F I L T E R

the climate centre on Brøset

AAR 4546 ZEB-DESIGN, Architecture, NTNU

Fall 2011

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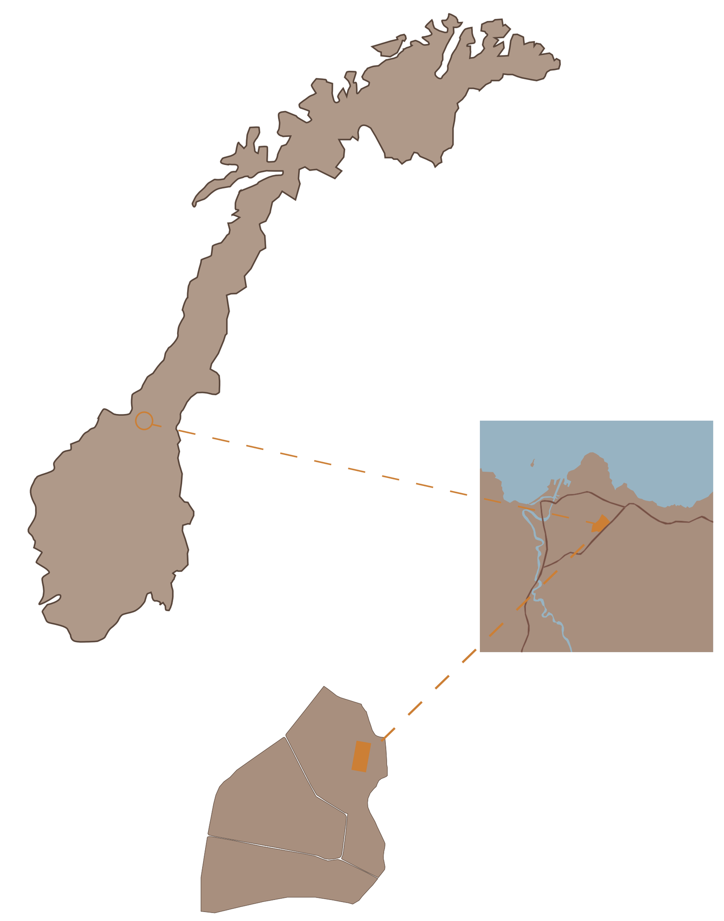
Site plan 1:500



The main concept of the project is filter. It will be a pilot project for reducing CO2 emissions and energy consumption. The Filter will filter pollution, thoughts, people, light, nature and energy through to the new green neighbourhood Brøset. The filter concept has been used in different layers in oder to clean the heavy and dirty local evironment by the high road and ends with ”clean energy” production.

Layers of the Filter:

-First layer: The green structure. The original woods will be kept as the first layer of the Filter. It is the layer which gives the first cleaning of noise from the neighbouring highway and it absorbs CO^2 from the traffic and industry pollution.

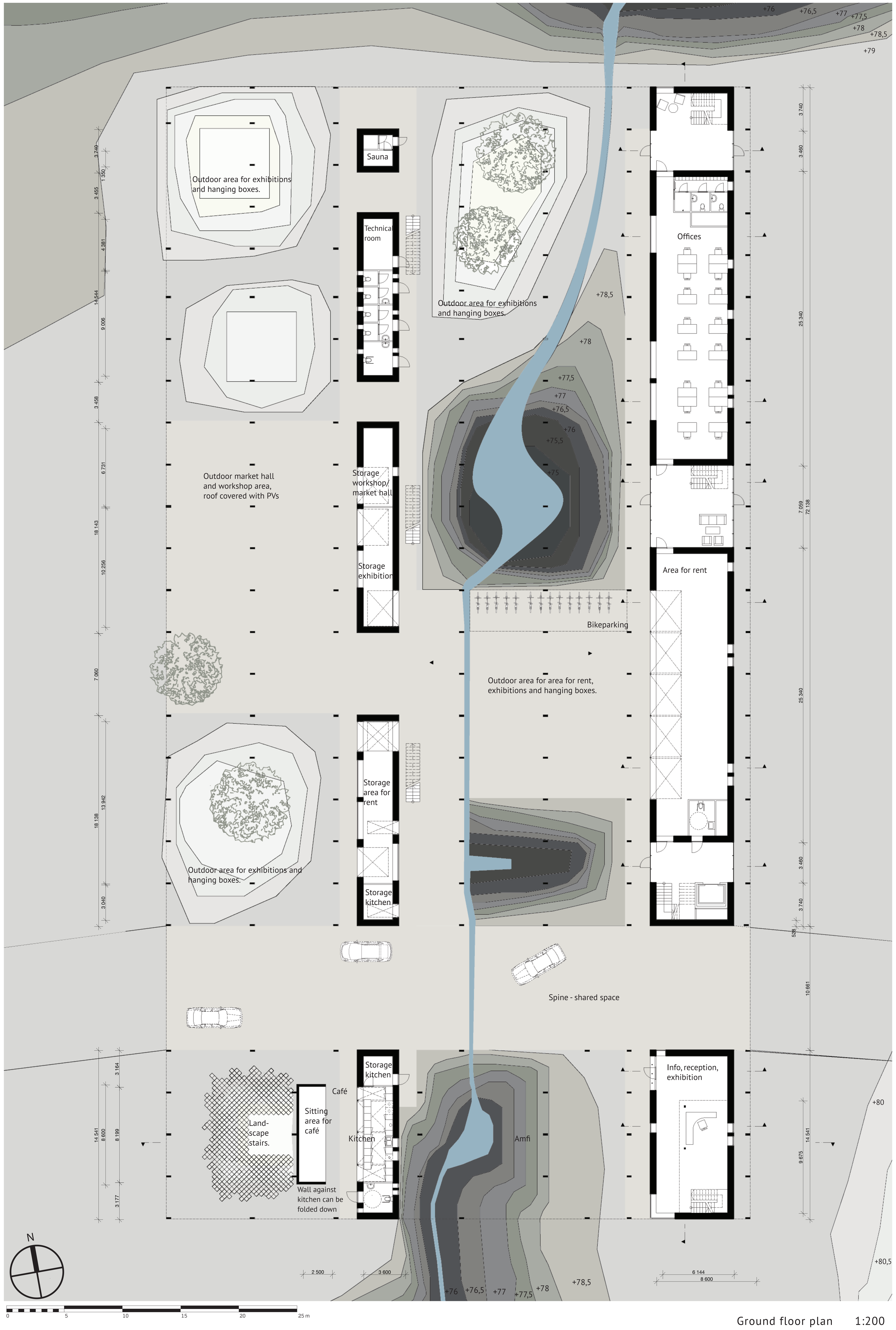
-Second layer: The brick building construction uses its firmed structure and darker colour to keep a harmonious dialog with the local developed area and reminding people the local story of brick production in Brøset. Bricks are good absorbants of pollution and will help to clean the air. Furthermore, it also acts as an efficient noise barrier for the ecological area.

-Third layer: Local site ecological development. In order to extend the ecological area, the local river and the trees are brought into the Filter. Storm water management has been designed into the ecological developing area for cold water supply on site.

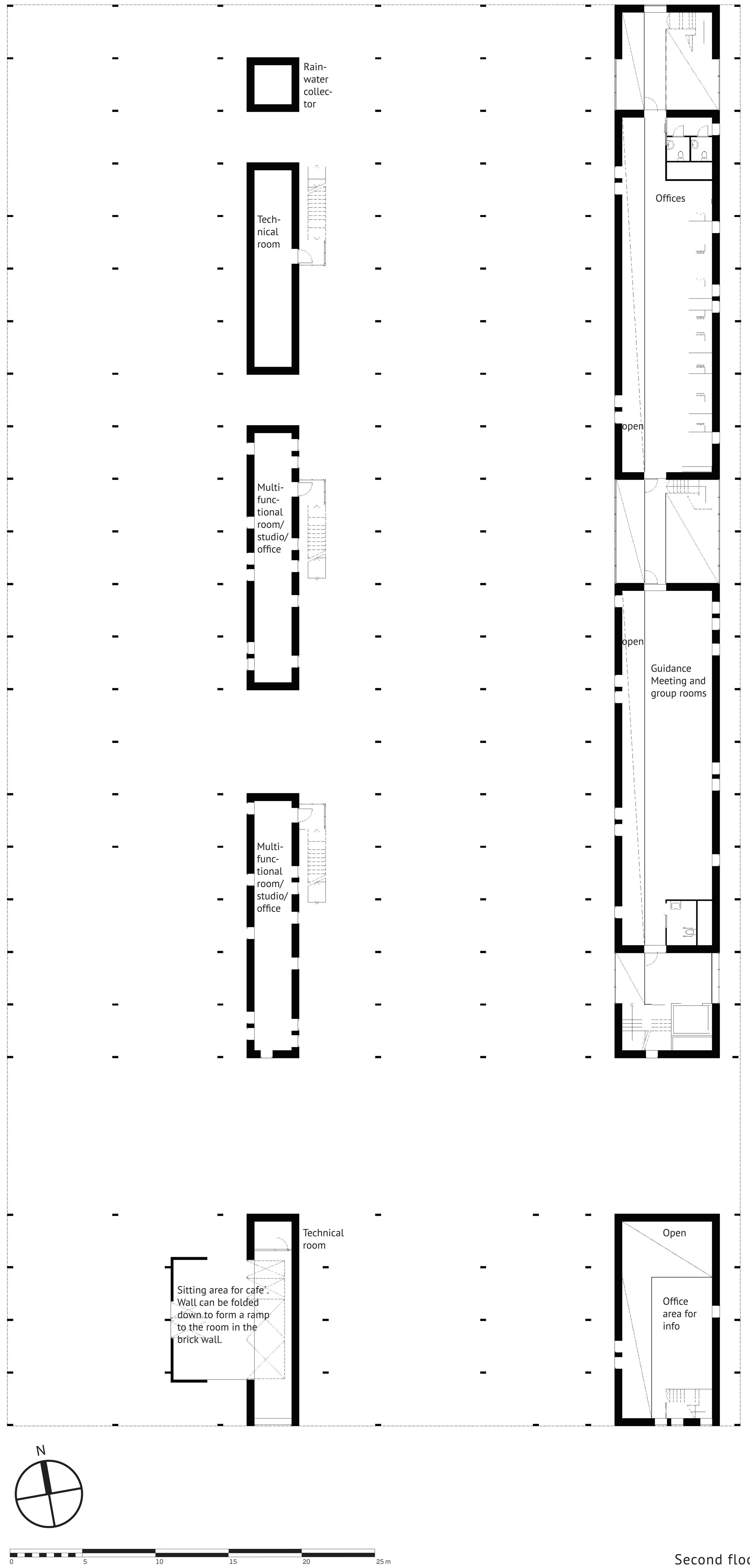
Fourth layer: Covers the whole climate centre. It expresses the concept with recycled timber lattice roof in a pictographic way. And it is also the renewable energy production area with PVs and solar thermal collector.

The buildings in Filter:

We have chosen the materials carefully in order to achieve the energy efficiency and reduction of CO^2 emission and simultaneously fulfill the architectural design desire. The outer skin of the buildings are made of dark bricks. The internal walls of the buildings are built with recycled materials. Besides the passive strategies for reducing the energy use, such as adding insulation, efficient technical equipments also have been used in the building. A balanced ventilation system (heat recover system) will clean up the intake air and recycle the heat from the extracted area. PVs are using for covering the electricity demand. And the solar thermal, heat pump system are used to fullfil the heating demand of the building.

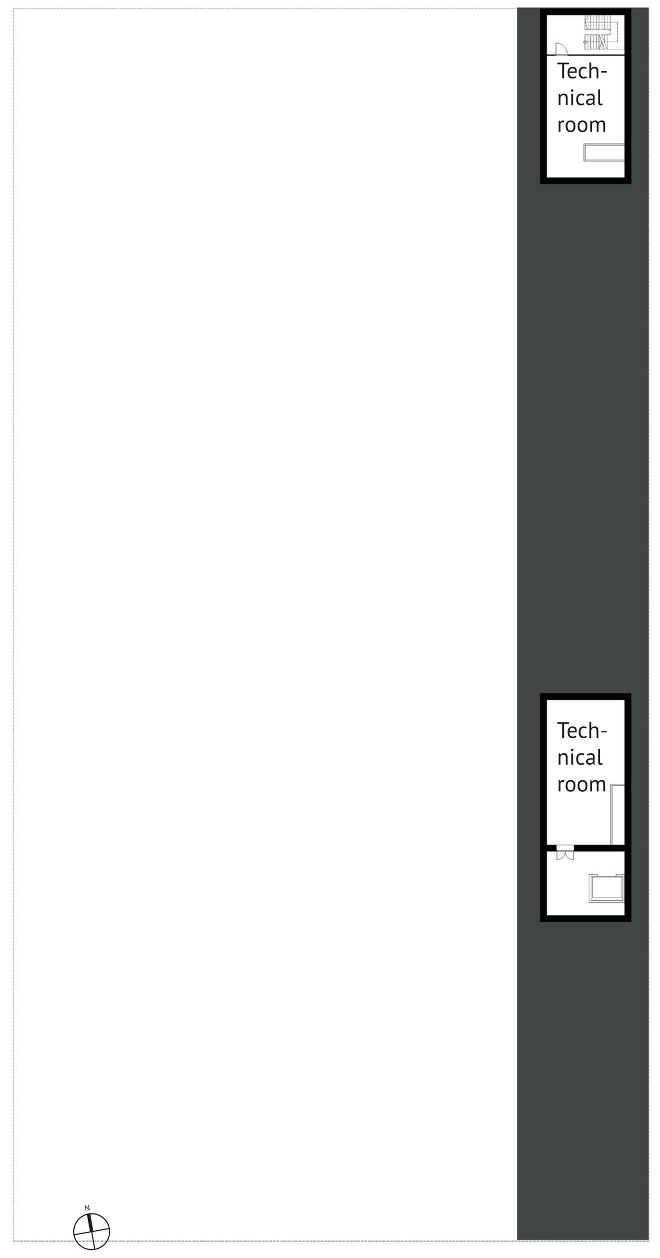


Ground floor plan 1:200

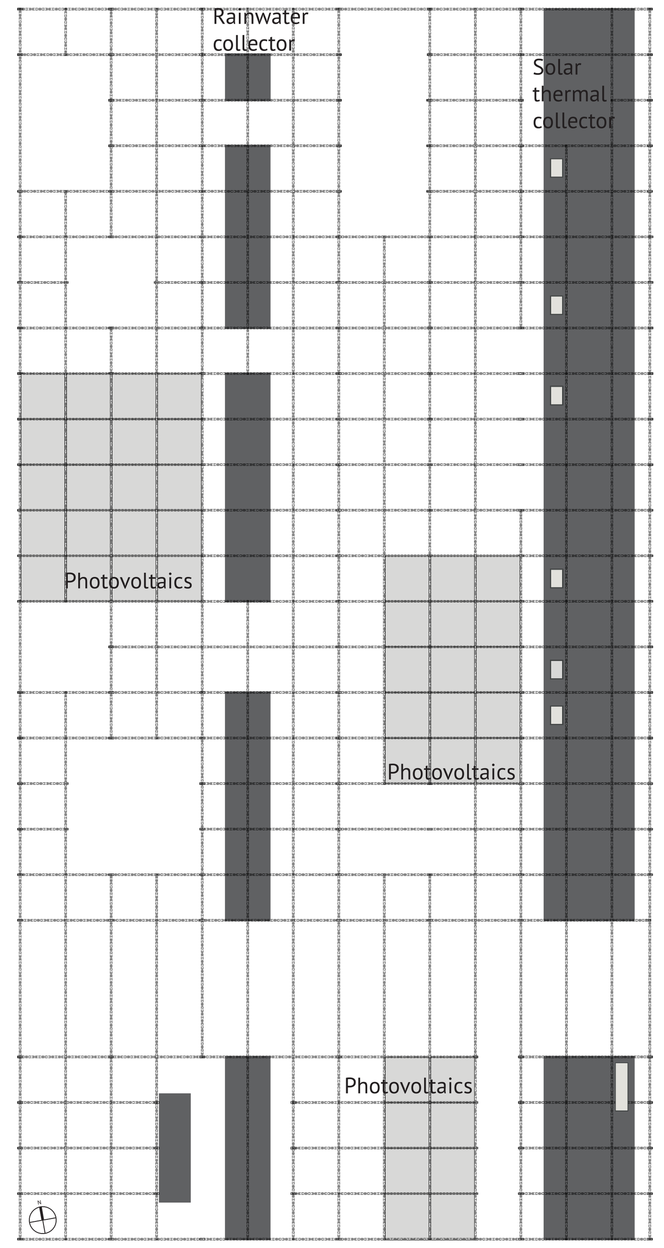


Second floor plan 1:200

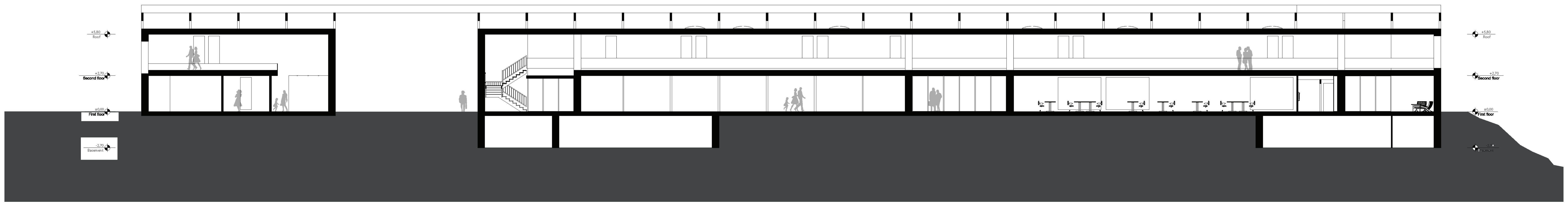
Section A 1:200



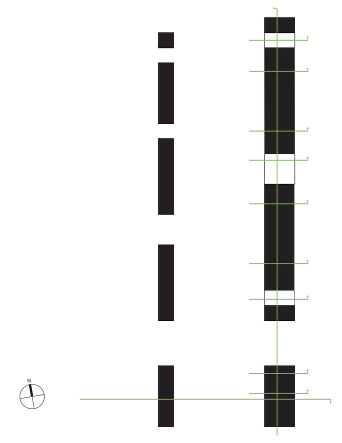
Basementplan 1:500



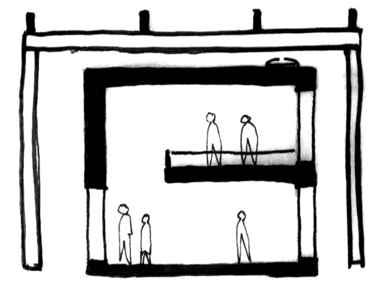
Roofplan 1:500



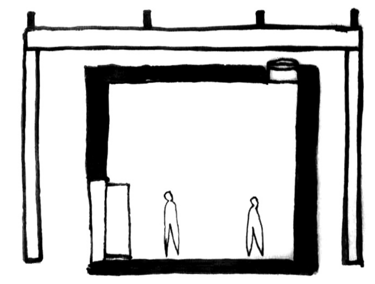
Section B 1:200



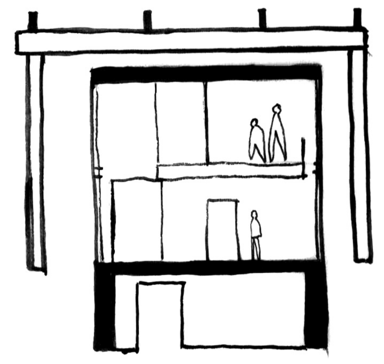
West facade 1:200



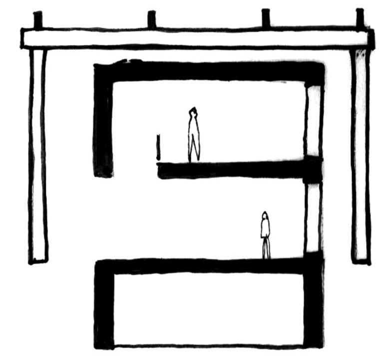
Section C



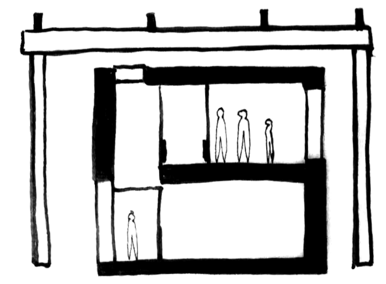
Section D



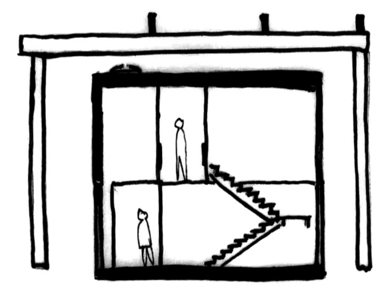
Section E



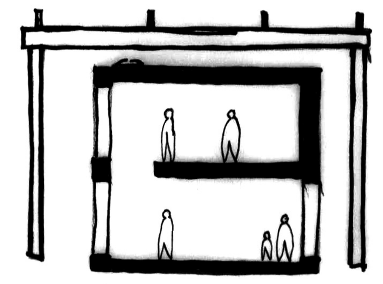
Section F



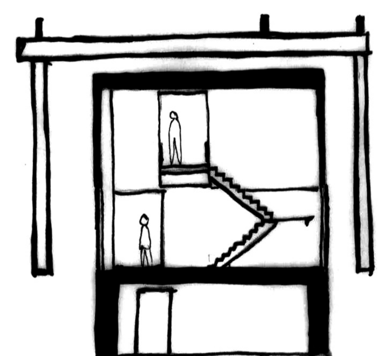
Section G



Section H



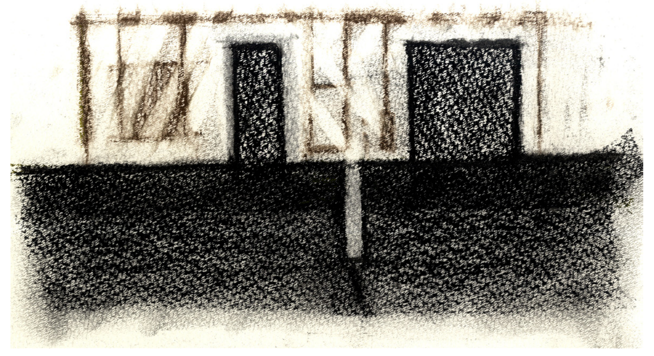
Section I



Section J

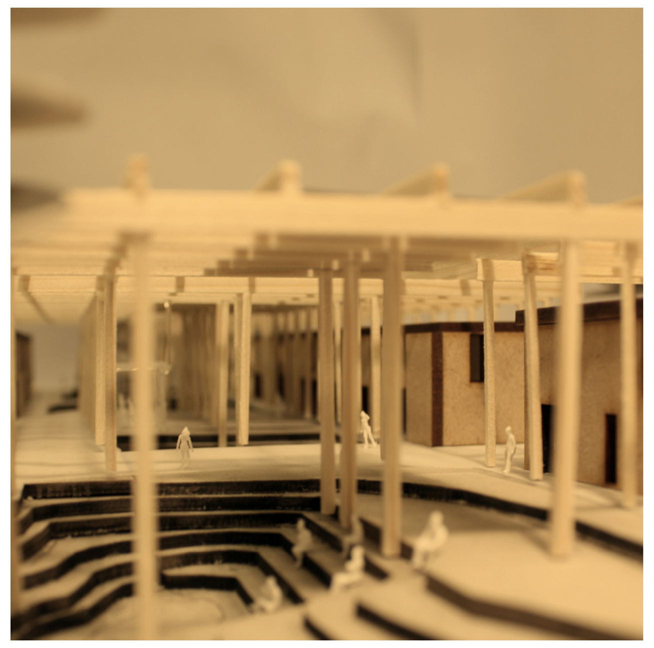
Sections through the main inhabited wall 1:200

Filter is about experiencing:

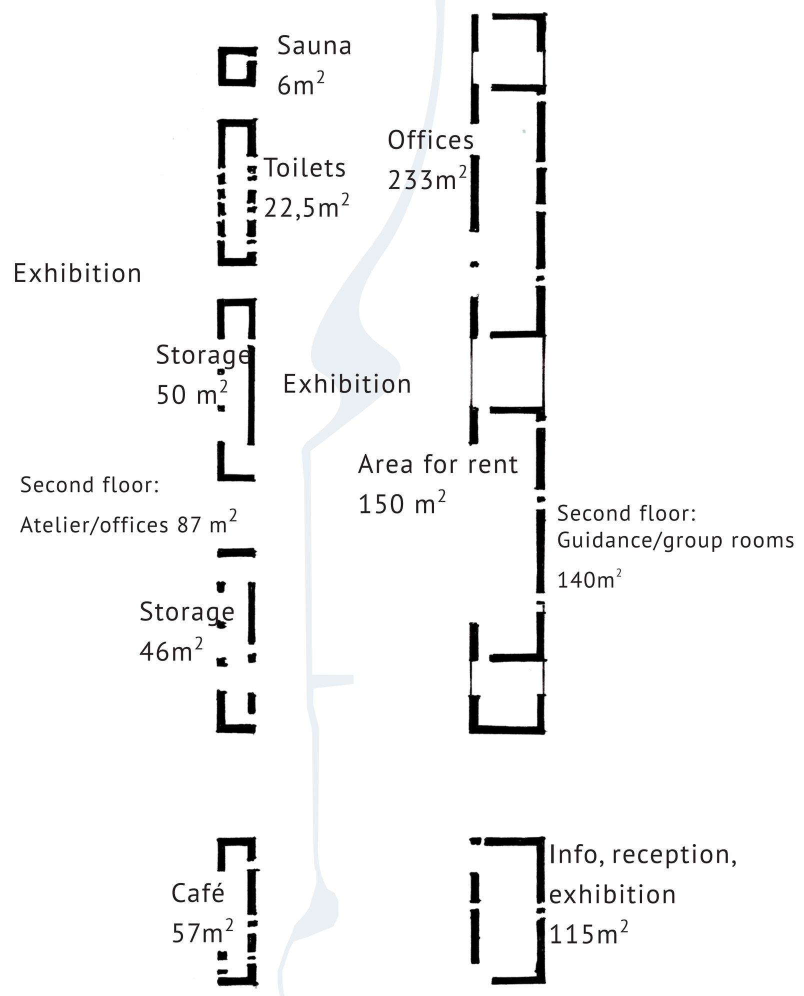


a concept

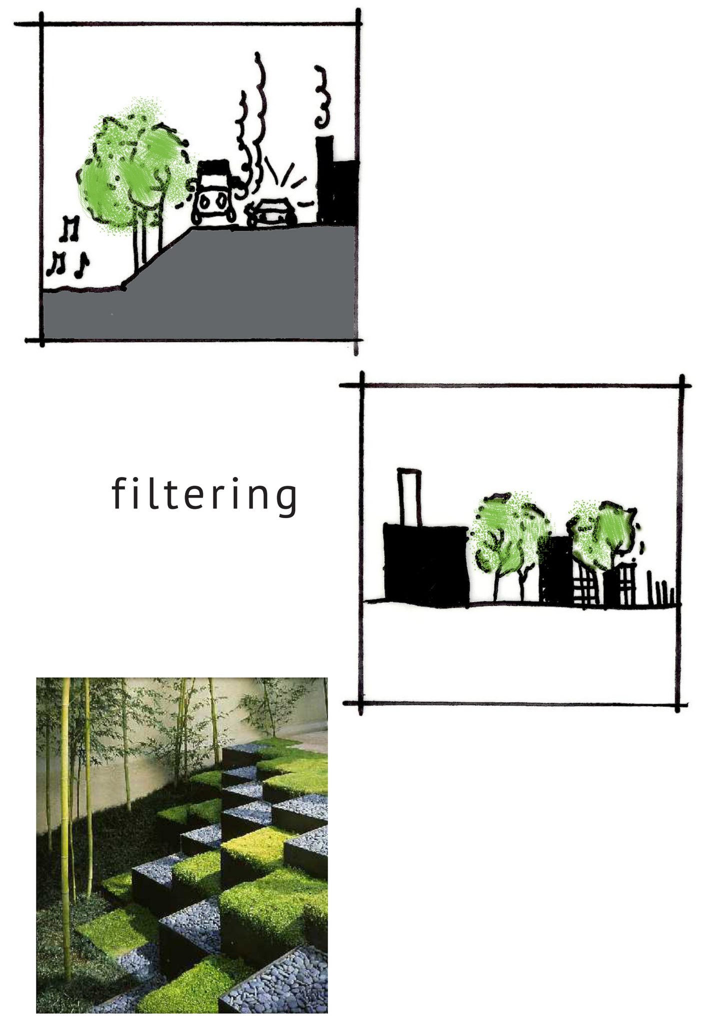
the weather and climate



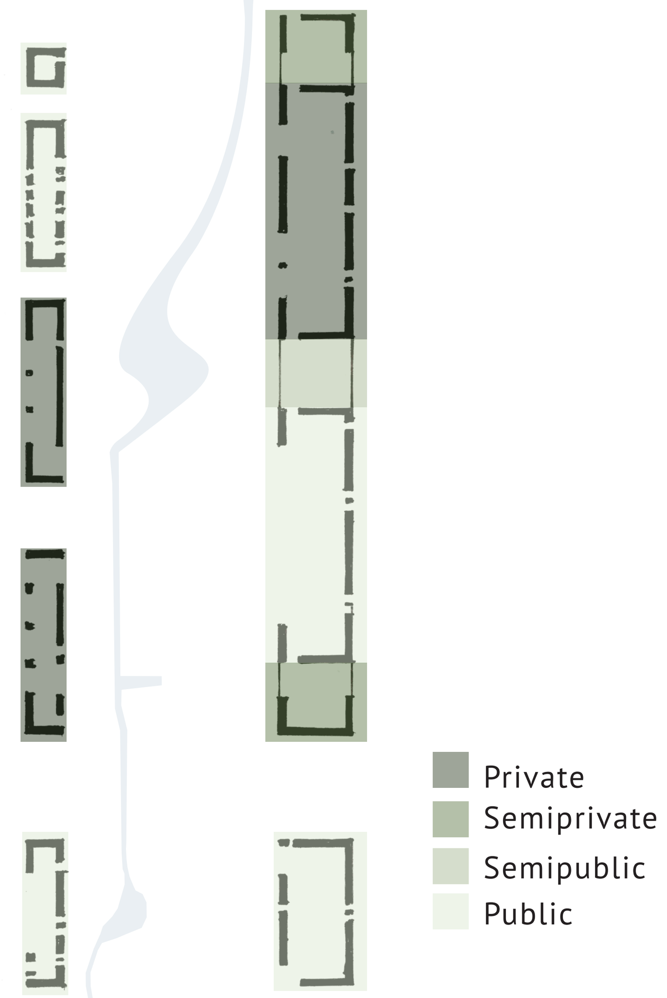
architecture



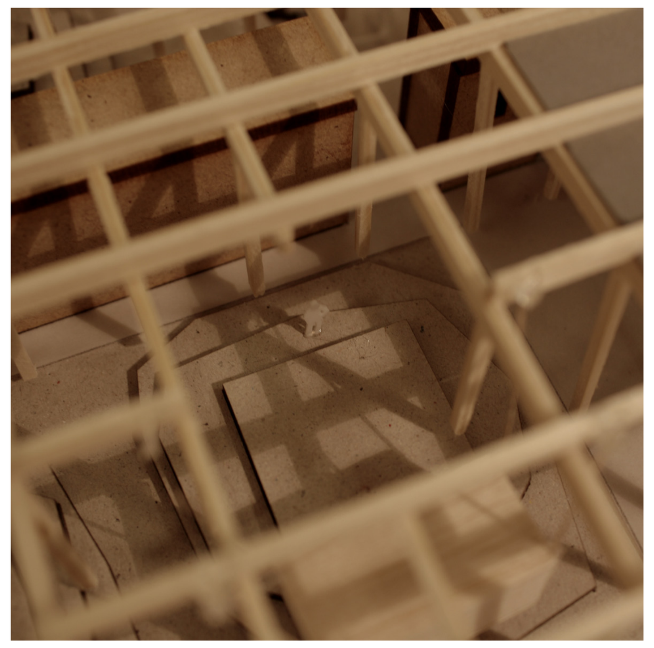
functions



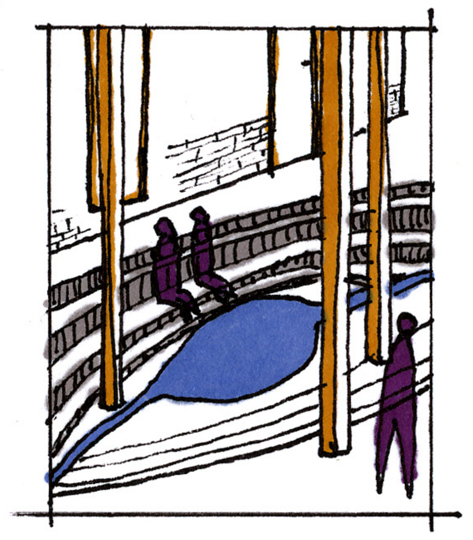
filtering



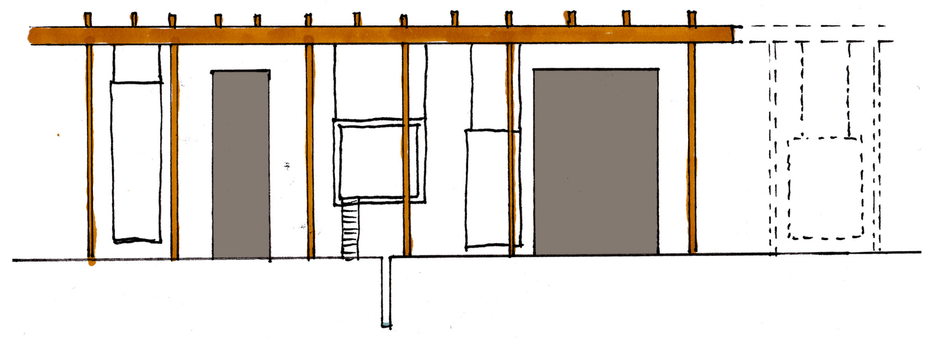
zones



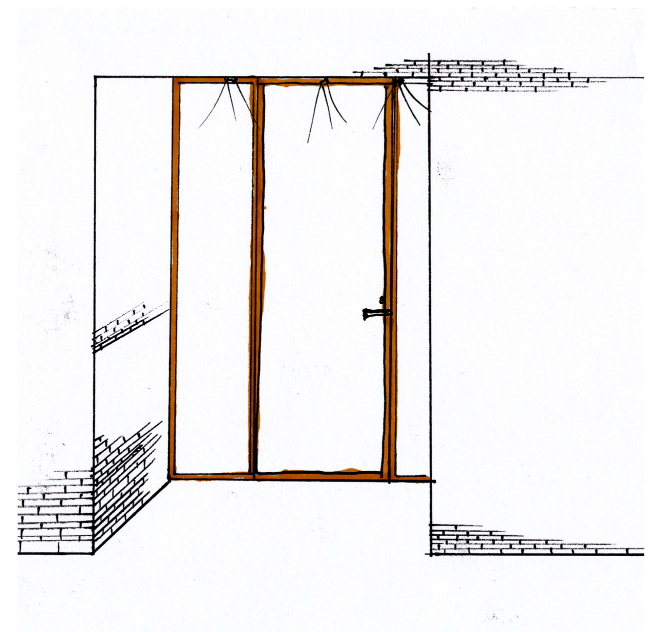
light



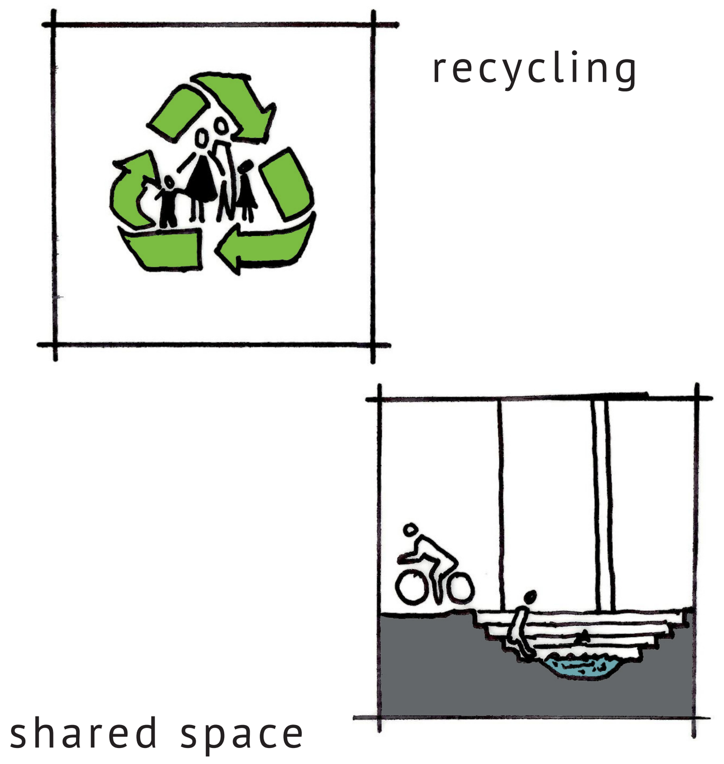
water



elasticity

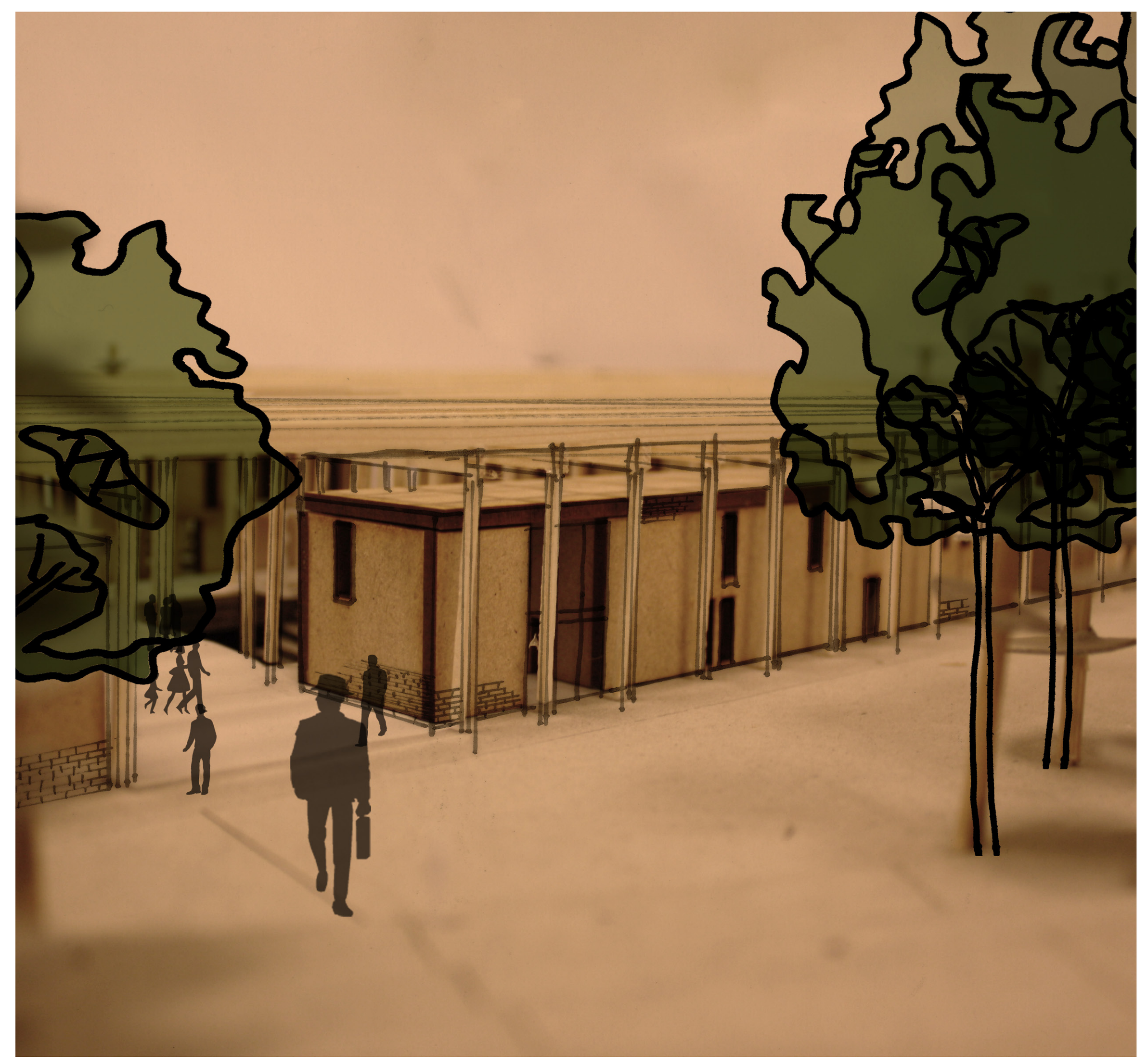


the walls



recycling

shared space



Energy calculations

	heat		electricity		total
	Net energy demand [Kwh/a]	Specific energy demand [Kwh/(m^2a) (542m^2)]	Net energy demand [Kwh/a]	Specific energy demand [Kwh/(m^2a) (542m^2)]	
heating	16091.98	29.69			
domestic hot water(DHW)	3794	7.00			
fans			6482.32	11.96	
pumps			1523.02	2.81	
lighting			8455.2	15.60	
technical equipment			10146.24	18.72	
sum	**19885.98**		**26606.78**		**46492.76**
		36.69		**49.09**	**85.78**

Figure 1: Annual energy budget according to NS3031

Figure 1 shows the energy consumption of the Climate Centre according to NS3031. This calculation assumes it is an office building. But there is a Cafe in our centre, so the specific energy demand of DHW is set by 7kwh/m^2 not 5kwh/m^2 which is the demand of offices.

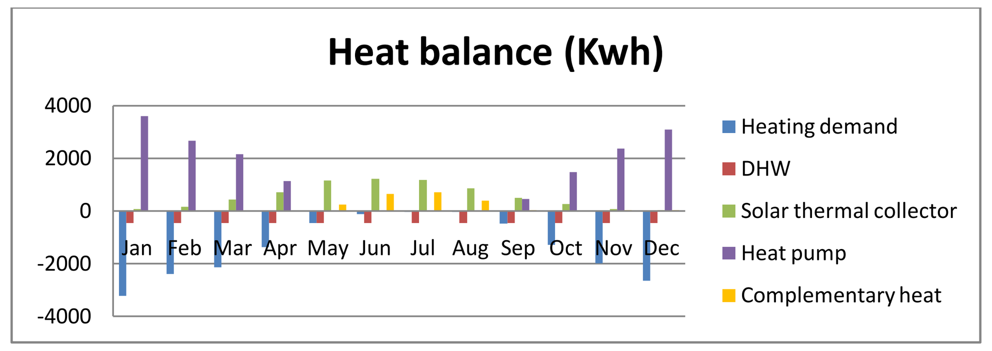


Figure 2: Heat balance of Climate Centre

Figure 2 shows that the heat of the Climate Centre mainly comes from Solar Thermal Collect in the summer and the Heat pump in the winter. (2 Ground Source Heat Pumps and 12.6m^2 of Solar Thermal Collector.)

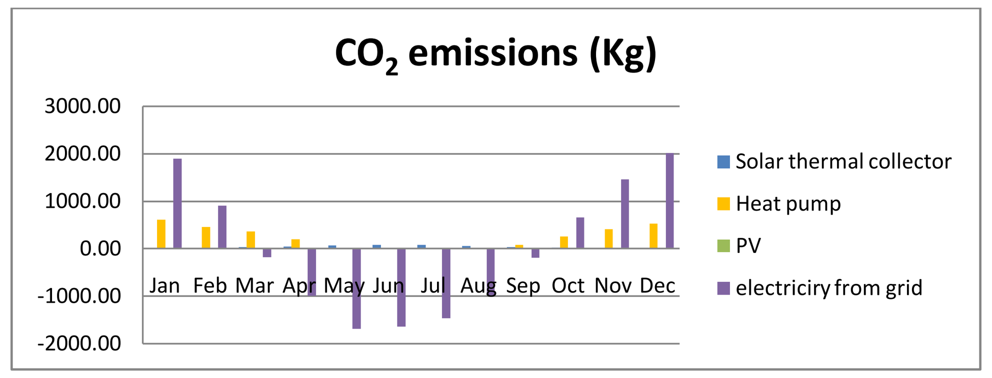


Figure 7: The operational CO2 emissions of the Climate Centre

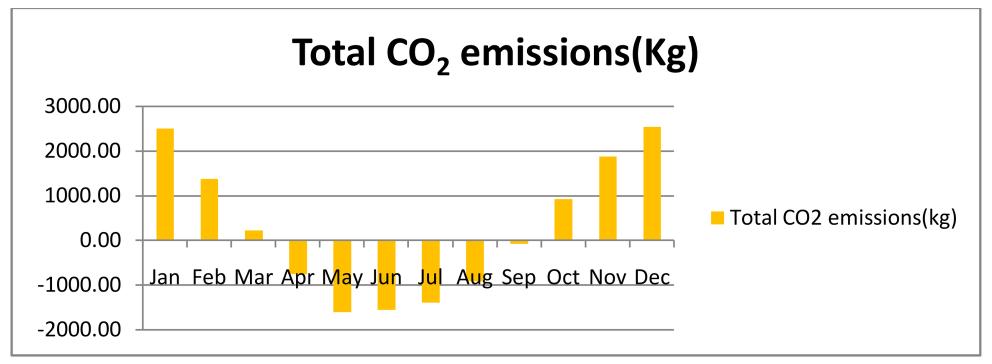


Figure 8: Total CO2 emissions of the Climate Centre

Figure 7 and 8 show that the operational CO_2 emissions of the Climate Centre could more or less meets the 'zero' emission building.

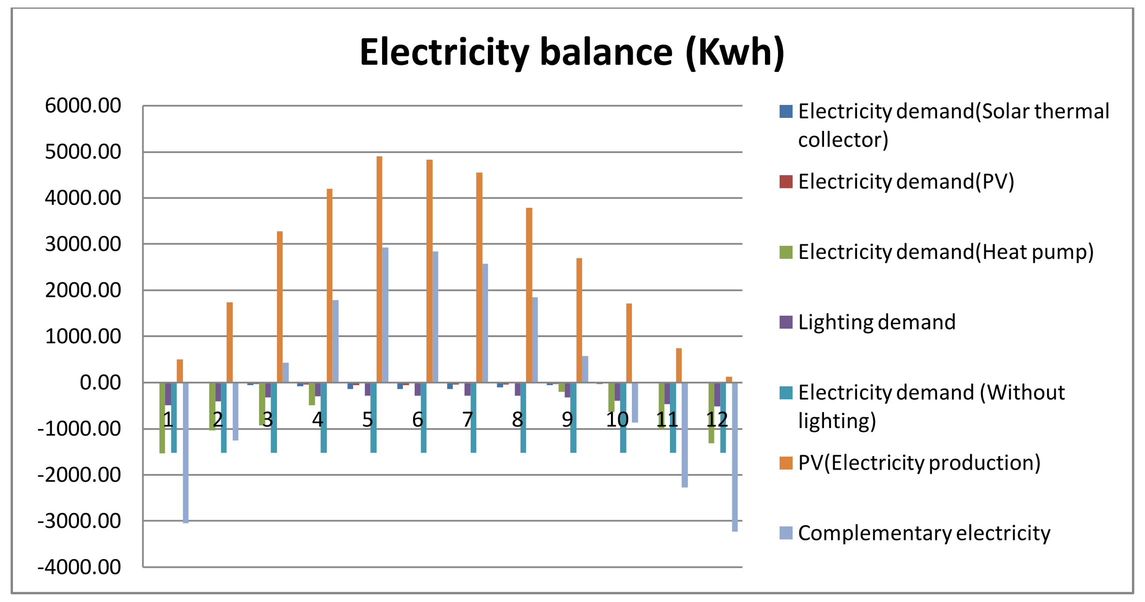


Figure 3: Electricity balance of the Climate Centre

Figure 3 shows that the electricity of the Climate Centre mainly comes from PV (420m^2), but in the winter, when there is not too much sun, the electricity could also be provided by the electricity grid since the electricity in Norway is from the hydro power.

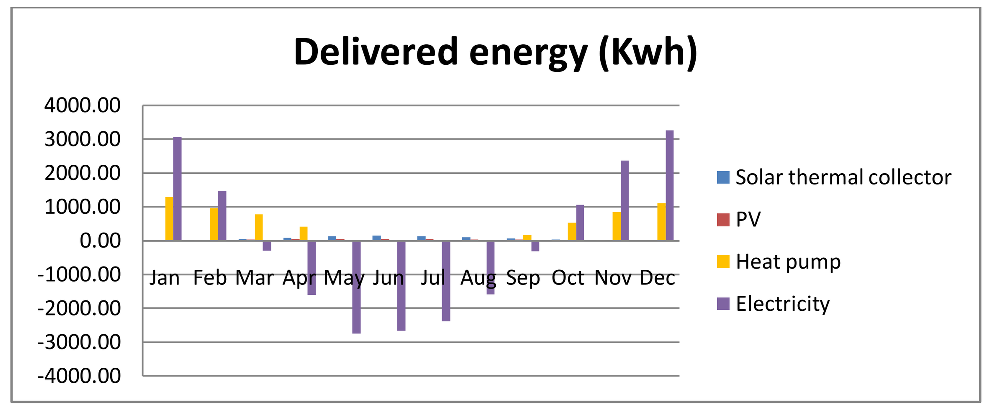


Figure 4: Delivered energy of different systems

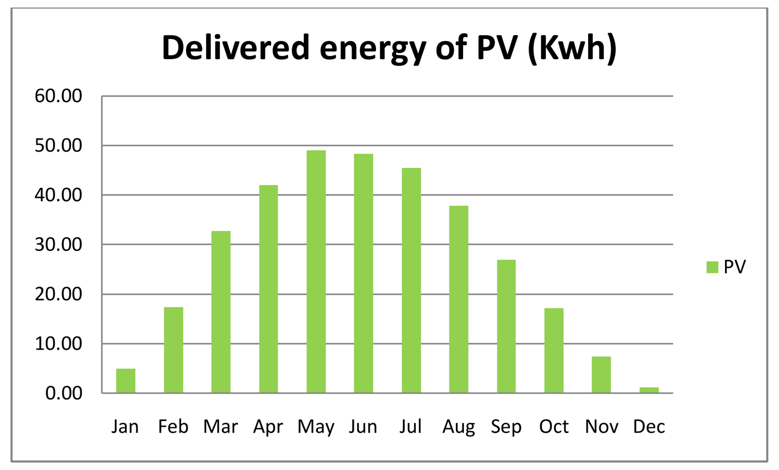


Figure 5: Delivered energy of PV

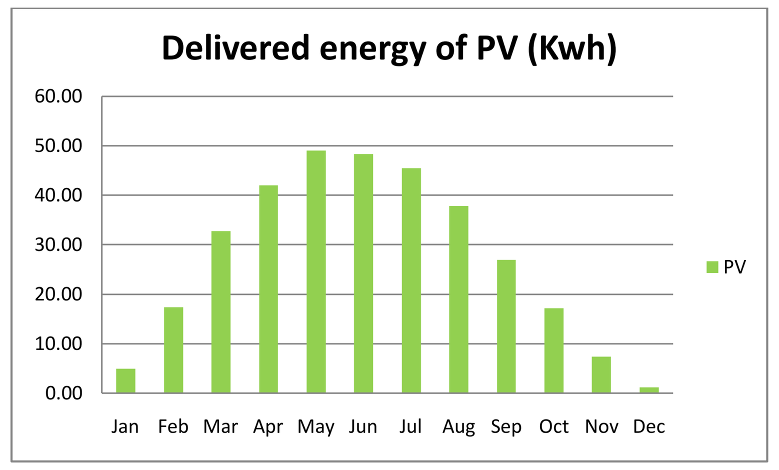


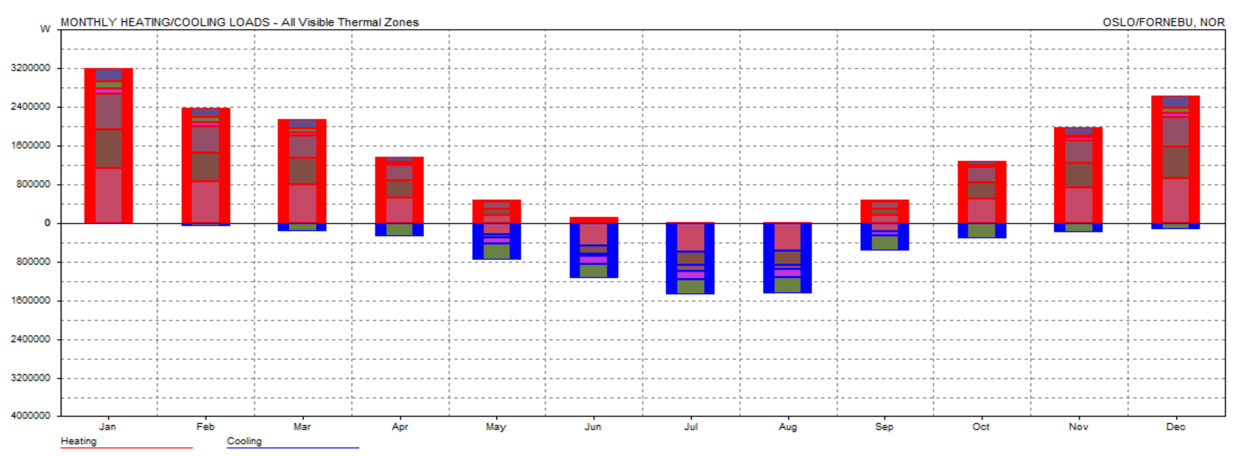
Figure 5: Delivered energy of PV

MONTHLY HEATING/COOLING LOADS

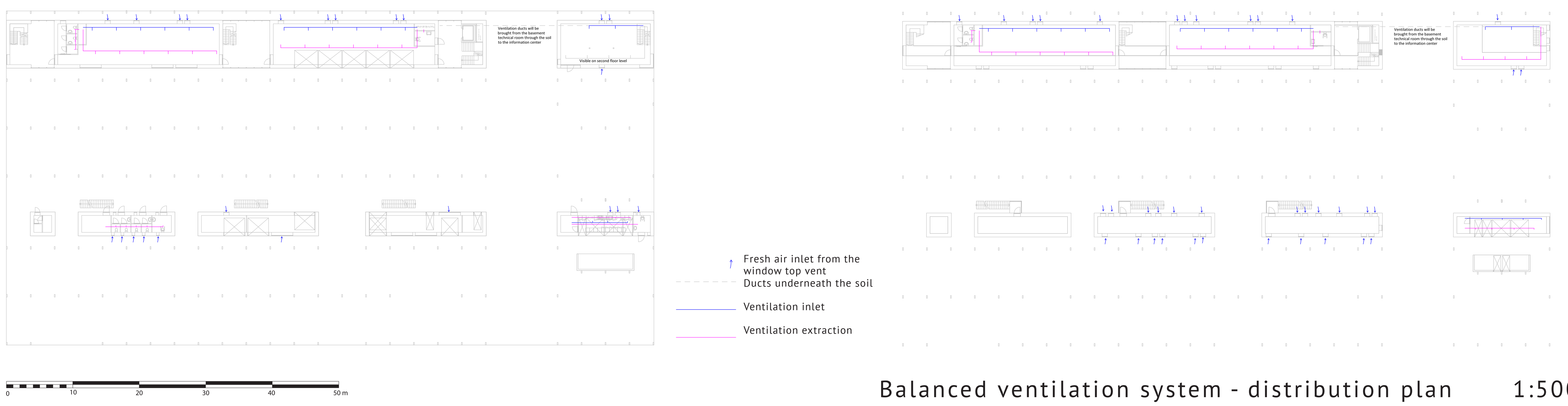
All Visible Thermal Zones
Comfort: Zonal Bands

Max Heating: 12226 W at 03:00 on 31st December
Max Cooling: 14843 W at 15:00 on 31st July

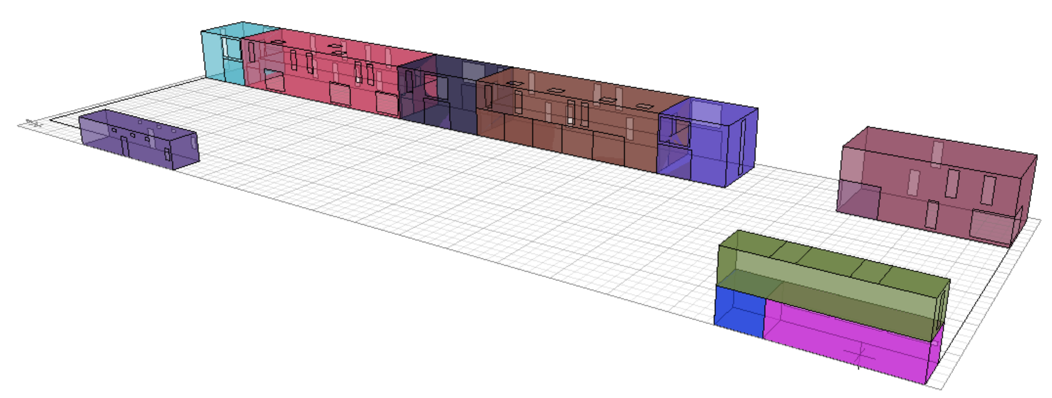
MONTH	HEATING (Wh)	COOLING (Wh)	TOTAL (Wh)
Jan	3216673	15444	3232117
Feb	2386122	57139	2443261
Mar	2145823	170856	2316679
Apr	1380785	282299	1663084
May	484285	753650	1237935
Jun	121270	1140415	1261684
Jul	16133	1472437	1488570
Aug	15648	1449273	1464921
Sep	495746	567090	1062836
Oct	1284651	308226	1592877
Nov	1984201	197464	2181665
Dec	2640796	116294	2757089
TOTAL	**16172133**	**6530586**	**22702720**
PER M²	**29878**	**12065**	**41944**
Floor Area:	**541.267 m2**		



BREEAM Assessment			87,22%
	Criteria affect design decision	Credits	Section score
Management		10	12%
Health & Wellbeing		13	15%
Daylighting	Minimum daylighing factor is 2% in the occupied zone(See Ecotect Daylighting analysis).	1	
View Out		1	
Glare Control		1	
High frequency lighting		1	
Internal and external lighting levels	Daylight factors more than 5%, shading device provided	1	
Lighting zones & controls		1	
Potential for natural ventilation		1	
Indoor air quality	Balanced ventilation system	1	
Volatile Organic Compounds	No or low-VOC paint	1	
Thermal comfort	Air velocity,humidity,quality control	1	
Thermal zoning	Zoning according to the functions and use	1	
Microbial contamination		1	
Acoustic Performance	Impact sound, airborne sound insulation,noise barrier	1	
Energy		18	14,25%
Reduction of CO2 Emissions	Recycle materials, low emission, local suppliers	10	
Sub-metering of Substantial Energy Uses		1	
Sub-metering of high energy load Areas and Tenancy		1	
External Lighting	Automatic control (on/off)	1	
Low zero carbon technologies	Heat pump, PV, Solar thermal collector	3	
Lifts	Energy efficent lifts	2	
Escalators & travelling walkways			
Transport		10	8%
Provision of public transport	Local bus route, cycling route, hiking route	3	
Proximity to amenities	Consideration in the design process	1	
Cyclist Facilities	Local route	2	
Pedestrian and cycle safety	Consideration in the design process	1	
Travel plan	Consideration in the design process	1	
Maximum car parking capacity	Consideration in the design process	2	
Water		6	6%
Water Consumption	Rain water recycle, water circulation	3	
Water meter	Water use control	1	
Major leak detection	Choice of equipment consideration	1	
Sanitary supply shut off	Choice of equipment consideration	1	
Materials		10	9,62%
Materials Specification (major building elements)	Major building materials description (see analysis)	4	
Hard landscaping and boundary protection			
Re-use of building façade			
Re-use of building structure			
Responsible sourcing of materials	Major building materials description (see analysis)	3	
Insulation	Major building materials description (see analysis)	2	
Designing For Robustness	Major building materials description (see analysis)	1	
Waste		5	5,36%
Land Use & Ecology		1	1%
Pollution		12	10%
Innovation		6	6%

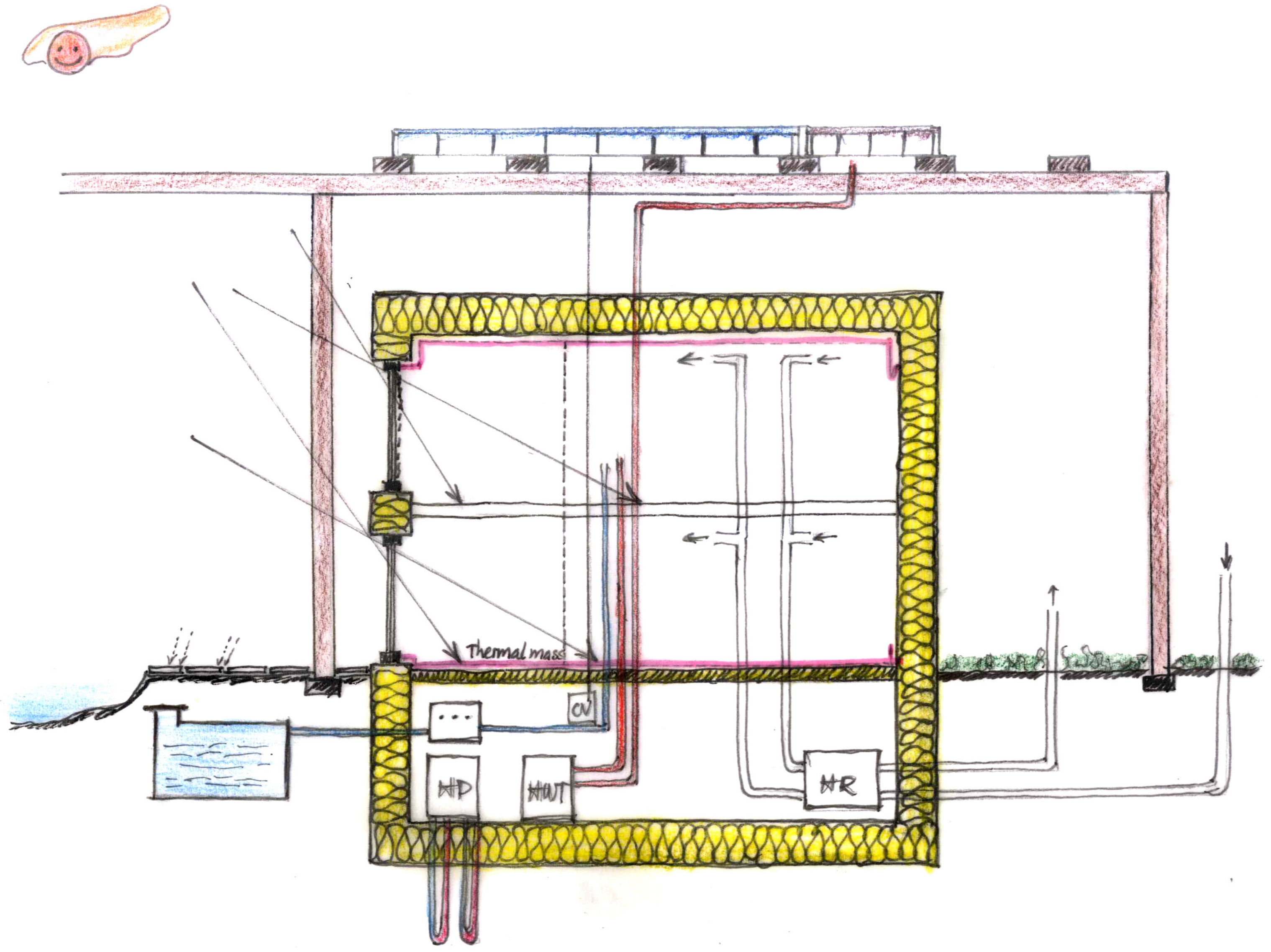


Balanced ventilation system - distribution plan 1:500



Ecotect model
The thermal zones in the project.

Technical solutions



Rainwater collection in the sauna

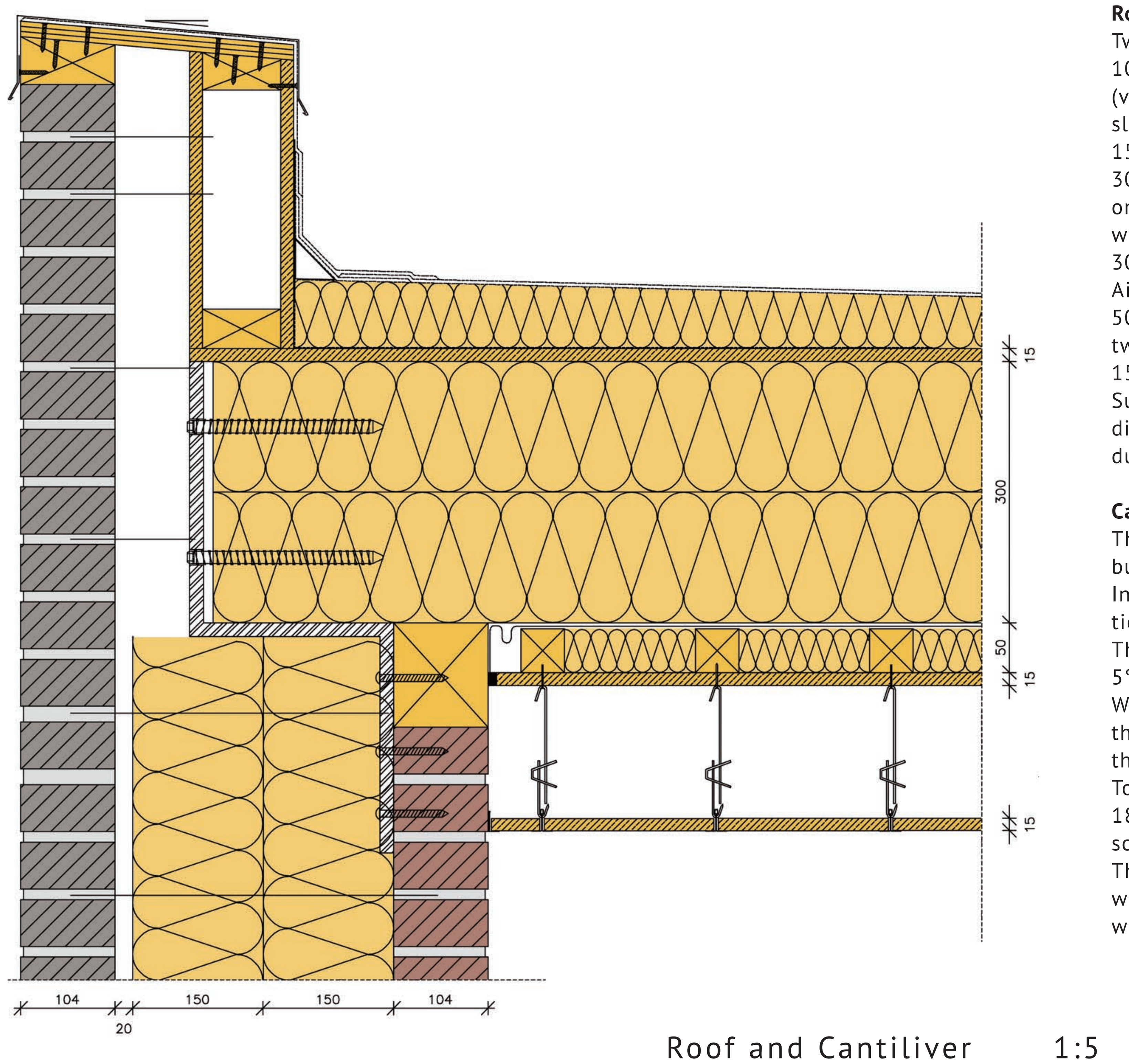
Materials

Component	Structure	Thermal insulation		Skin	Window	Roof	Outdoor Structure
Materials	Mortar type: Lime mortar Easier to dismantle			Mortar type: Lime mortar Easier to dismantle			
Recycled	:-)	:-)		:-(	Lack of information	:-)	:-)
CO_2 Emission	CO_2: 0.24kgco $_2$/kg Architectural requirement	CO_2: 0.98kgco $_2$/kg Comparison: Rockwool 1.1 kgco$_2$/kg	0.35kgco $_2$/kg (ICE data base) XPS 4.39 kgco$_2$/kg	CO_2: 0.24kgco$_2$/kg Architectural requirement	Thermal requirement	CO_2: 0.31kgco $_2$/kg	CO_2: 0.31kgco $_2$/kg
Supplier	Local supplier Wienerberger	Closest Hunton	Abroad	Closest Local collection	Local supplier Nordan	Closest Kjeldstad trelast	Closest Kjeldstad trelast

U-values

Building Components	U-Value (W/m^{2}k)	Project report 42 requirement
Ground support floor	0,08	≤ 0,15Wm^{2}K
External wall	0,12	≤ 0,15Wm^{2}K
Roof	0,10	≤ 0,13Wm^{2}K
Window	0,70	≤ 0,80Wm^{2}K

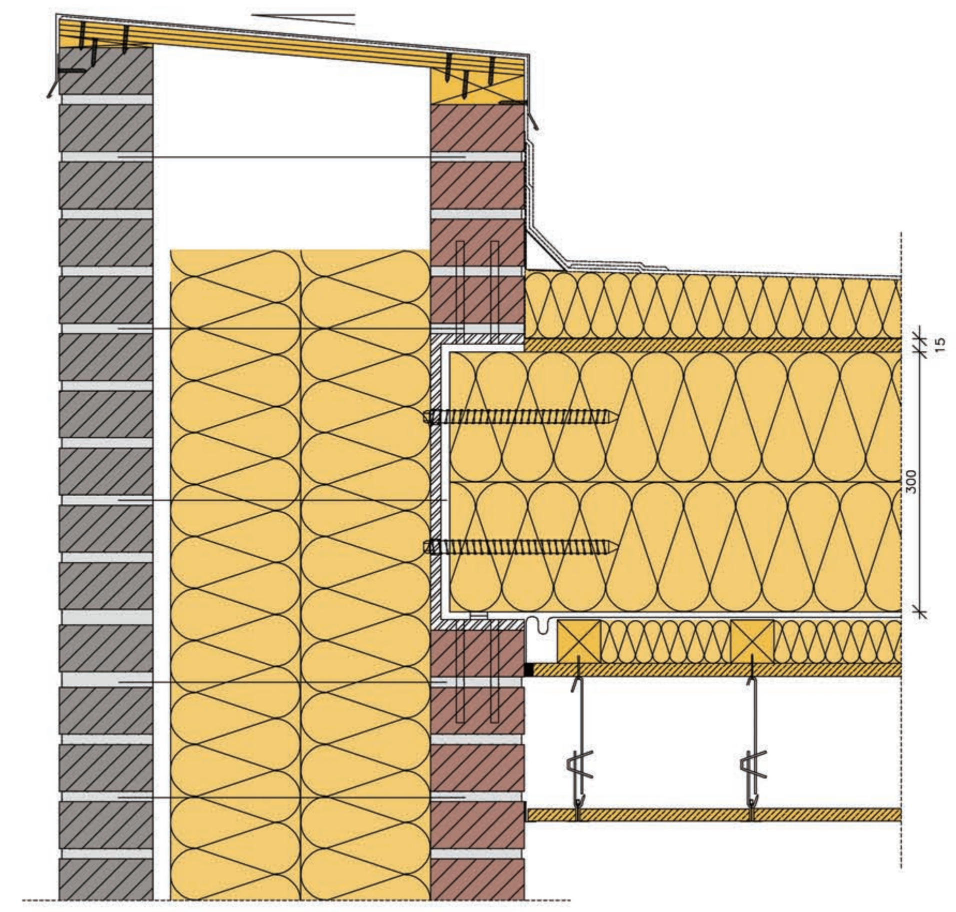
Details



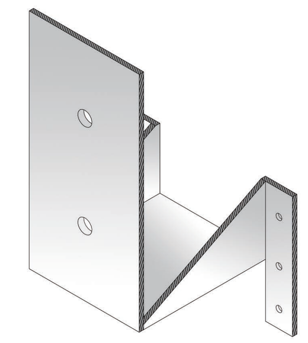
Roof and Cantiliver 1:5

Roof
Two layers of roofing felt
100mm wedge shaped insulation (various thicknesses for creating slope on the flat roof)
15mm OSB board
300mm glulam timber beam resting on the brick inner wall supported with steel brackets
300mm wood fibre insulation
Airtight layer
50mm inner insulation layer lay between the wooden battens
15mm wooden board
Suspended wooden ceiling (hanging distance depending on the service duct size)

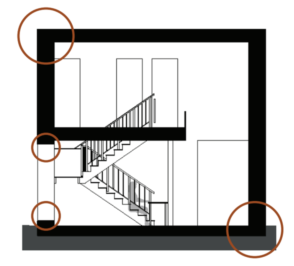
Cantilever
The inner leaf of the cantilever is built up by wooden stud wall
Inner leaf is hold together by wall ties with outer leaf brick.
The aluminium cap has a slope of 5° towards the roof
Wooden battens is used to create the slope and fixed with screws to the brick
To support the aluminium cap, 18mm weather resistant plywood screwed to the battens
The roofing felt on top of the wedged insulation continued all the way up under the aluminium cap

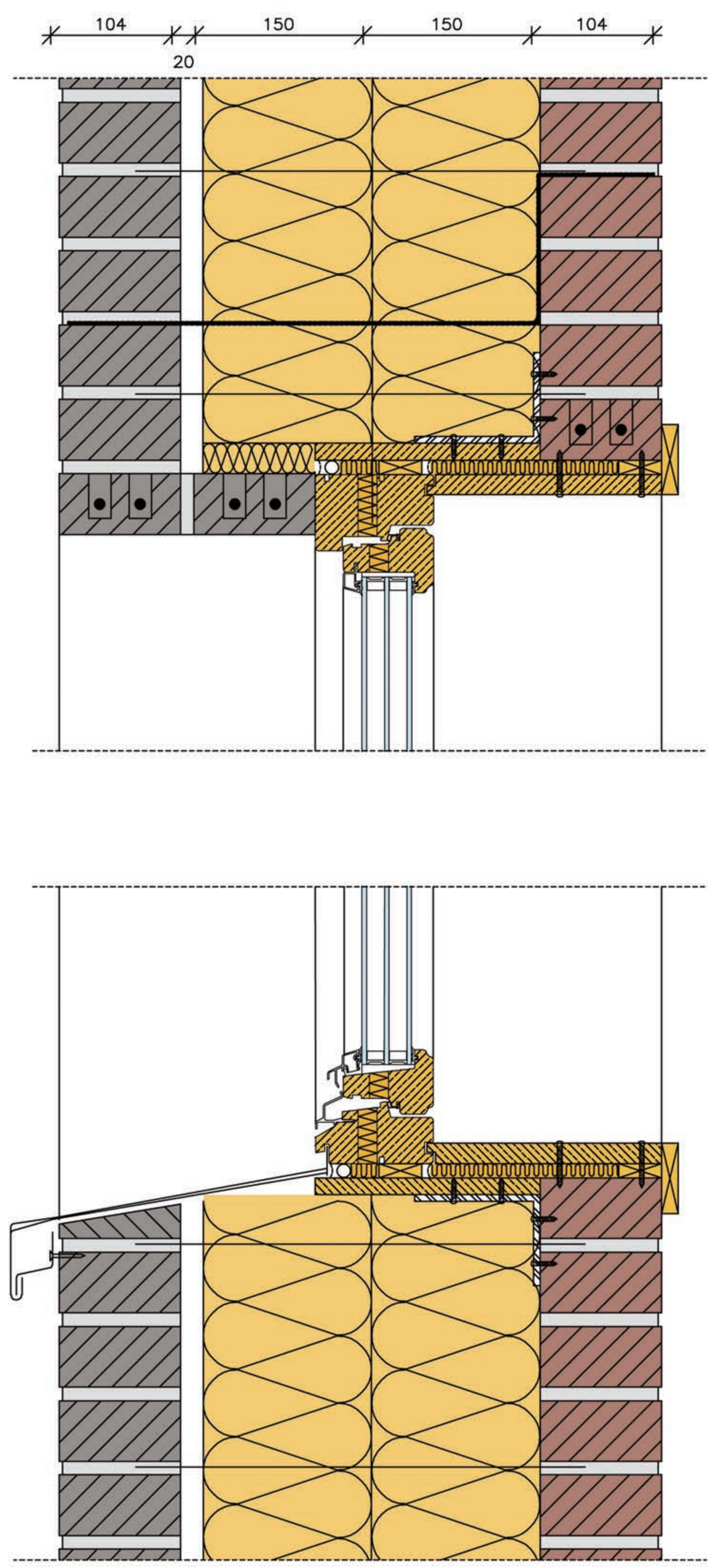


Another solution for the roof construction. No scale.



Steal bracket for carrying the roof timber beam.
No scale





External wall and window 1:5

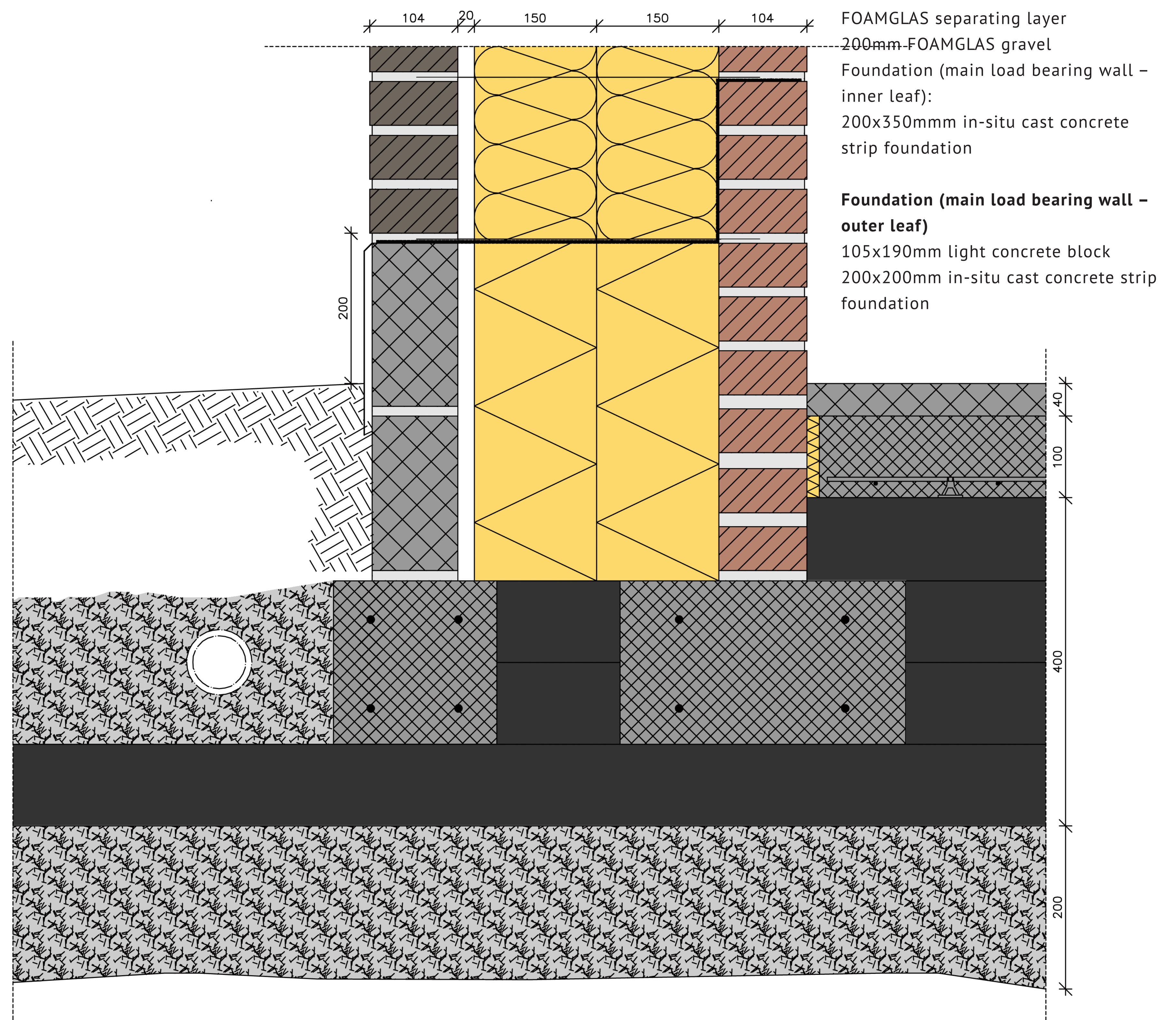
External wall
226x104x60mm WIENERBERGER bratsberg glatt brun bricks
20mm drainage gap
2x150mm HUNTON wooden fibre insulation
226x104x60mm local recycled red bricks
One layer of white paint
Brick inner layer and outer layer is connected with wall ties (every third layers of bricks)

Windows
Brick lintels are using on top of the opening for supporting the bricks
NORDAN triple glazing 0,7 windows are used with insulated window frame
Windows are located in the insulation layer for preventing the thermal loses

Building material references
Brick: http://www.wienerberger.no/
Insulation: http://www.hunton.no/
Glulam beams: http://www.kjeldstad-trelast.no/
Light concrete block (LECA block): http://www.weber-norge.no/

Ground support floor
40mm in-situ cast concrete floor
100mm In-situ cast concrete floor
300mm (4 x100mm) FOAMGLAS floor board
FOAMGLAS separating layer
~~200mm FOAMGLAS gravel~~
Foundation (main load bearing wall – inner leaf):
200x350mm in-situ cast concrete strip foundation

Foundation (main load bearing wall – outer leaf)
105x190mm light concrete block
200x200mm in-situ cast concrete strip foundation



Foundation and Ground Support Floor 1:5