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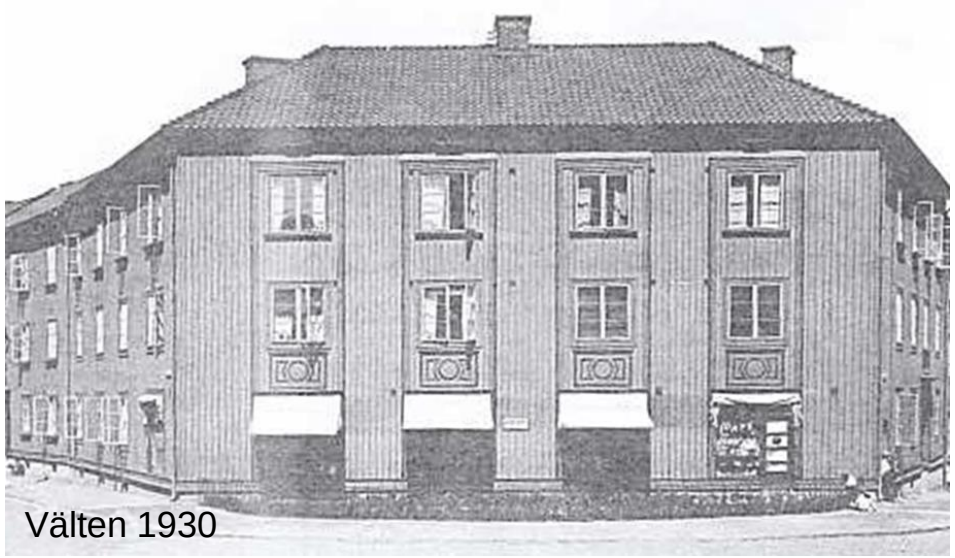
The need for ICT and analysis for buildings

Pär Johansson, Assistant Professor
Division of Building Technology/Building Physics Modelling
Department of Architecture and Civil Engineering (ACE)

Lecture in DAT300, 2018-10-08

Super insulation materials

Retrofitting of listed buildings

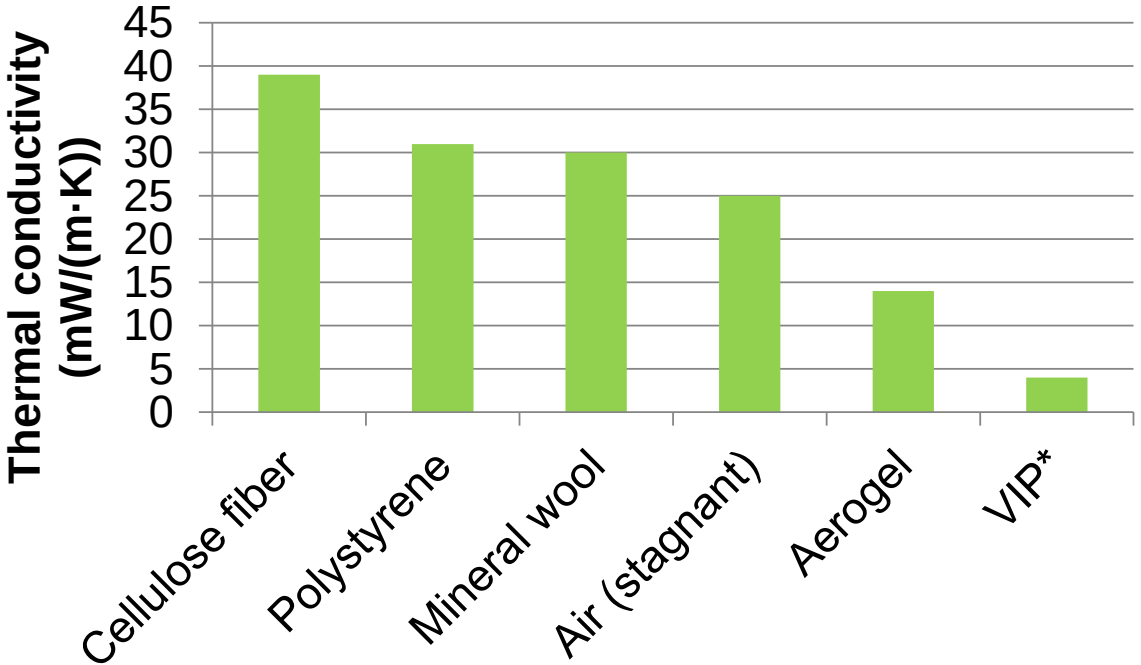


Välten 1930

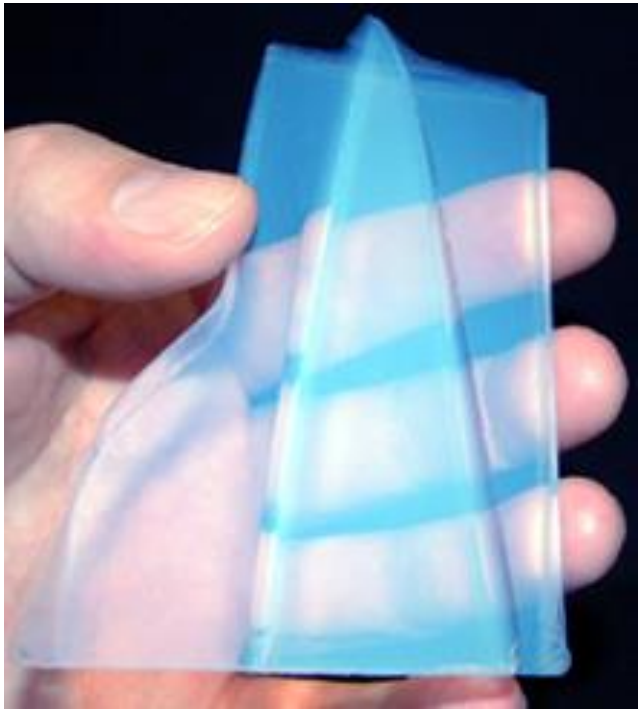
Välten 2006

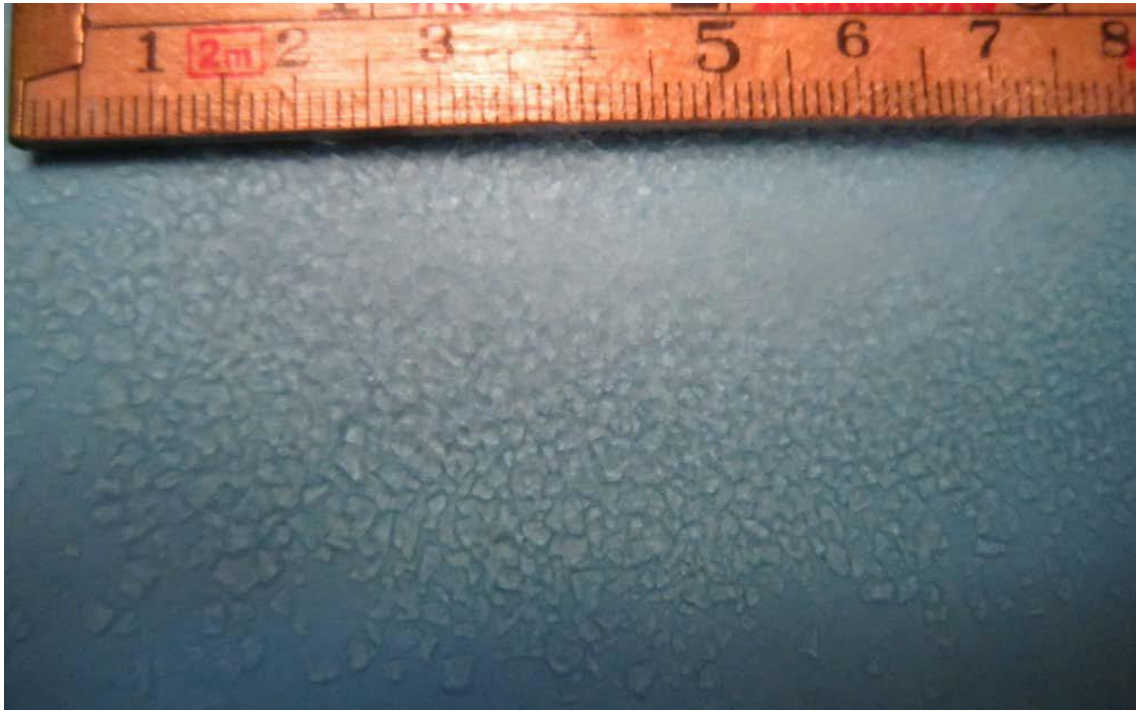
Super insulation materials

Retrofitting of listed buildings

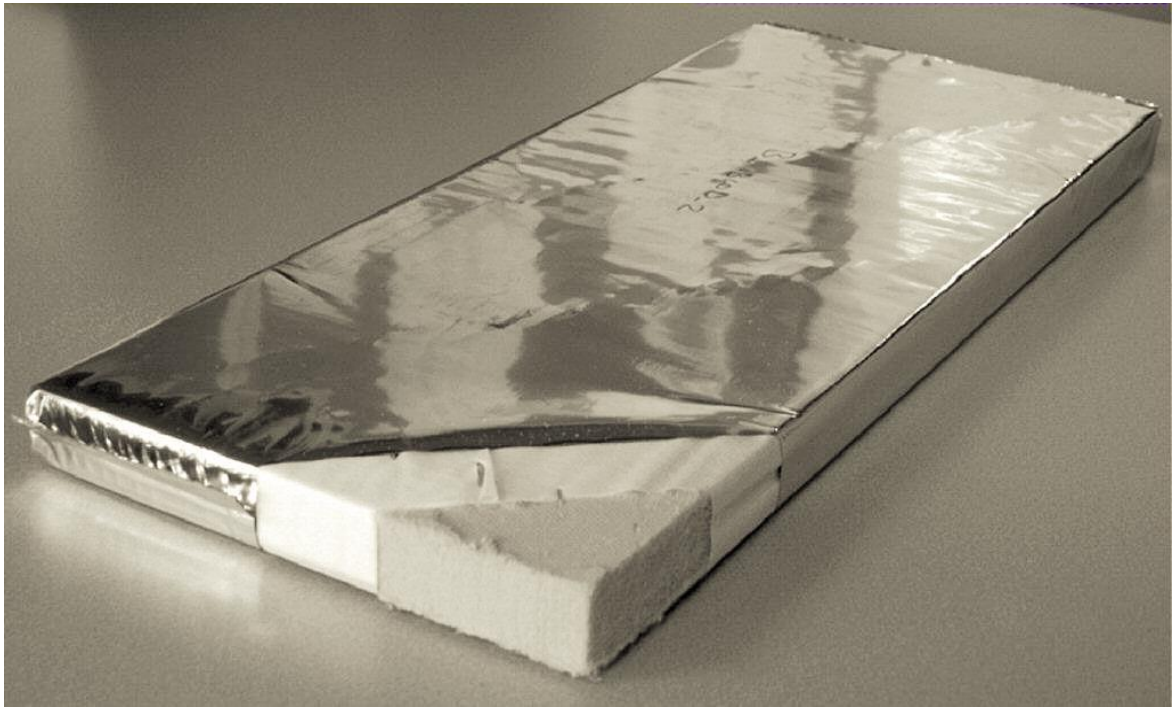


Aerogel; granular and composites

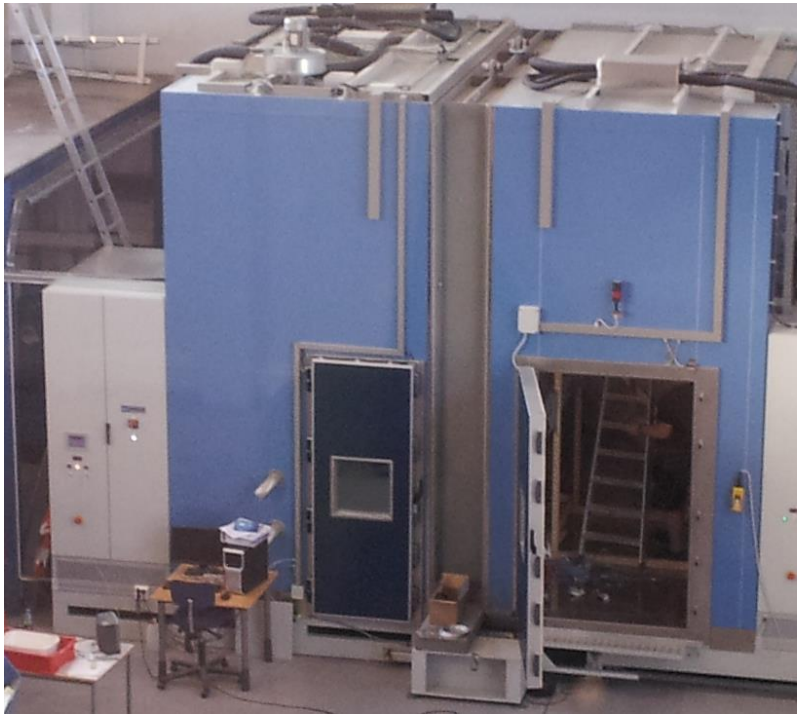




Vacuum insulation panels



Internal insulation



Summary

- Energy performance
- Moisture resistance
- Long-term durability
- Thermal comfort
- Heritage values
- Character-defining elements

Building Physics

30% of energy use in Sweden used for heating of buildings

Functional demands of a building

- **Heat, air and moisture transport in buildings, focus on the thermal envelope**
- **We want our buildings to be energy efficient and durable, with high indoor air quality and thermal comfort**
- **Heat is used in the building and ”leaks” out of the building**

Reducing heat losses

- Material properties
- Insulation thickness
- Thermal bridges

Reducing peak heating and cooling load

- Thermal energy storage
- Phase change material
- Control system
- Optimization
- Neural network

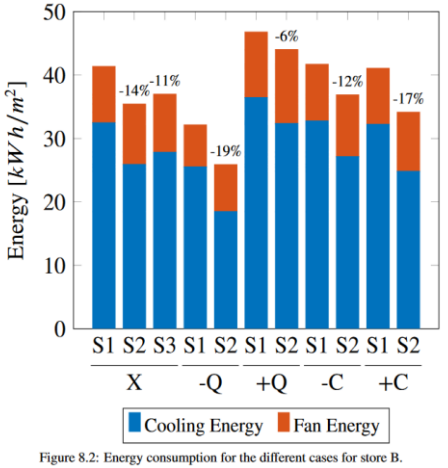
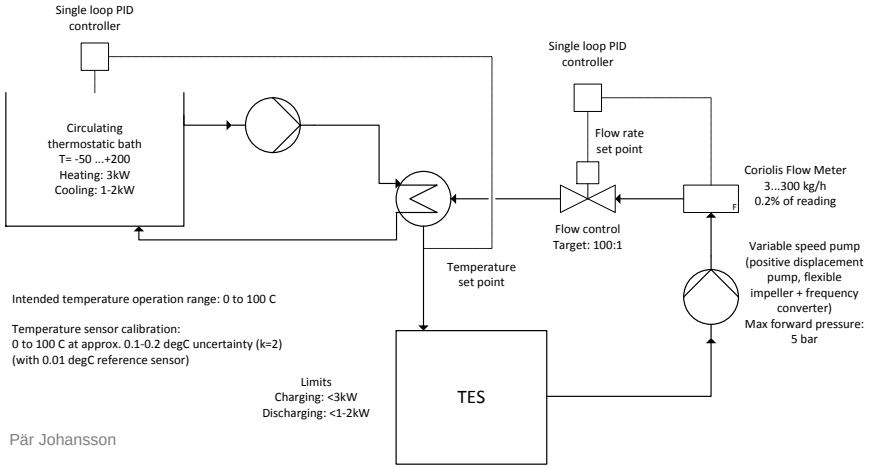
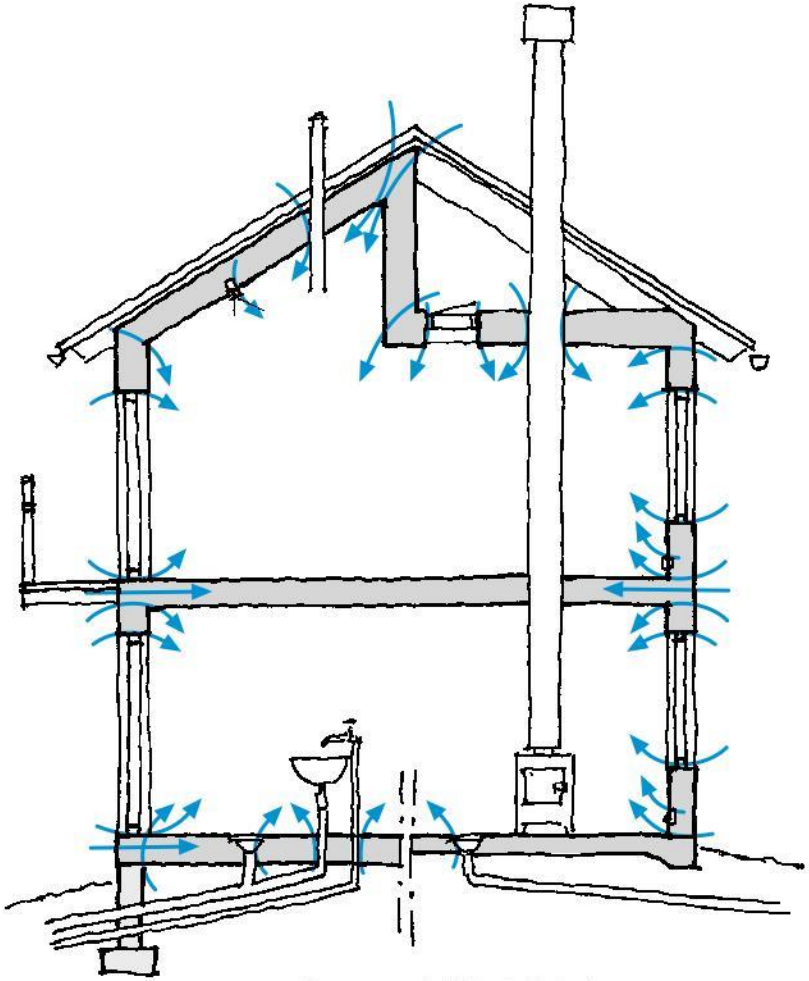


Figure 8.2: Energy consumption for the different cases for store B.



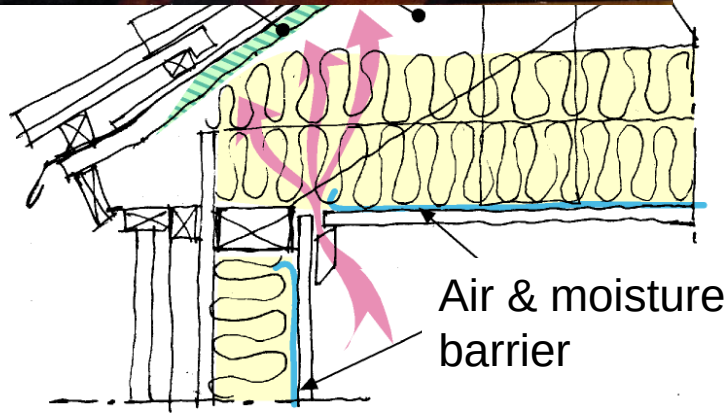
Air transport through the building envelope

- Energy use
- Thermal comfort
- Air quality
- Moisture damage
- Sound propagation



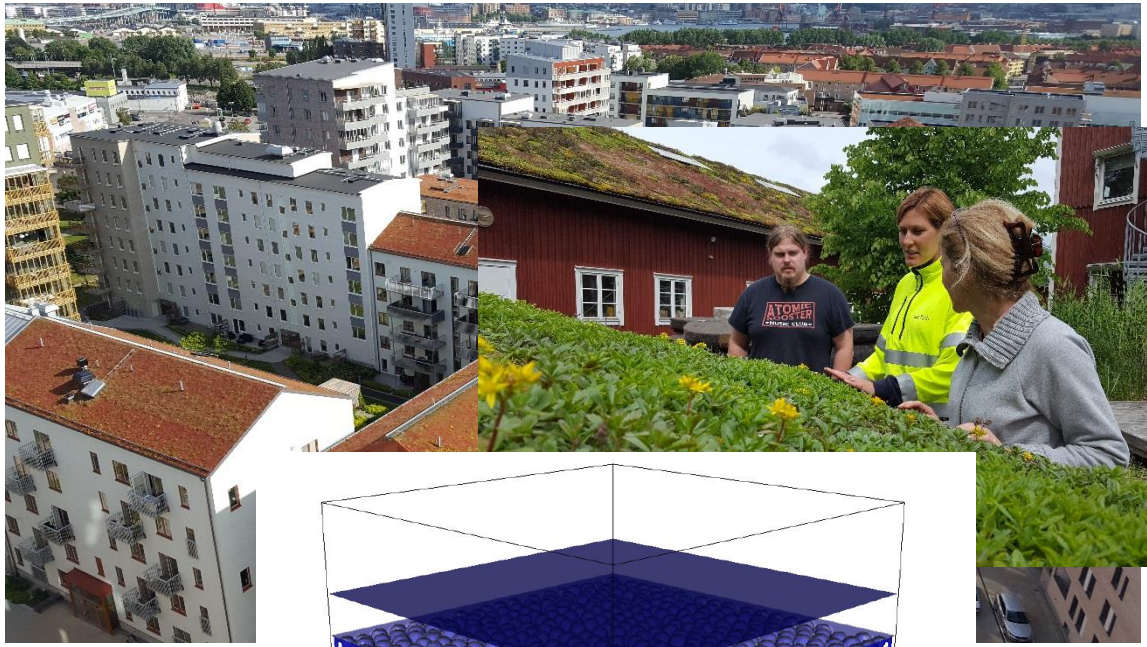
Moisture protection

- **Organic materials are subjected to mould and rot, brick is subjected to frost damage, some glue have high emissions at high moisture levels, shrinkage and expansion of materials due to moisture**



Storm water buffering

- Green roofs
- Ecosystem services
- Reducing flooding
- Different substrates



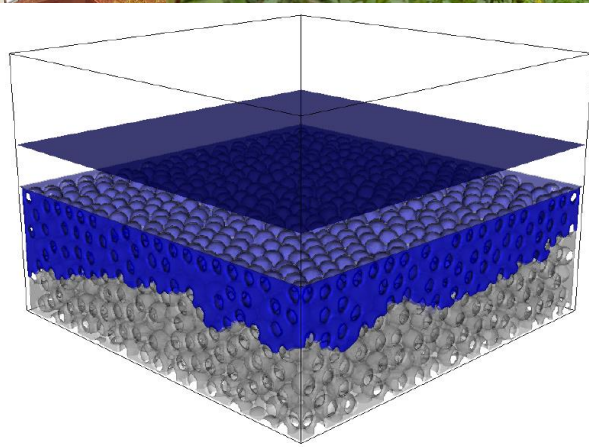
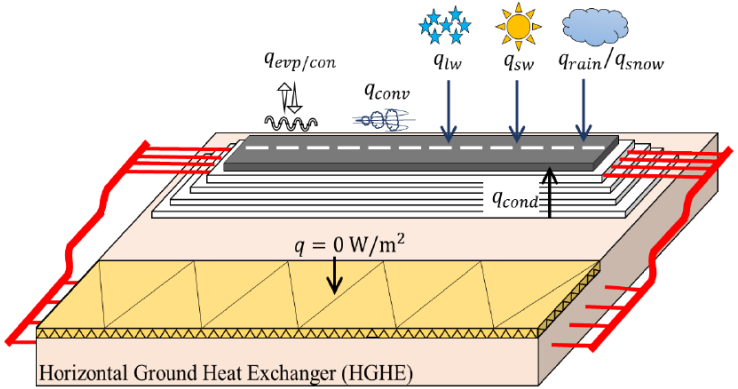
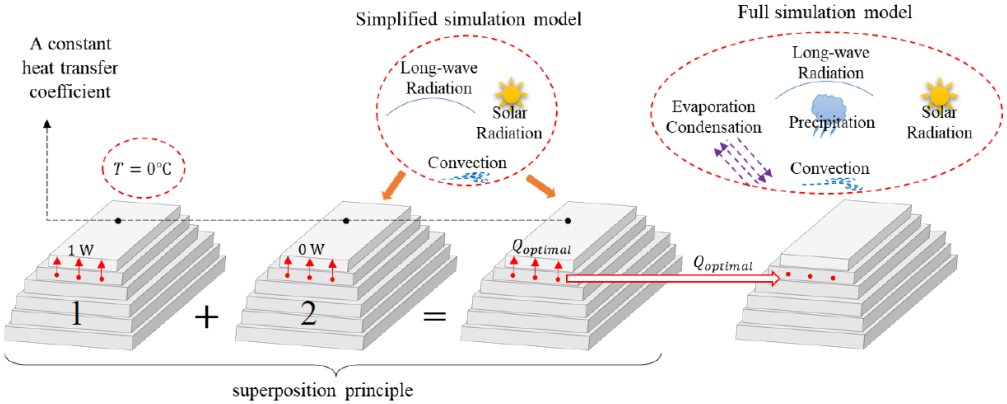


Figure 3.4: Infiltration on Grid 3, example at iteration 150,000.

Ice free roads

- Hydronic heating pavement
- Renewable energy
- Reduce slippery conditions

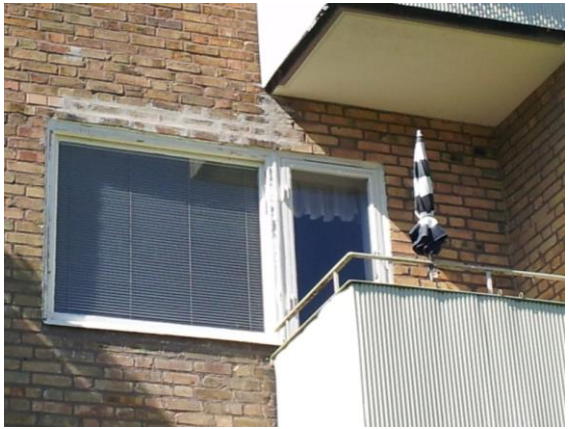




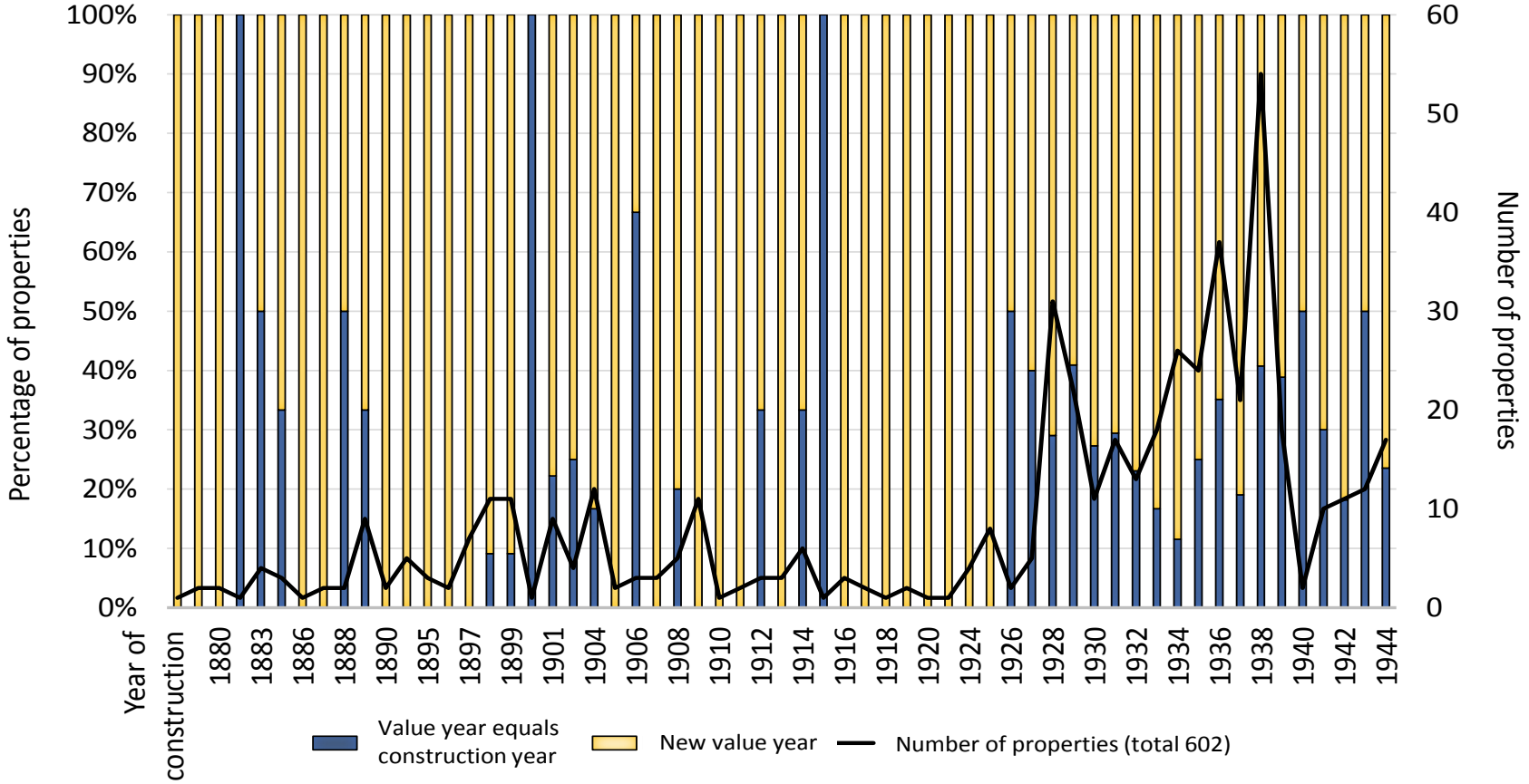
2018:11 Unmanned aerial vehicle (UAV) based sensors for facade investigation

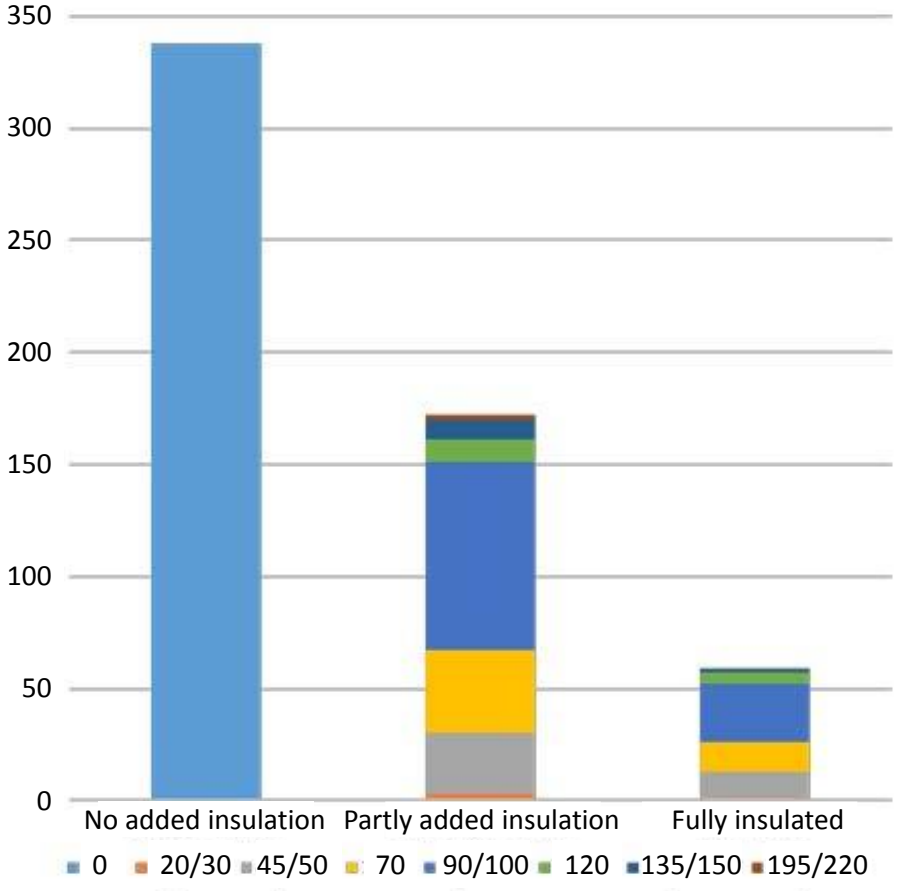
Imaging spectrometry can be used for fast, frequent and objective identification of façade types and conditions. Recent development of high quality but lightweight hyperspectral imaging hardware makes it possible to analyze the components in real time.

This project may be divided in two parts: i) control the UAV based on information of coordinates, optimization of flights path, ii) interpret information from the sensor, normal video or other sensor such as IR, to find façade material, color, damages.




kWh/m2
A < 38 (12)
B < 56 (40)
C < 75 (81)
D < 101 (417)
E < 136 (971)
F < 176 (526)
G > 176 (78)


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of properties
60
50
40
30
20
10
0
Number of properties
Year of construction
1880
1883
1886
1888
1890
1895
1897
1899
1901
1904
1906
1908
1910
1912
1914
1916
1918
1920
1924
1926
1928
1930
1932
1934
1936
1938
1940
1942
1944
Value year equals construction year
New value year
Number of properties (total 602)


350
300
250
200
150
100
50
0
No added insulation
Partly added insulation
Fully insulated
0
20/30
45/50
70
90/100
120
135/150
195/220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2018:12 Interpret building photography

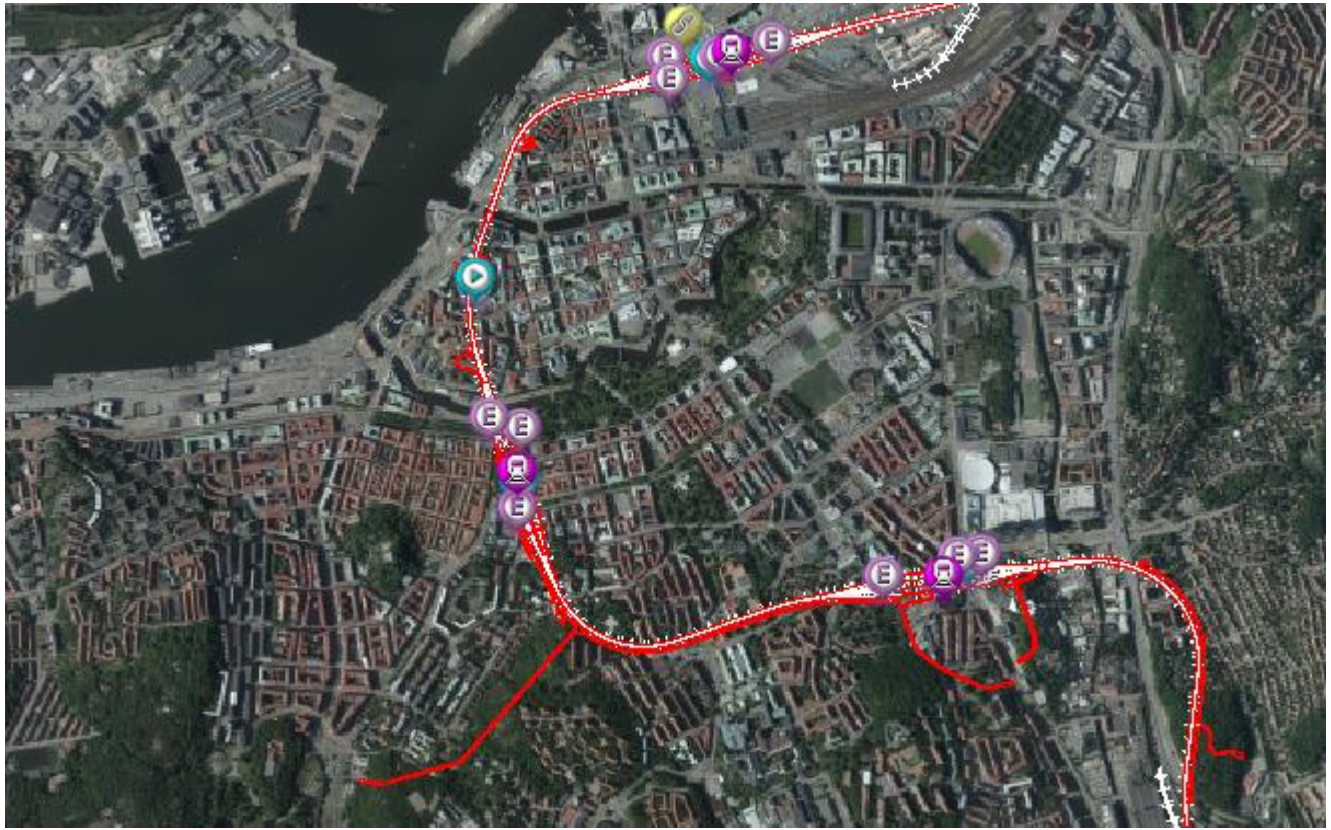
There are documentations of many of the buildings by photography from a survey. The focus of the inventory is on cracks and settlements. Information from the survey may be important to form a knowledge base of the different building materials used in the area.

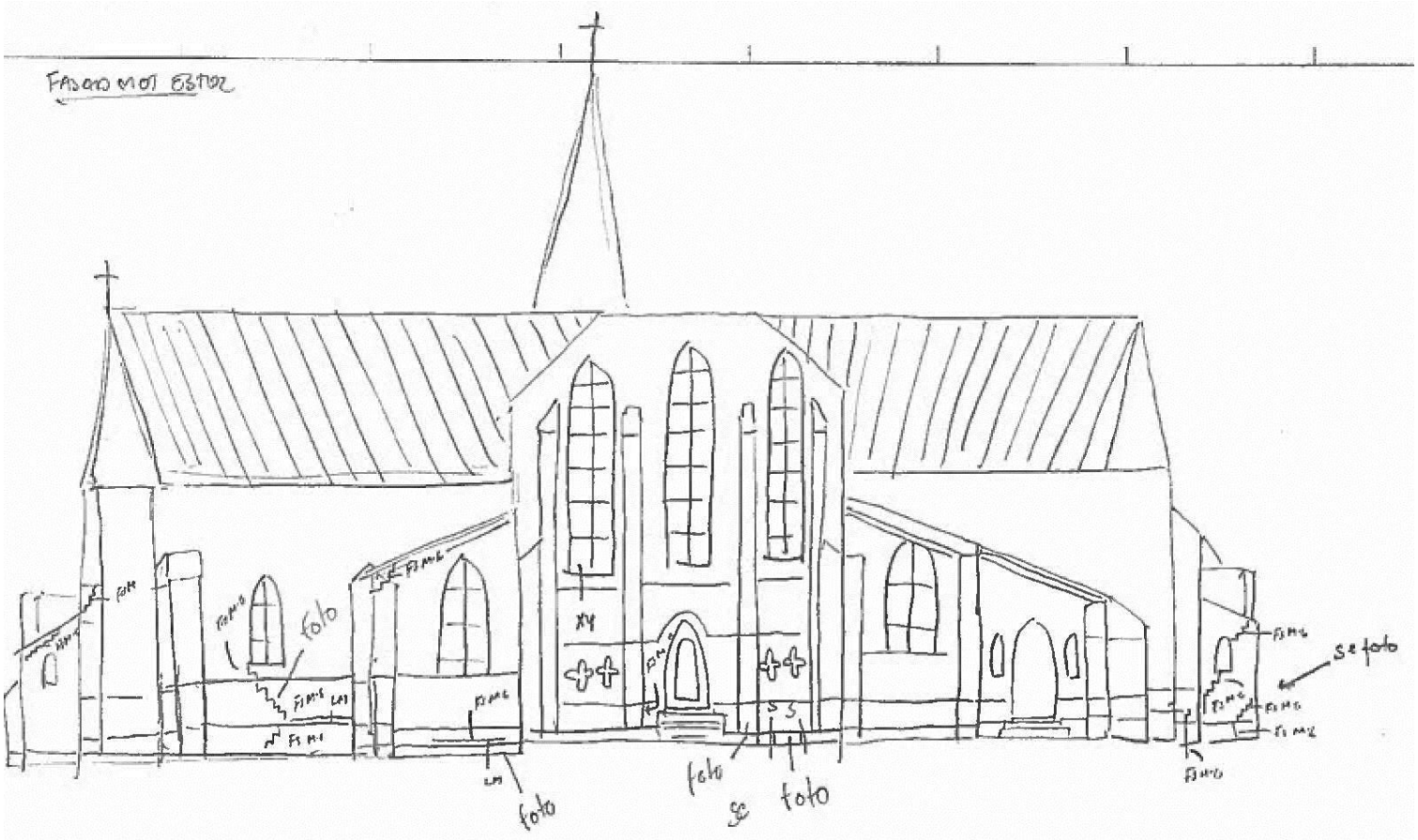
This project aims to interpret building materials and other information such as color of the façade from photography.

2018:13 Understanding legacy documents for building codes

Before and during a planned tunnel project underneath central Gothenburg, Trafikverket (Swedish Transport Administration) perform detailed building inspections of all buildings within 150 m of the works. These are documentations of in total 1,171 buildings by hand writing where inspections are performed both from the outside and inside of buildings.

This project aims to interpret the written information/symbols to catalogue the building typologies, façade materials and damages of the buildings.




FASAD MOT ÖSTER
foto
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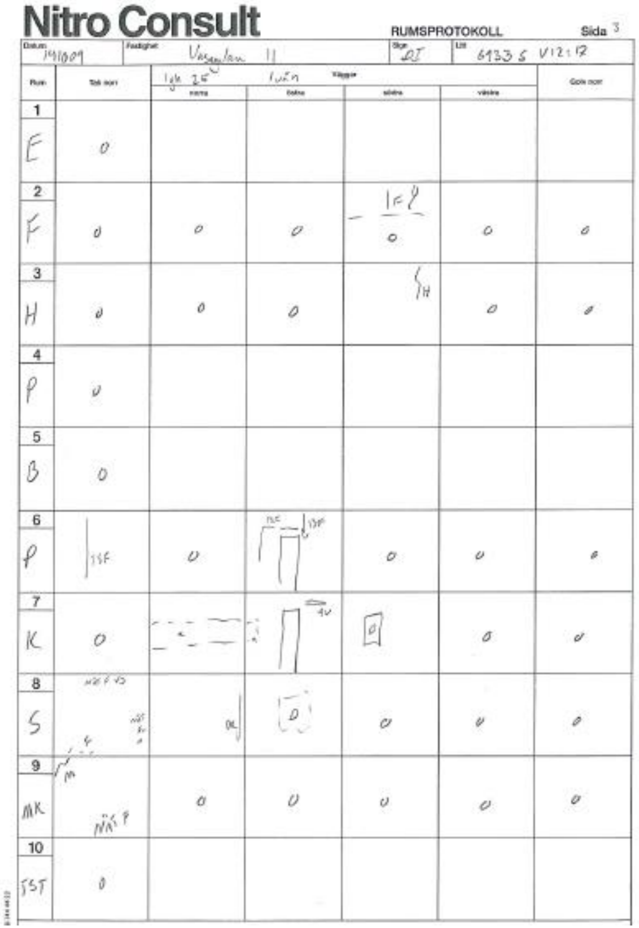
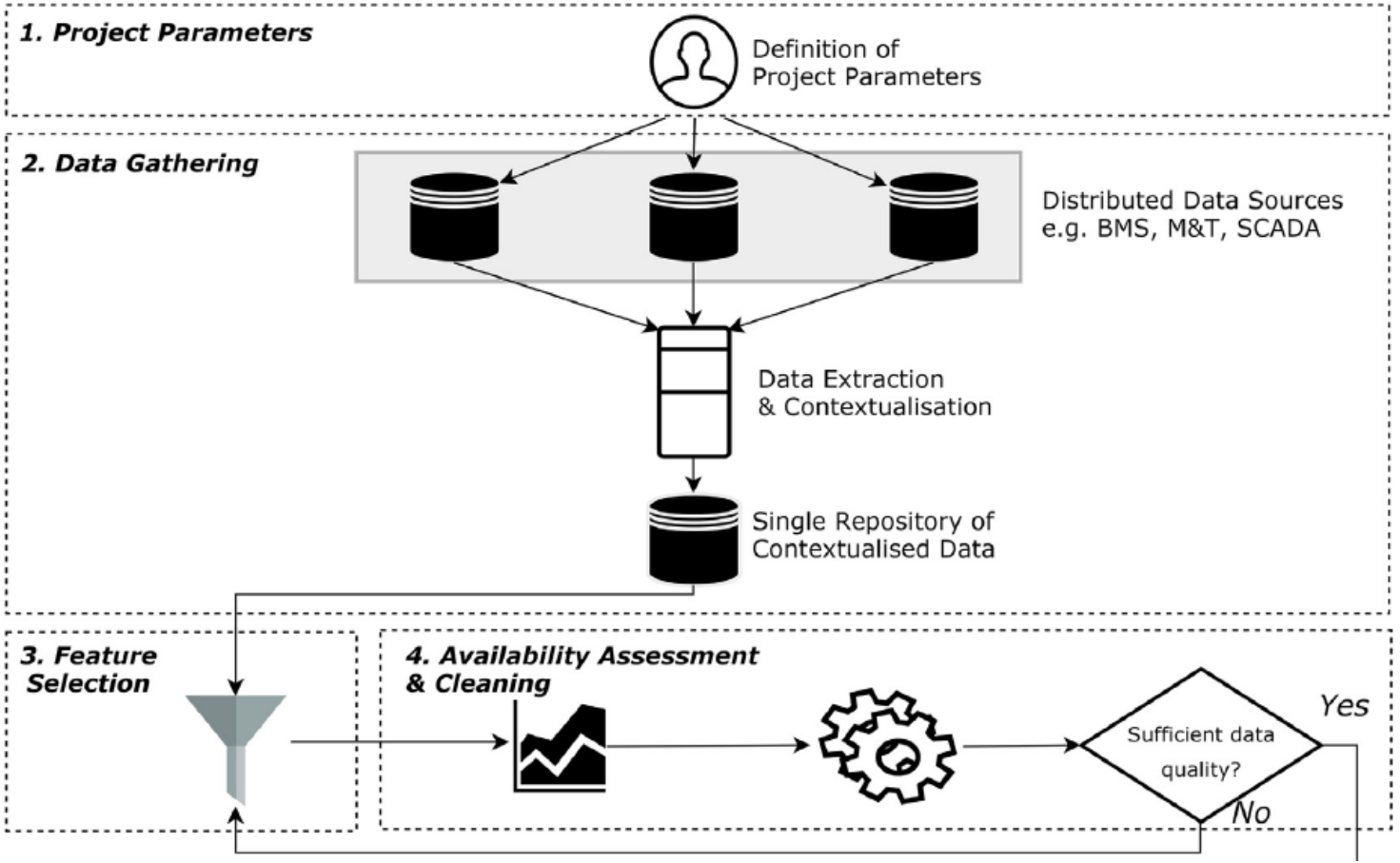
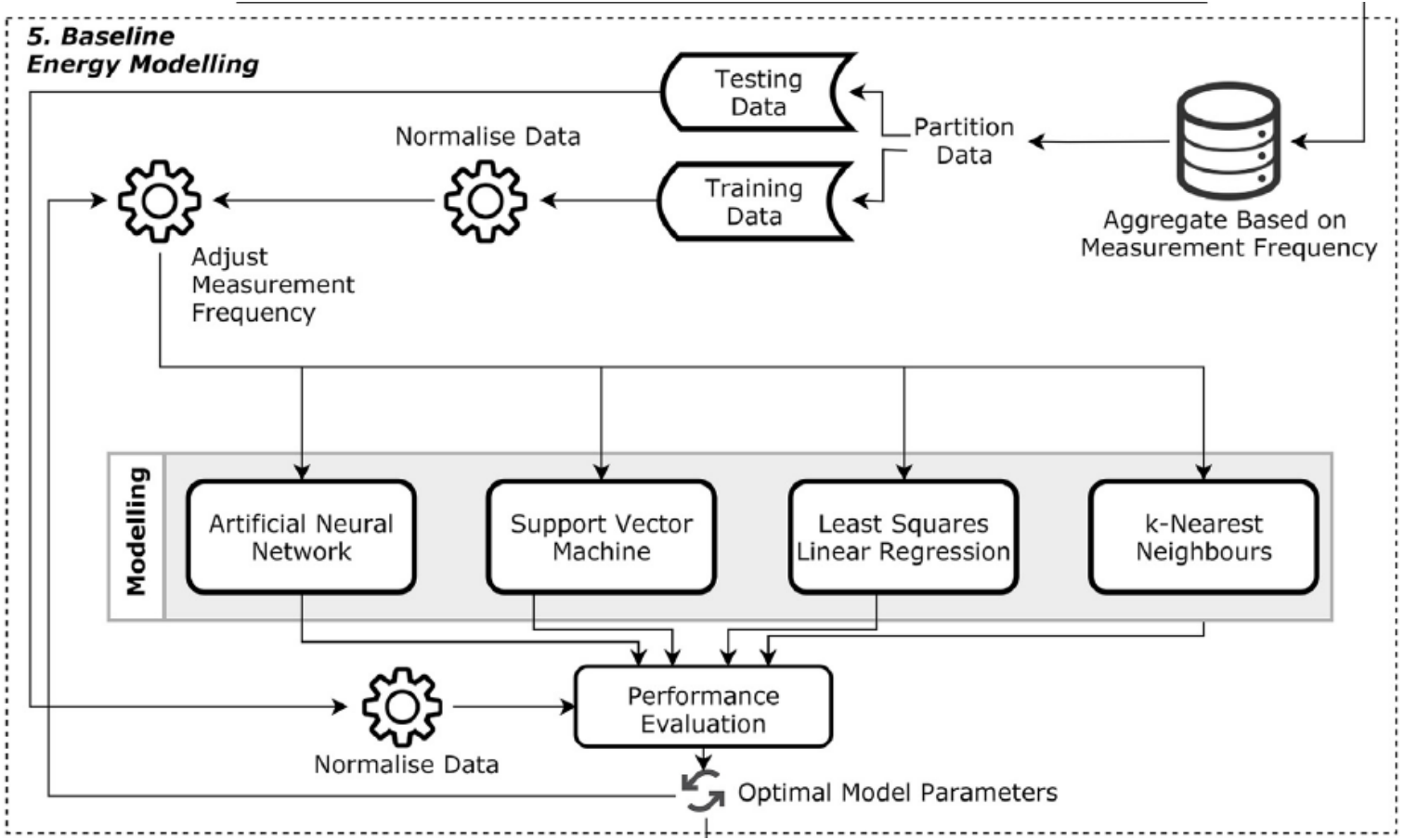

Nitro Consult

RUMSPROTOKOLL Sida 3

Datum 141009 | Fastighet Vasen... 11 | Sign | Littera 6133 5 V12:12

Rum	Tak norr	Väggar norra	östra	södra	västra	Golv norr
1 E	0					
2 F	0	0	0	IFG 0	0	0
3 H	0	0	0	[illegible]	0	0
4 P	0					
5 B	0					
6 P	TSF	0	[illegible]	0	0	0
7 K	0	[illegible]	[illegible]	0	0	0
8 S	[illegible]	[illegible]	0	0	0	0
9 MK	[illegible]	0	0	0	0	0
10 TST	0					


1. Project Parameters
Definition of
Project Parameters
2. Data Gathering
Distributed Data Sources
e.g. BMS, M&T, SCADA
Data Extraction
& Contextualisation
Single Repository of
Contextualised Data
3. Feature
Selection
4. Availability Assessment
& Cleaning
Sufficient data
quality?
Yes
No


5. Baseline
Energy Modelling
Testing Data
Partition Data
Normalise Data
Training Data
Aggregate Based on Measurement Frequency
Adjust Measurement Frequency
Modelling
Artificial Neural Network
Support Vector Machine
Least Squares Linear Regression
k-Nearest Neighbours
Performance Evaluation
Normalise Data
Optimal Model Parameters

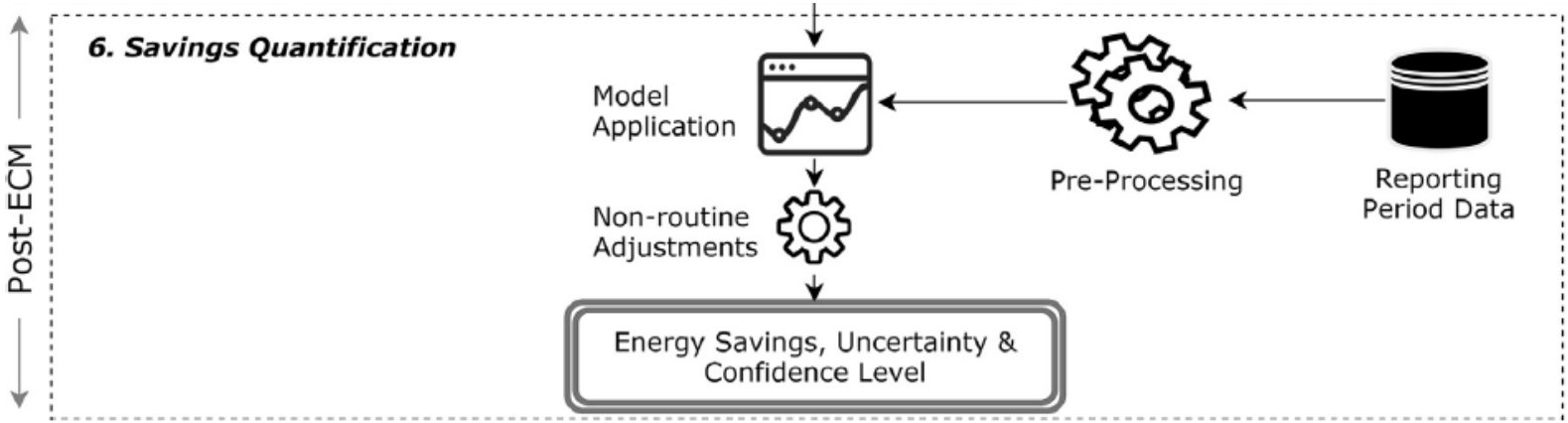


Fig. 1. Process flow diagram of the proposed methodology.

The specific objectives of the project are to:

- **evaluate tools for in-situ service life assessment of brick masonry**
- **identify relevant performance criteria for durability assessment**
- **investigate extent of damages to brick masonry**
- **develop a methodology for early identification of potential performance failures**
- **optimize timing and selection of retrofitting measures**

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