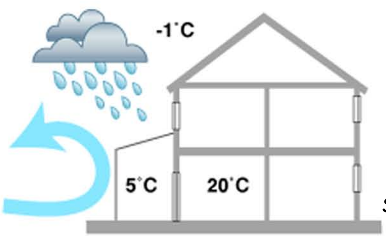
Linesoya Environmental House

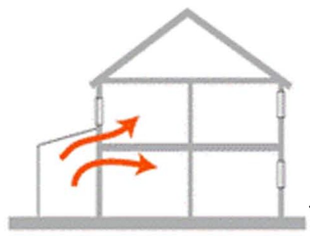
The Sunspace

Concept

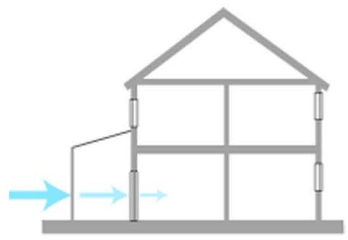
Environmental concept



Sunspace = climate buffer



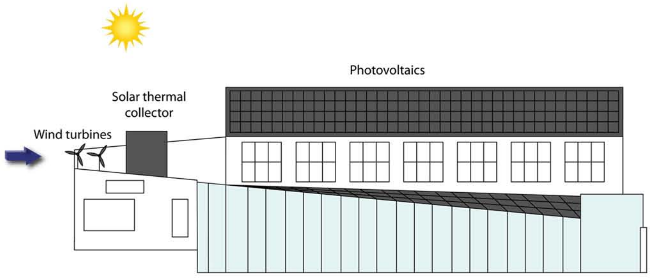
Sunspace = pre-heating air



Sunspace = reducing heat losses

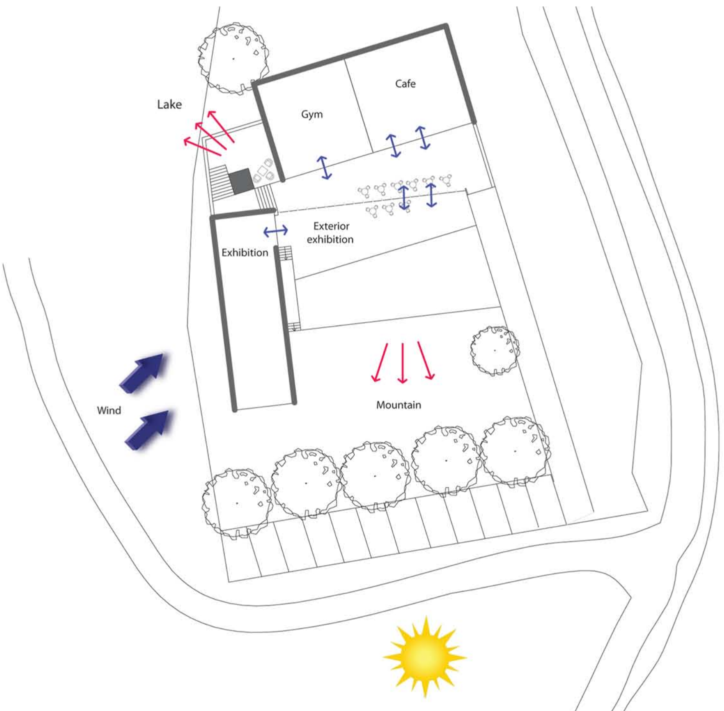
Energy concept:

There are a lot of energetical benefits provided by the sunspace. It is an unheated space adjacent to the main building. First of all, it is a climatic buffer zone that acts as an intermediate space between the indoor and outdoor. As the temperature in the sunspace is higher than the outdoor temperature, it reduces the heat losses from the building to outside. The sunspace also pre-heats the air before it enters the building.



Use of local energy: sun and wind

By the installation of wind turbines, a solar thermal collector and photovoltaics, the project uses the energy available on site.



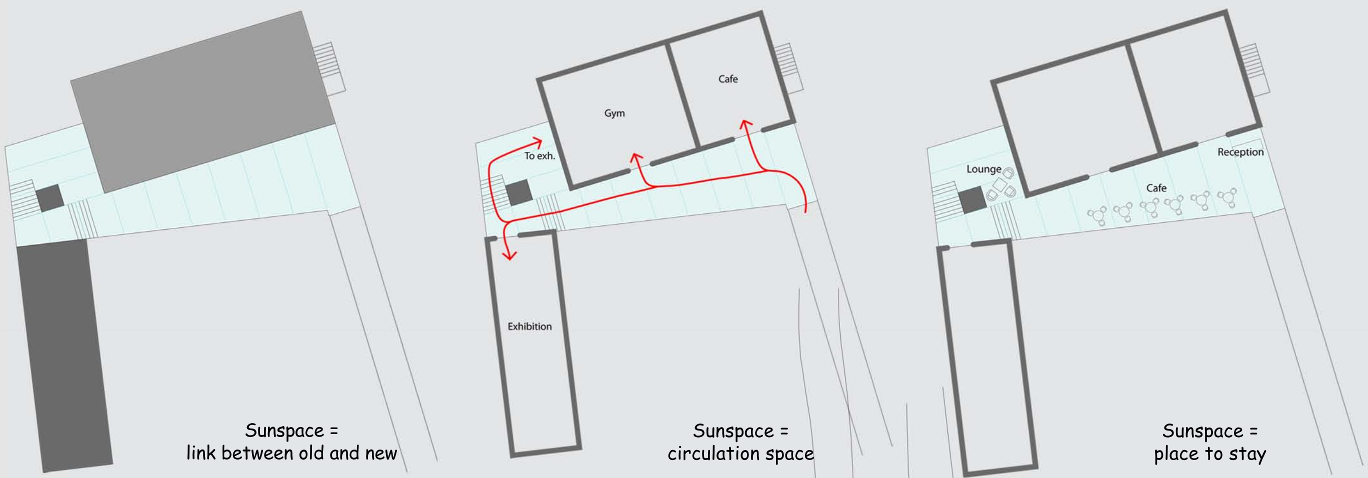
Interactions with the surroundings:

The project is designed in order to take advantage of the solar radiation and the wind energy available on the site.

Both buildings open up towards the South, ie towards the sun and the view. On the platform, the reading space is oriented towards the view to the lake. The building West of the main building acts as a protection against the wind. This creates a protected and active outdoor space where outdoor exhibition or an extension of the café can be installed.

Architectural concept

The main concept of the project is to add a sunspace on the South facade of the building. The addition of this sunspace has both architectural and enegetical advantages.



Sunspace = link between old and new

Sunspace = circulation space

Sunspace = place to stay

Site plan 1-200

Architectural concept:

The sunspace acts as a transition space between the old and the new building. It is an active space from where people enter the building. It is also from the sunspace that the people will enter the different areas: café, gym, exhibition. Moreover, it provides spaces to stay: the extension of the café and the reading area on the platform maximize the benefits of the sunspace even more.

Charline Langerock , Mila Shrestha, Noora Alinaghizadeh

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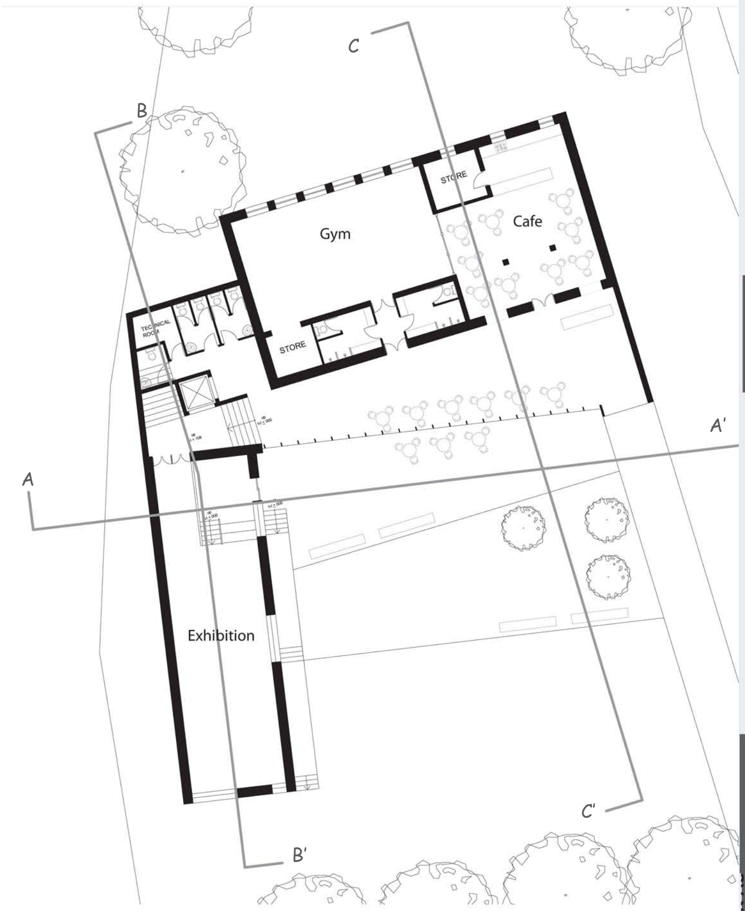
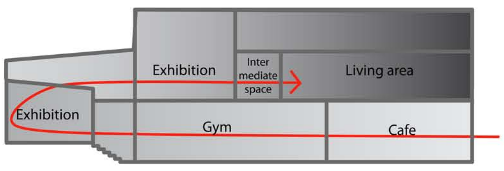
Project



Ground floor plan 1-200



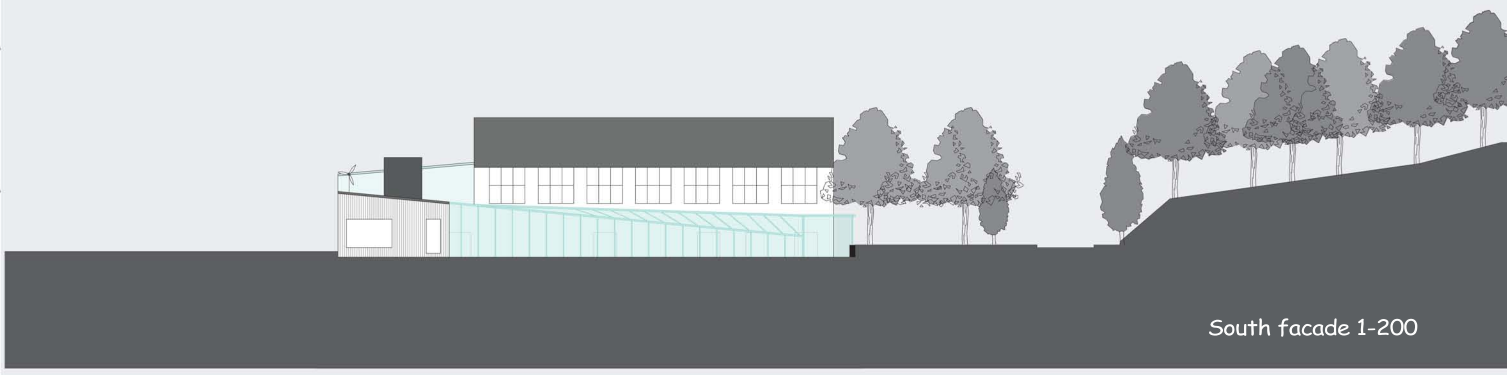
Function distribution:

The building houses several functions, all accessible from the sunspace: a café, a gym, an exhibition space, an intermediate space and a residential area. The building should fulfill the privacy requirements of the inhabitants. Hence the function distribution of the building is done in a way that the space flows from a very public area to the private area. In addition, the transition spaces provided between the functions make the design more flexible.

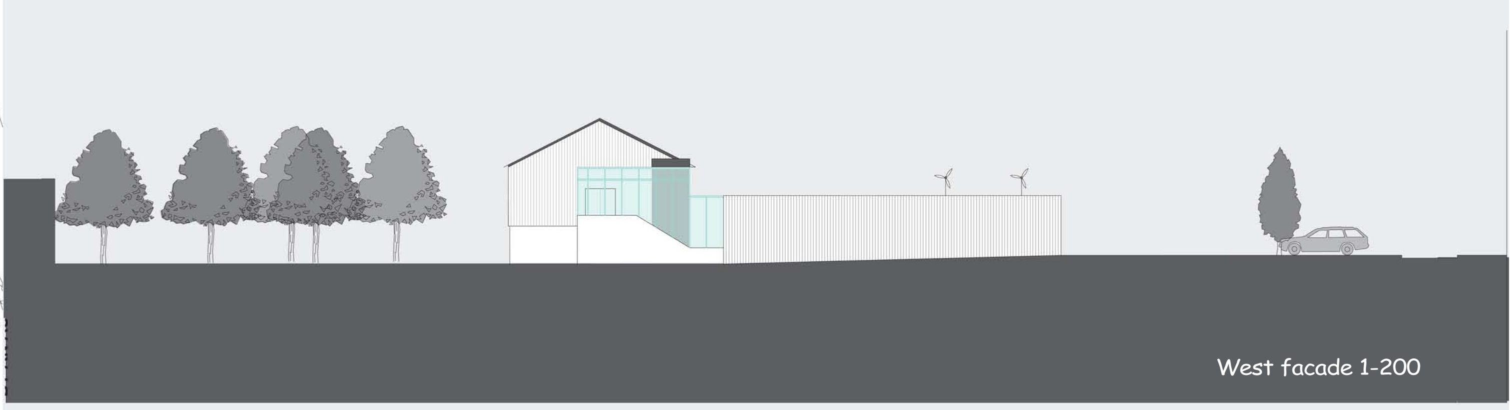
Flexibility of design:

The ground floor can be used in several ways: It is designed to house a café adjacent to a gym hall. But if the gym is not in use, or if there is a special event requiring a lot of space, the café and the gym can become a huge gathering space for the neighbourhood or the visitors. This flexibility is made by a movable translucent wall between the gym and the café.

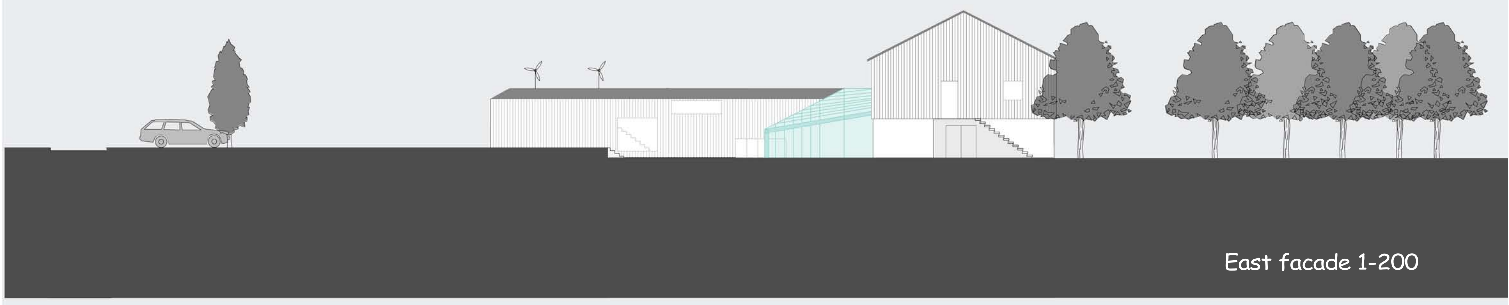
Similarly on the first floor, there is a transition space between the exhibition and the residence that can either be a part of the residence or the exhibition. It could for example house the video room of the exhibition, where explanatory movies about the project are shown, and become the home cinema of the residential part in the evening.



South facade 1-200



West facade 1-200



East facade 1-200

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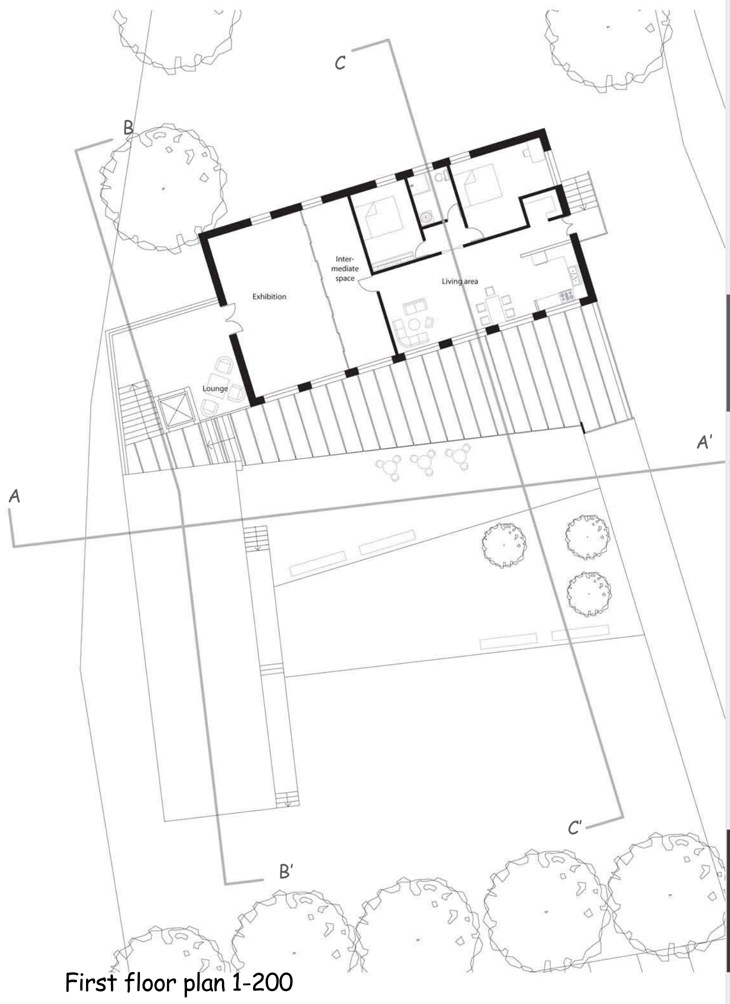
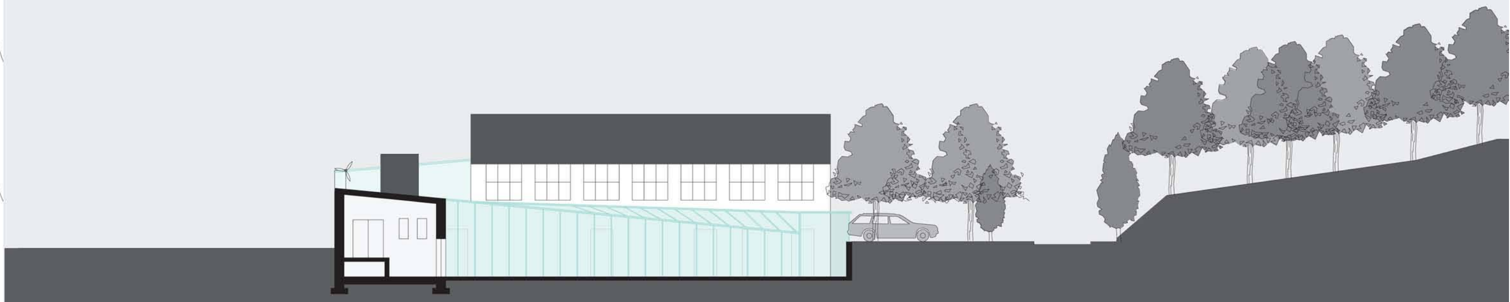
Linesoya Environmental House

The sunspace

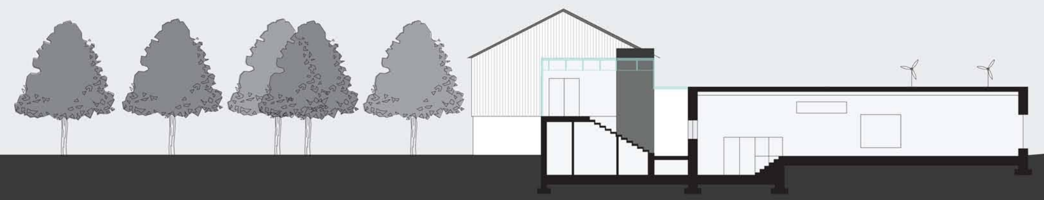
Project



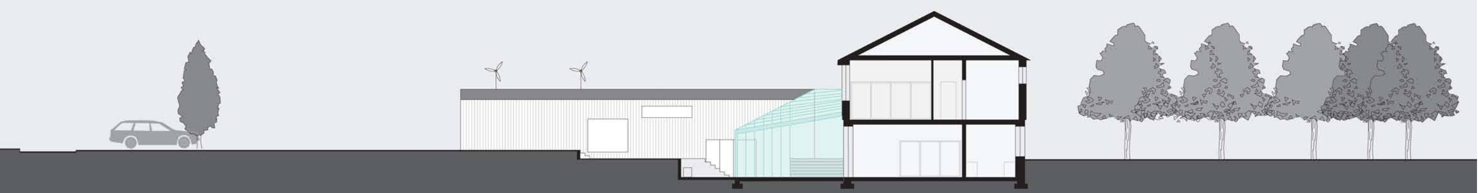
First floor plan 1-200



Section A A' 1-200



Section B B' 1-200



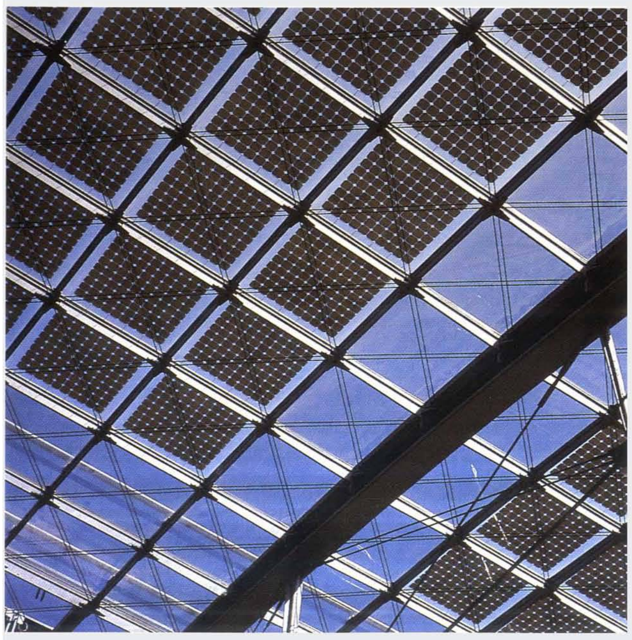
Section C C' 1-200

The sunspace

The sunspace is an unheated space adjacent to the building. The thermal zoning is done in the way that each function is insulated separately. So if a space is not used, it is not necessary to heat it. This will enable to save a lot of energy.

Structure:
The sunspace is an independant structure from the building. It is made of self bearing glass columns. At several points it is possible to open up the glass panels, so that the café can expand outside. This also creates more interaction between the sunspace and the oudoor space (housing an outdoor exhibition for example). Opening up the sunspace in this way and in it's roof enables natural air movements that can cool down the space in the summer. The sunspace then becomes a shielded outdoor space.

Shading:
The integrated PV cells printed on the glass don't have only the function of producing energy. It also acts as a shading device



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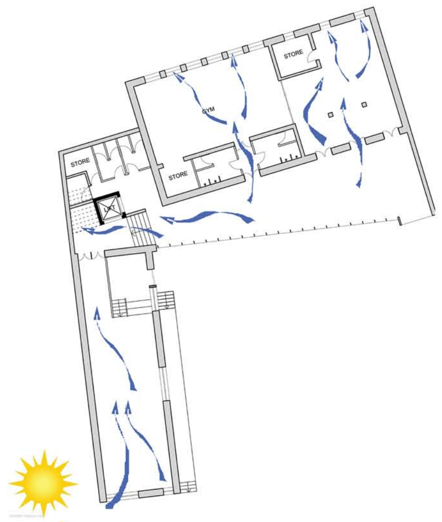
The Sunspace

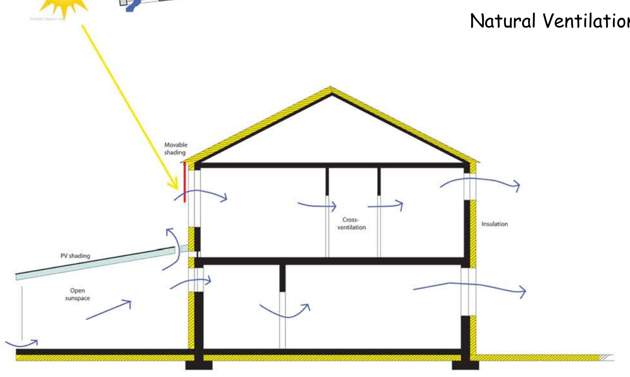
Energy Analysis

Passive Strategies

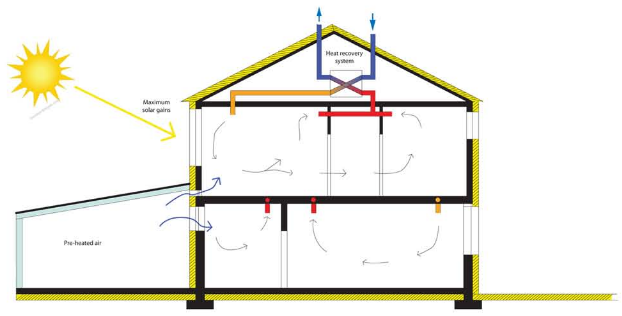
The natural ventilation is mainly done by cross-section ventilation. Some important air volumes are also rising up to the upper part of the sunspace. In the winter, this air is pre-heated in the sunspace before entering the building. In the summer, in order to avoid averheating, the sunspace is completely open and the warm air rises out of the sunspace through a roof opening.



Natural Ventilation



Summer strategies



Winter strategies

Our main focus for energy demand of building was reaching the passive house standard, which is less than 15 kWh/m2 energy use for space heating. In order to make the calculations as accurate as possible, we used Ecotect, PHPP and the formulas of the lectures. To make the calculations as accurate as possible, we divided the model into six thermal zones. We also programmed different operation hours for each zone.

1. Residential
In use all year around. Heating demand: 40 kWh/m2

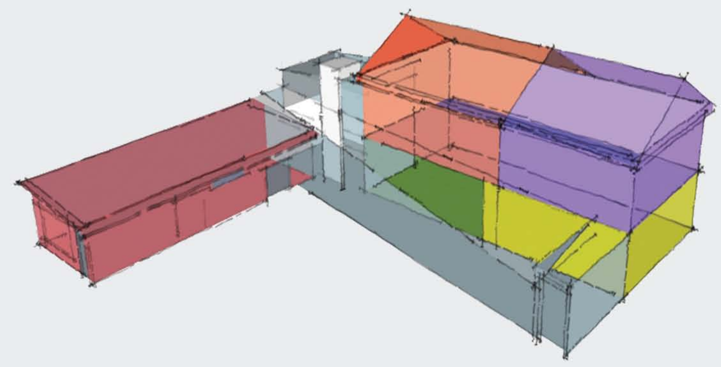
2. CAFE
Weekdays and weekends: 10-20. Heating demand: 1,8 kWh/m2

3. Gym
Weekdays: 14-20, Weekends: 10-20. Heating demand: 5 kWh/m2

4.Exhibition:
Weekdays: 14-18, Weekends: 10-18. Heating demand: 2,8 kWh/m2

5. New exhibition:
Weekdays: 14-18, Weekends : 10-18. Heating demand: 5,6 kWh/m2

6. Sunspace:
Weekdays and weekends: 10-20. Heating demand: 0 kWh/m2



Ecotect results:

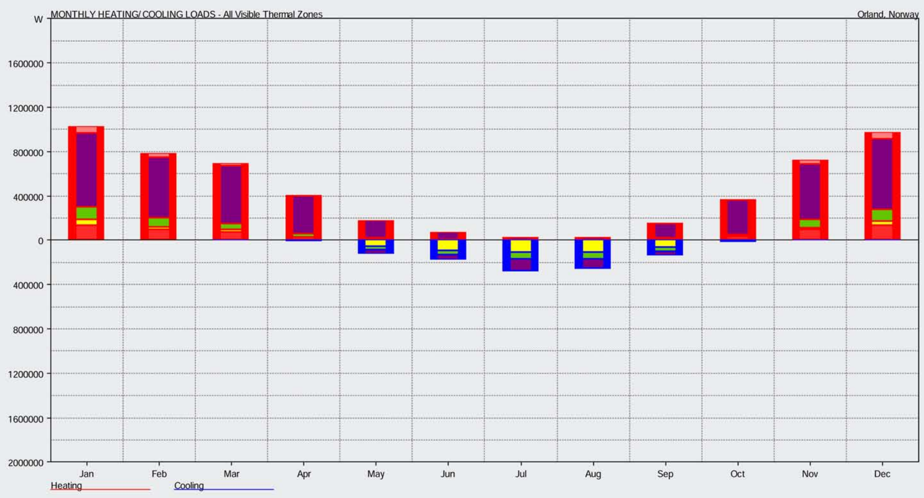
Air change rate: 0.12 ; Wind sensitivity: 0.1

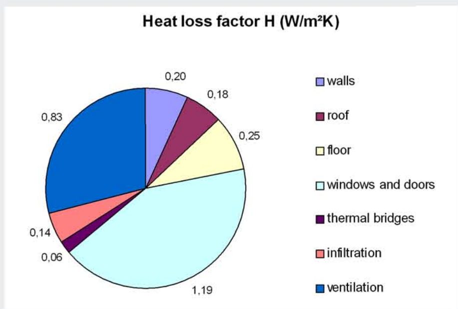
Heating demand = 9,05 kWh/m2. year
Most energy is used by the residential area.

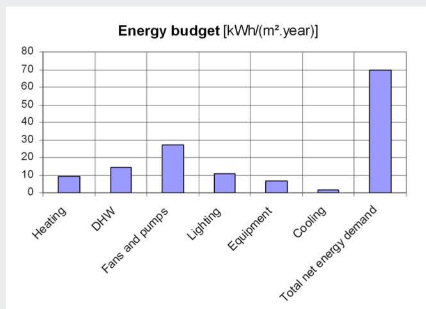
If the sunspace didn't exhist, the heating demad would have been of 11,45 kWh/m2.year. So we can see in the energetical benefit of the sunspace

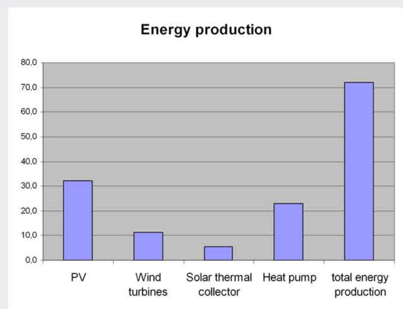
U-values:

U-walls (1st floor) = 0,10
U-walls (ground floor) = 0,15
U-floor = 0,13
U-roof = 0,09
U-windows = 0,61
U-doors = 0,79









Heat loss factor:

The total heat loss factor is 2,83 W/m2.K From this value, 42% of these heat losses go through the windows and doors and 30% are due to ventilation. In addition to that, 22% of the heat losses go through the envelope (walls, roof and floor). As the airtighness of the building is maximized, and the thermal bridges are minimized, the heat losses due to infiltration and thermal bridges are very small: Together they represent only 7% of the heat losses.

Energy budget:

Total specific net energy demand = 70 kWh/m2.year.

This amount corresponds to the energy demand needed for heating, domestic hot water, fans and pumps, lighting, equipment and cooling.

Energy production:

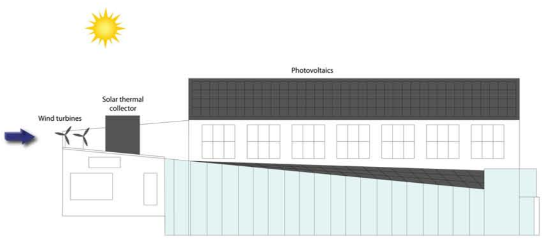
Total energy production = 72 kWh/m2.year

This energy is produced by:
- 130 m2 PV panels
- 2 wind turbines
- 4 m2 solar thermal collector
- heat pump

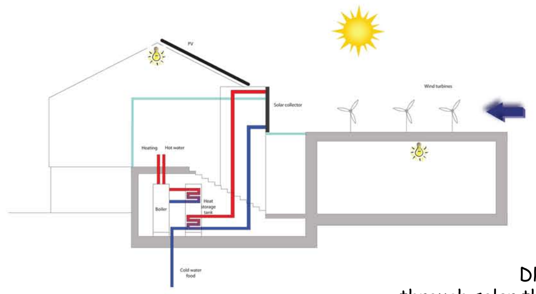
(The calculations are based on the assumption that the PV panels don't produce any energy during 4 winter months)

Active Strategies

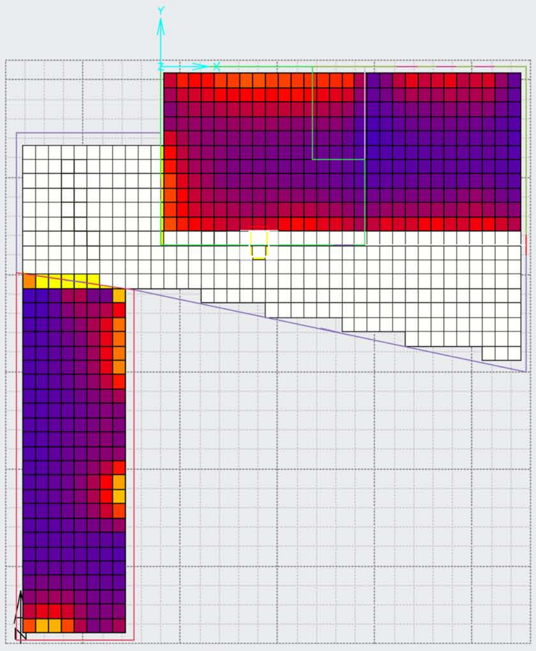
Energy is produced by PV panels and wind turbines to generate electricity, and by a thermal solar collector to supply some of the needed Domestic Hot Water and heating. The rest of the heating and the DHW energy will be provided by a heat pump

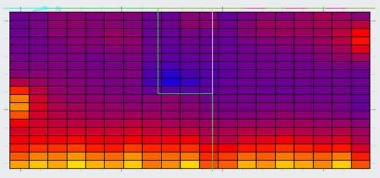


Wind and solar use



DHW and heating through solar thermal collector





Daylighting and solar shading:

Maximum daylight is allowed into the building through large openings on the south. The original window size is kept the same.

Movable vertical shading devices are provided on the windows in order to prevent the building from overheating. As these shading devices are removable, they provide flexibility of use and won't reduce the rare incoming winter daylight, when it is not necessary to shade.

The sunspace receives solar radiation from the transparent roof surface. Printed PVs are used for shading, but they are still very translucent. In this way, the shading of the sunspace doesn't reduce the incoming daylight in the café.

The new exhibition building opens up to the South in order to take maximum advantage of the solar radiation. Additional openings on the East façade provide enough daylight into the building.

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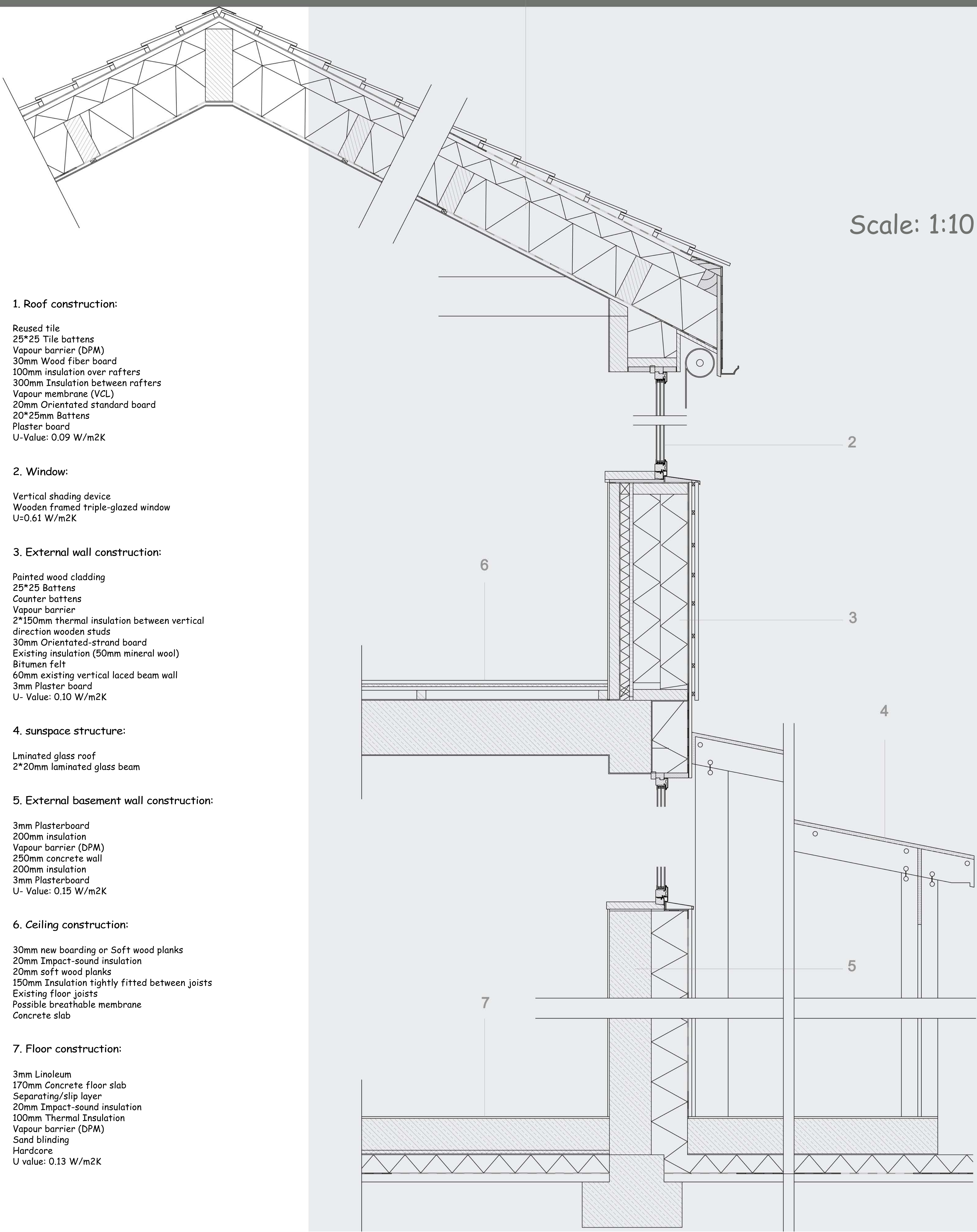
Detail



1. Roof construction:

Reused tile
25*25 Tile battens
Vapour barrier (DPM)
30mm Wood fiber board
100mm insulation over rafters
300mm Insulation between rafters
Vapour membrane (VCL)
20mm Orientated standard board
20*25mm Battens
Plaster board
U-Value: 0.09 W/m2K

2. Window:

Vertical shading device
Wooden framed triple-glazed window
U=0.61 W/m2K

3. External wall construction:

Painted wood cladding
25*25 Battens
Counter battens
Vapour barrier
2*150mm thermal insulation between vertical direction wooden studs
30mm Orientated-strand board
Existing insulation (50mm mineral wool)
Bitumen felt
60mm existing vertical laced beam wall
3mm Plaster board
U- Value: 0.10 W/m2K

4. sunspace structure:

Lminated glass roof
2*20mm laminated glass beam

5. External basement wall construction:

3mm Plasterboard
200mm insulation
Vapour barrier (DPM)
250mm concrete wall
200mm insulation
3mm Plasterboard
U- Value: 0.15 W/m2K

6. Ceiling construction:

30mm new boarding or Soft wood planks
20mm Impact-sound insulation
20mm soft wood planks
150mm Insulation tightly fitted between joists
Existing floor joists
Possible breathable membrane
Concrete slab

7. Floor construction:

3mm Linoleum
170mm Concrete floor slab
Separating/slip layer
20mm Impact-sound insulation
100mm Thermal Insulation
Vapour barrier (DPM)
Sand blinding
Hardcore
U value: 0.13 W/m2K