POST-WAR REFURBISHMENT

How to make your post-war house sustainable

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Content

Introduction
Methodology
Analysis row house
Refurbishment strategies
Other building types
Technical application
Conclusions

Content

Problem

Climate change

Earthquakes in Groningen

Problem

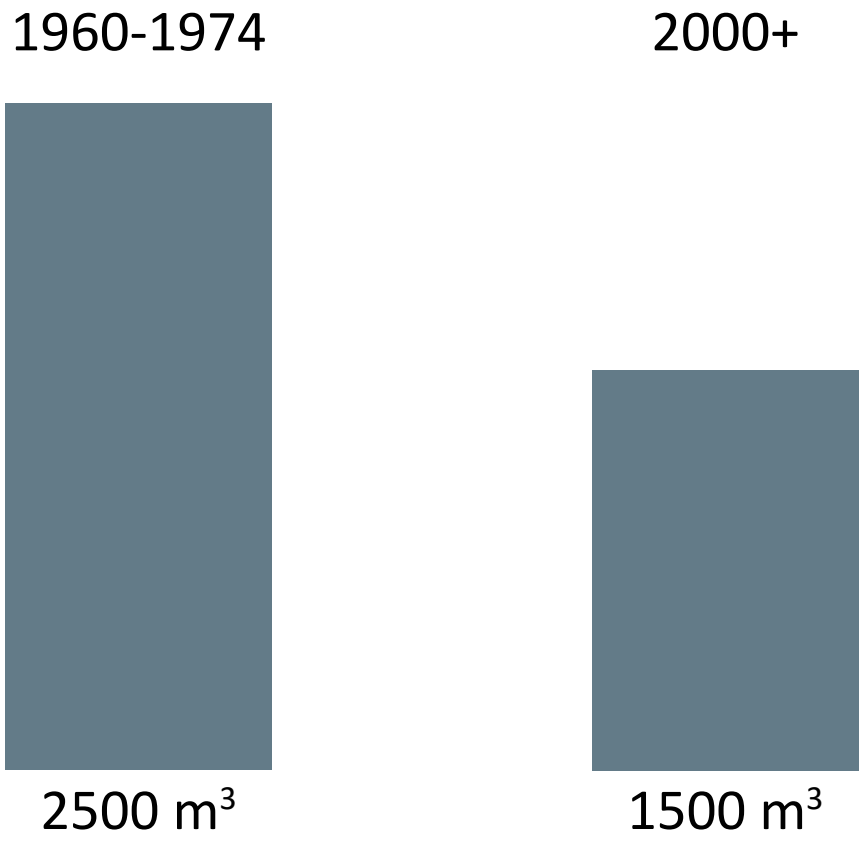
Gasproduction

- Coming 4 years: 21 billion m^3 → 12 billion m^3
- Complete stop: 2030

Major changes

Problem

±20% built 1960-1974



Research question

Which **strategies** are possible to **improve energy consumption** in **different** levels for **multiple** building types built between **1960-1974**?

Research question

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- Dutch houses
- Owner-occupied
- Late post-war

Research question

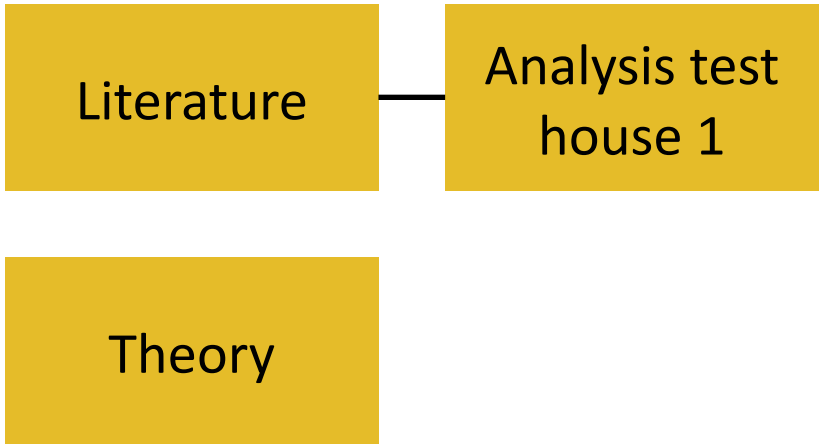
Which **strategies** are possible to **improve energy consumption** in **different** levels for **multiple** building types built between **1960-1974**?

- Dutch houses
- Owner-occupied
- Late post-war

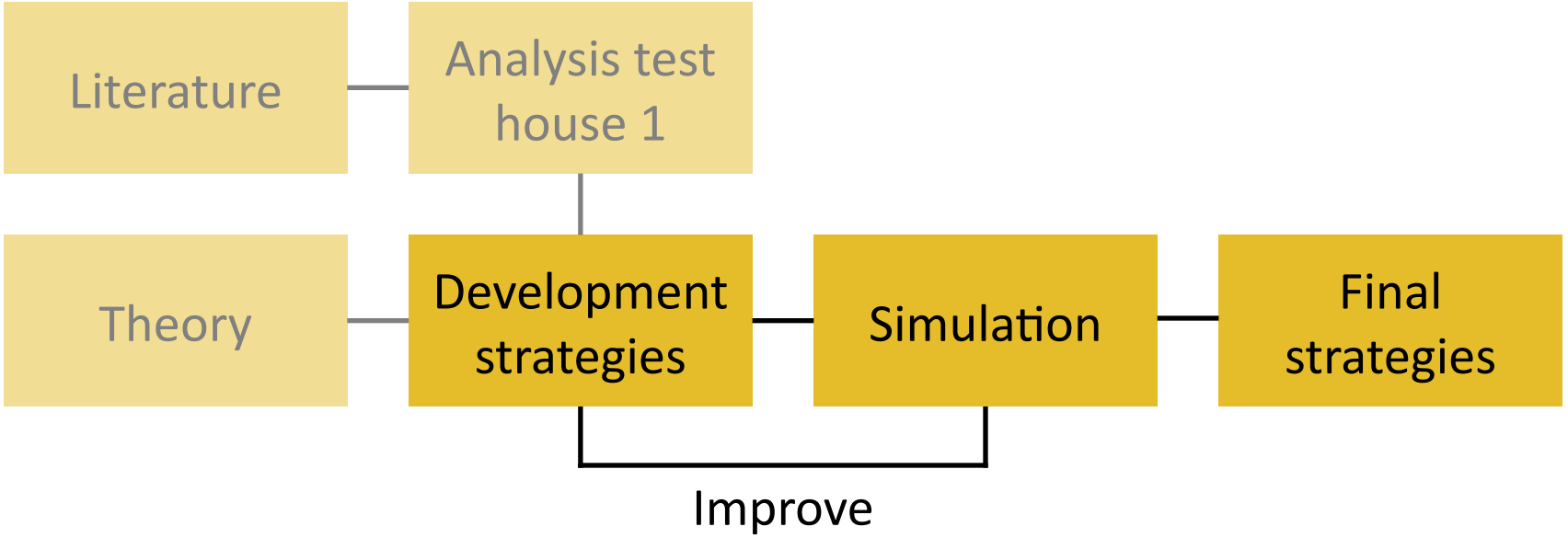
- Three strategies
- Improvement
- Budget
- Versatile

Content

Research-based design



Research-based design



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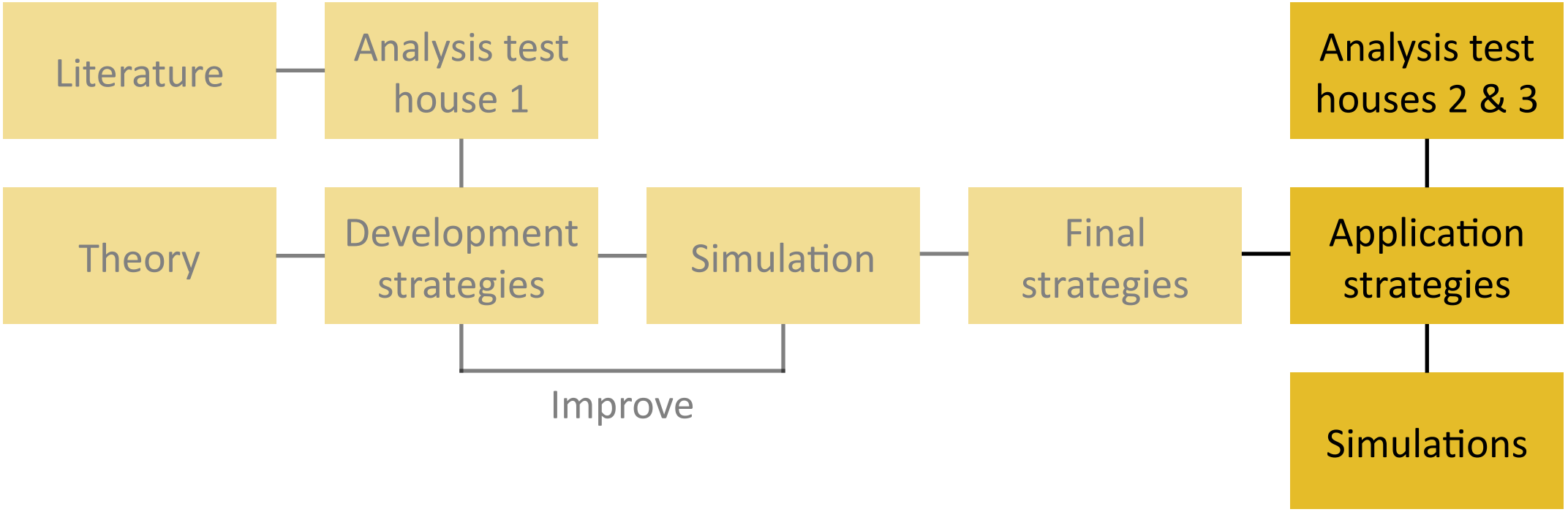

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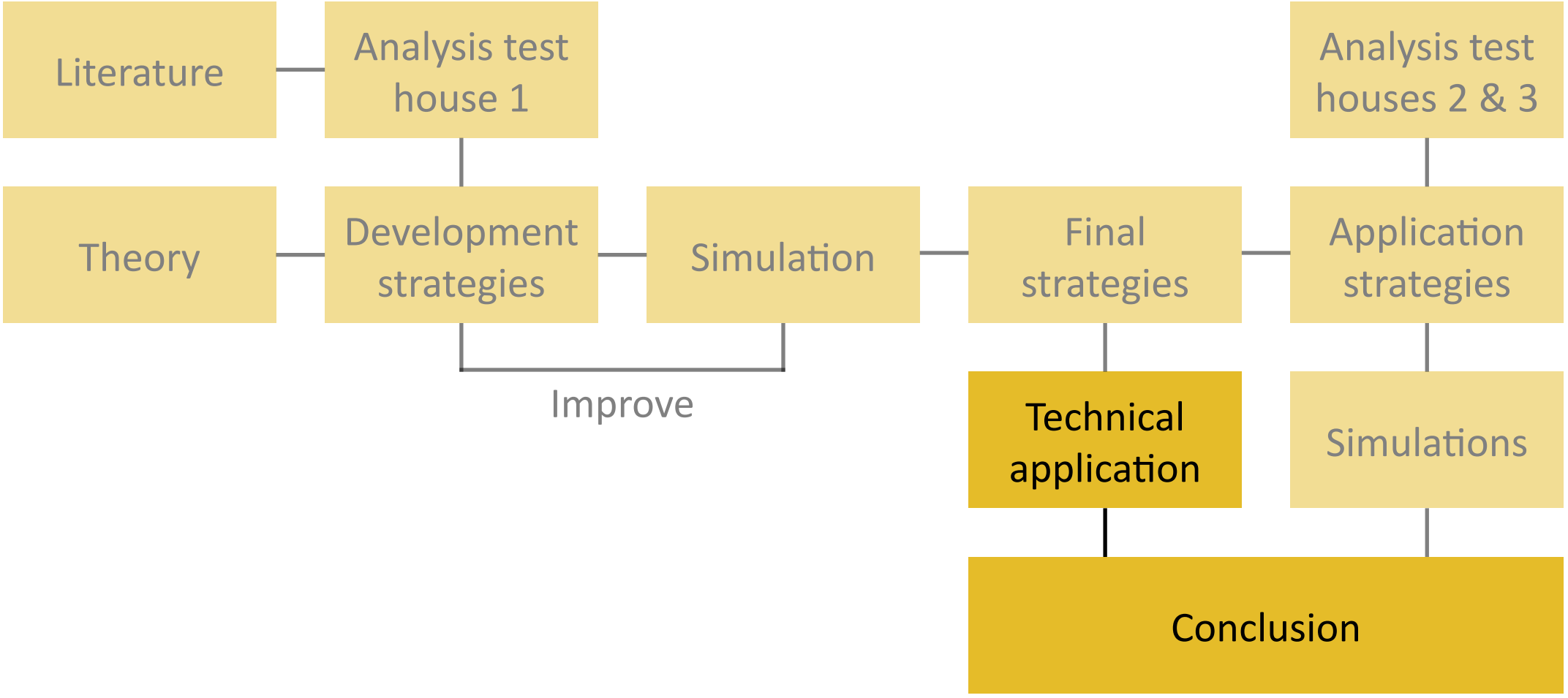
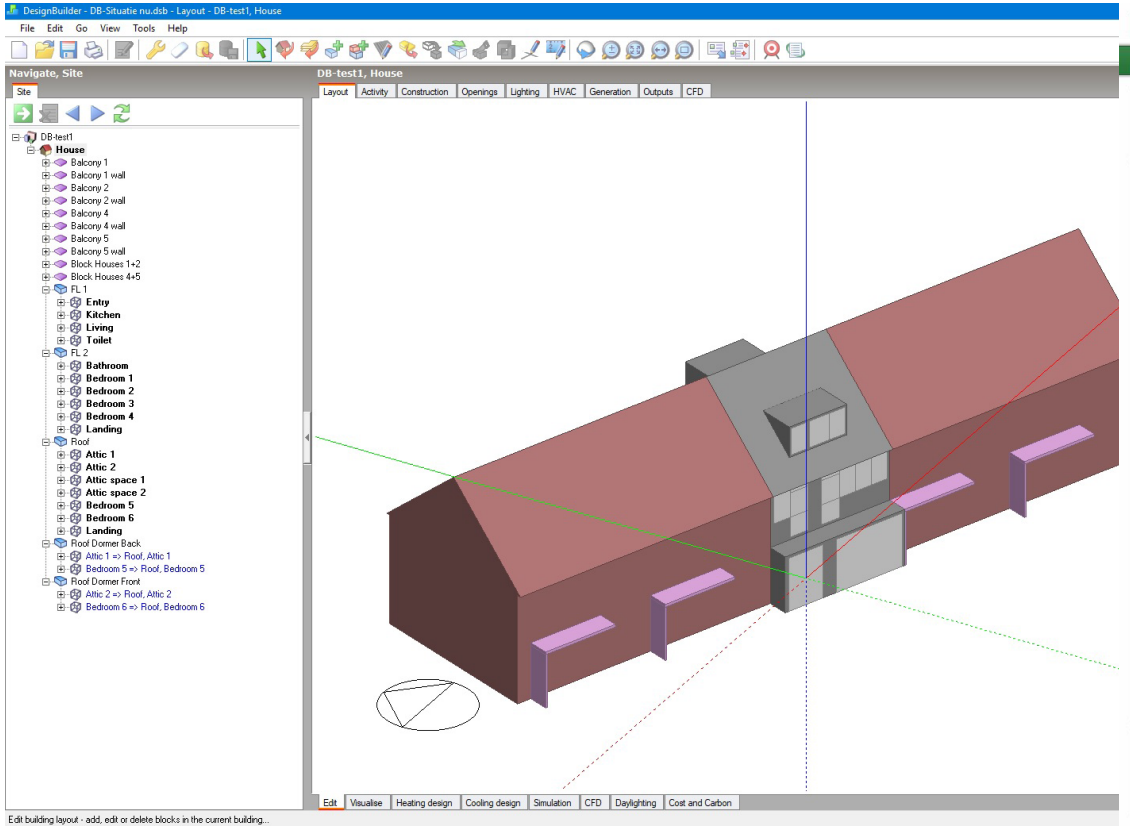
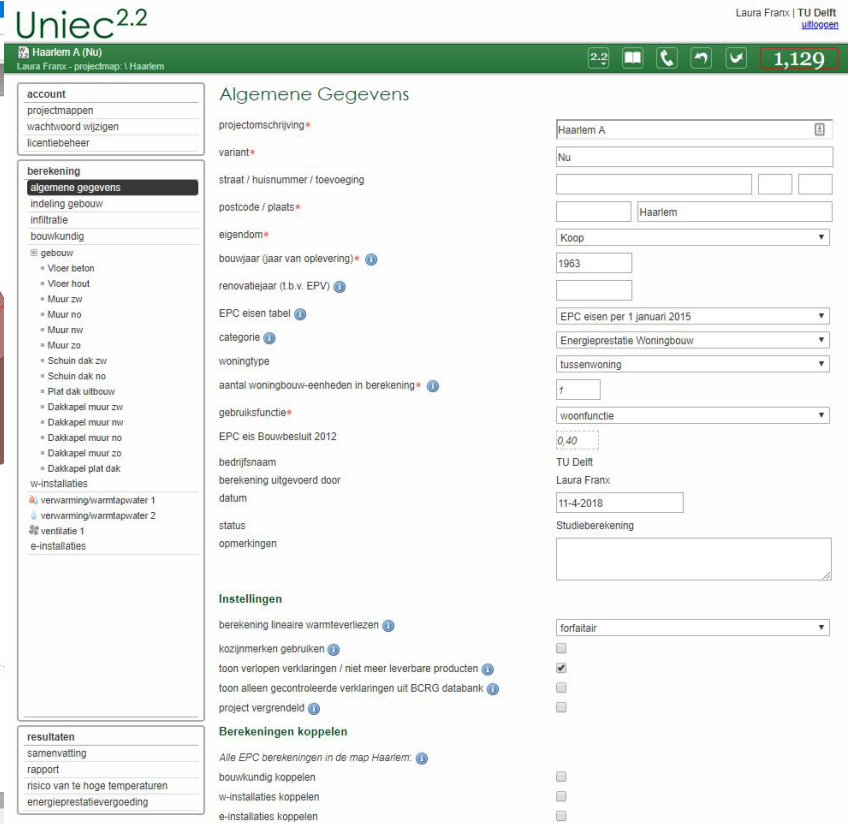


Simulations

Design Builder



Uniec 2.2



Simulations

Annual fuel consumption

Energy Performance Coefficient: EPC

- New houses: EPC ≤ 0,4

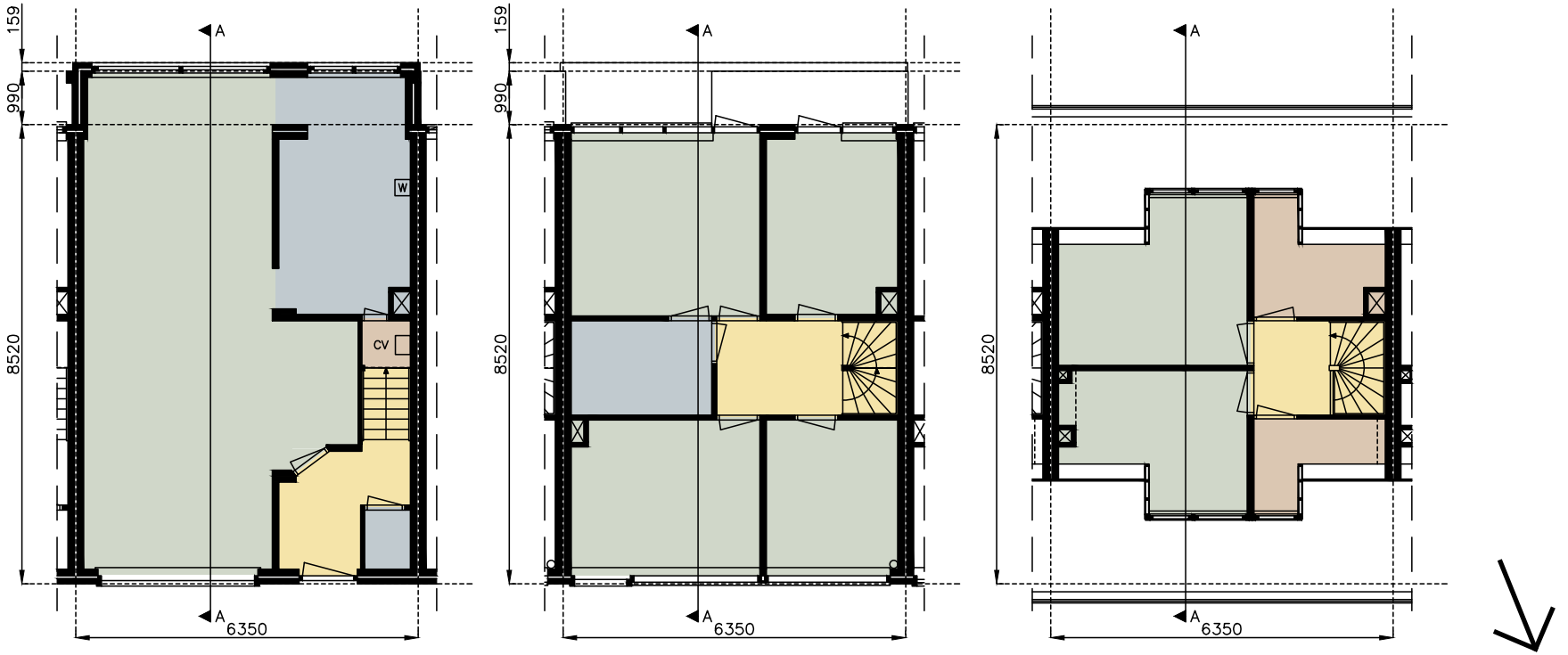
Content

Situation

Orientation

Situation

Floorplan



Level 1

Level 2

Level 3

Situation

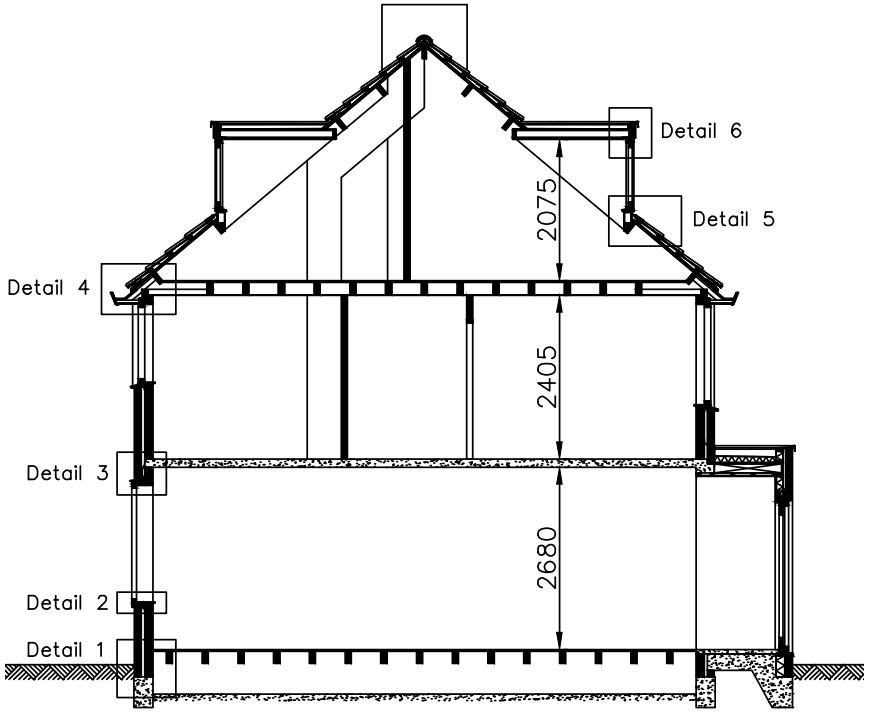
Facades

North face

South face

Situation

Construction



Section A-A

Situation

Installation

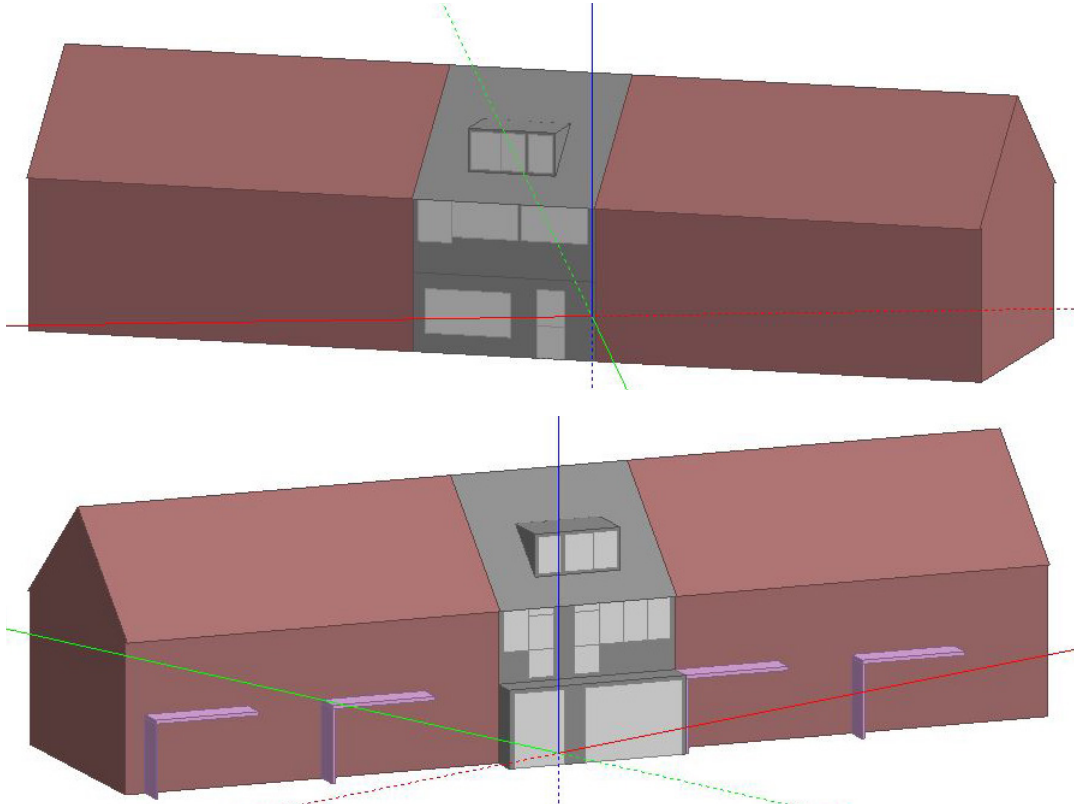
HR combi boiler
2012

Electric boiler 10L
2008

Natural ventilation

Simulation

Programs



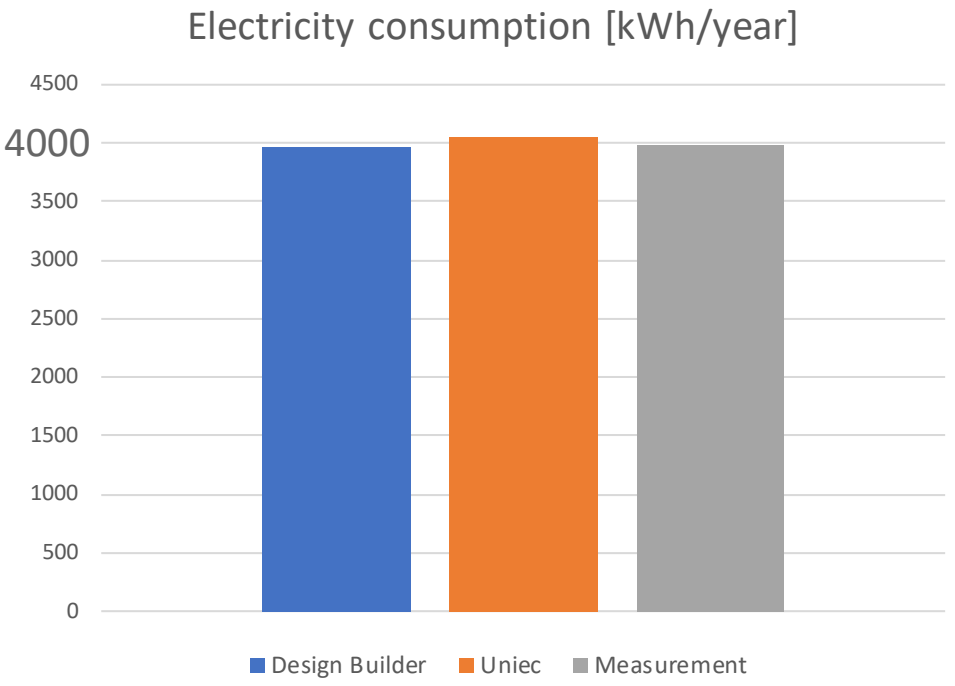
gebouw

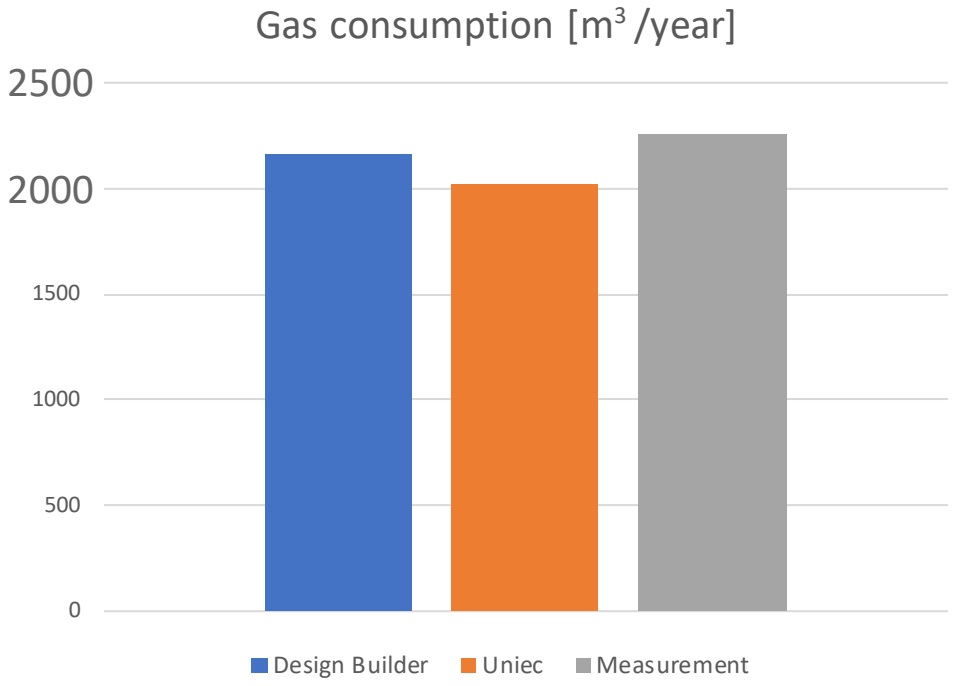
Definieer aanwezige scheidingsconstructies

constructie	begrenzing	L [m]
Vloer beton	vloer op/boven mv; boven kn	
Vloer hout	vloer op/boven mv; boven kn	
Muur zw	buitenlucht, ZW	
Muur no	buitenlucht, NO	
Muur nw	buitenlucht, NW	
Muur zo	buitenlucht, ZO	
Schuin dak zw	buitenlucht, ZW	
Schuin dak no	buitenlucht, NO	
Plat dak uitbouw	buitenlucht, HOR, dak	
Dakkapel muur zw	buitenlucht, ZW	
Dakkapel muur nw	buitenlucht, NW	
Dakkapel muur no	buitenlucht, NO	
Dakkapel muur zo	buitenlucht, ZO	
Dakkapel plat dak	buitenlucht, HOR, dak	

Simulation

Results





EPC = 1,13

Content

Basic insulation strategy (A)

Boundary conditions

- Simple techniques
- Improve ventilation
- Minimal disturbance
- Payback time: 10 years

Basic insulation strategy (A)

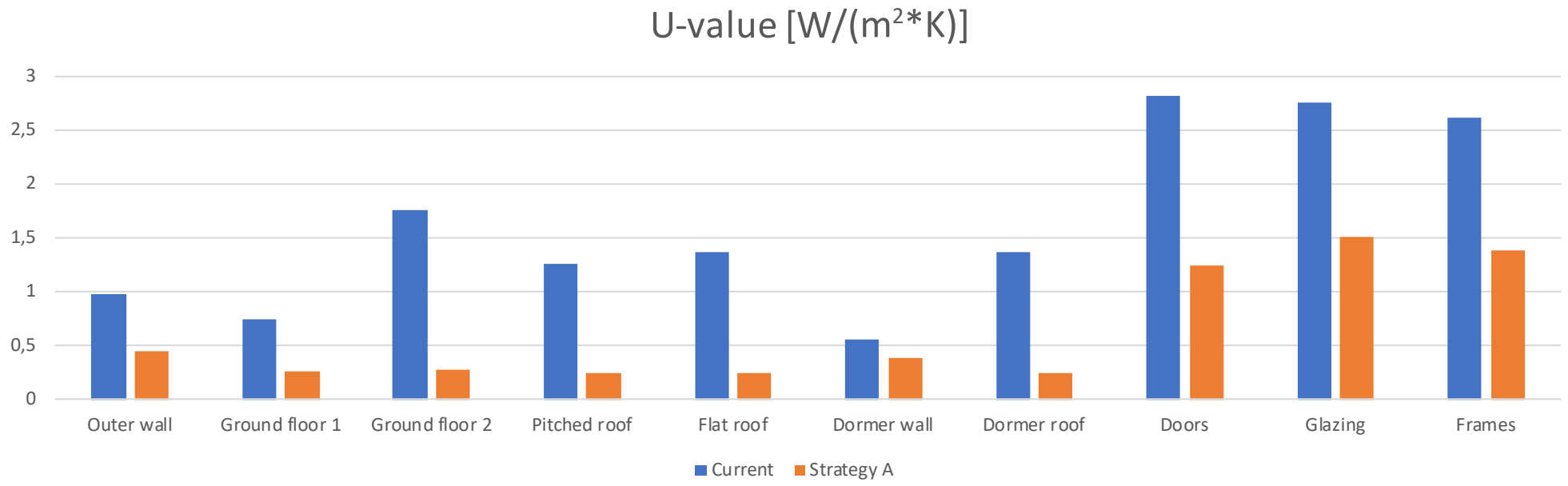
Insulation techniques

- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR++ glazing
- Frames with thermal break

Indoor climate

Basic insulation strategy (A)

Thermal transmittance



Basic insulation strategy (A)

Insulation techniques

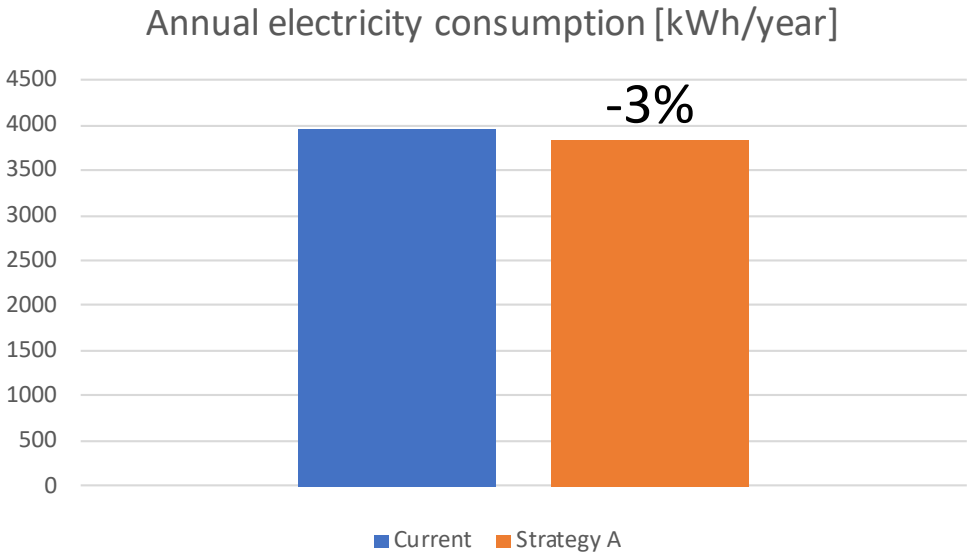
- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR++ glazing
- Frames with thermal break

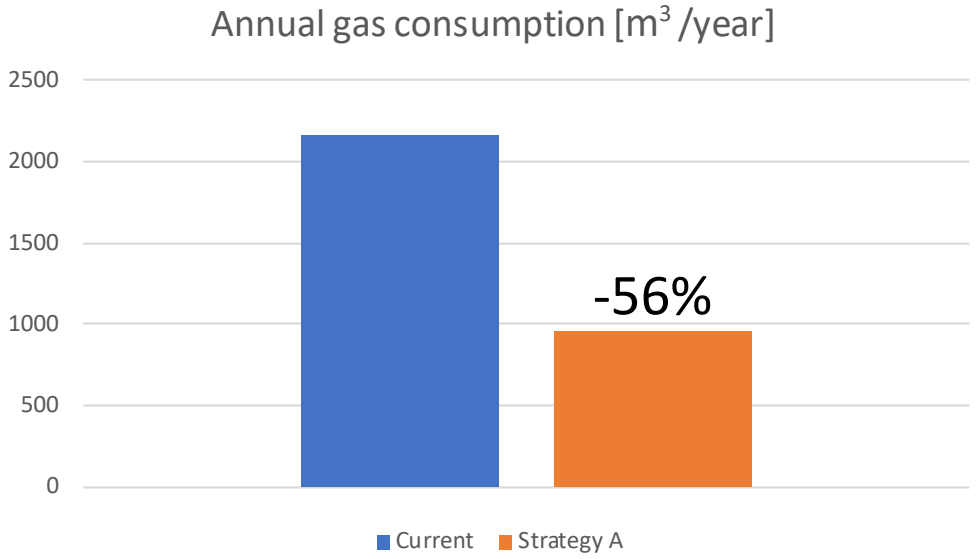
Indoor climate

- Installations < 15 years
- New and extra ventilation grills
- LED lighting

Basic insulation strategy (A)

Results row house





EPC = 0,77

Basic insulation strategy (A)

Visualisation

Current

Strategy A

Invest: €9.500,-
Payback time:
12 years

EPC ≤ 0,4 strategy (B)

Boundary conditions

- EPC ≤ 0,4
- Renewable energy
- Improve ventilation
- Medium disturbance
- Payback time: 10 - 25 years

EPC ≤ 0,4 strategy (B)

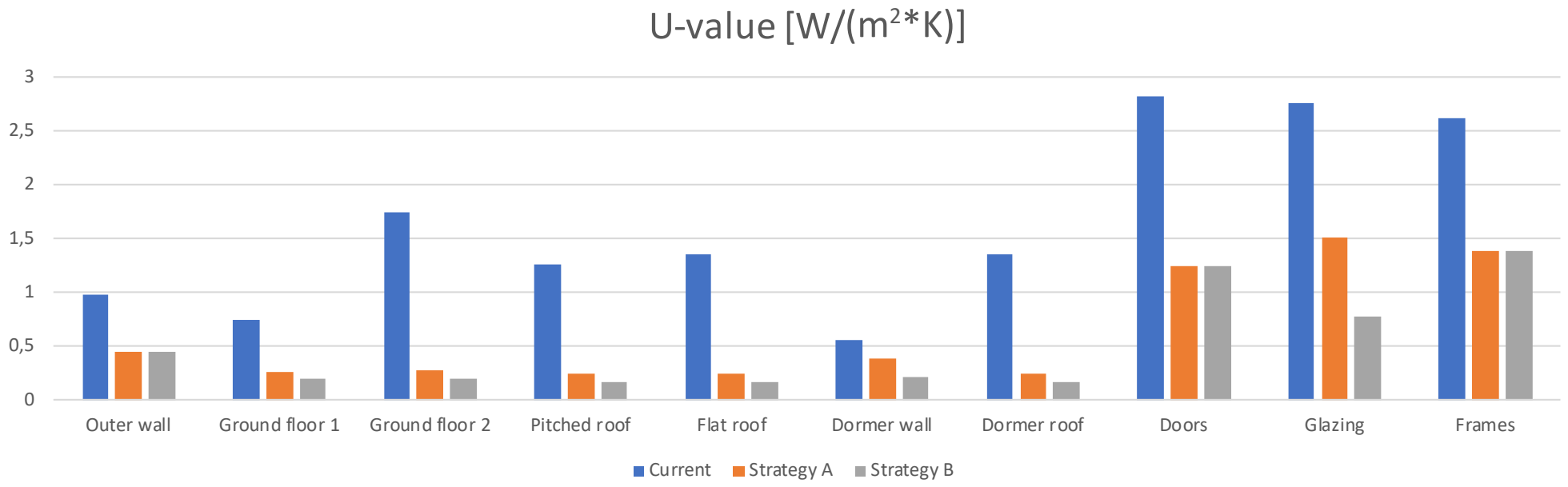
Insulation techniques

- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR+++ glazing
- Frames with thermal break

Indoor climate

EPC ≤ 0,4 strategy (B)

Thermal transmittance



EPC ≤ 0,4 strategy

Insulation techniques

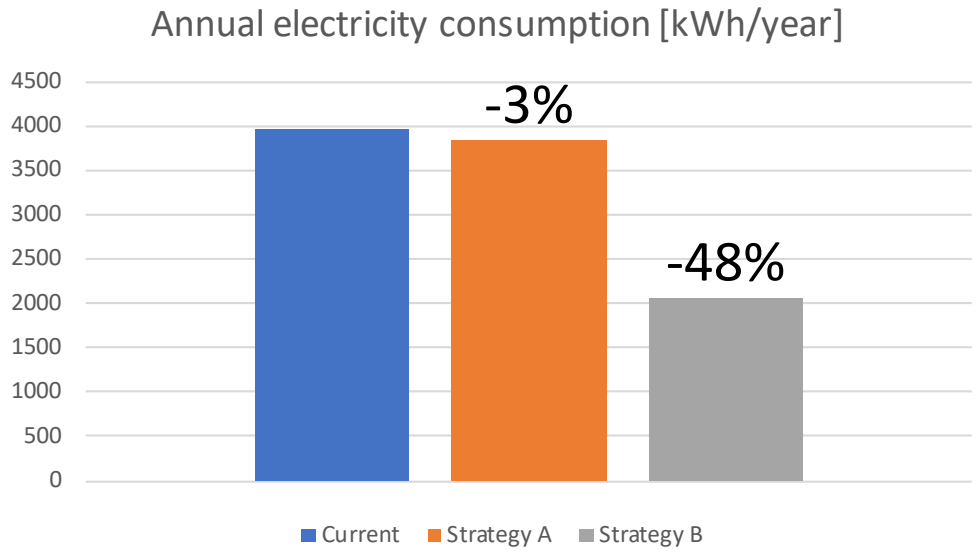
- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR+++ glazing
- Frames with thermal break

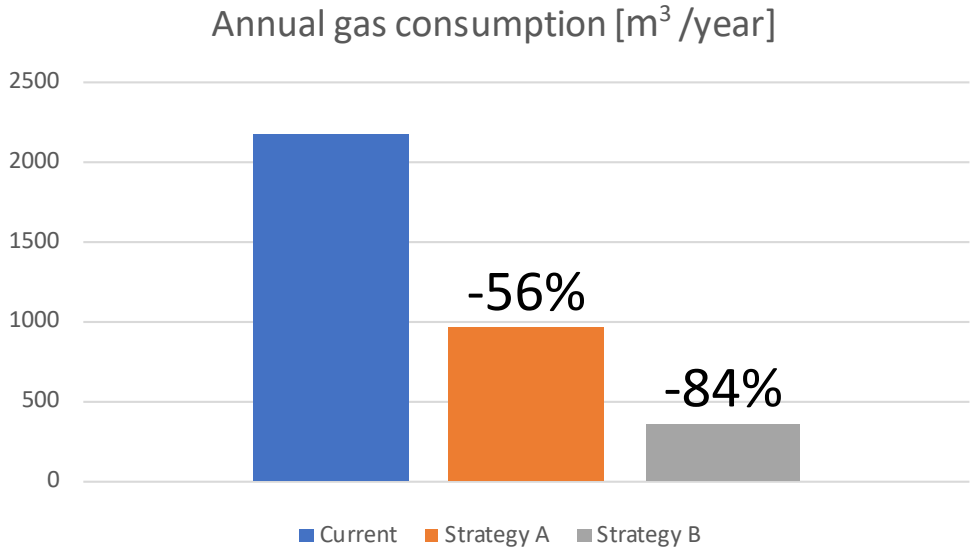
Indoor climate

- HR combi boiler & solar collectors
- PV-panels
- New and extra ventilation grills
- LED lighting

EPC ≤ 0,4 strategy (B)

Results row house





EPC = 0,37

EPC ≤ 0,4 strategy (B)

Visualisation

Current

Strategy B

Invest: €23.000,-
Payback time:
15 years

Net Zero Energy Building strategy (C)

Boundary conditions

- NZEB
- Gas-free
- Renewable energy
- Improve ventilation
- Extreme electricity reduction
- Electric cooking
- Payback time: 25+ years

NZEB strategy (C)

Insulation techniques

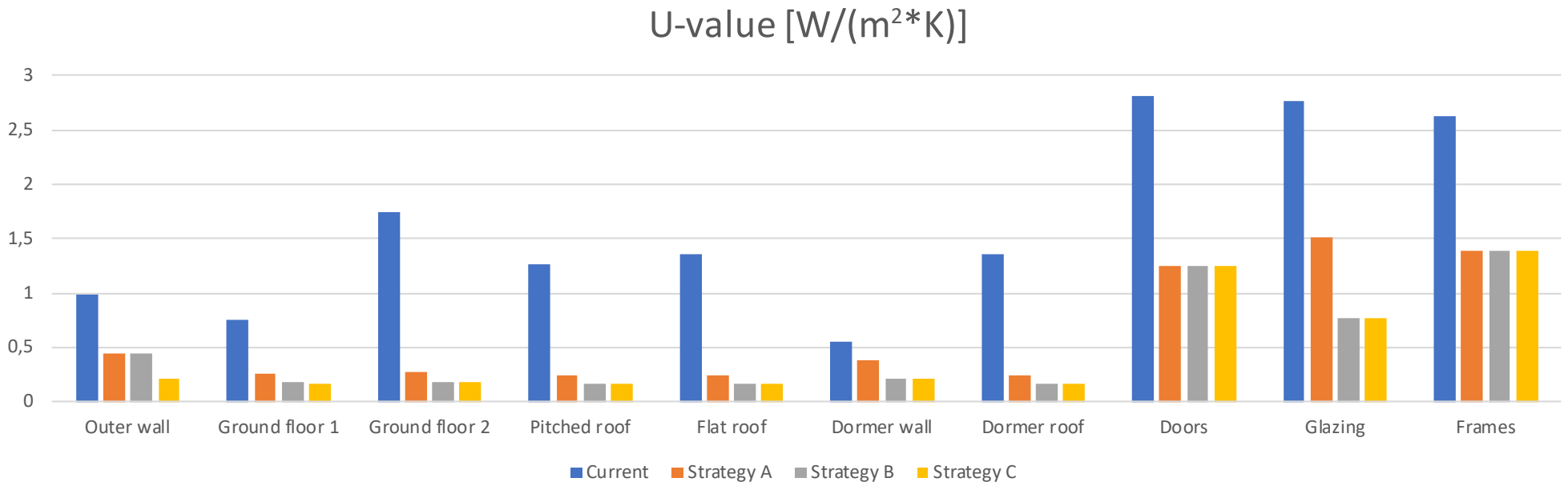
- Cavity wall + external insulation
- Crawl space insulation
- External insulation pitched roof
- External insulation flat roof
- New dormers
- HR+++ glazing
- Frames with thermal break

Indoor climate

Appliances

NZEB strategy (C)

Thermal transmittance



NZEB strategy (C)

Insulation techniques

- Cavity wall + external insulation
- Crawl space insulation
- External insulation pitched roof
- External insulation flat roof
- New dormers
- HR+++ glazing
- Frames with thermal break

Indoor climate

- Air heat pump & solar collectors
- Electric combi boiler
- PV-panels
- New and extra ventilation grills
- LED lighting

Appliances

NZEB strategy (C)

Insulation techniques

- Cavity wall + external insulation
- Crawl space insulation
- External insulation pitched roof
- External insulation flat roof
- New dormers
- HR+++ glazing
- Frames with thermal break

Indoor climate

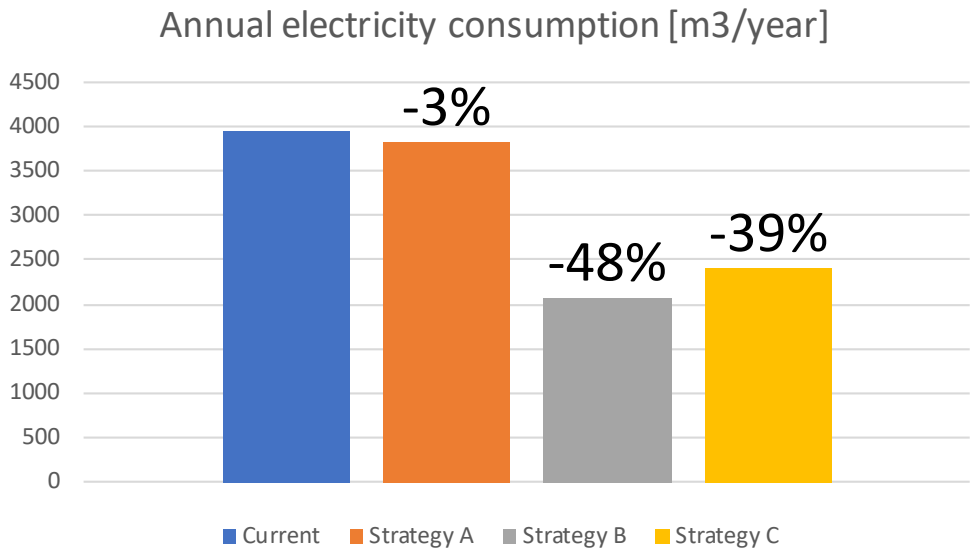
- Air heat pump & solar collectors
- Electric combi boiler
- PV-panels
- New and extra ventilation grills
- LED lighting

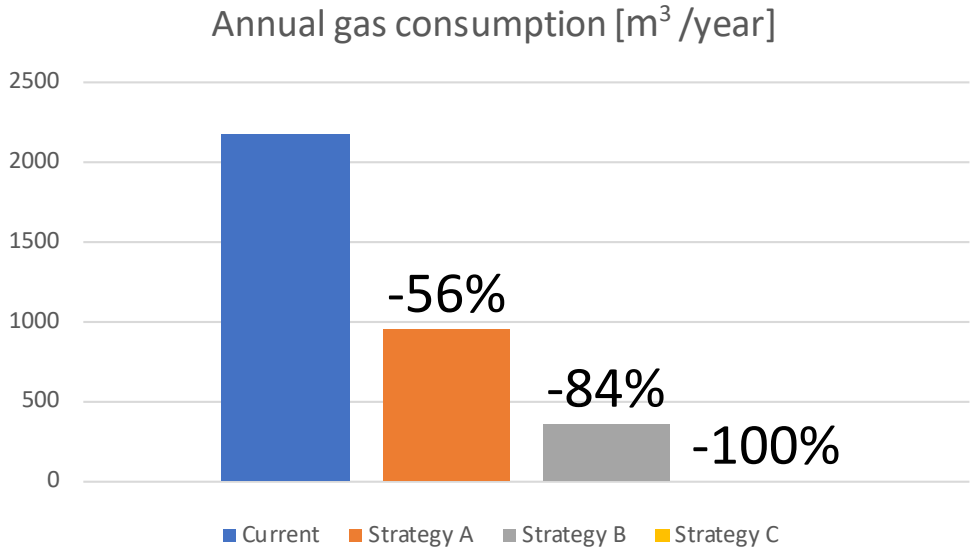
Appliances

- Induction cooking
- New appliances A++/+++

NZEB strategy (C)

Results row house





EPC = 0,15

NZEB strategy (C)

Visualisation

Current

Strategy C

Invest: €40.000,-
Payback time:
24 years

Comparison

Basic insulation (A)

Invest: €9.500,-
12 years

EPC ≤ 0,4 (B)

Invest: €23.000,-
15 years

NZEB (C)

Invest: €40.000,-
24 years

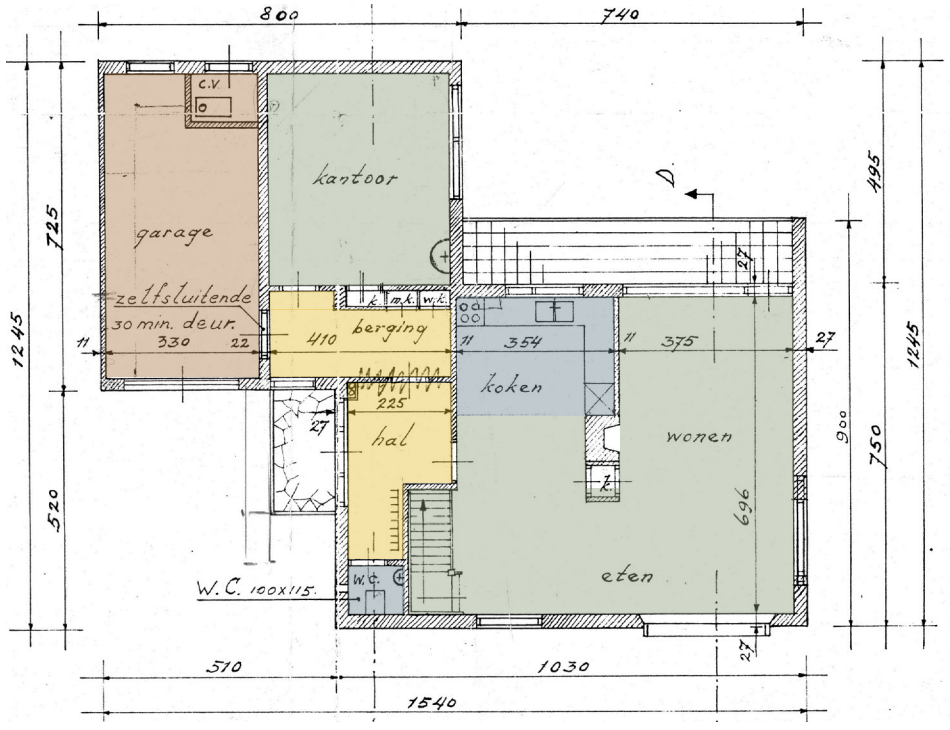
Content

Free-standing house

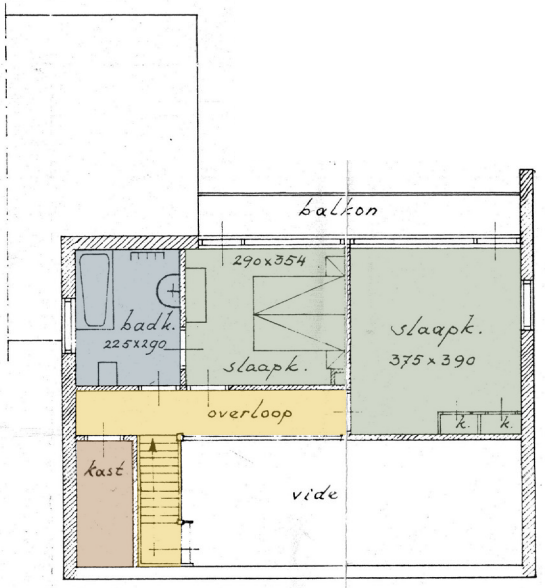
Situation

Free-standing house

Floorplans



Level 1



Level 2

N

Free-standing house

Facades

Free-standing house: strategy A

Insulation techniques

- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- HR++ glazing
- Frames with thermal break

Indoor climate

- HR combi boiler
- New and extra ventilation grills
- LED lighting

Free-standing house: strategy B

Insulation techniques

- Cavity wall insulation
- Crawl space insulation
- Internal insulation pitched roof
- HR+++ glazing
- Frames with thermal break

Indoor climate

- HR combi boiler & solar collectors
- PV-panels
- New and extra ventilation grills
- LED lighting

Free-standing house: strategy C

Insulation techniques

- Cavity wall + external insulation
- Crawl space insulation
- External insulation pitched roof
- HR+++ glazing
- Frames with thermal break

Indoor climate

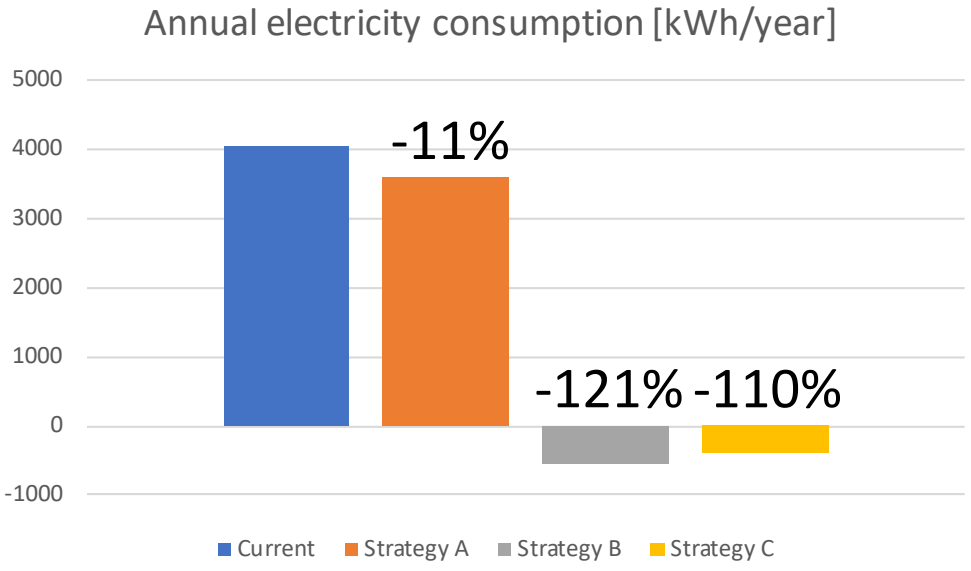
- Air heat pump & solar collectors
- Electric combi boiler
- PV-panels
- New and extra ventilation grills
- LED lighting

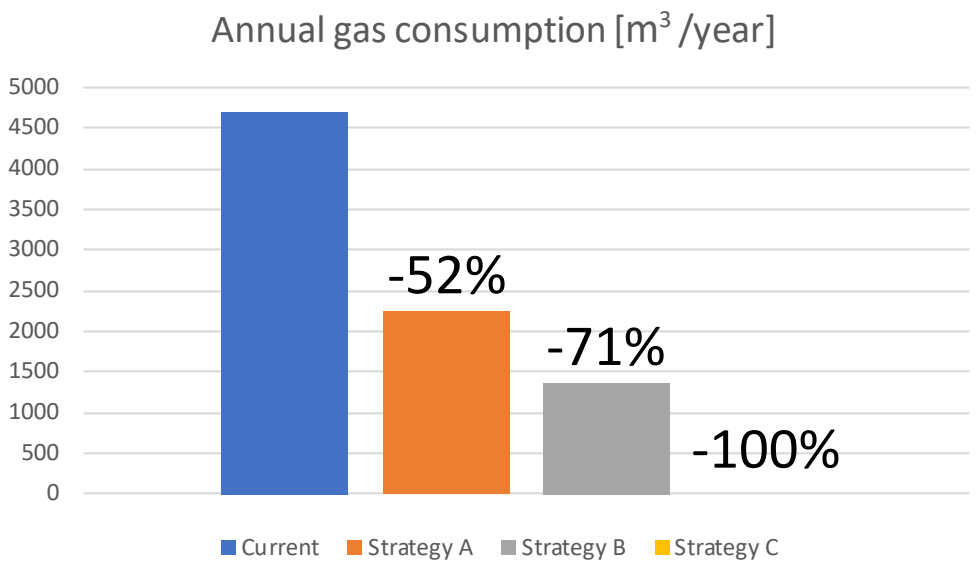
Appliances

- Induction cooking
- New appliances A++/+++

Free-standing house

Results





Free-standing house

Basic insulation (A)

Invest: €25.000,-
15 years

EPC ≤ 0,4 (B)

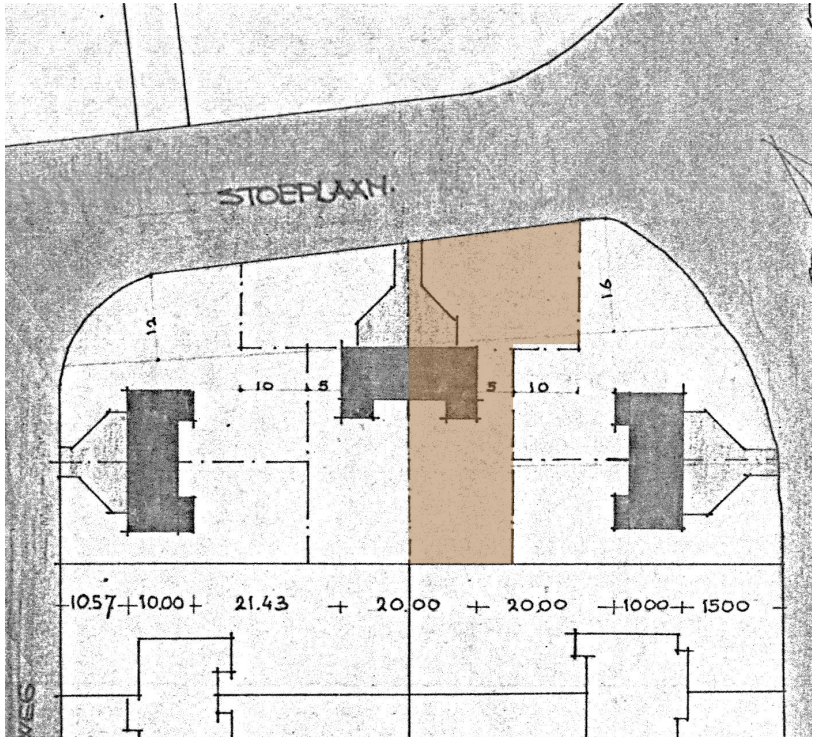
Invest: €38.000,-
13 years

NZEB (C)

Invest: €69.000,-
17 years

Semi-detached house

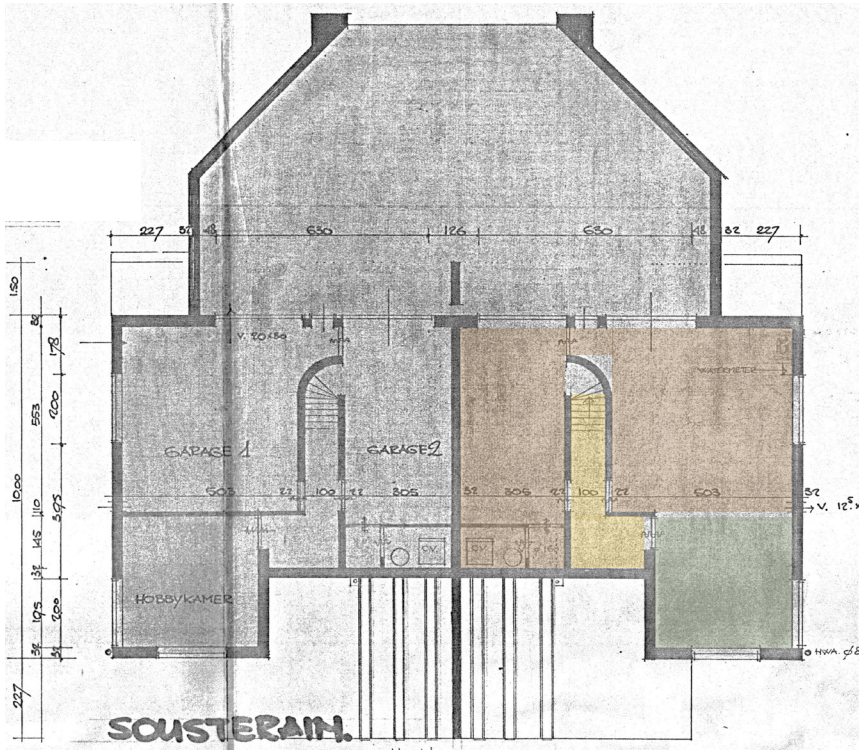
Situation

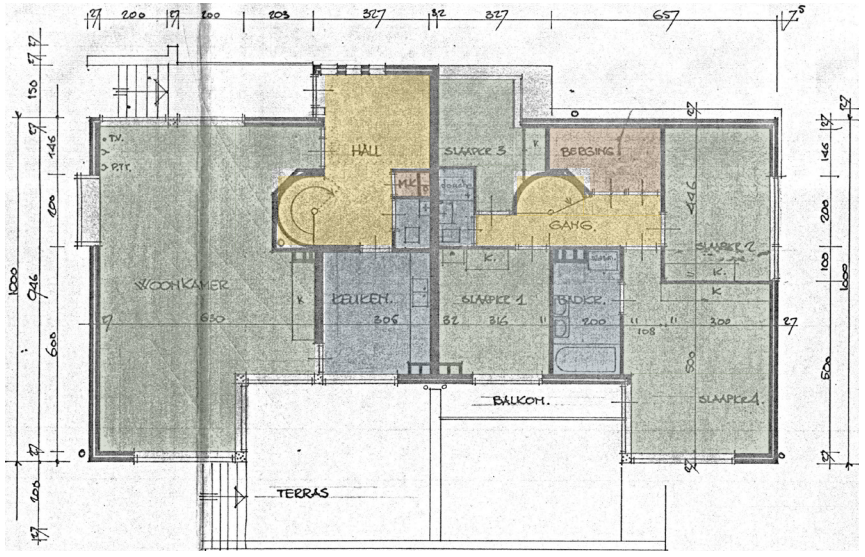


N

Semi-detached house

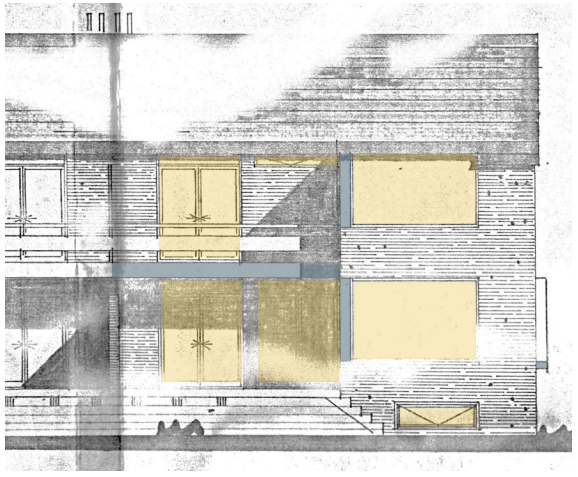
Floorplans

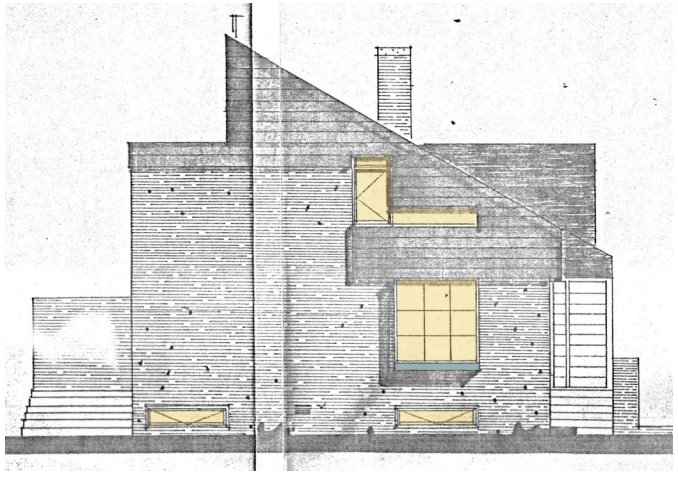


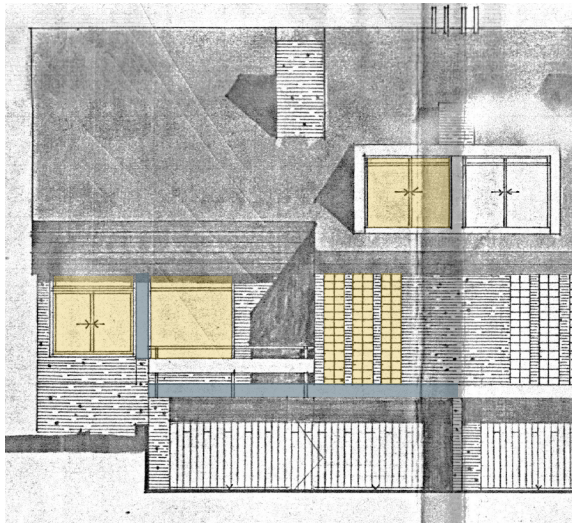


Semi-detached house

Facades







Semi-detached house

Installations

- Hot air heating
- Stand-alone boiler

Natural ventilation

Semi-detached house: strategy A

Insulation techniques

- Cavity wall insulation
- ~~Crawl space insulation~~
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR++ glazing
- Frames with thermal break

Indoor climate

- Installations < 15 years
- New ventilation grills
- LED lighting

Semi-detached house: strategy B

Insulation techniques

- Cavity wall insulation
- ~~Crawl space insulation~~
- Internal insulation pitched roof
- External insulation flat roof
- Insulating dormers
- HR+++ glazing
- Frames with thermal break

Indoor climate

- ~~HR combi boiler & solar collectors~~
- ~~PV panels~~
- New and extra ventilation grills
- LED lighting

Semi-detached house: strategy C

Insulation techniques

- ~~Cavity wall + external insulation~~
- ~~Crawl space insulation~~
- ~~External insulation pitched roof~~
- External insulation flat roof
- New dormer
- HR+++ glazing
- Frames with thermal break

Indoor climate

- ~~Air heat pump & solar collectors~~
- ~~Electric combi boiler~~
- ~~PV panels~~
- New grills
- LED lighting

Appliances

- Induction cooking
- New appliances A++/+++

Semi-detached house

Insulation techniques

- Complete internal insulation
- HR+++ glazing
- New frames with thermal break

Indoor climate

- LT floor heating
- Air heat pump
- Electric combi boiler
- Mechanical ventilation
- LED lighting

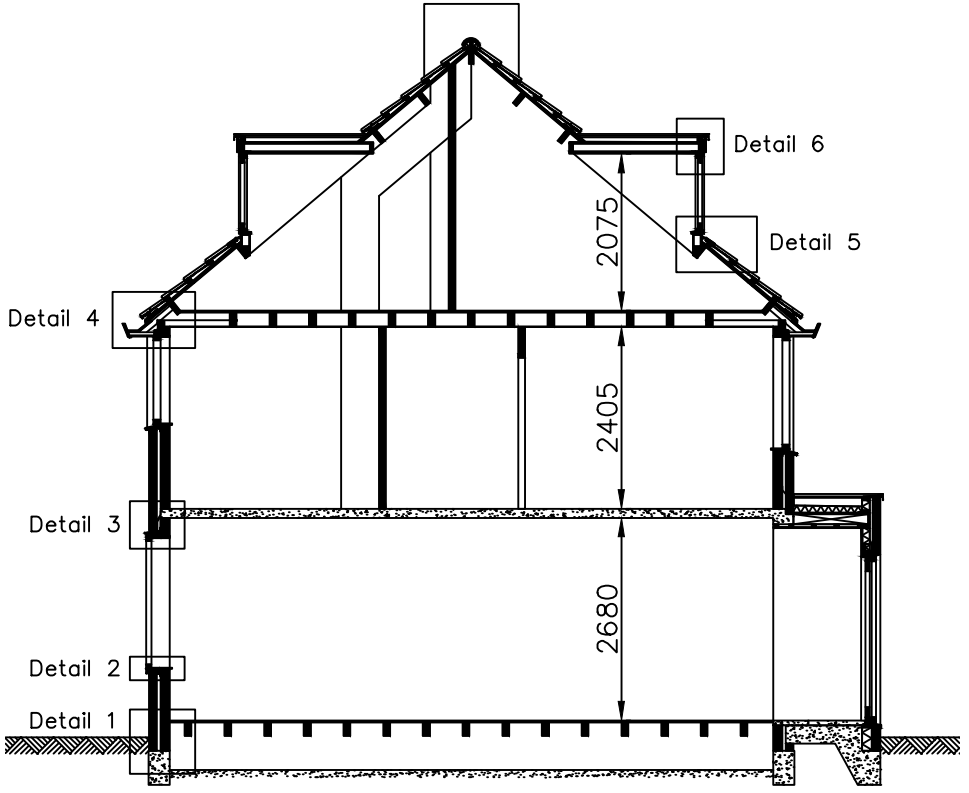
Appliances

- Induction cooking
- New appliances A++/+++

Content

Technical application

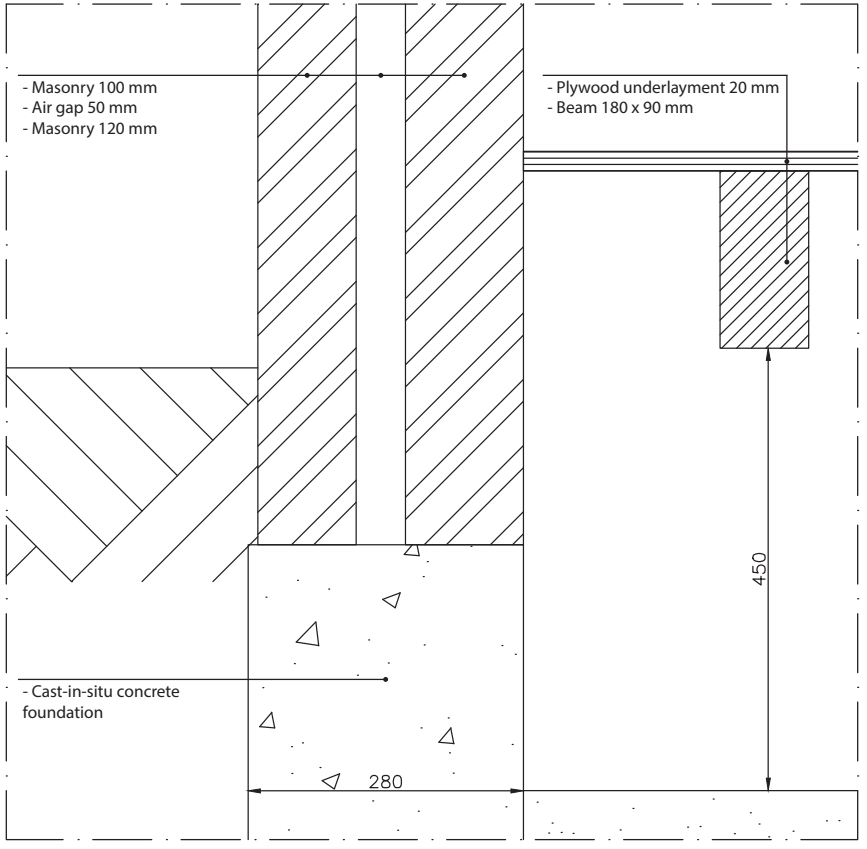
Section current situation



Section A-A

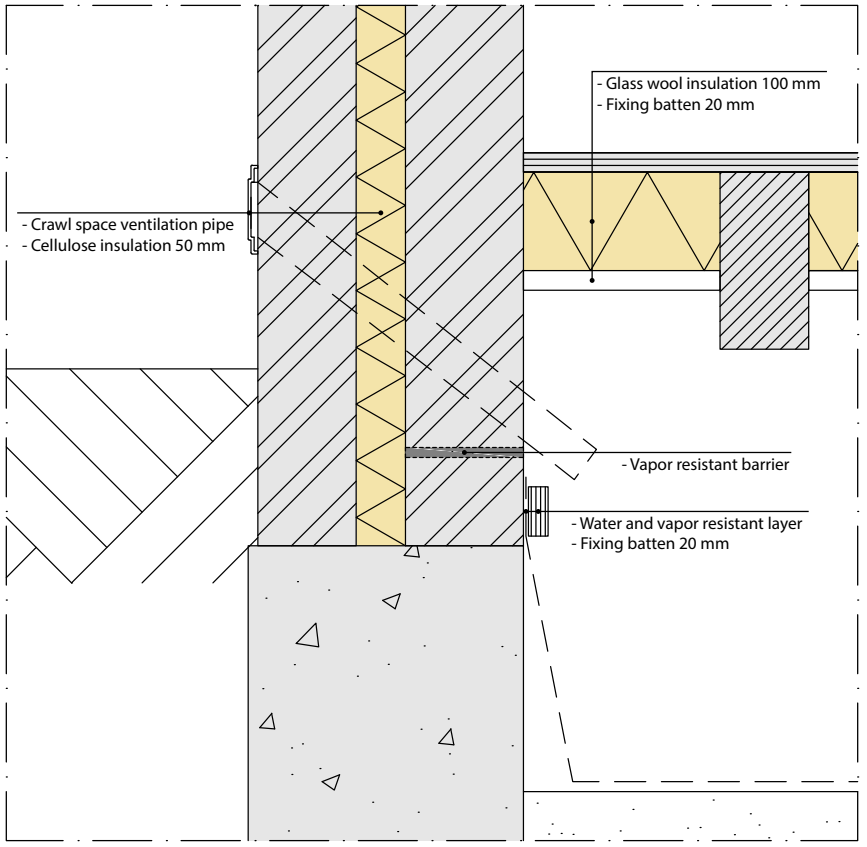
Technical application

Detail 1: current situation



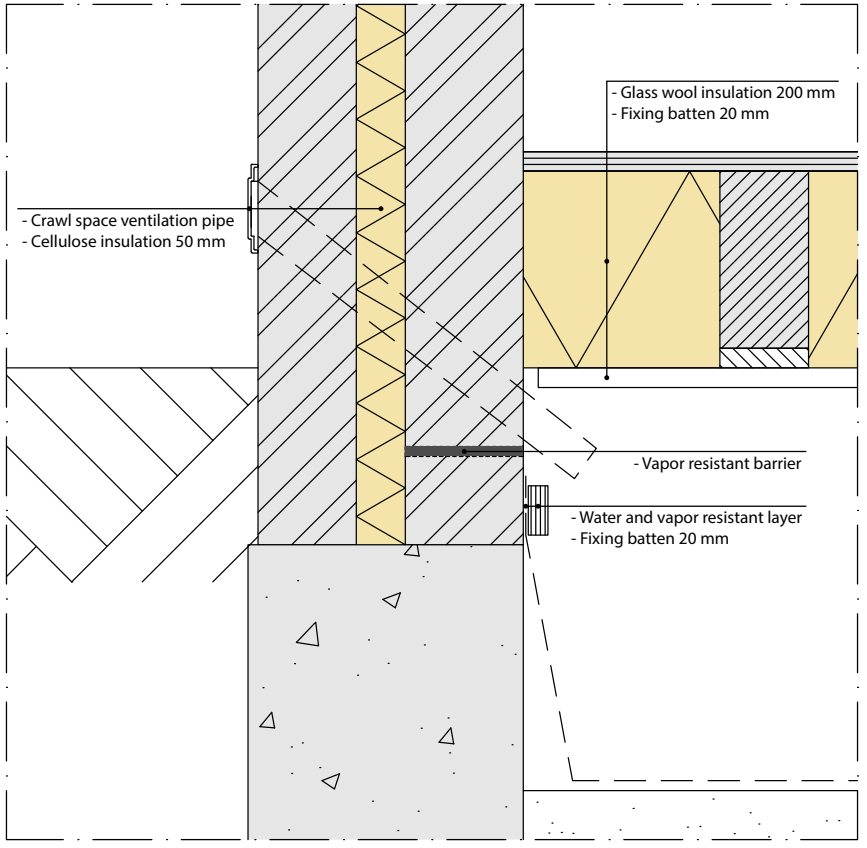
Technical application

Detail 1: strategy A



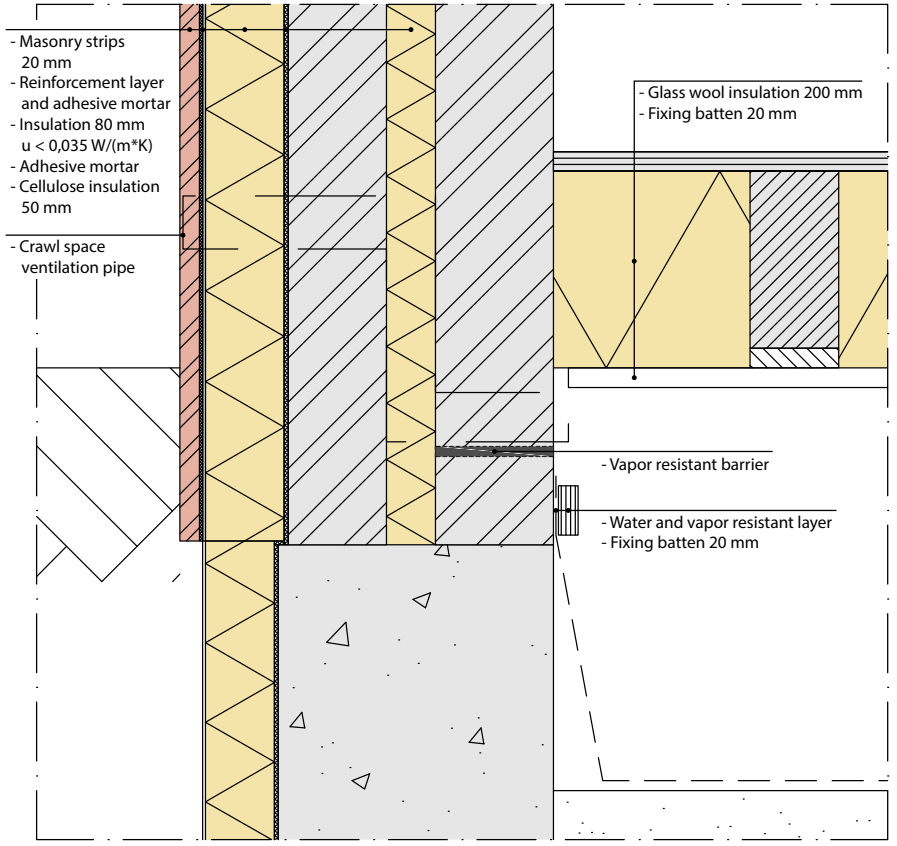
Technical application

Detail 1: strategy B



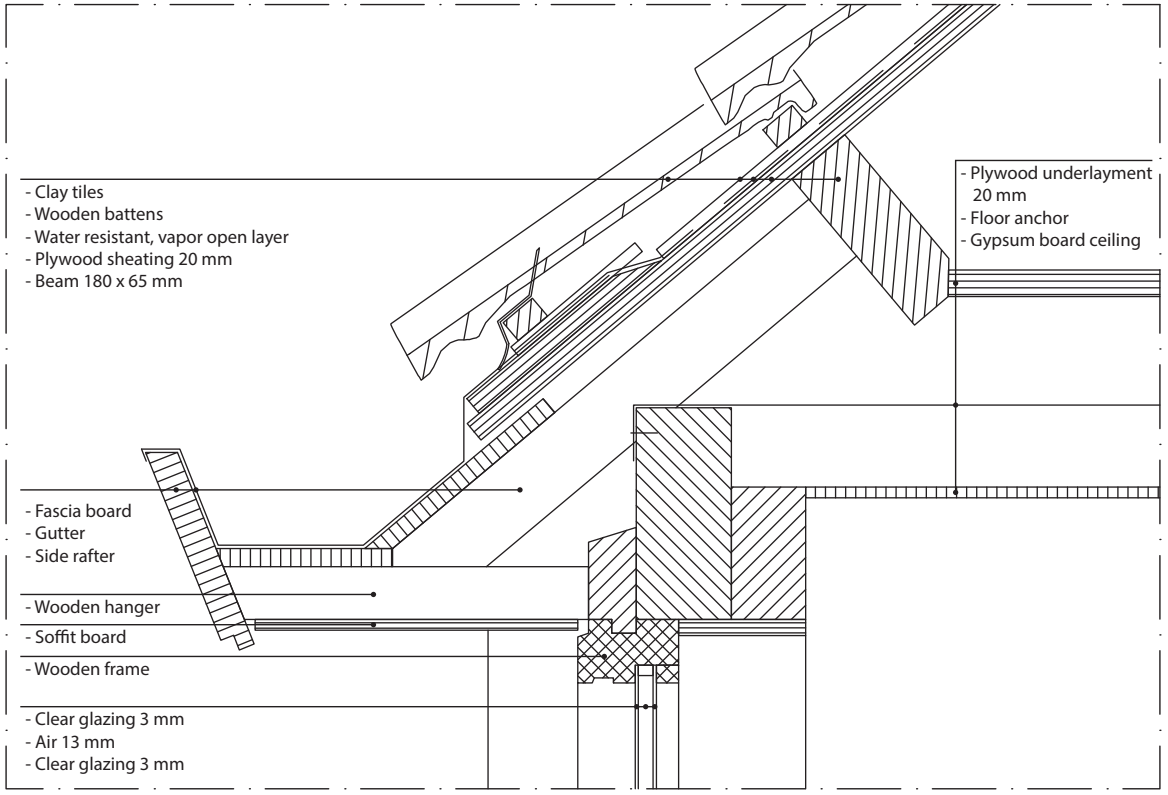
Technical application

Detail 1: strategy C



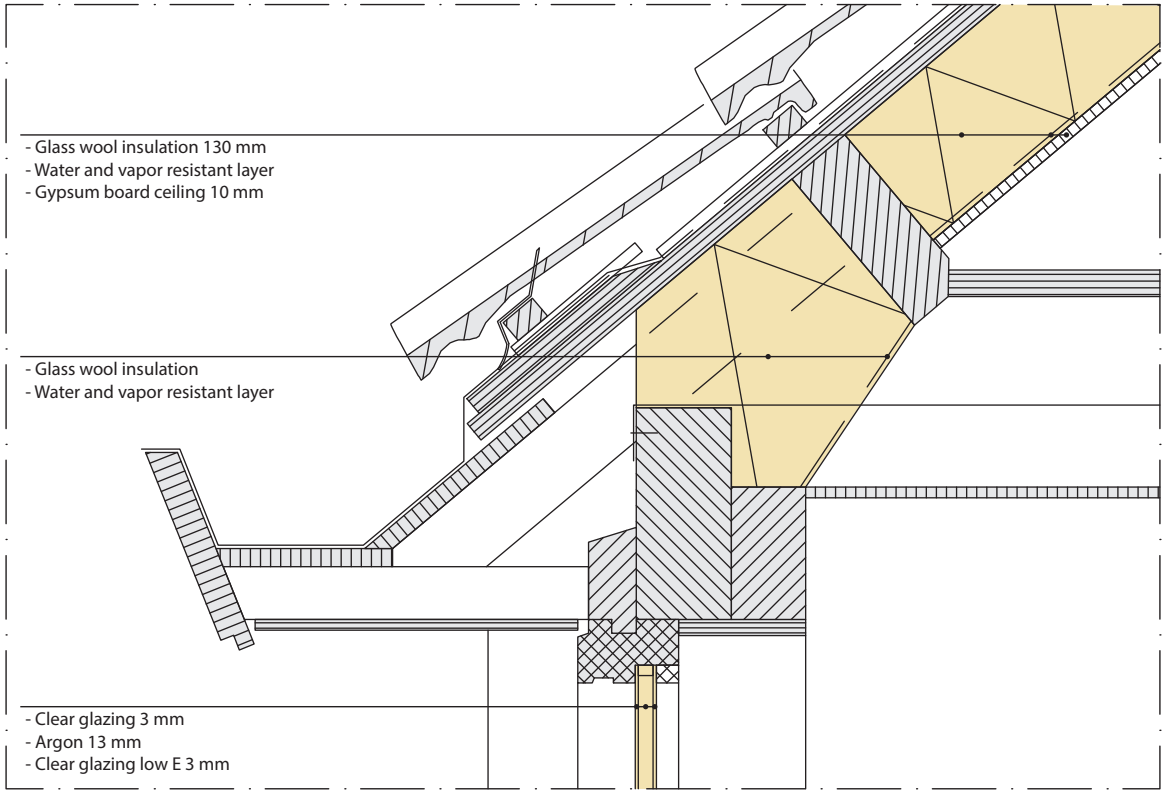
Technical application

Detail 4: current situation



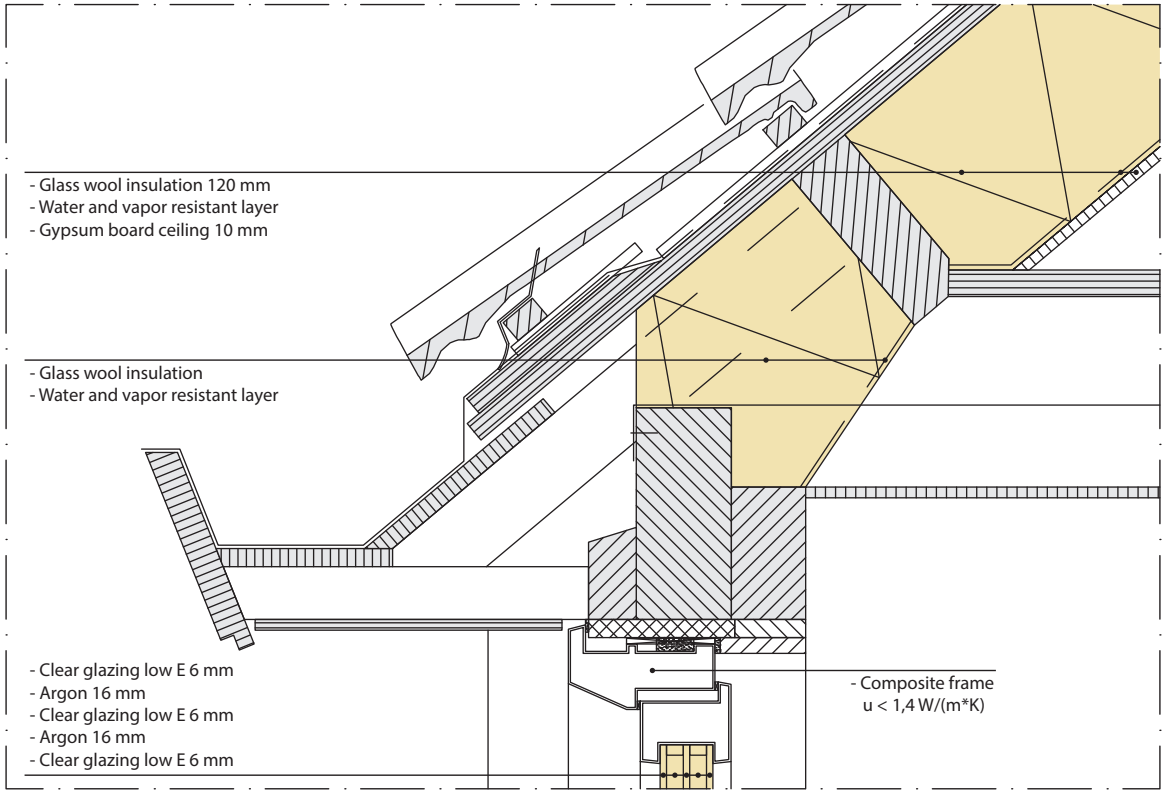
Technical application

Detail 4: strategy A



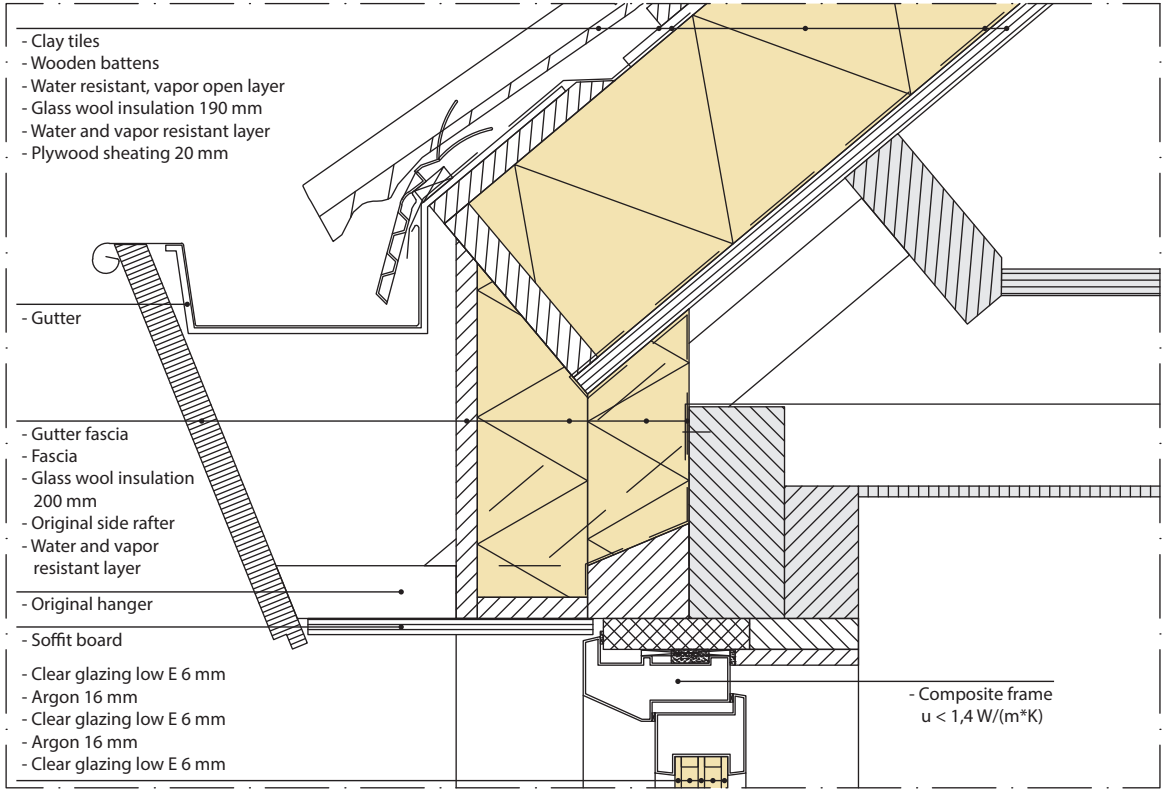
Technical application

Detail 4: strategy B



Technical application

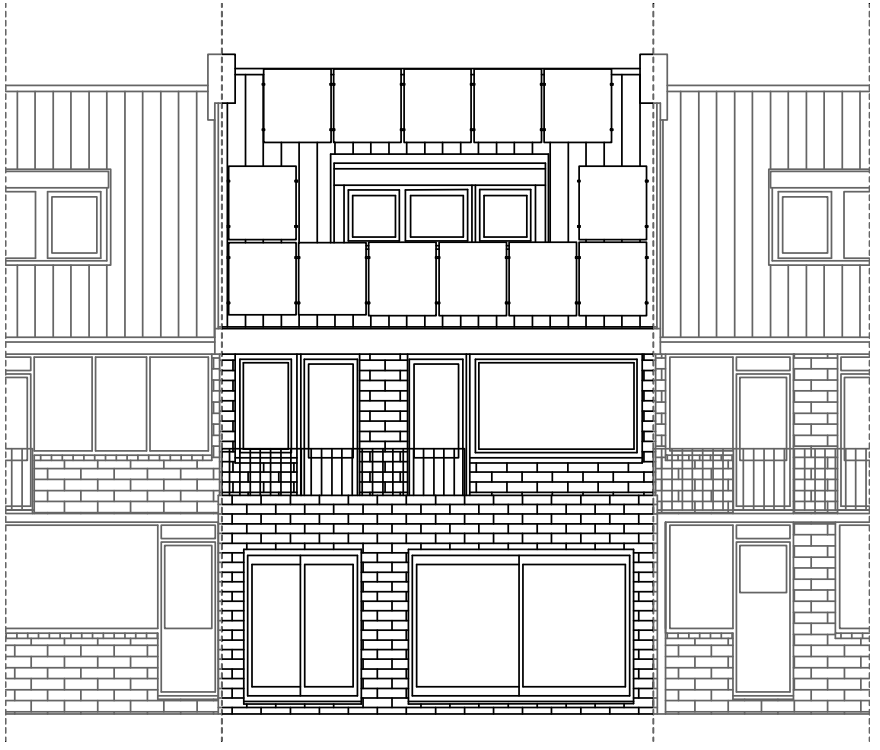
Detail 4: strategy C



Technical application

Facades: strategy C

North face



South face

Content

Conclusions

Which **strategies** are possible to **improve energy consumption** in **different** levels for **multiple** building types built between **1960-1974**?

- Basic insulation strategy (A)
- EPC ≤ 0,4 strategy (B)
- NZEB strategy (C)

Unique situations

Conclusions

Advise

- Society
- Home-owner