Challenges and opportunities in renovation of building envelope

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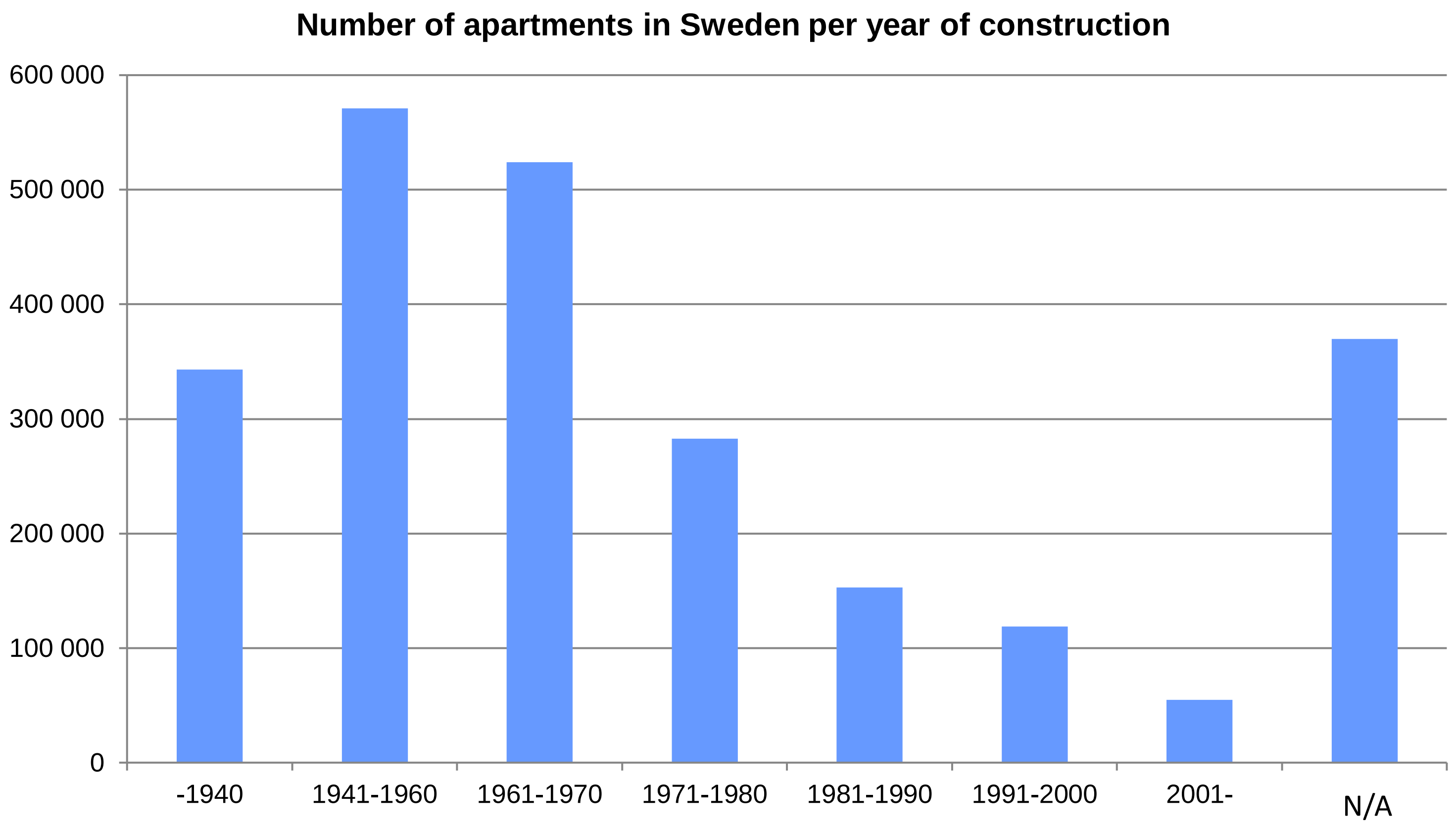
Background

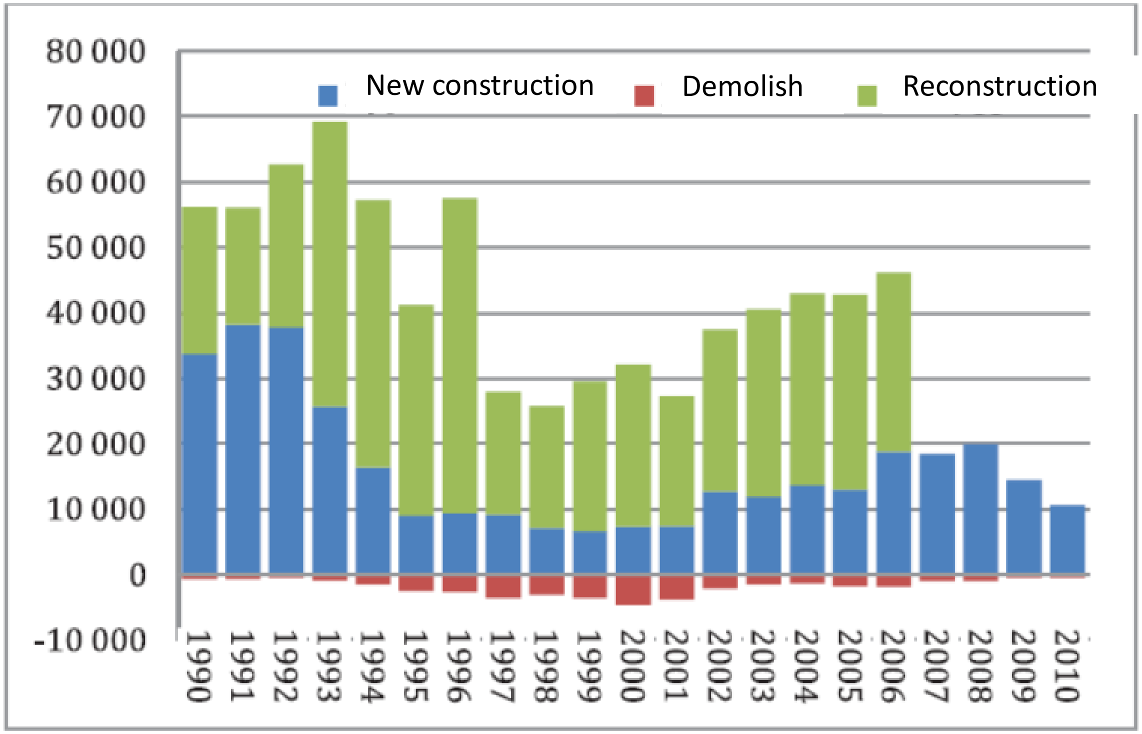
- Urgent need for renovation of post-war building stock
- Renovation rate must be doubled to reach goals for 2050
- Lack of policies to handle shortage of housing and affordability together with stricter regulations on energy use
- Knowledge in renovation is highly fragmentized and difficult to access
- Lack of skilled manpower and competences needed to handle the complexity
- A short term and limiting view favouring low cost and efficiency with a disregard for environmental, social, architectural and cultural historical aspects

Many apartments in need for renovation

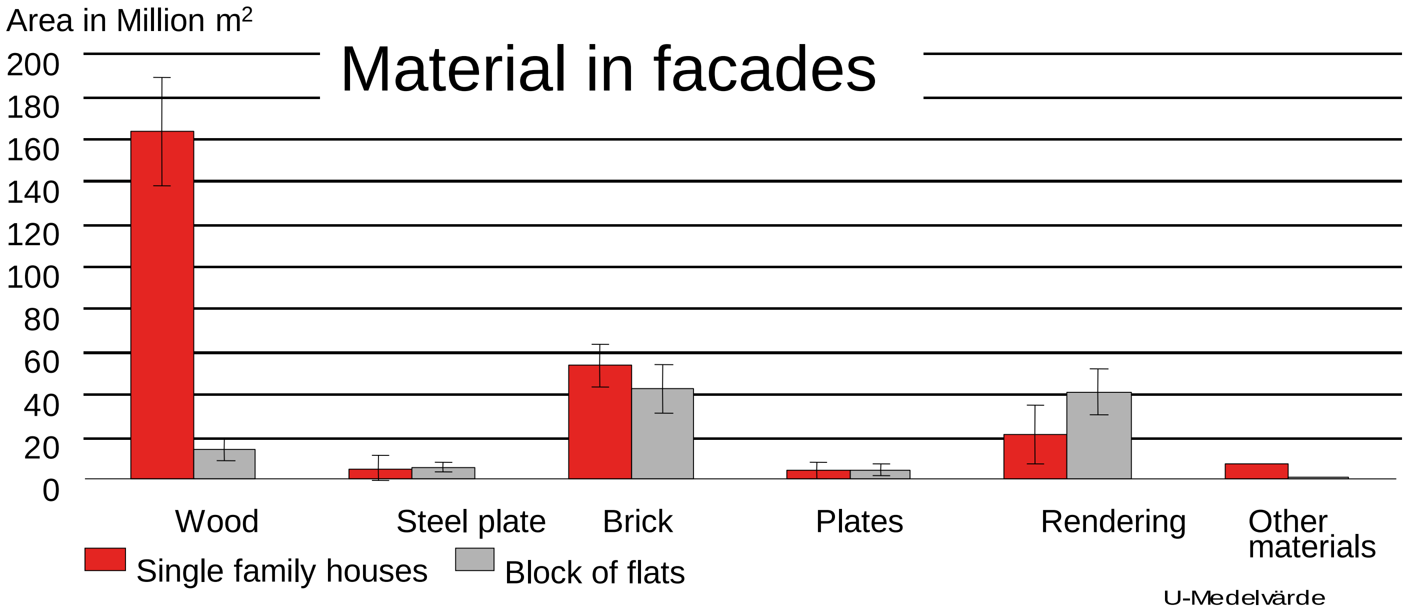


Double the renovation rate to reach the energy goals

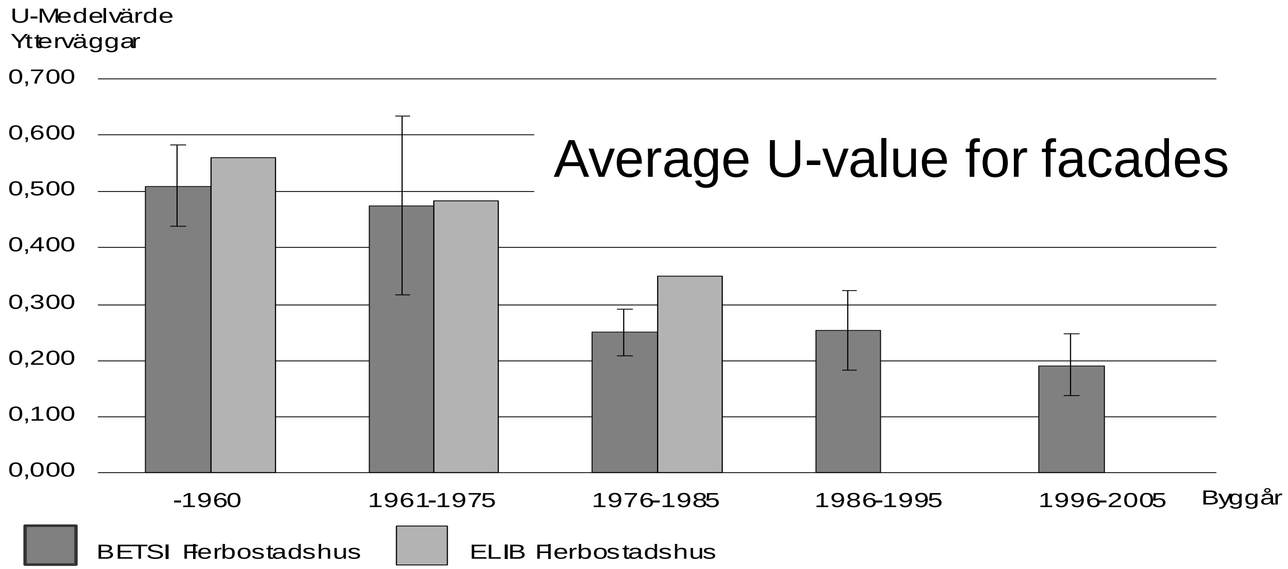
- Swedish Government decided to decrease the energy use to half 2050 (based on 1995 consumption)
- 1,5-2 million apartments need measures to become more energy efficient



Information on the technical status of buildings



Data from the BETSI study, The Swedish National Board of Housing, Building and Planning – BOVERKET



Swedish building stock in numbers and the energy saving potential

Table: Overview of the Swedish building stock in numbers. Source: AERTO project Multifunctional facades.

Year of construction	-1940	1941-1960	1961-75	1976-1985	1986-1995	1996-2005	References for statistics
Picture (representative)							
Number of buildings in Tsd.	38	46	32	12	35	12	ELIB 6/BETSI
Number of dwelling units in Tsd.	365 (382 acc. to SCB 2007)	746 (646 accord. to SCB 2007a)	698	192			ELIB 6
Living space, total in Tsd. m²	26 400	38 300	60 000	20 000	35 000	15 000	Energy statistics
Facade surface area (milj. m²)	18	34	26	10			ELIB 6
Facade U-value (W/m²K)	0,58	0,54	0,43	0,27	0,25	0,19	ELIB 6/BETSI
Fraction of buildings facades already renovated (%) (estimation)	50%	25%	10%				PM Miljonprogrammet
Average energy for heating (kWh/(m²•a))	149	155	144	144	ca 135	ca 126	Energy statistics
Energy saving potential	50%	50%	50%	30%			

Σ8TWh

When is the right time to renovate?

- Wait until components are worn-out or…
- replace before they reach their end of lifespan?
- Technical failures are the most common cause for initiating renovation
- If these measures are not taken there is a risk of acute damage that are costly to renovate
- Another reason for renovation is high costs for heating

EXAMPLES FROM 3 PILOT PROJECTS

How far can we reach without a new façade? Pilot project 1: Maratonvägen

Maraton street before: 145 kWh/m²

Maraton street after: 92 kWh/m²

Maratonvägen in Halmstad

Before renovation:

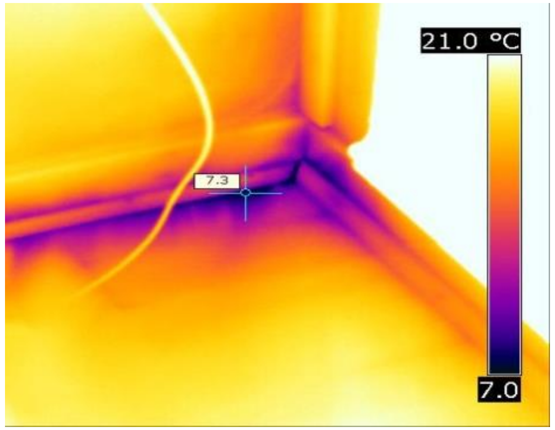
- Air leakage, draught from infill walls
- Thermal bridges and cold floors
- Corrosion in brick façade above windows and at balconies
- Energy use: 145 kWh/m^2, year

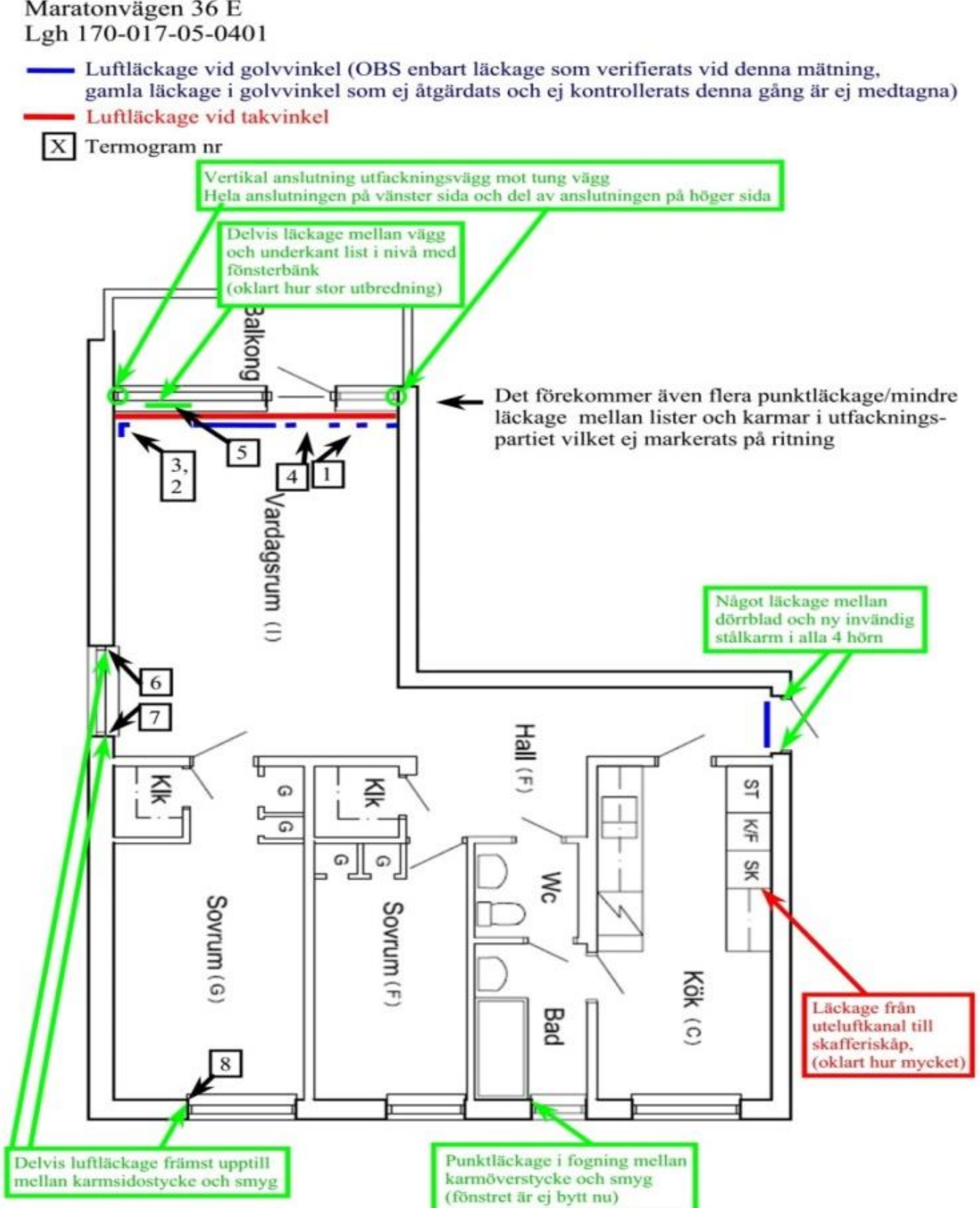
After renovation:

- New 3-pane windows and balcony doors
- New infill walls behind balconies
- Air-tightness through sealing
- New roof with 500 mm insulation
- Energy use: 92 kWh/m^2, year

Measurements of air-tightness at Maratonvägen

- Thermography and air-tightness measurements and detection of leakages in existing and completed apartments
- Before: 1,41 l/sm^2
- After (design value): 0,5 l/sm^2
- After (measured): 0,86 l/sm^2
- There are still some leakages at window connections and at infill walls.





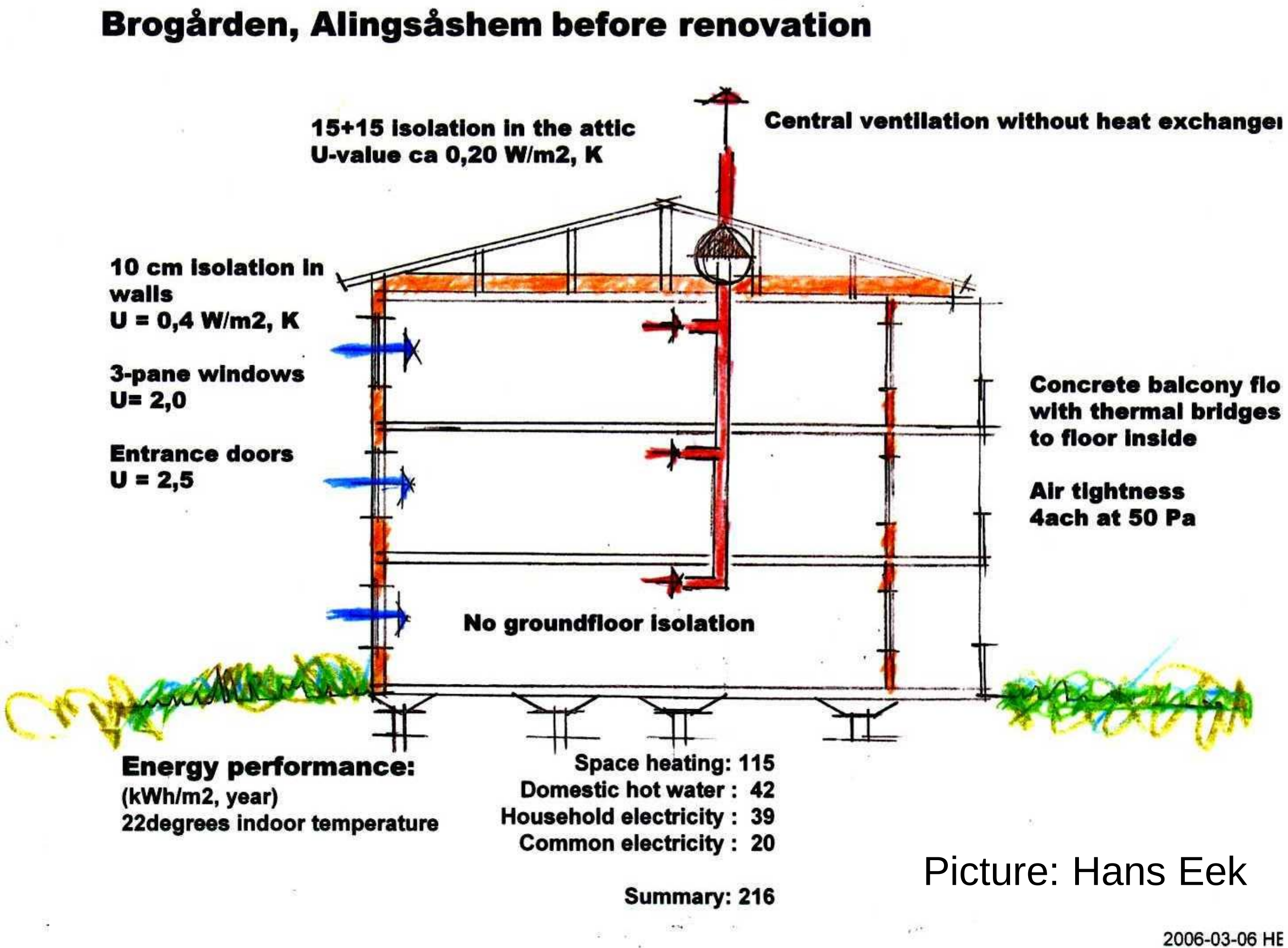
How far can we reach with a new façade?
Pilot project 2: Brogården

Brogården before: 177 kWh/m²

Brogården after: 65 kWh/m²

Before renovation – the building status and energy performance

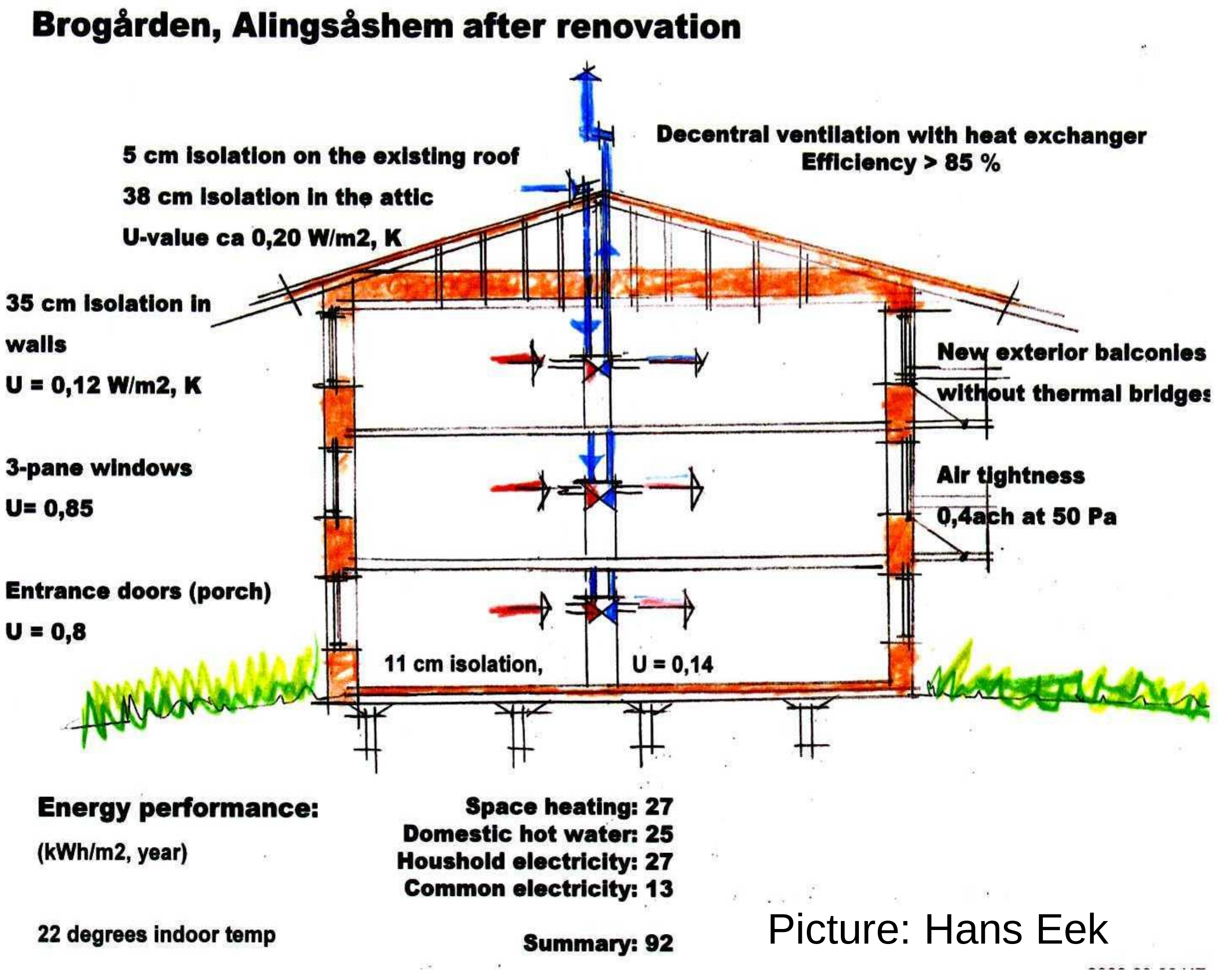
- 300 apartments built in 1973 were renovated to "passive house standard”
- Long term partner contract between AB Alingsåshem and Skanska



Picture: Hans Eek

Design of new constructions and installations

- New facades, windows
- Insulated roof, base and ground slab
- Ventilation with heat recovery



Picture: Hans Eek

Pilot project 3: Katjas gata 119

Before: 178 kWh/m², yr

After: 60 kWh/m², yr

Total renovation!

Katjas gata 119

Before renovation:

- Prefabricated concrete facade elements
- Carbonation and leakage
- Air leakage, draught from infill walls
- Thermal bridges and cold floors
- Energy use: 178 kWh/m^2, year

After renovation:

- Additional insulation of 200 mm cellular plastic boards and rendering
- Air tightness through tightening material
- New 3-pane windows with solar control
- Insulation on attic and in crawl space
- New heat- and ventilation systems
- New water and sewage, electricity
- Energy use: 60 kWh/m^2, year

Energy efficiency measures

New heat- and ventilation systems

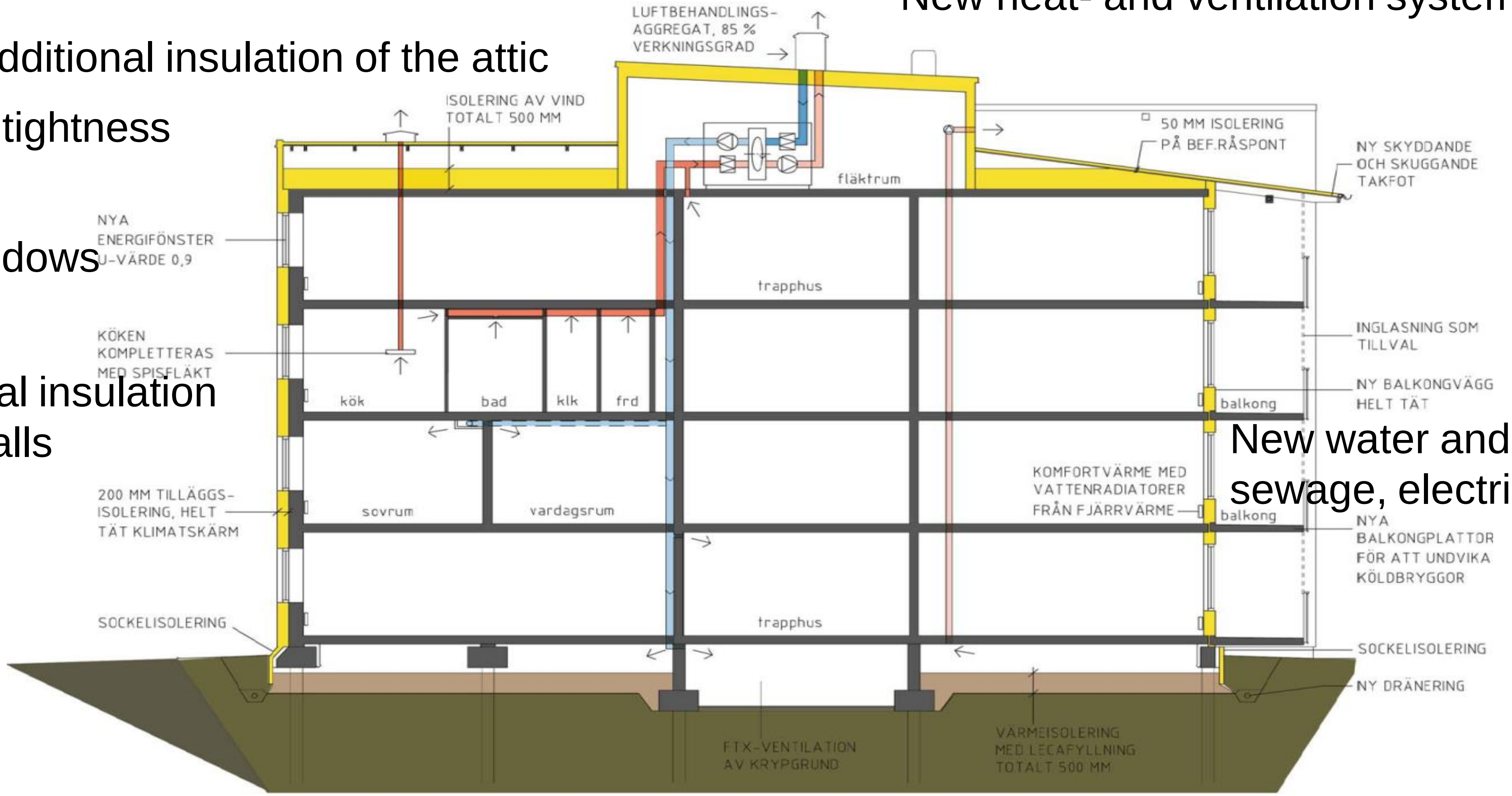
Additional insulation of the attic

Better air-tightness

New windows

Additional insulation of the walls

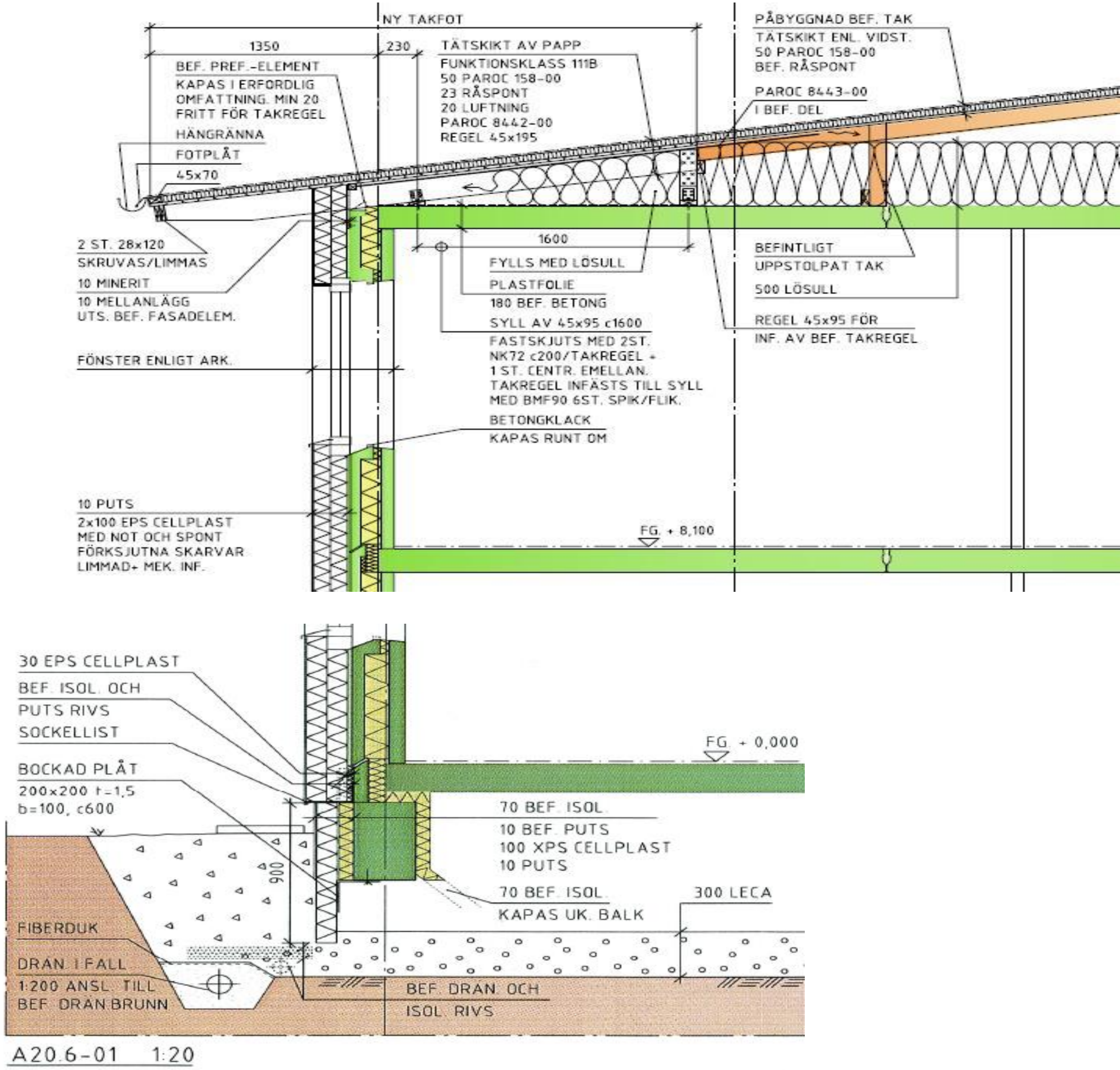
New water and sewage, electricity



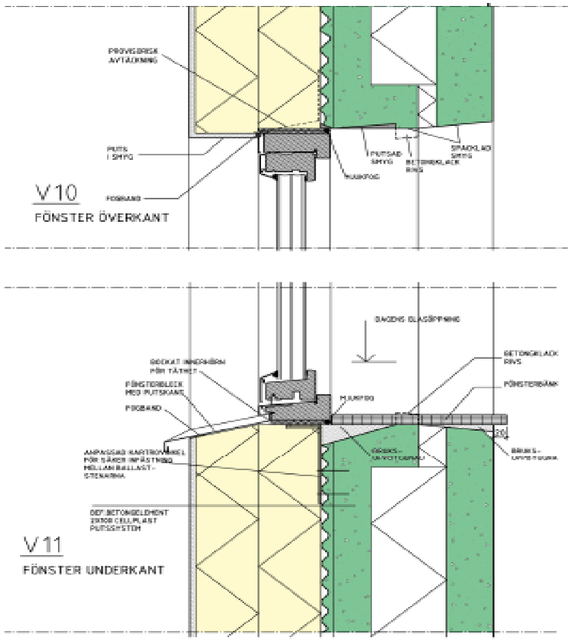
Additional insulation of the basement

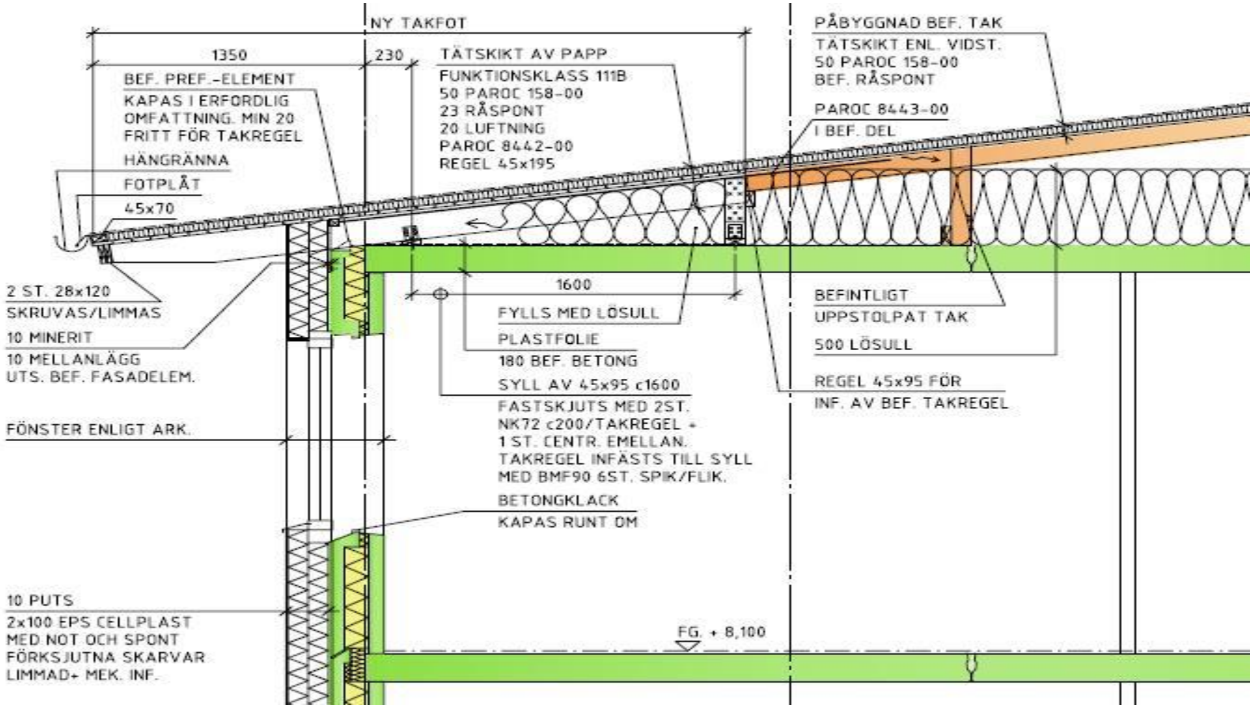
Simulation of hygro-thermal conditions

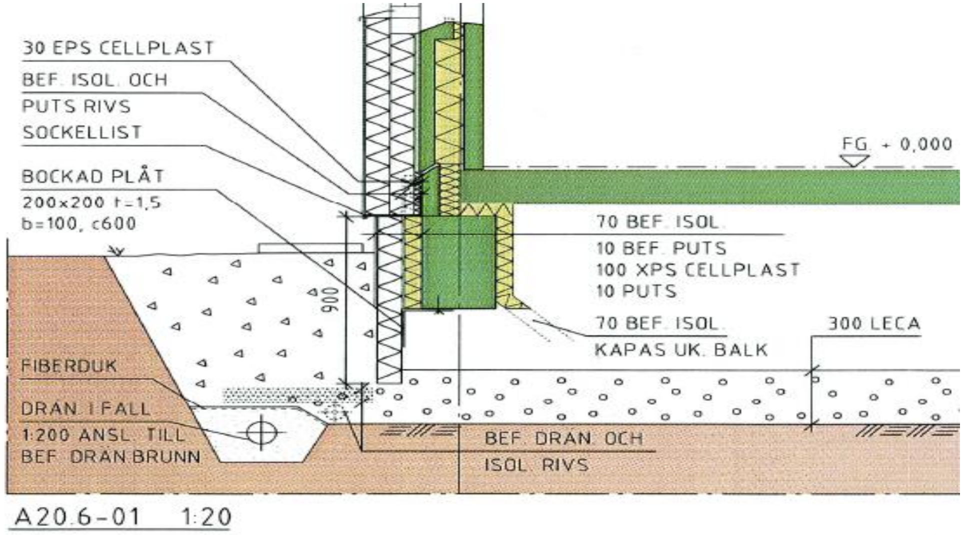
- Hygro thermal analyses of attic and crawl space using HAM-Tools.



- Hygro thermal simulations of additional insulation of the exterior wall using Wufi ®Pro 4.2.





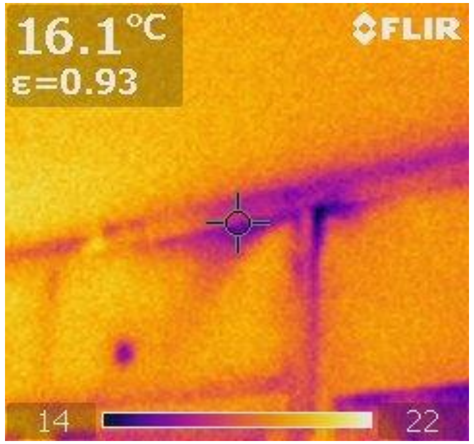


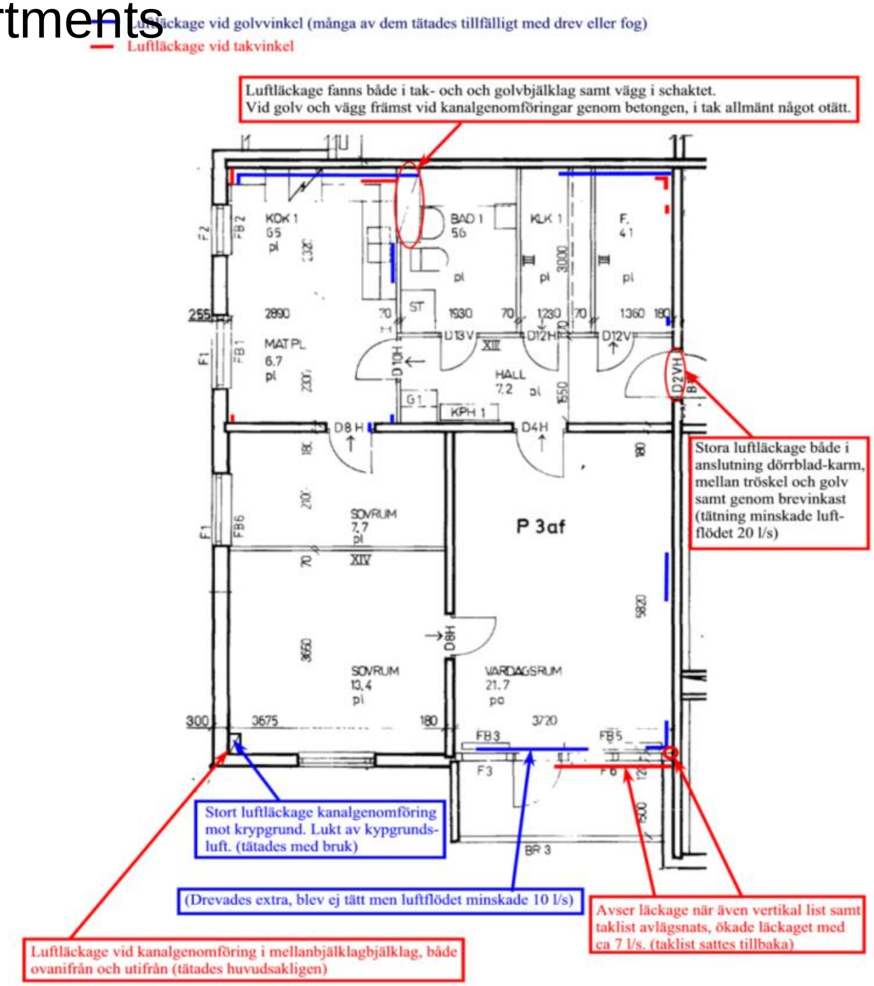
Evaluation of joints and connections at windows

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

Measurements of air tightness during renovation

- Termography, 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/sm^2 for one apartment
- After: 0,13 l/sm^2 for the whole building





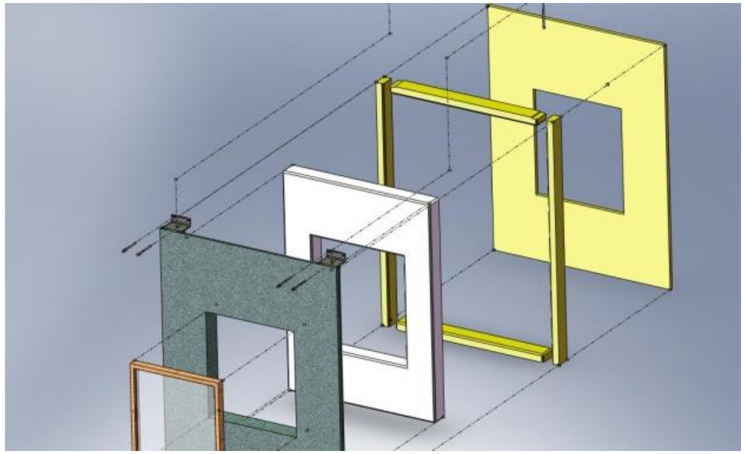
HOW CAN WE MAKE THE RENOVATION PROCESS MORE EFFICIENT?

Prefabricated Elements for Adding Insulation and Upgrading of External Facades

- The aim was to create market-driven development of efficient solutions for improving the energy performance (insulation and air tightness) of exterior walls and façades of existing multi-family dwellings built between 1940 and 1975.
- The solutions must:
  - Be produced and installed in an efficient manner,
  - be cost efficient,
  - have a low level of environmental impact from a life cycle perspective,
  - be durable, which means having little need for maintenance and
  - involve a low risk of damage.

Pilot project 1: Järva, Stockholm

- One facade at a multi-family building in Järva, Sweden (Svenska Bostäder)
- Svenska Bostäder decided to use the system from Soleed.
- Light elements of concrete and insulation which is an advantage in terms of installation and transport.
- The prefabricated wall permits tenants remaining in the apartments during renovation.
- Some problems with the on-site coordination and mounting.



Renovation with remaining residents

- Prefabricated concrete elements including windows are mounted from the outside.
- Old windows are taken down from the inside.
- The manufacturing is made in a factory with minimum work on site .
- Minimal intrusion on residents life.

Pilot project 2: Brogården in Alingsås

- Last phase, consisting of 3 buildings out of 16 renovated buildings in Brogården, Alingsås owned by AB Alingsåshem
- Skanska Sweden AB has together with Sundolitt and Europrofil developed a prefabricated wall used at the three last buildings.
- The building owner AB Alingsåshem and their partners have worked on continuous improvement of the design and construction process.
- They have made many changes in the design and manufacturing of the wall structure during the project.

Development of the exterior wall

The wall developed for the first pilot house

More rational manufacturing of the wall, fewer layers, fewer screws

Prefabricated wall that can be mounted in one day

Prefabricated elements

Pilot project 3: Lagersberg in Eskilstuna

- One multifamily building with 24 apartments in Lagersberg, Eskilstuna, Sweden owned by Eskilstuna Kommunfastigheter AB
- A building with 24 apartments was chosen as a pilot building to use SFRONT facade renovation system consisting of 180 mm insulation with integrated ventilation ducts.
- The building has been equipped with supply and exhaust ventilation system with heat recovery and a new ventilation room was built on the roof.

Technical innovations for façade and ventilation

- Supply and exhaust ventilation system with heat recovery
- Pipes are placed on the outside of the old façade
- New ventilation room was built on the roof
- Additional insulation of the façade

READ MORE…

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GROUP EXERCISE

Discuss with your neighbours

Kalendervägen in Gothenburg

<u>Before renovation:</u>

- Built in the 1950-ties
- 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/m^2, year

<u>Requirements:</u>

50 % reduction in energy demand

30 years payback time

100% occupancy, short renovation process

Kv Malörten

<u>Before renovation:</u>

Multifamily building from 1930

Wooden façade

U-value before 1,12 W/m2,K

<u>Requirements:</u>

50 % reduction in energy demand

30 years payback time

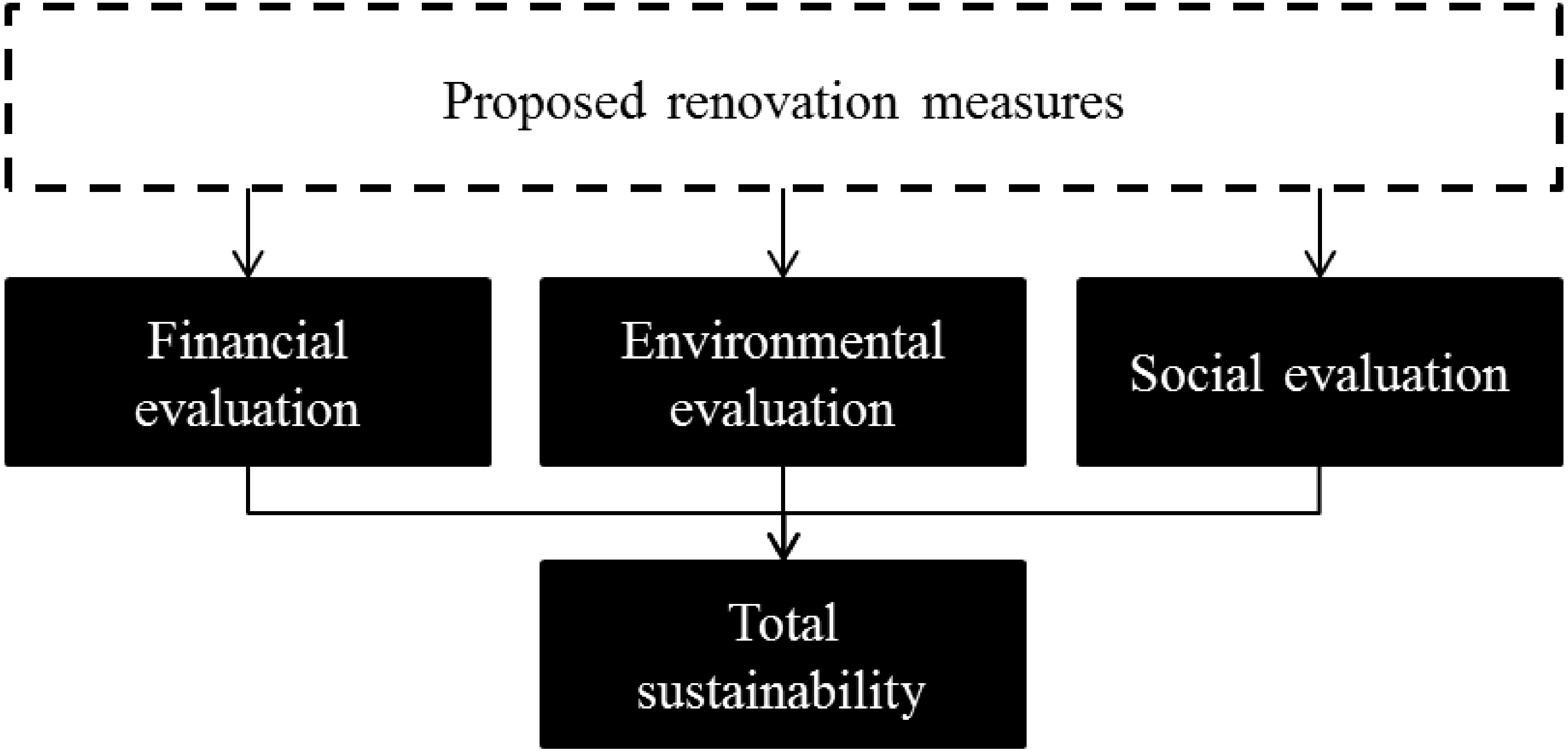
100% occupancy, short renovation process

Group exercise

Discuss and come with suggestions:

- Technical measures
  - Building envelope (insulation and new façade?)
  - Heat and ventilation
  - Water and sewage system
- Cultural historical values
- Social aspects/possibilities
- Tenants’ interaction/tenants remaining?
- Costs and financing of renovation

Methodology to assess renovation alternatives in terms of sustainability



Case study – investigation of 3 renovation alternatives

- Owner: Bostads AB Poseidon
- Location: Gothenburg, Sweden
- Building: 4-story, multi-family building
- Heated area: 1387 m^2
- Calculation period: 30 years
- Data for the case study comes from a pre-study performed by the property owners

Renovation alternatives

1

No renovation
- Extensive maintenance cost are added

3

Change of ventilation system
- Balanced ventilation with heat recovery

2

Insulation and ventilation improvements
- 500 mm new mineral wool insulation on roof, 200 mm added insulation to the exterior walls
- Added external vertical EPS board below ground level around the building
- New windows with improved U-value (0.9 W/m2 K)
- Balanced ventilation with heat recovery

4

Extra insulation
- New windows with improved U-value (0.9 W/m2 K)
- 500 mm new mineral wool insulation on roof
- 200 mm added insulation to the exterior walls

THANK YOU!