



New design

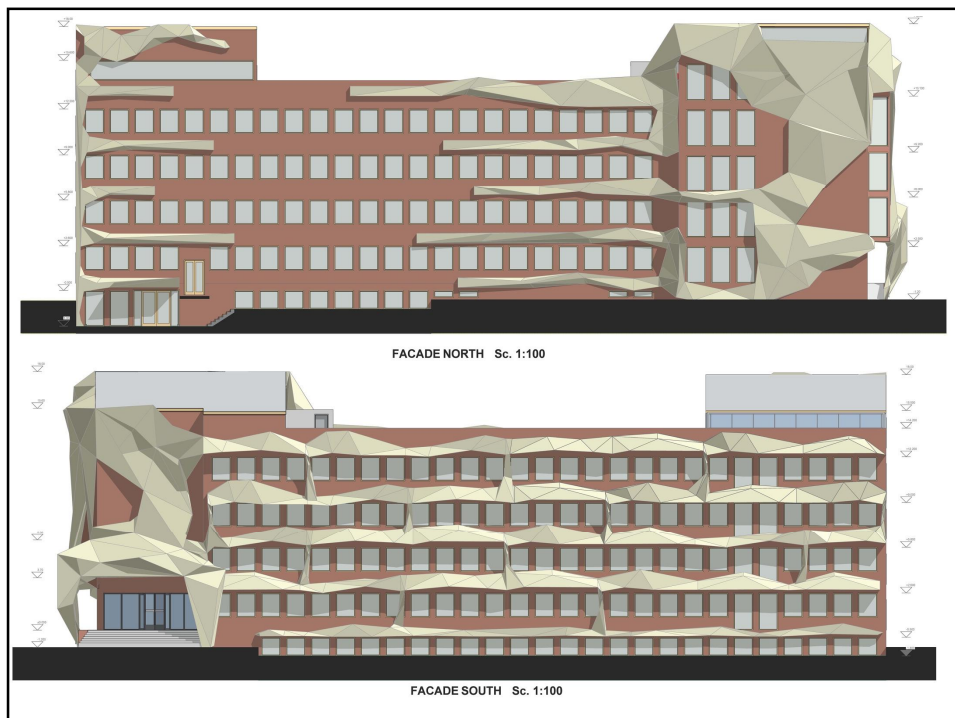


New design

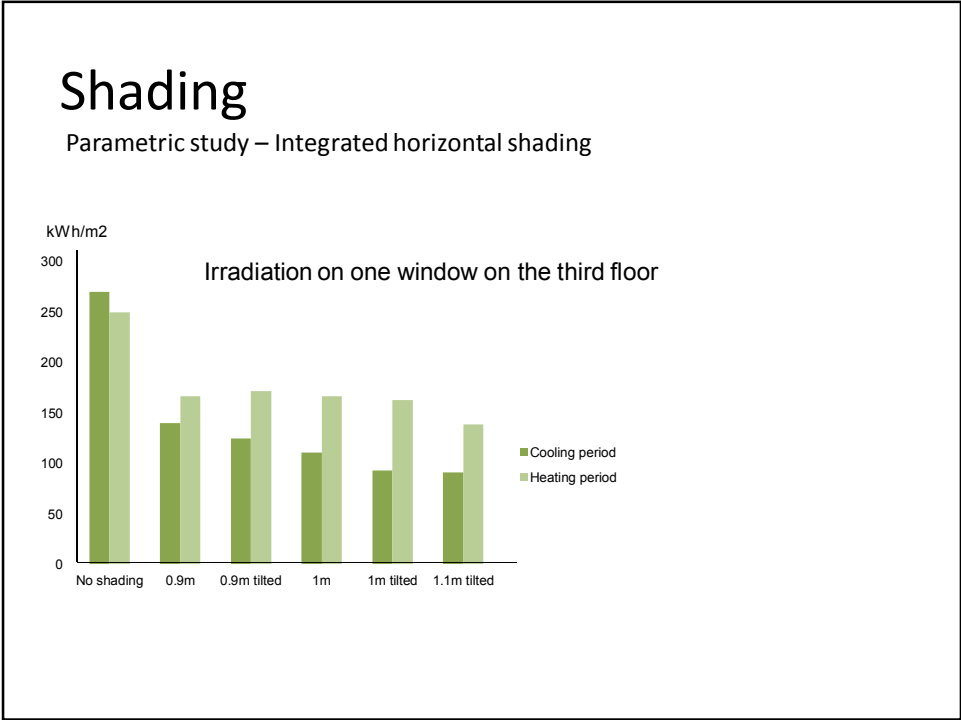
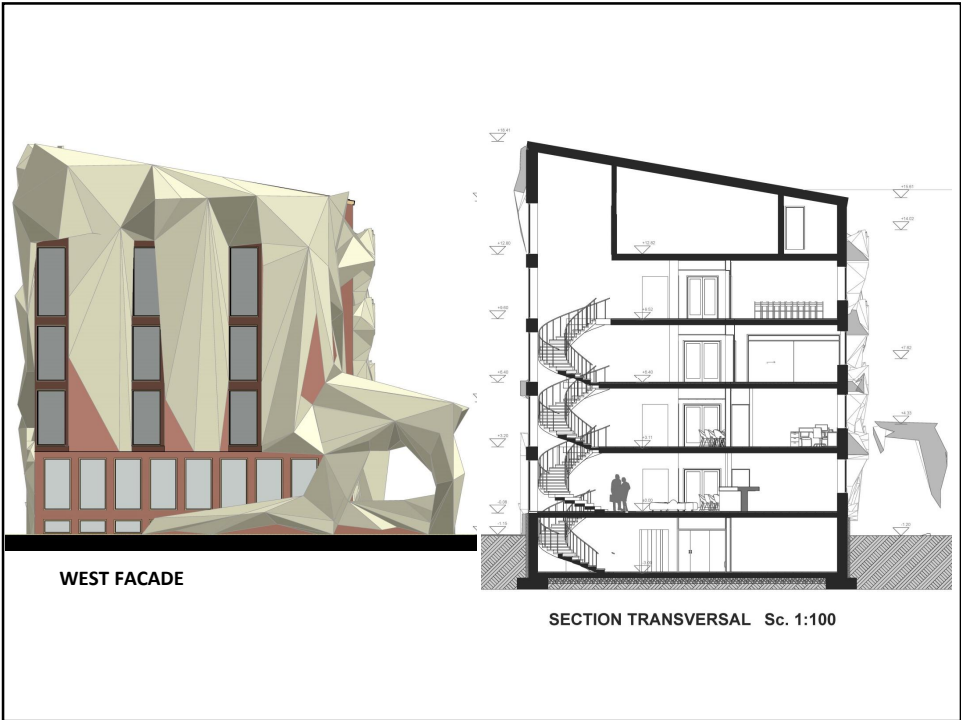


## Measures taken

- Shading device
- Improved daylight distribution
  1. Light well
  2. Changed planview – open planview
  3. Higher reflection
  4. Changed windows towards West
- Added insulation & changed windows/doors
- Heat exchanger with higher efficiency
- Green roof
- PV-panels





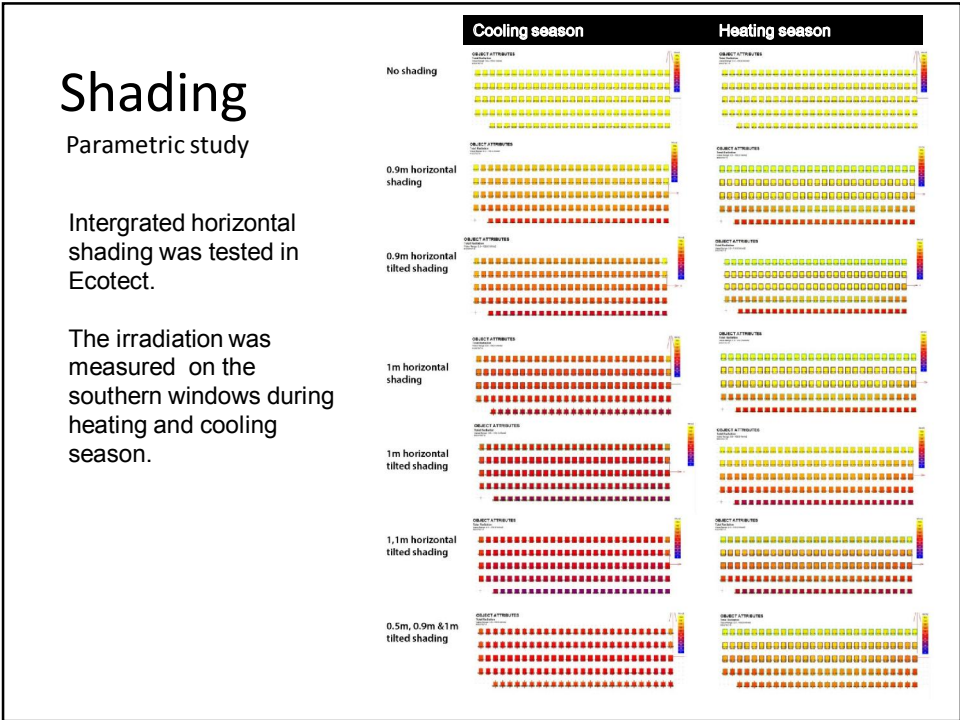


# Shading

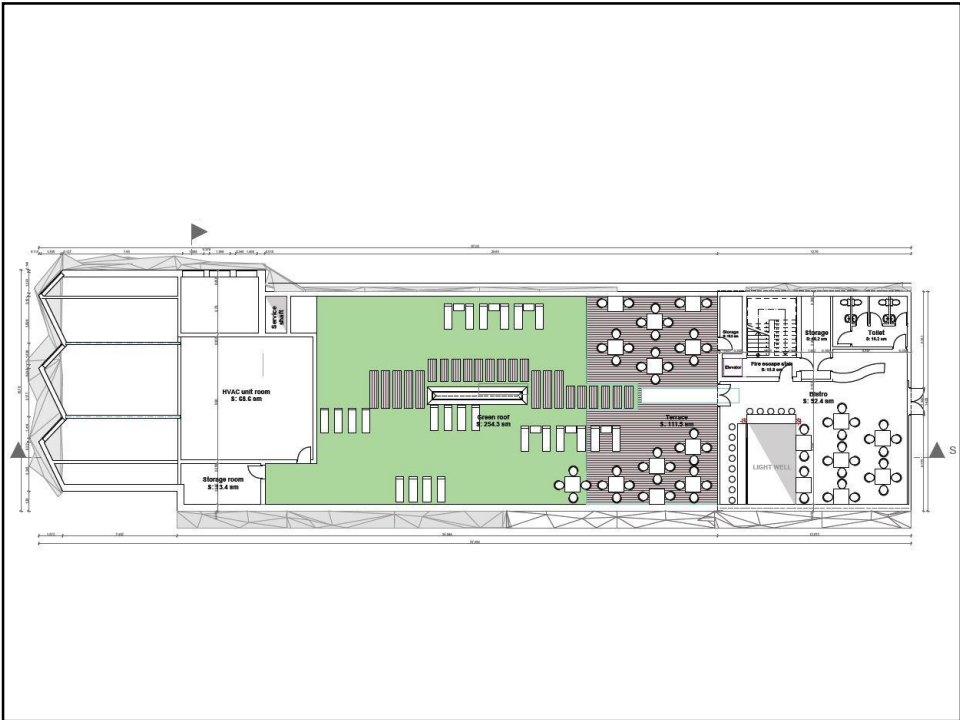
Parametric study

Integrated horizontal shading was tested in Ecotect.

The irradiation was measured on the southern windows during heating and cooling season.

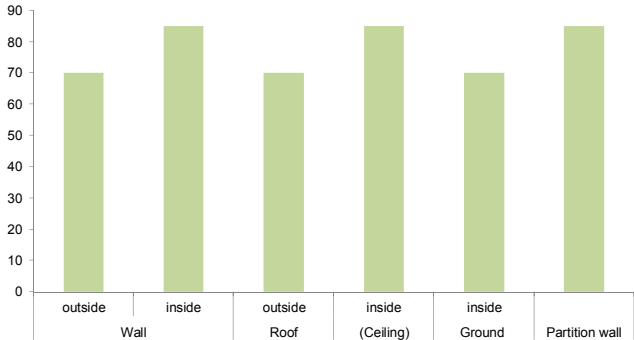






# Daylight

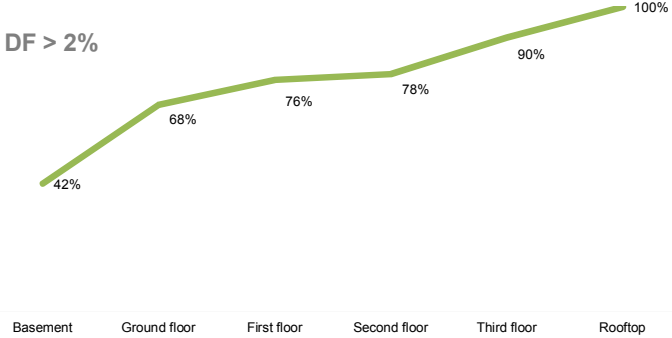
Increased reflectance (%)



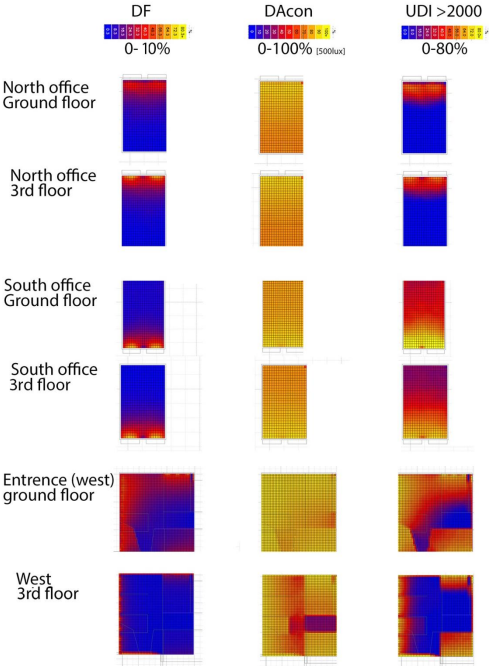
# Daylight

Daylight factor: The ratio of internal light level to external light level

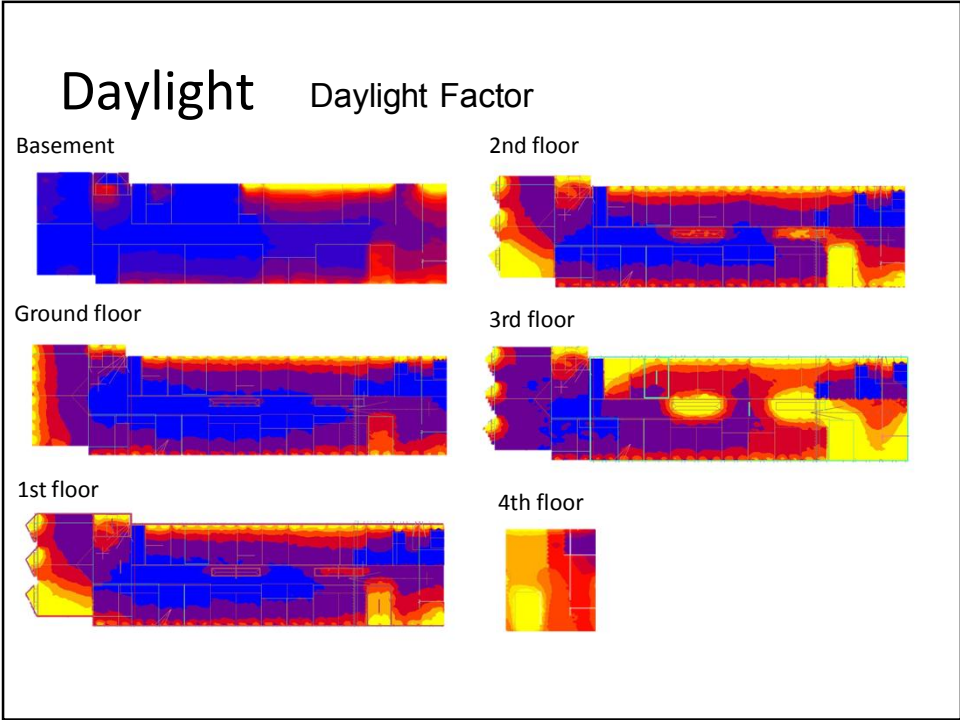
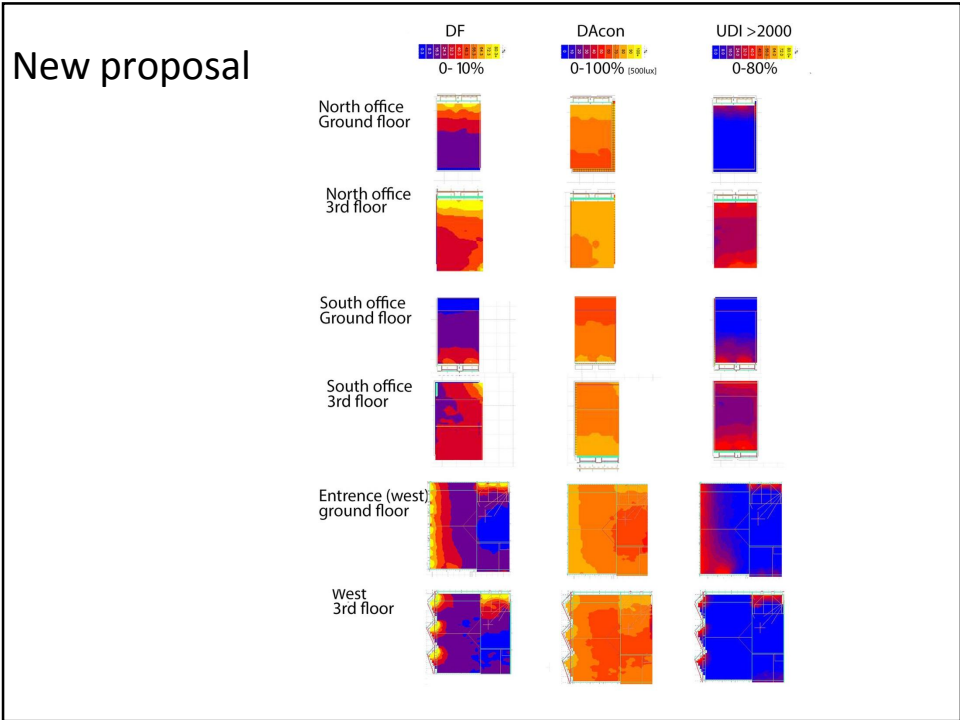
Average Daylight factor for the entire building 72%  
Without the basement it is instead: 79%  
Breeam: 80%



## Existing



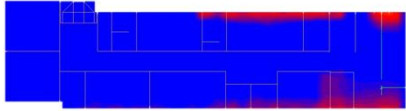




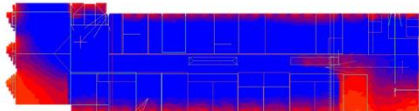
# Daylight

Usefull Daylight Index > 2000 lux

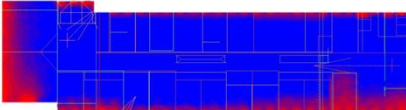
Basement



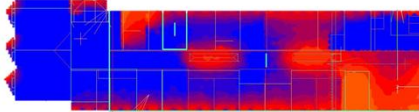
Second floor



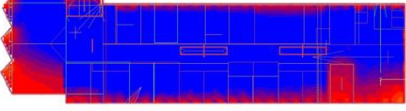
Ground floor



Third floor



First floor



Rooftop

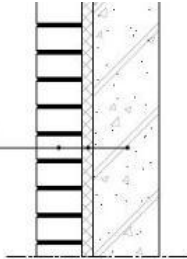


# Details

## Wall

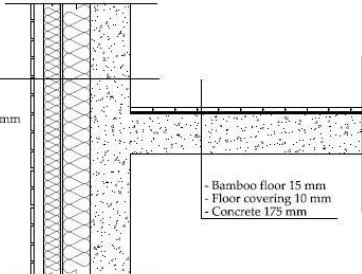
U-value: Existing = 0.85 W/m2K  
New = 0.16 W/m2K

120 mm brickwork  
30 mm mineral wool  
175 mm reinforced concrete



- Brick cladding 10 mm
- Metal sheet 3 mm
- Ventilated airgap 45 mm + steel columns 45 x 95 mm
- Rock wool 70 mm ( $\lambda = 0.033$  W/m.K)
- Gypsumboard, exterior 13 mm
- Mineral wool 120 mm ( $\lambda = 0.036$  W/m.K)
- Concrete 175 mm
- Gypsumboard, interior 13 mm

- Bamboo floor 15 mm
- Floor covering 10 mm
- Concrete 175 mm

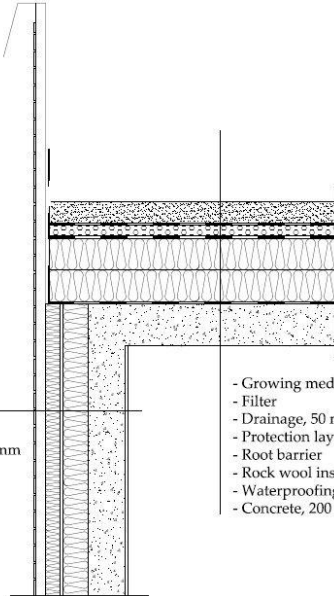


# Details

## Roof/wall

New: 0.11 W/m<sup>2</sup>K  
Existing: 0.39 W/m<sup>2</sup>K

- Brick cladding 10 mm
- Metal sheet 3 mm
- Ventilated airgap 45 mm + steel columns 45 x 95 mm
- Rock wool 70 mm ( $\lambda = 0.033$  W/m-K)
- Gypsumboard, exterior 13 mm
- Rock wool 120 mm ( $\lambda = 0.036$  W/m-K)
- Concrete 175 mm
- Gypsumboard, interior 13 mm

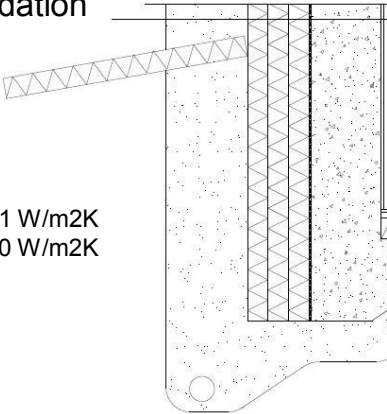


- Growing media, 100 mm
- Filter
- Drainage, 50 mm
- Protection layer
- Root barrier
- Rock wool insulation, 300 mm
- Waterproofing membrane
- Concrete, 200 mm

# Details

## Basement, wall & foundation

New: 0.11 W/m<sup>2</sup>K  
Existing: 1.30 W/m<sup>2</sup>K



- Soil
- Drainage
- Extruded polystyrene, 300 mm
- Waterproofing membrane
- Concrete, 345 mm
- Rendering

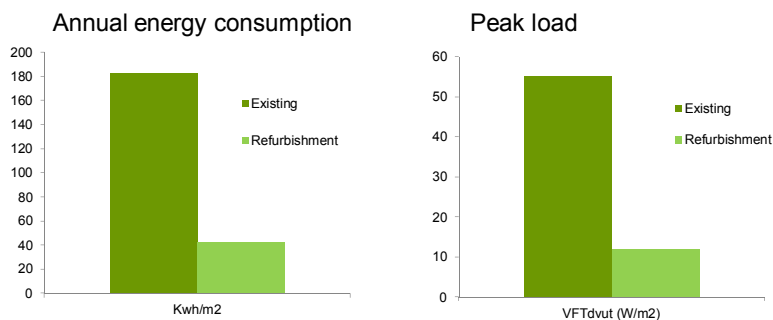
- Flooring
- Polystyren, 100mm
- Concrete, 200 mm
- Drainage

New: 0.31 W/m<sup>2</sup>K  
Existing: 1.54 W/m<sup>2</sup>K

# Energy consumption

## Steady state

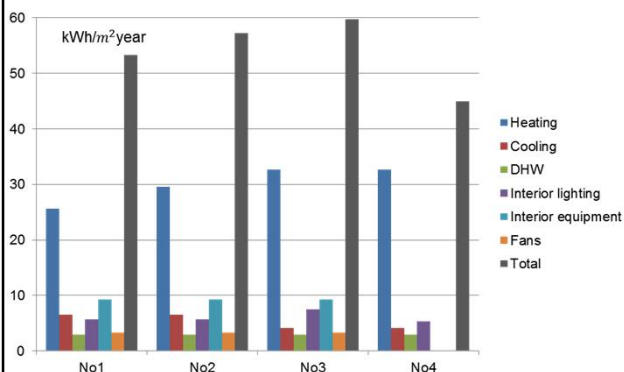
Input	Existing building	Refurbishment
Ventilation heat exchange	75%	86%
Thermal bridges	1.4 x transmission losses	1.1 x transmission losses
Air leakage	0.2 1/h	0.1 1/h



FEBY12 criteria (Swedish passive house criteria)

# Energy consumption

## Parametric study in Design Builder

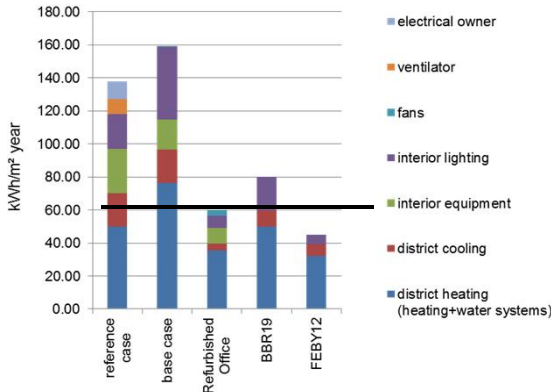


- **No1:** 20°C heating + 26°C cooling.
- **No2:** 21°C heating + 26°C cooling.
- **No3:** 21°C heating + 25°C cooling + shading device.
- **No4:** 21°C heating + 25°C cooling + shading device + photovoltaic panels, 377m<sup>2</sup>.



# Energy consumption

## Design Builder



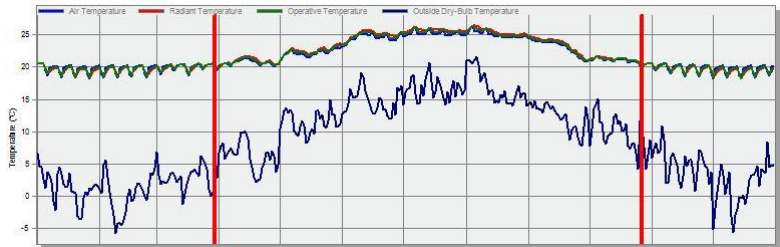
- FEBY12 = 63 kWh/m2 year for district heating/cooling and building electricity.
- Refurbished Office (No3) = 50 kWh/m2 year for district heating/cooling and building electricity. 60 kWh/m2 year in total energy consumption.
- Base Case = 141 kWh/m2 year for district heating/cooling and building electricity.

# Thermal comfort

## Design Builder

The Operative temperature is more than 26°C for 4 working days over the whole year. The criteria from FEBY12 is maximum 10 working days, which is clearly met!

To prevent overheating at any time of the year, an openable window as high as possible will be intergrated in the refurbished office building



**THE END** Thank you for listening

