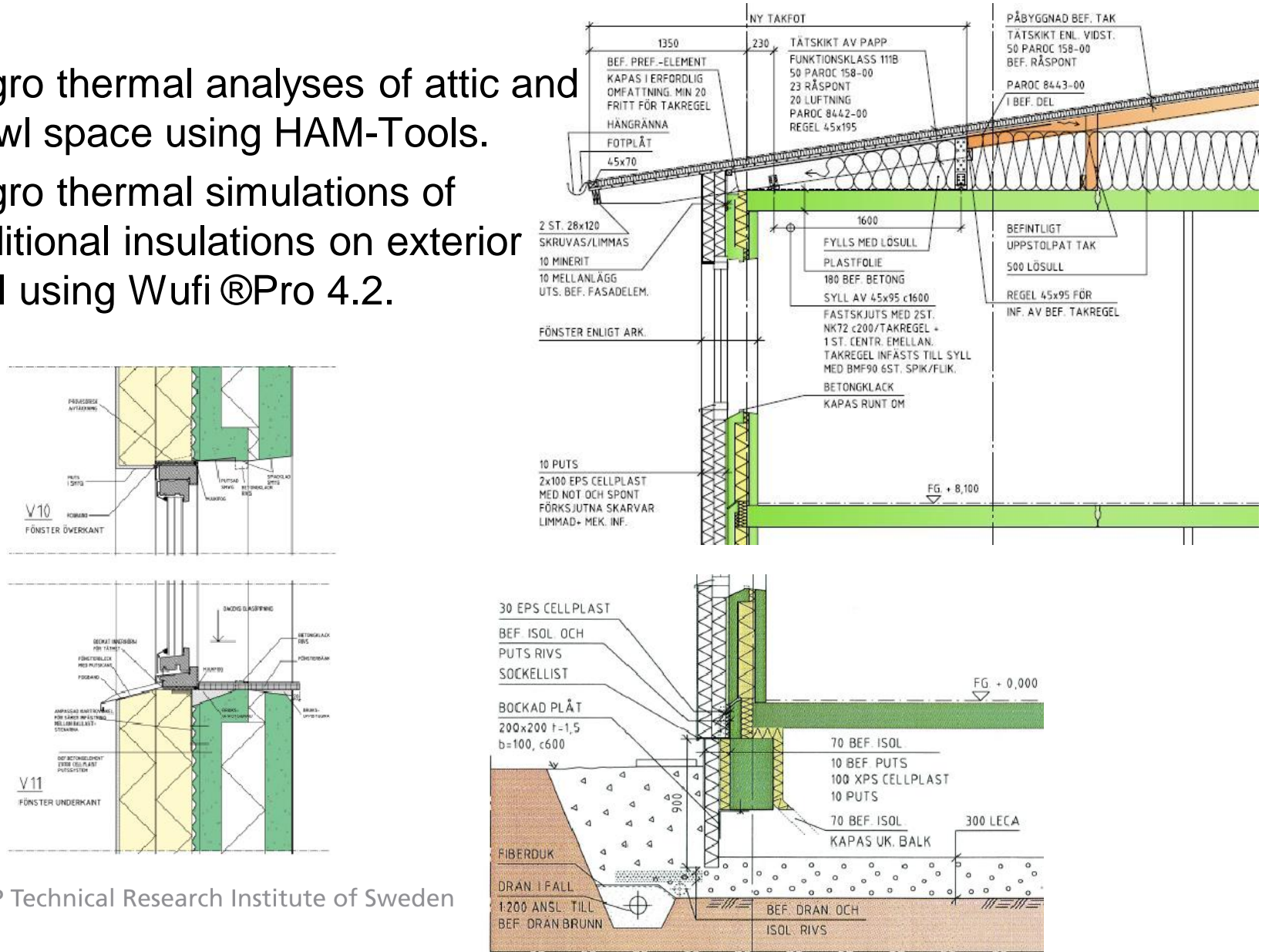
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Simulation of hygro-thermal conditions

- Hygro thermal analyses of attic and crawl space using HAM-Tools.
- Hygro thermal simulations of additional insulations on exterior wall using Wufi ®Pro 4.2.

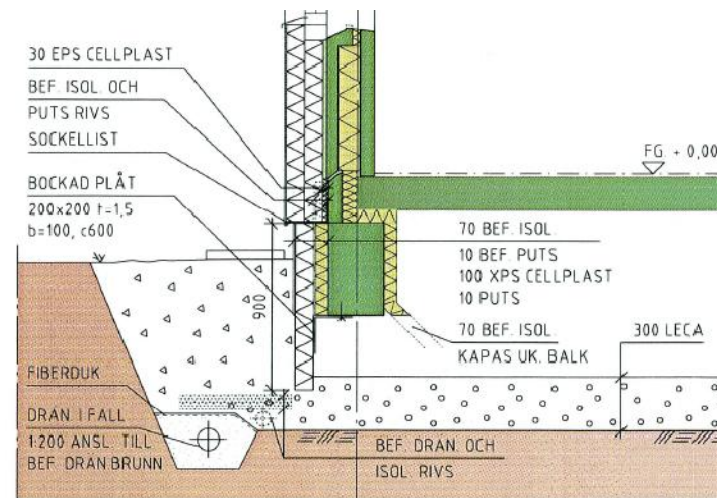
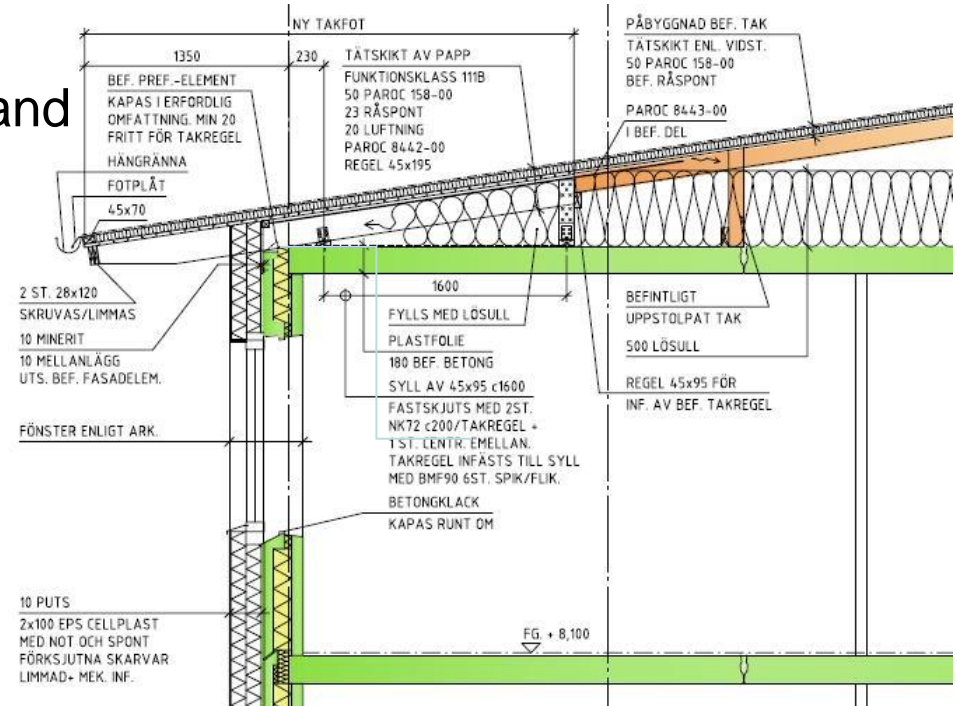
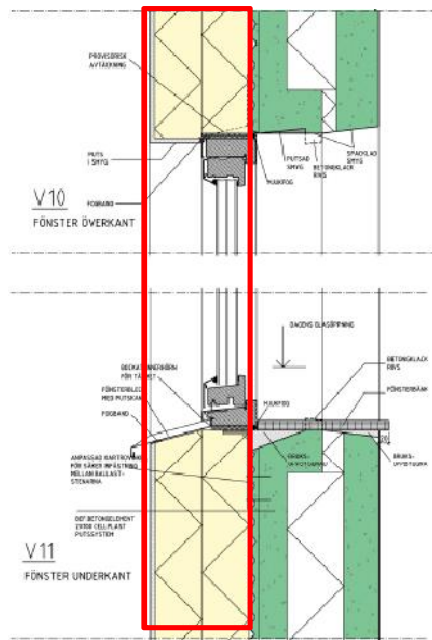


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Evaluation of joints and connections at windows

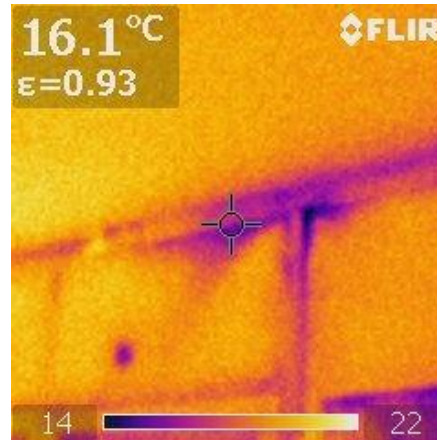
- Moisture inspections
- Insufficient rain tightness at window connections
- Confirmed by tests in the lab
- A new solution was developed and verified through lab tests.



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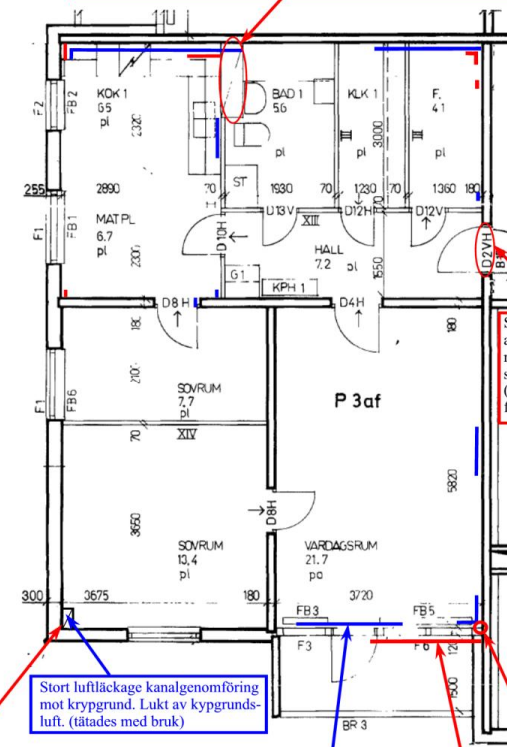
Measurements of air tightness during renovation

- Thermography, air-tightness measurements (Blowerdoor) and detection of leakages in existing, empty and in completed apartments
- Advice and following up on sealing methods
- Before: 1,18 l/sm² for one apartment
- After: 0,13 l/sm² for the whole building



— Luftläckage vid golvvinkel (många av dem tätades tillfälligt med drev eller fog)
 — Luftläckage vid takvinkel

Luftläckage fanns både i tak- och golvbjälklag samt vägg i schaktet.
 Vid golv och vägg främst vid kanalgenomföringar genom betongen, i tak allmänt något otätt.



Stora luftläckage både i anslutning dörrblad-karm, mellan tröskel och golv samt genom brevvinkast (tätning minskade luftflödet 20 l/s)

Stort luftläckage kanalgenomföring mot kryppgrund. Lukt av kypgrunds-luft. (tätades med bruk)

(Drevades extra, blev ej tätt men luftflödet minskade 10 l/s)

Luftläckage vid kanalgenomföring i mellanbjälklagbjälklag, både ovanifrån och utifrån (tätades huvudsakligen)

Avser läckage när även vertikal list samt taklist avlägsnats, ökade läckaget med ca 7 l/s. (taklist sattes tillbaka)



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Maratonvägen in Halmstad

Before renovation:

- Air leakage, draught from infill walls
- Thermal bridges and cold floors
- Corrosion in brick façade above windows and at balconies
- Energy use: 145 kWh/m², year



After renovation:

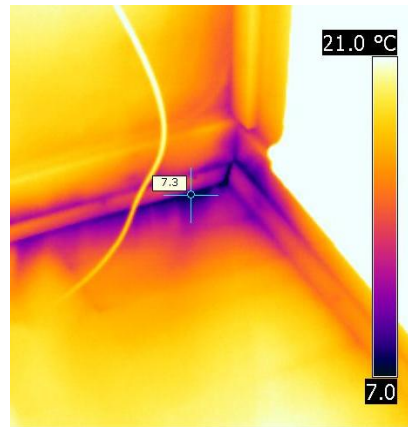
- New 3-pane windows and balcony doors
- New infill walls
- Air tightness through sealings
- New roof with 500 mm insulation
- Energy use: 92 kWh/m², year



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Measurements of air-tightness at Maratonvägen

- Thermography and air-tightness measurements and detection of leakages in existing and completed apartments
- Before: 1,41 l/sm²
- After (design value): 0,5 l/sm²
- After (measured): 0,86 l/sm²
- There are still some leakages at window connections and at infill walls.



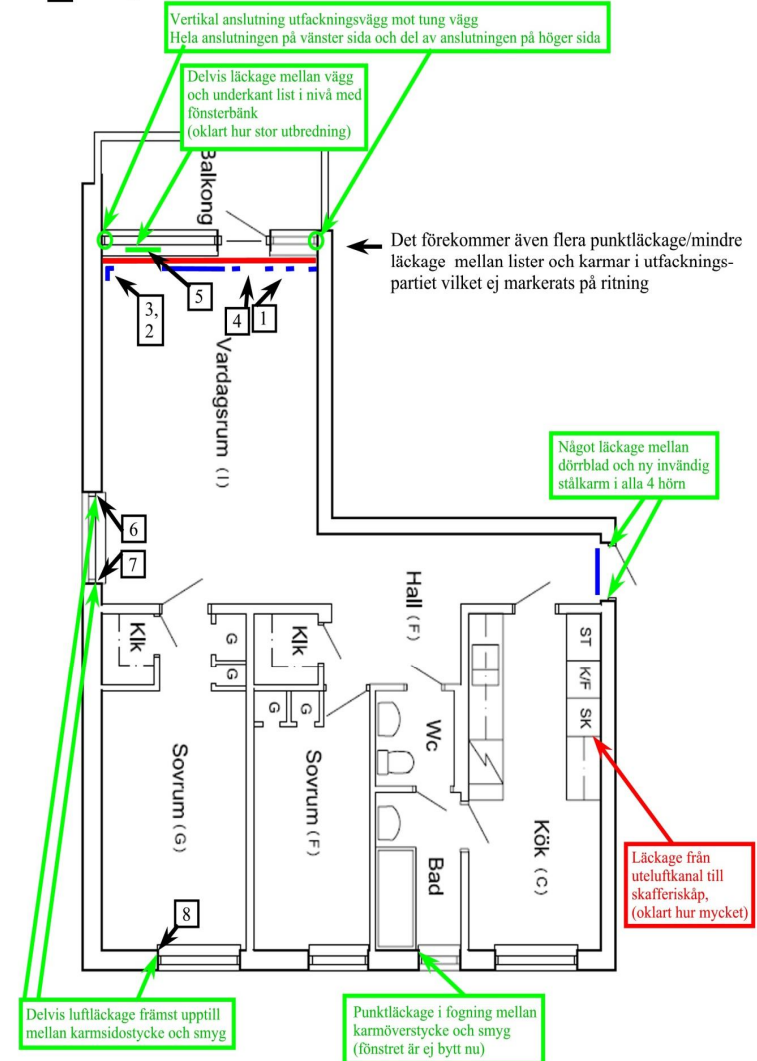
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- Luftläckage vid golvvinkel (OBS enbart läckage som verifierats vid denna mätning, gamla läckage i golvvinkel som ej åtgärdats och ej kontrollerats denna gång är ej medtagna)
- Luftläckage vid takvinkel

X Termogram nr



Kalendervägen in Gothenburg

Before renovation:

- Concrete and lightweight concrete walls with insufficient insulation
- Windows are in poor condition
- Ongoing roof leakage
- Carbonation and corrosion on balcony slab and on roof above the roof deck
- Energy use: 196 kWh/m², year

The experts supported with an inventory of technical status and proposed measures.

Unfortunately, no decision is taken yet to carry out the renovation due to high calculated costs.



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Results

- It is possible to decrease the energy use in existing buildings by additional insulation and by improving the air tightness in combination with new systems for heating and ventilation with heat recovery.
- Some measures involves a risk of moisture damage and poor indoor environment.
- To avoid this a number of working methods were used to evaluate different renovation alternatives and performances in the projects:
 - Inventory of technical status before renovation
 - Hygro thermal simulations of different design alternatives
 - Moisture inspections at building site
 - Full scale testing of rain tightness in laboratory
 - Measurements of air tightness at different stages of renovation



Conclusions

- The building owners have benefitted from assistance from the researchers and experts.
- If the investigations, simulations, measurements and testing had not been done a number of designs and solutions had been chosen that could have led to moisture damage and poor indoor environment.
- The working methods are general and could be used on a larger scale in all renovation project.



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Thank you for your attention!



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