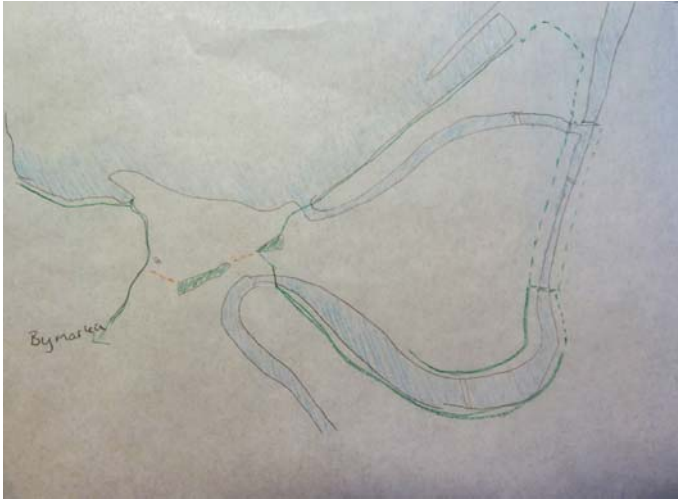


PROCESS

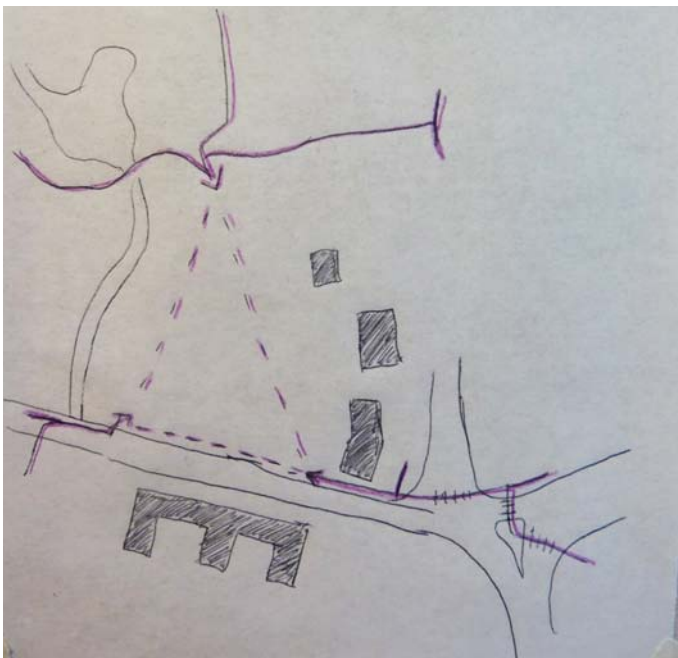


Prepared file for cutting. Lasercut. Glued the pieces together.



Today there exists a continuous path around the city centre. Either path with no cars, or with own cycling lane. There also exists a car free path from Ilsvika to Bymarka, that follows Ilabekken.

These two paths are almost connected through Ilaparken. My site is today the biggest break between the two paths.



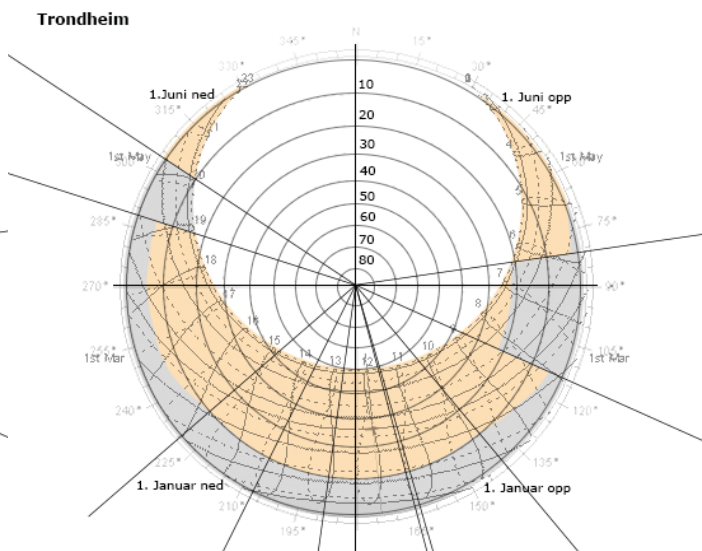
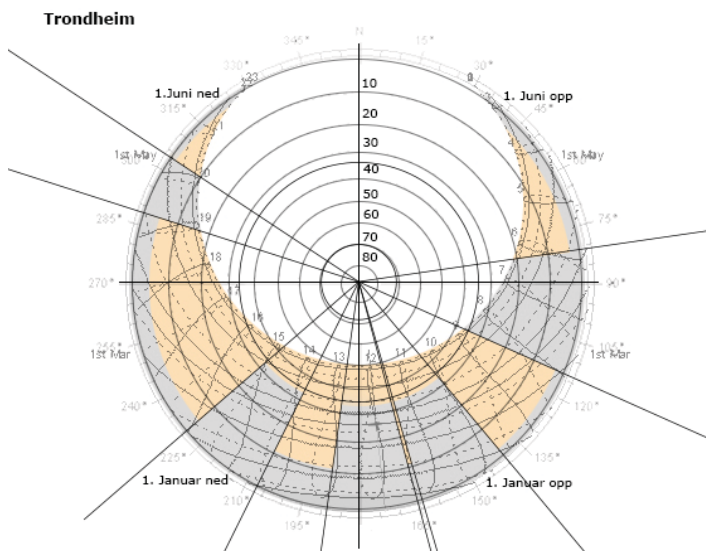
Approaching site by foot



- Industrial
- Public
- Commercial
- Green areas



- Cars
- Foot and bike
- Public transport



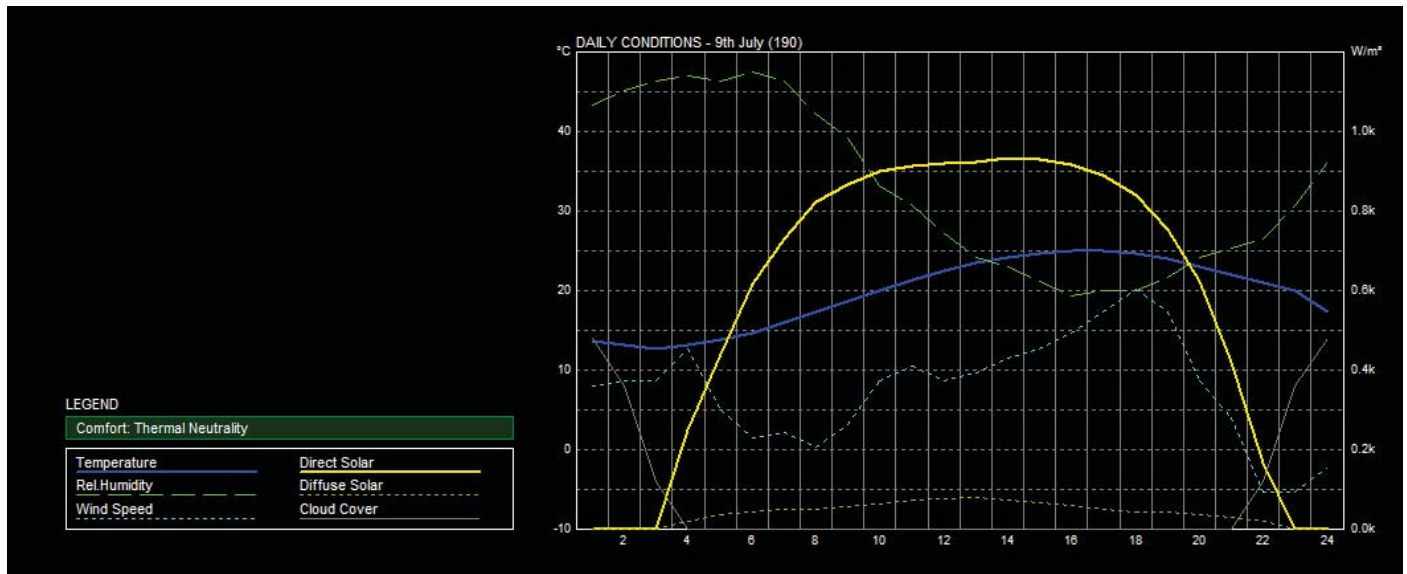
Analysis of sun conditions on site. Shadows from neighbouring buildings are worst case scenarios. Left image is on the level of the ground. Right image is 10 meter above ground.

### Solvinkler fra sør kl 12 - Trondheim

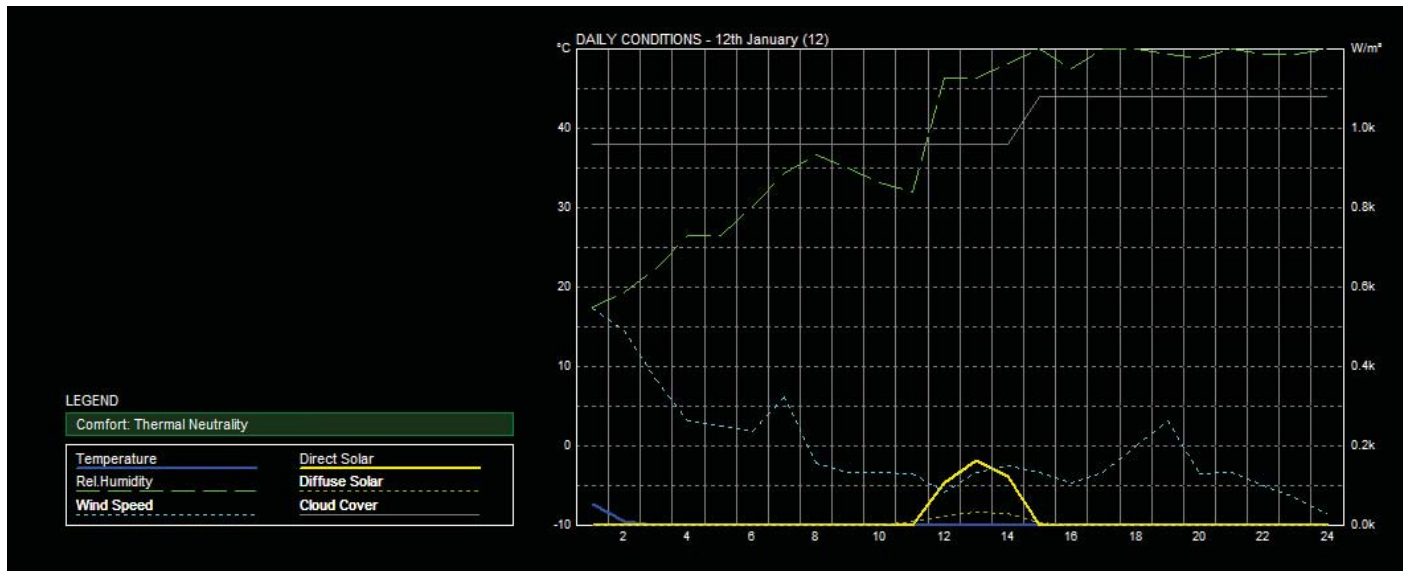
Jan	4
Feb	9
Mars	19
April	31
Mai	41
Juni	48
Juli	46
August	38
September	26
Oktober	15
November	7
Desember	3



## Hottest and coldest day Trondheim

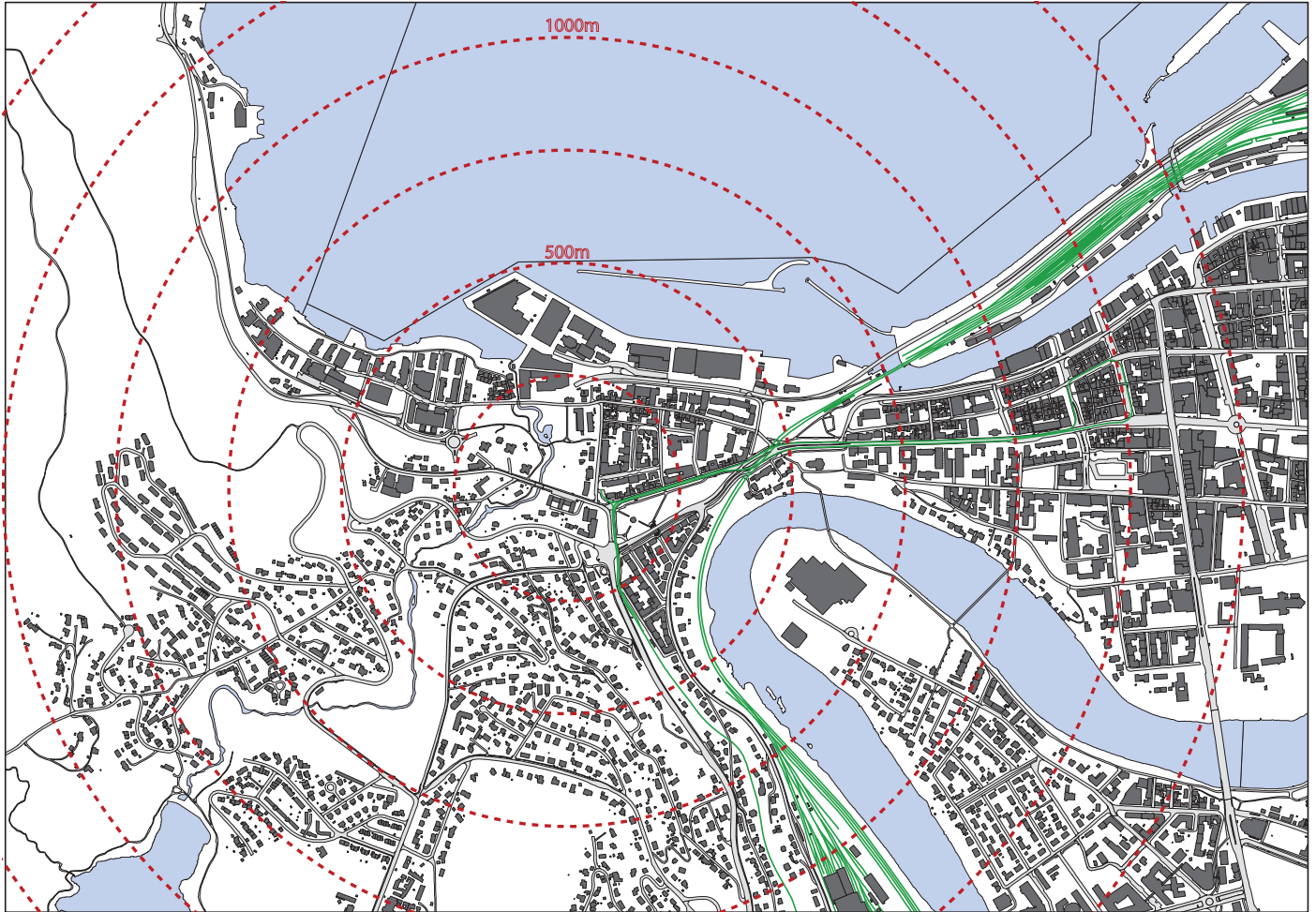


Hot peak



Cold peak

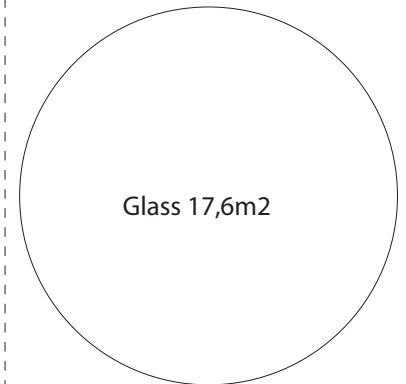
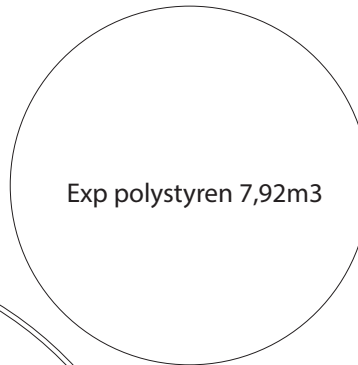
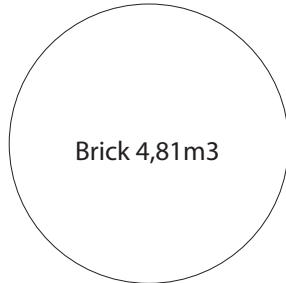
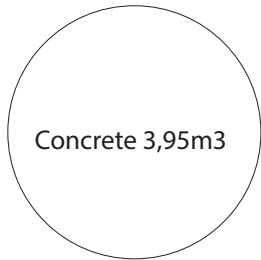
Distances. Ca 1,5 km to target.



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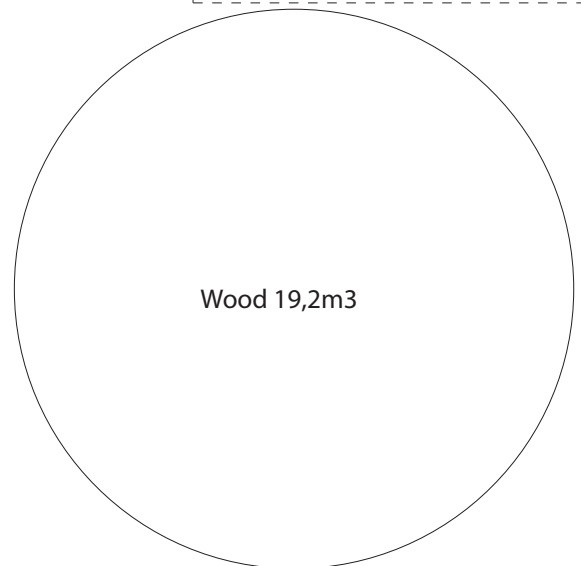
Amount of material pr. ton CO<sub>2</sub>

○ Steel 0,07m<sup>3</sup>



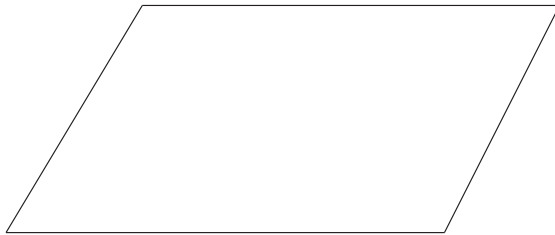
○ PV

Aerogel ?



Emissions from the different materials. For one ton CO<sub>2</sub> you can get \_\_\_m<sup>3</sup> cellulose fibre insulation. Almost double of Glass and Rock wool. PV gives approximately 5m<sup>2</sup> per ton.



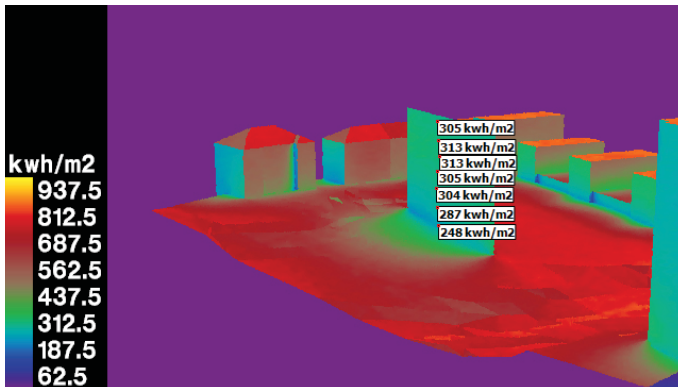


Producing electricity, European average: 0,132kgCO<sub>2</sub>/kWh

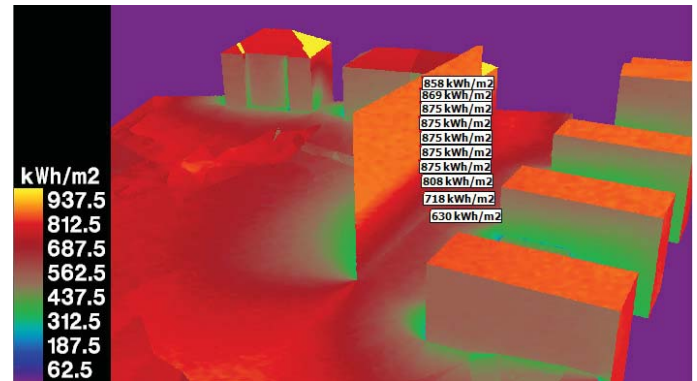
Producing PV:  
emissions per year (lifetime: 30years): 199kgCO<sub>2</sub>/m<sup>2</sup>  
6,63kgCO<sub>2</sub>/m<sup>2</sup>

Electricity produced to pay back production of PV: 50,3kWh/(m<sup>2</sup>\*year)  
Solar radiation required (15% efficiency): 335kWh/(m<sup>2</sup>\*year)

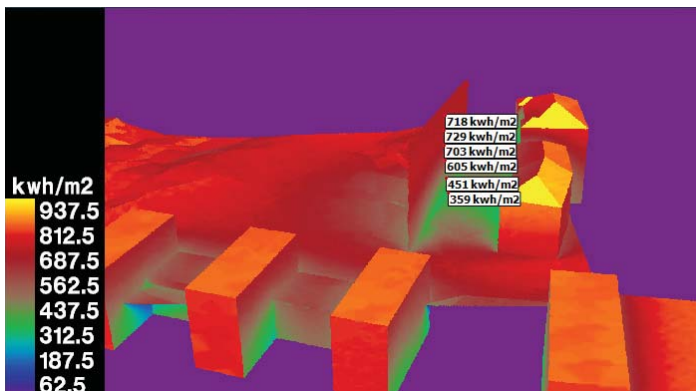
Study of potential for producing energy. All surfaces are either paralell to the road, or 90 degrees on road. Only the facade to the north has too low radiation for a PV panel to pay back its own emissions.



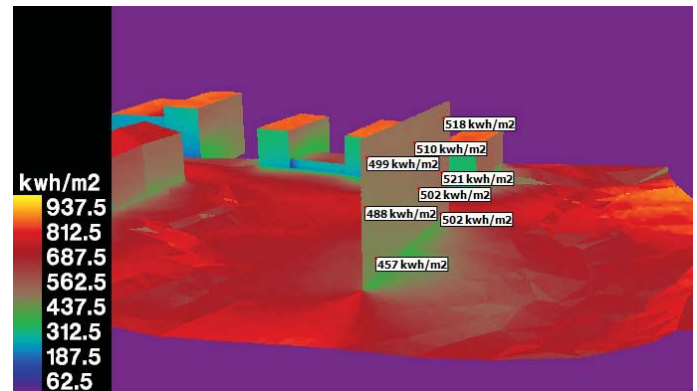
North



South



East



West

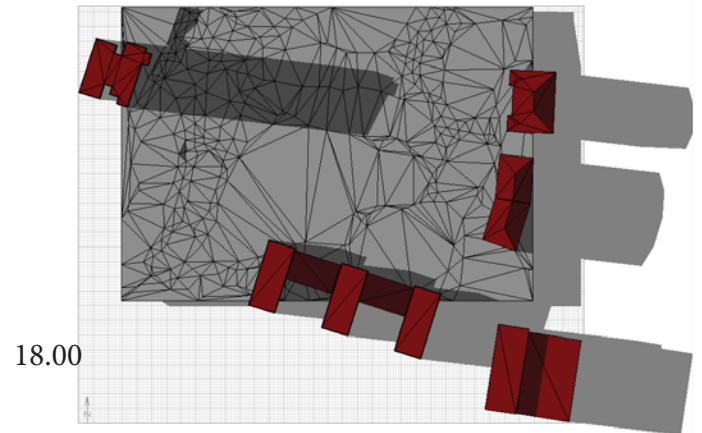
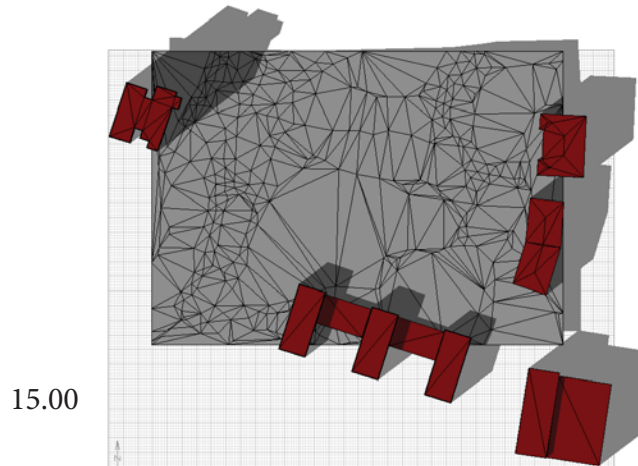
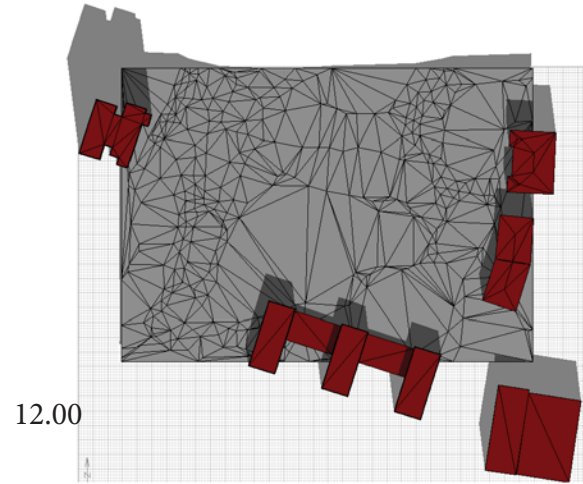
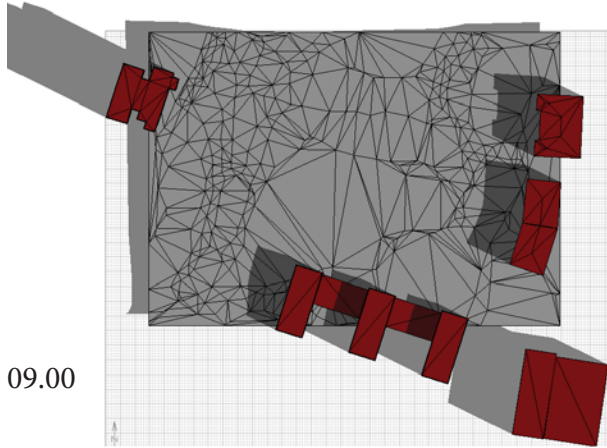
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Considering water as thermal mass.  
Reference projects where they use  
recycled bottles.  
Maybe not necessary for housing in  
Norway



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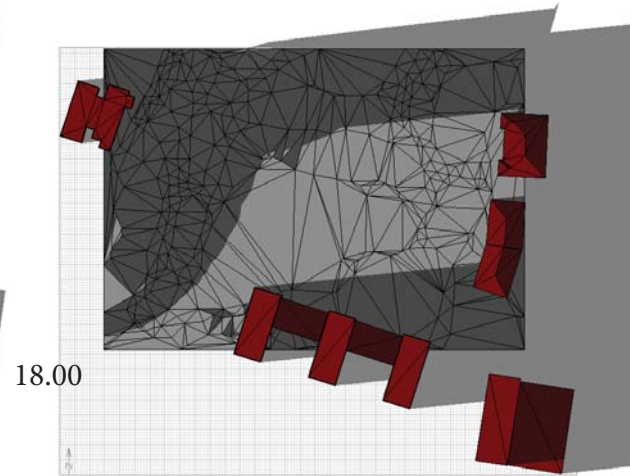
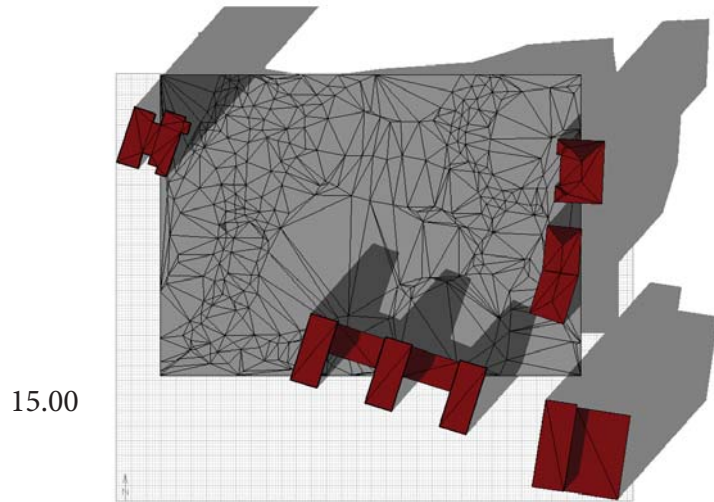
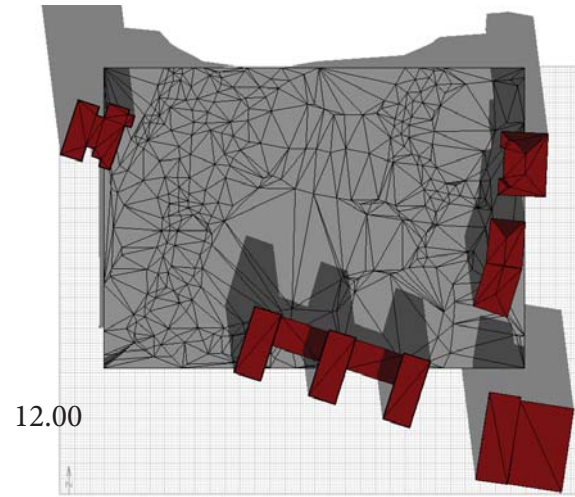
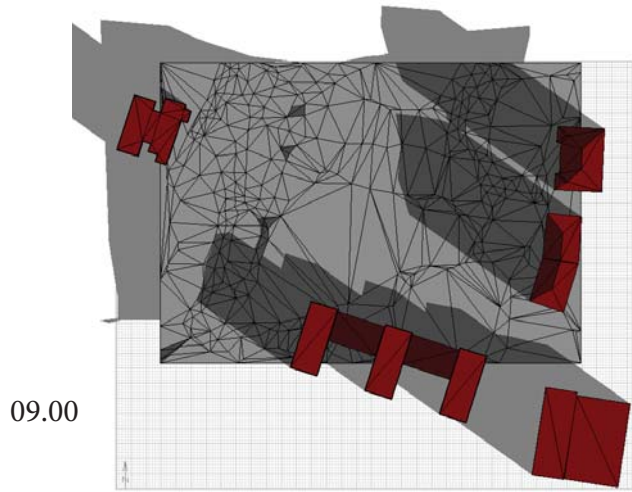
Shadow study 21 Juli

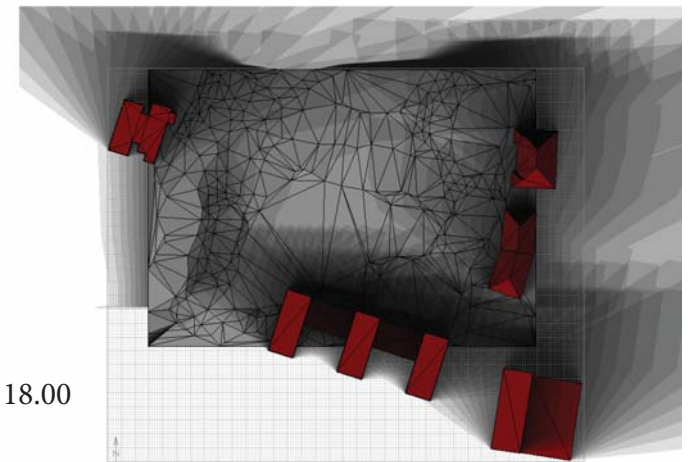
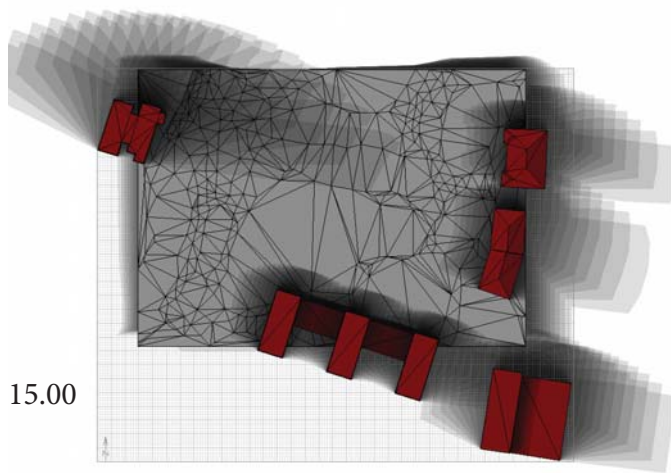
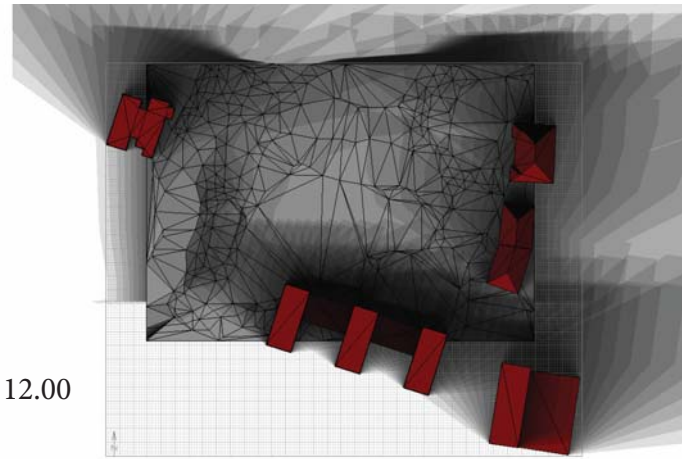
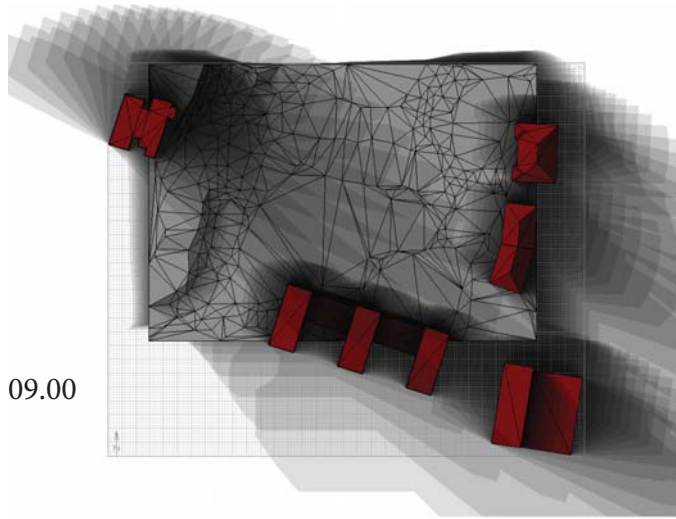




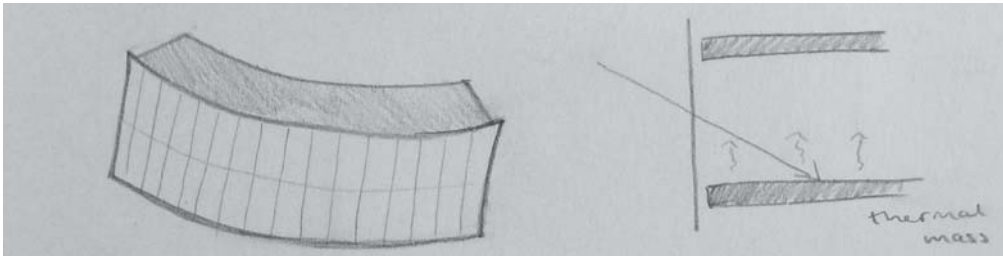
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Shadow study 21 March

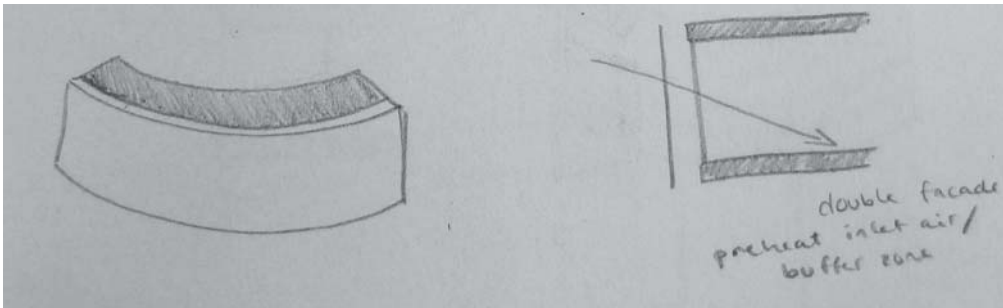




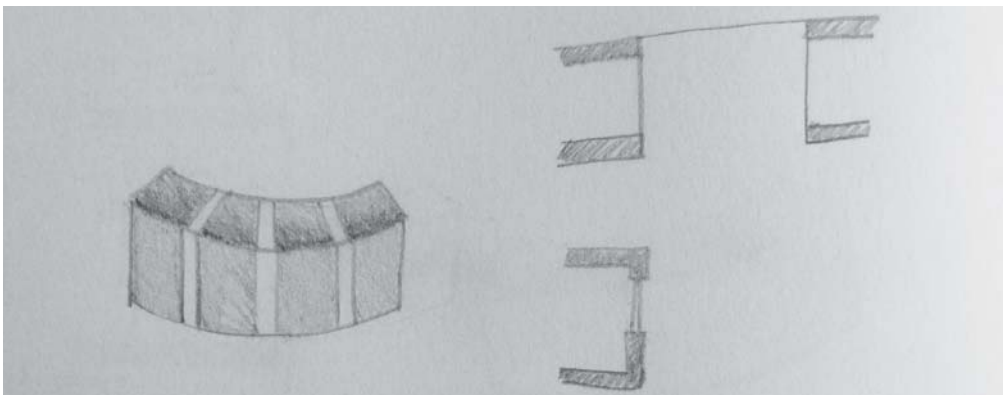




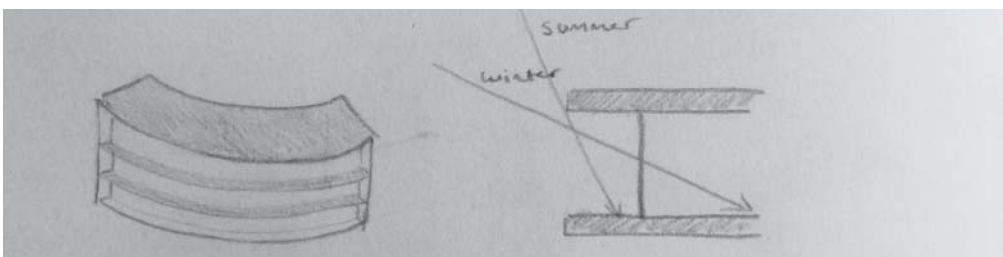
Facade when direct gain.



Facade when direct gain through double facade. Preheated air is used for ventilation.



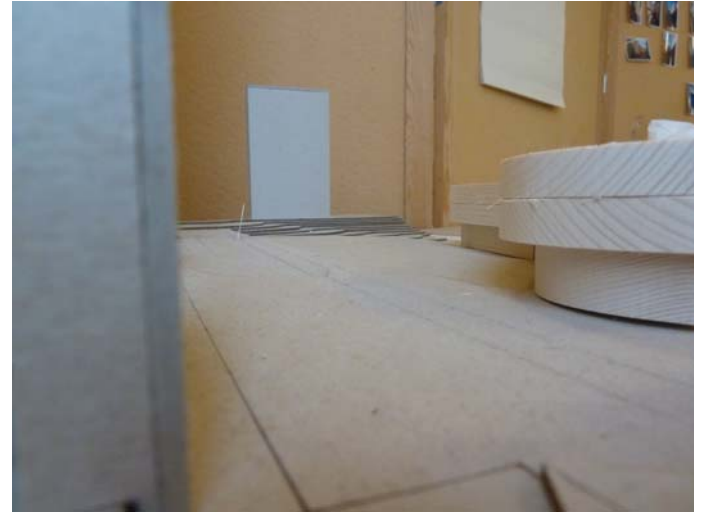
Buffer space between smaller buildings. For preheating air, and/or greenhouse.



Summer sun is blocked and winter sun heats building.

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## Alternative 1

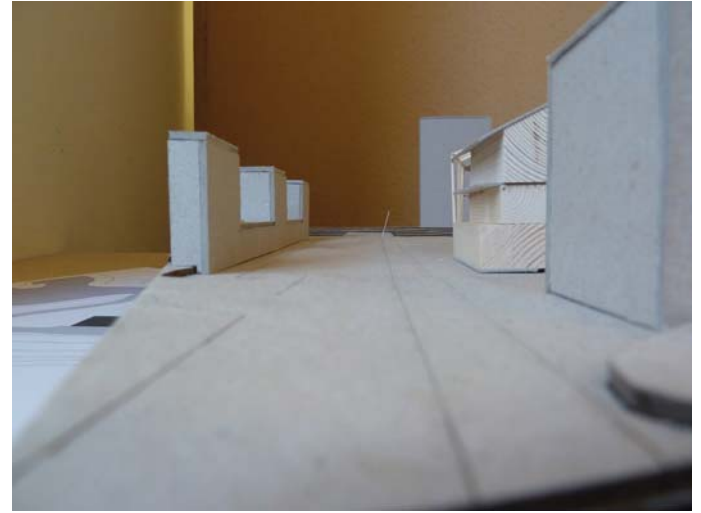


Edges of the building leads the walkers to an outdoor area. The building embraces the area.

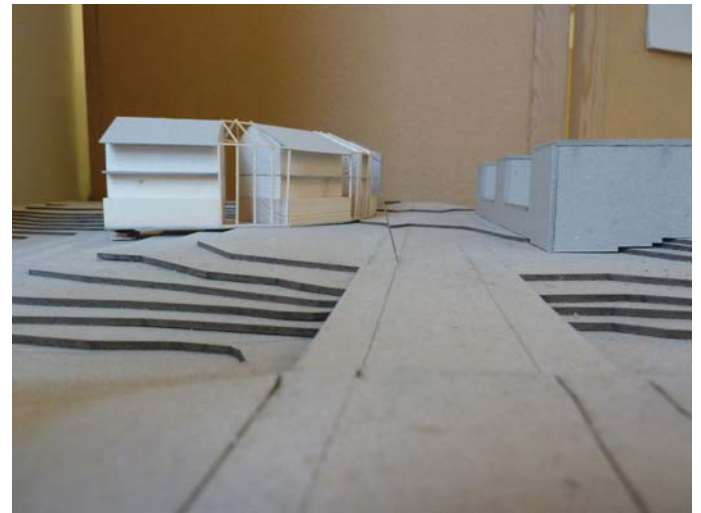


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Alternative 2

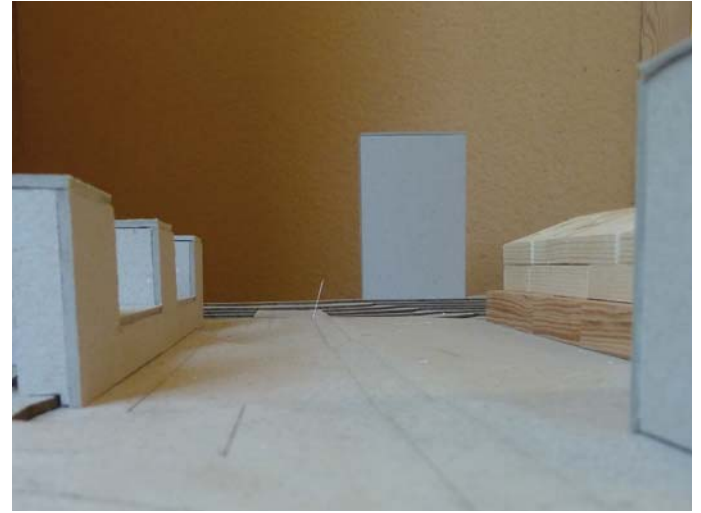


Building leads the walkers to the park of Ilabekken.

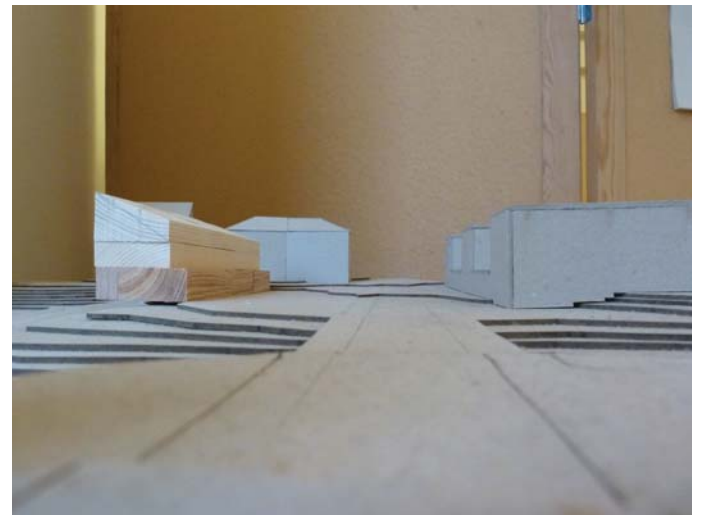


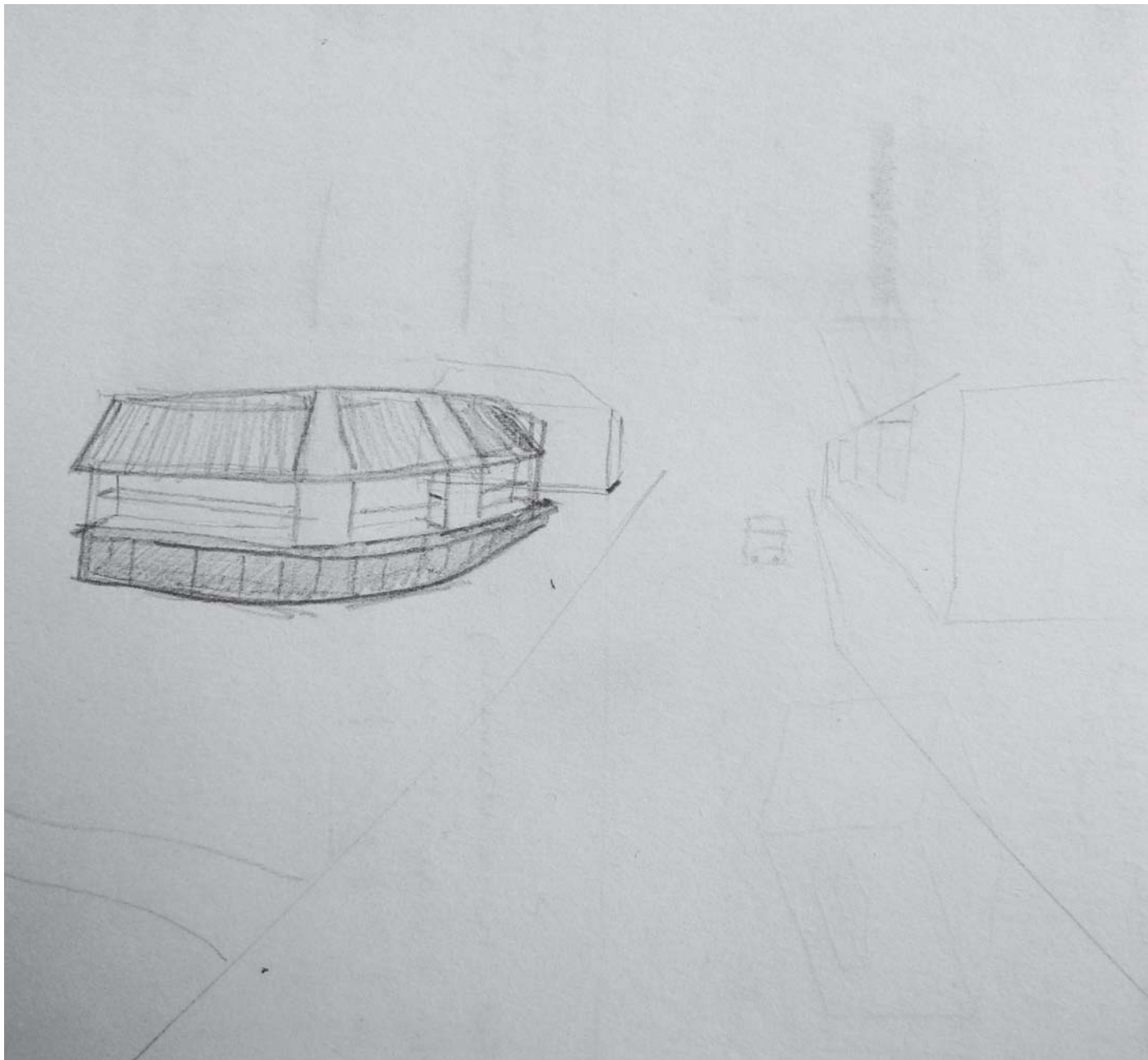
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### Alternative 3

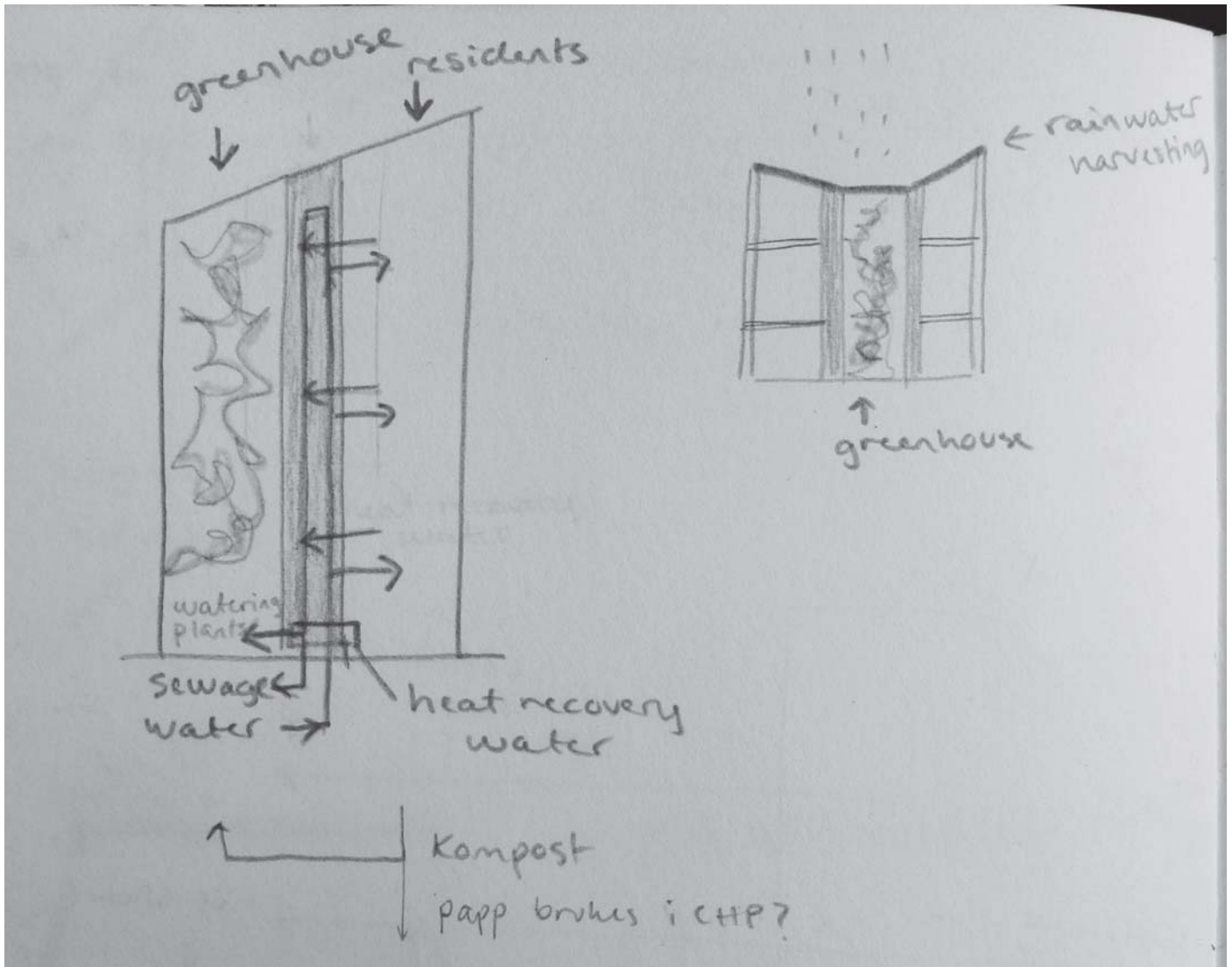


Building creates a space in front of itself connected to the road. The space can be a transition to the park along Ilabekken.

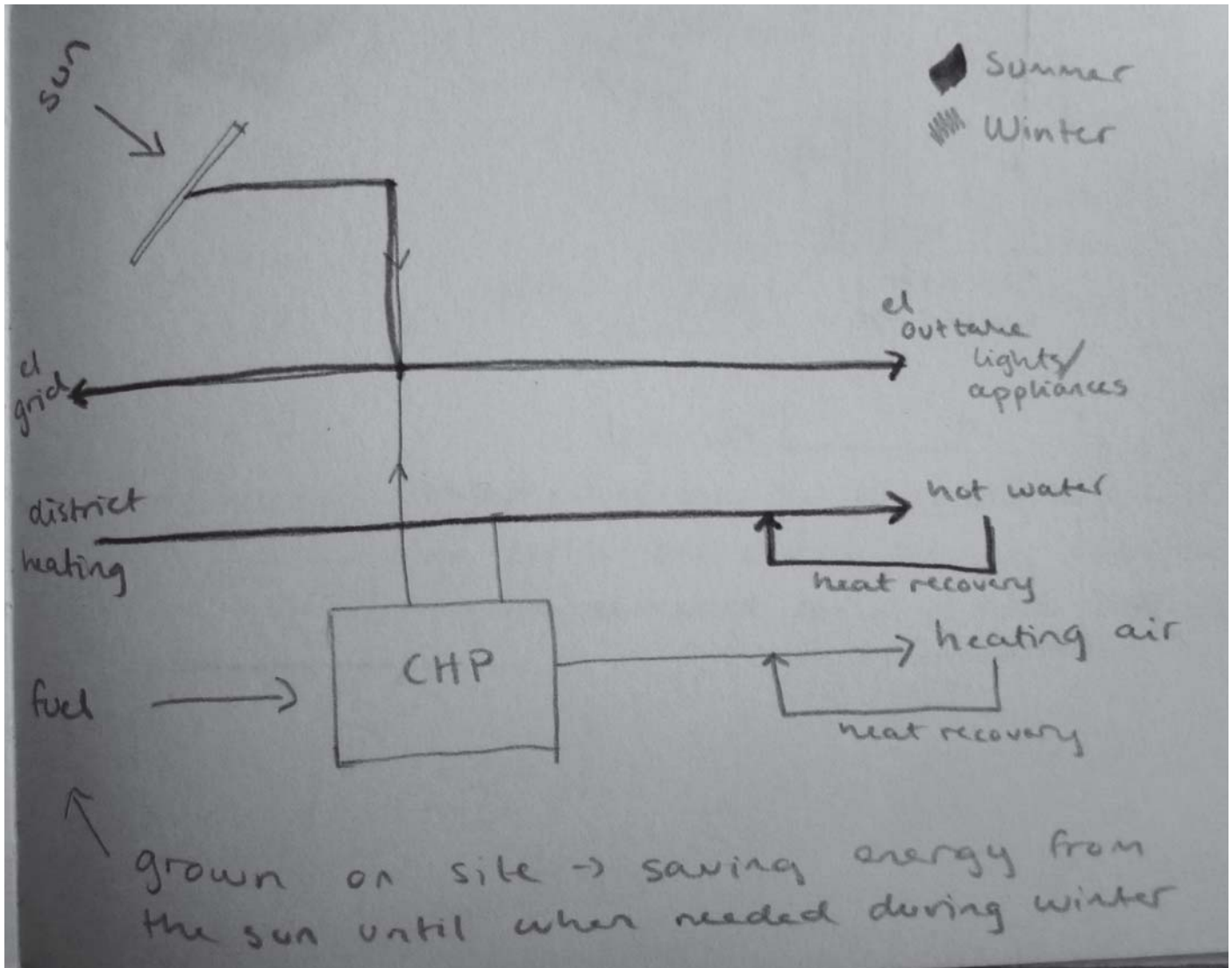




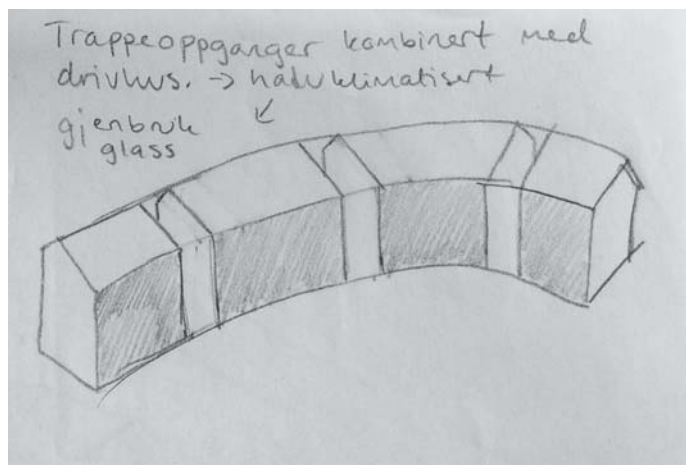
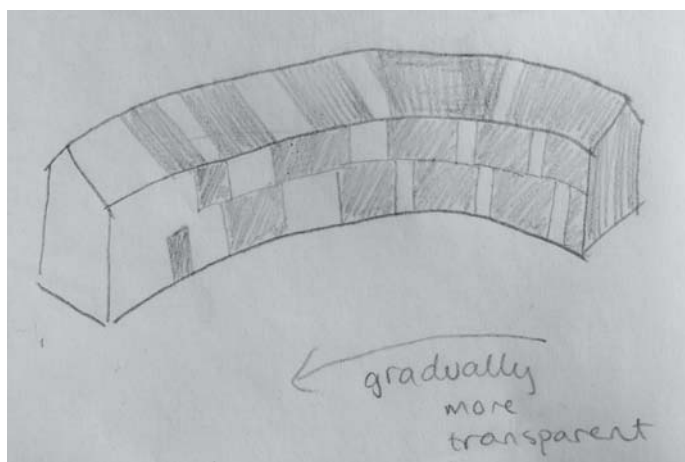
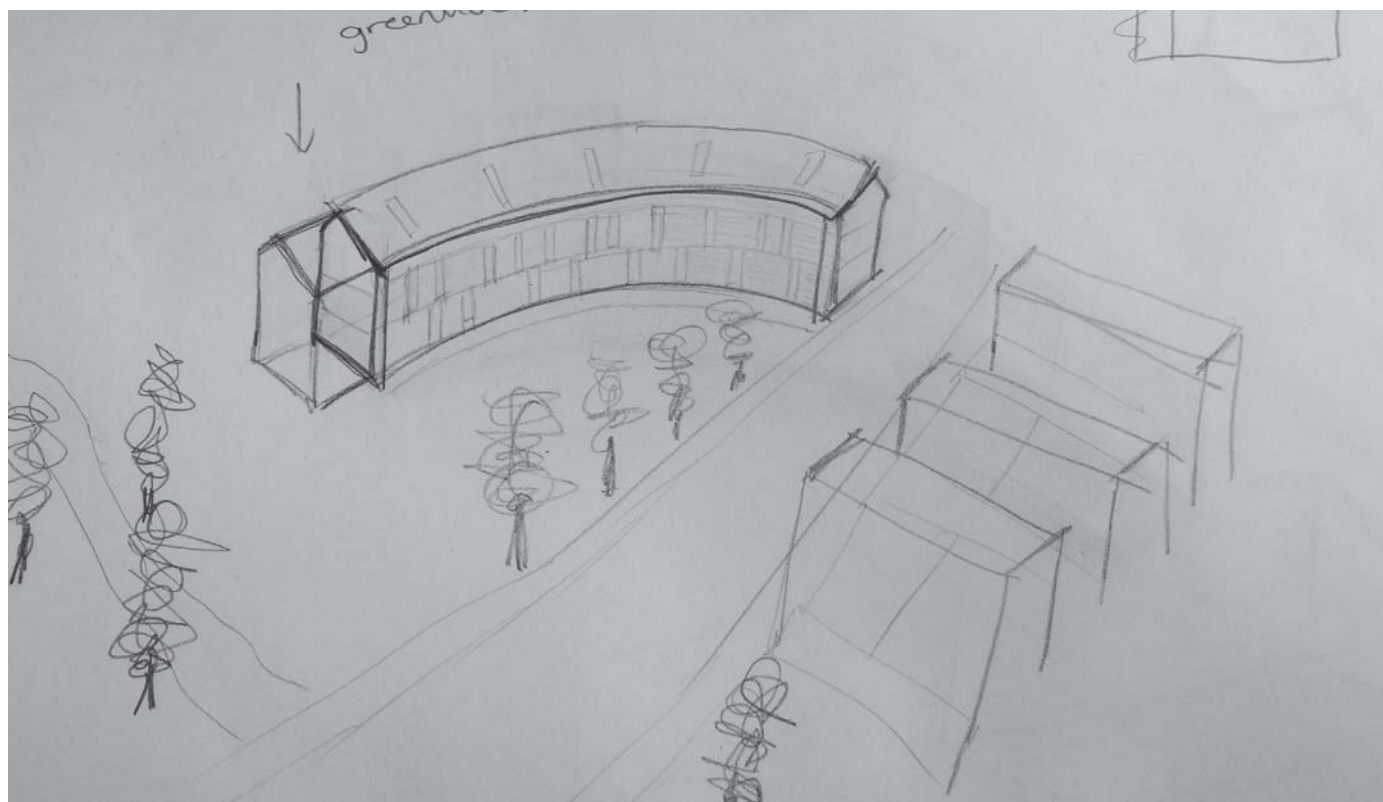


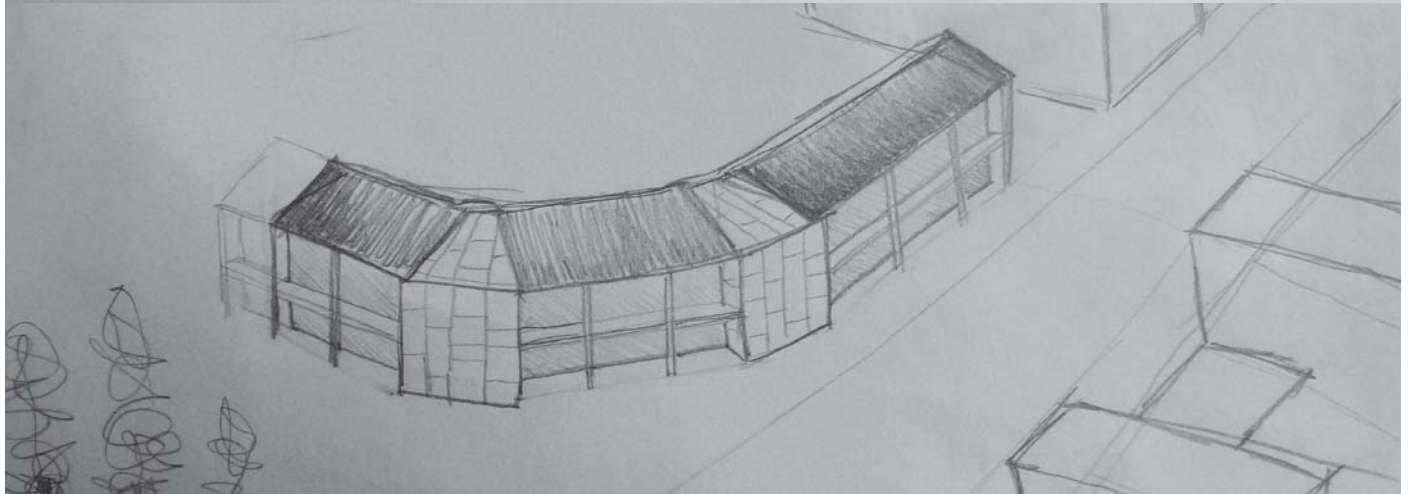
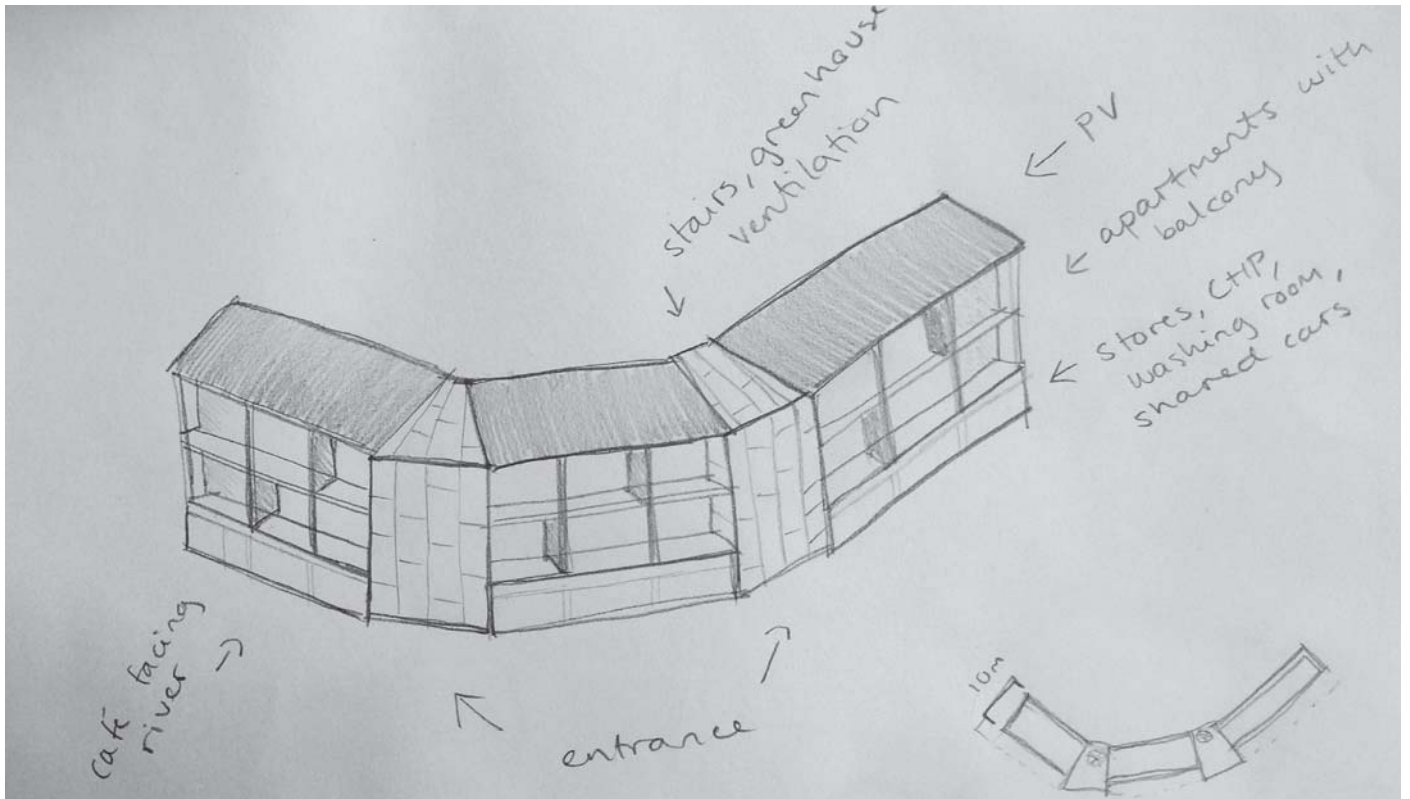


Growing on site to use for fuel. It is a good way of storing energy. You can use the energy from the sun during summer to heat your house during winter. It's like a sustainable battery. If the fuel is used in a CHP you get both heat and electricity. This is a good combination together with PV panels, because then you have electricity from the CHP during winter, when the PV is not producing that much.



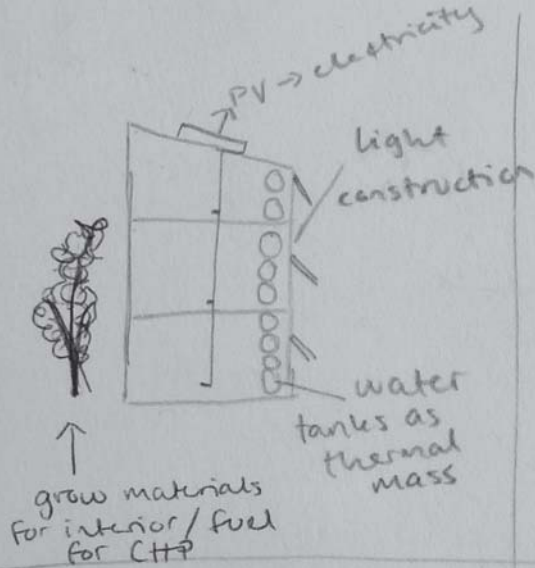
Sketch of possible energy system. When asking a person from Sintef if it was possible to grow fuel for the CHP on site, he said that it was probably not possible. You need a large area for growing, but also a suited place to dry what you grow and prepare it for use in the CHP. In Trondheims case, it would maybe be better to use heat pumps, considering that fuel is not accessible from somewhere nearby. However, in the future it could be an option.





SUMMER

DAY



WINTER

light construction

rooms are warm when used / heated

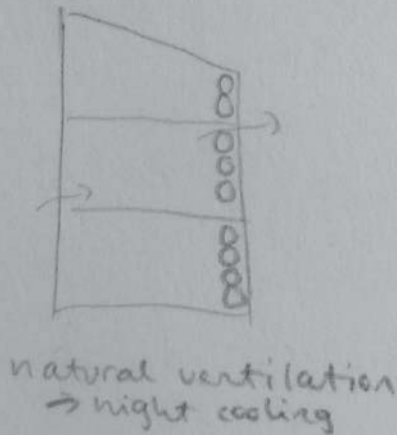
+20°C

CHP + District heating vs. (heatpump?)

Ideal temperature while sleeping → lowers heat loss (lower difference in/out)

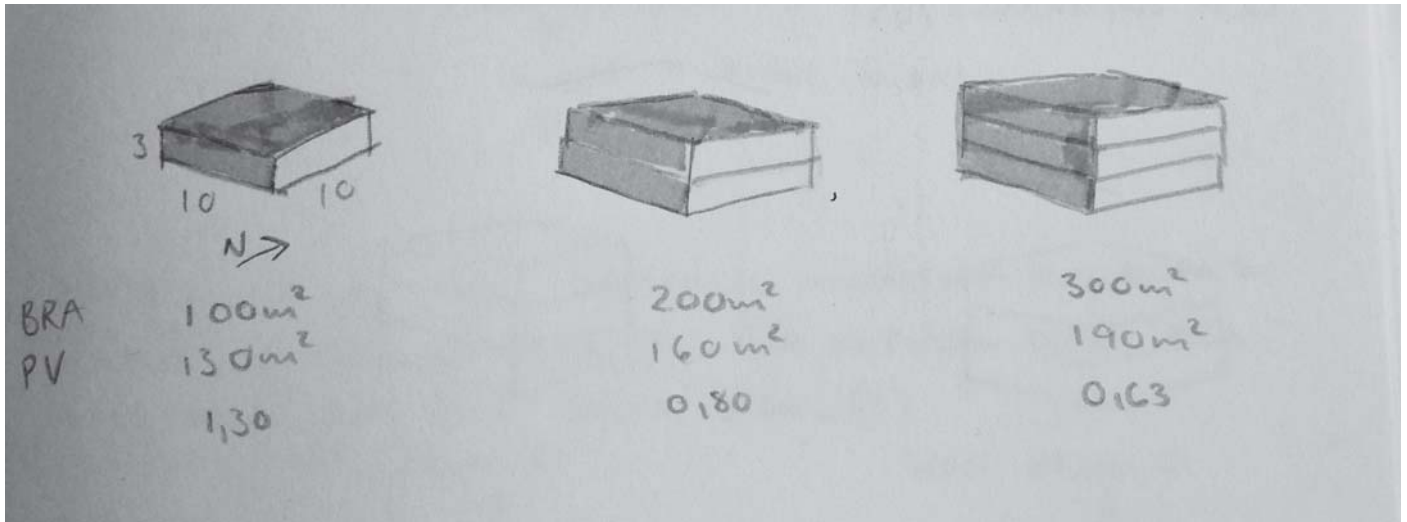
+14°C

NIGHT

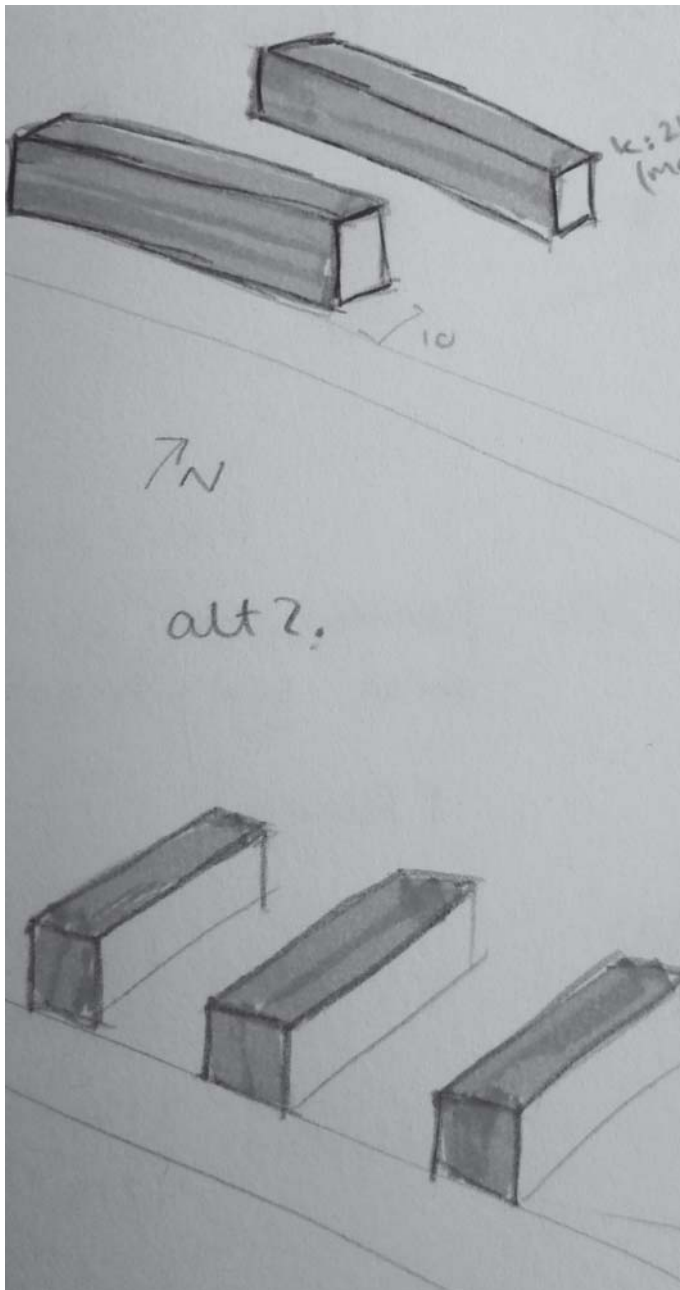


CHP





The roof and the south facade are best suitable for producing energy. The buildings surplus of energy is affected by the ratio between “Area of PV” and “heated floor area”. This ratio is becoming lower for every additional floor. It will be easier to make a zero emission building with a one story building than a three story building. However, it is not sustainable to build one story buildings close to the city centre.



Area roof: 1050m<sup>2</sup>

Area south facade: 367,5/floor (3,5m)

PV/heated area:

If 1 floor:  $1417,5/1050 = 1,35$

If 2 floors:  $1785/2100 = 0,85$

If 3 floors:  $2152,5/3150 = 0,68$

Area roof: 1040m<sup>2</sup>

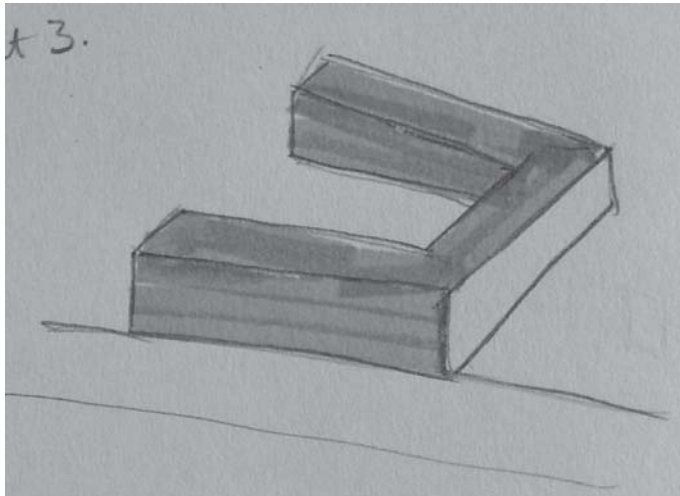
Area south facade: 105/floor (3,5m)

PV/heated area:

If 1 floor:  $1145/1040 = 1,10$

If 2 floors:  $1250/2080 = 0,60$

If 3 floors:  $1355/3120 = 0,43$



Area roof: 1290

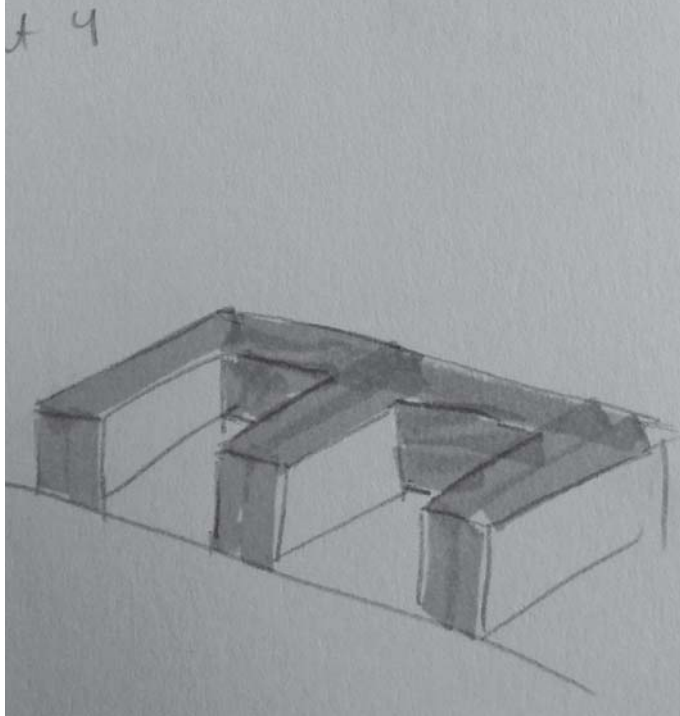
Area south facade: 367,5/floor (3,5m)

PV/heated area:

If 1 floor:  $1657,5/1290 = 1,28$

If 2 floors:  $2025/2580 = 0,78$

If 3 floors:  $2392,5/3870 = 0,62$



Area roof: 1406

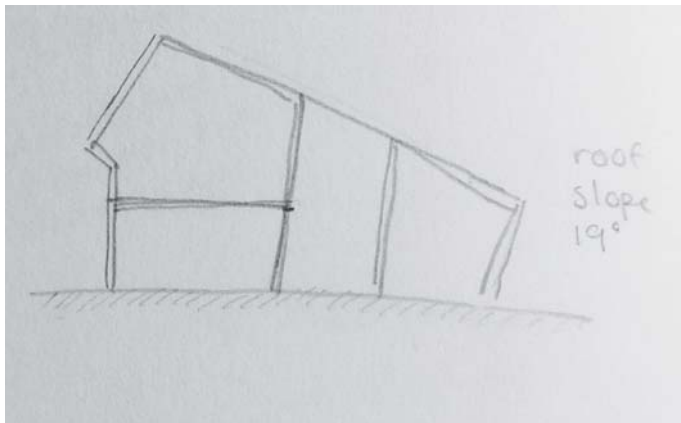
Area south facade: 590/floor (3,5m)

PV/heated area:

If 1 floor:  $1996/1406 = 1,42$

If 2 floors:  $2586/2812 = 0,92$

If 3 floors:  $3176/4218 = 0,75$



### ZEB Pilot House - Snøhetta

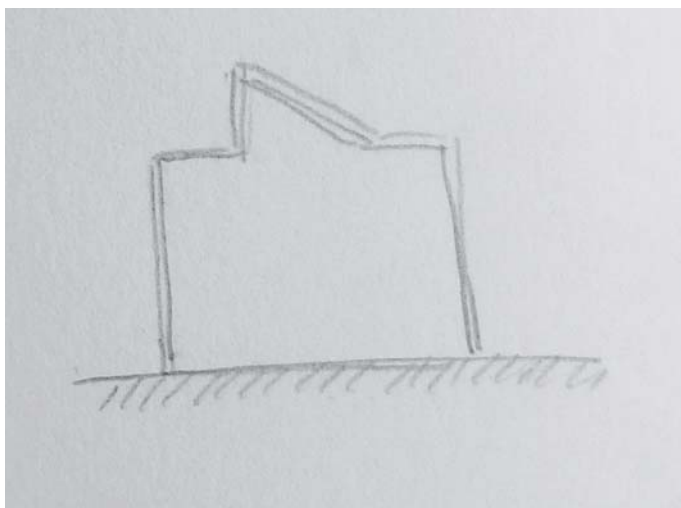
Area PV: 150m<sup>2</sup>

Heated area: 203m<sup>2</sup>

Solar collectors: 16m<sup>2</sup>

PV/heated area:

$$166/200=0,83$$



### ZEB Living Lab

Area PV: 70m<sup>2</sup>

Heated area: 100m<sup>2</sup>

PV/heated area:

$$70/100=0,70$$

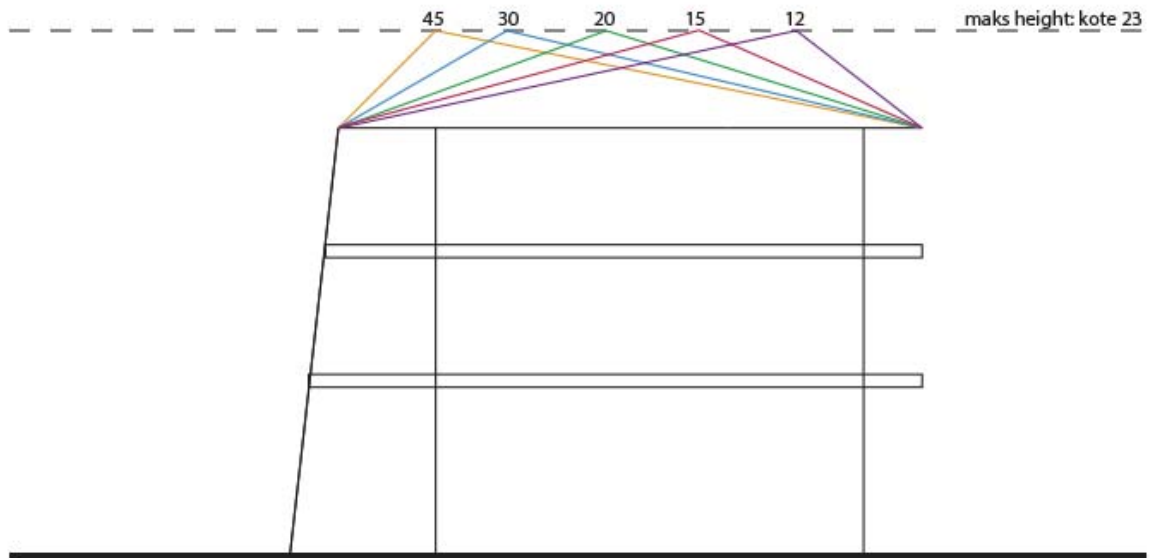
### Solar Siedlung, Freiburg

Area PV: 50m<sup>2</sup>

Heated area: 138m<sup>2</sup>

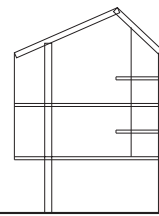
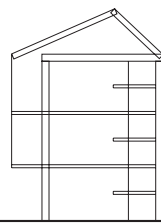
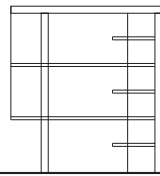
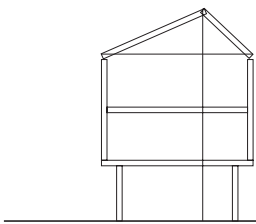
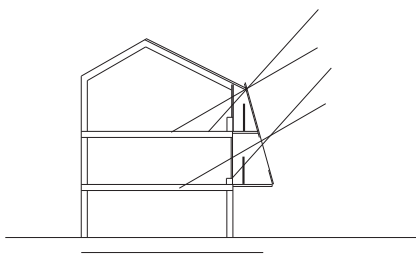
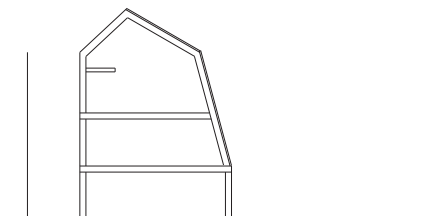
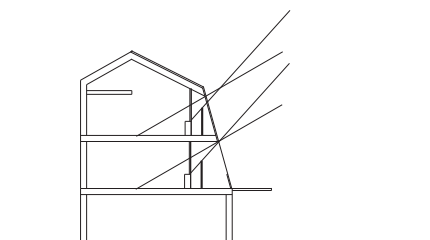
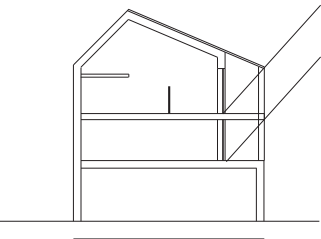
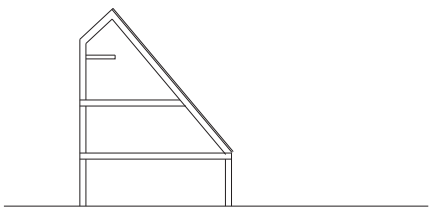
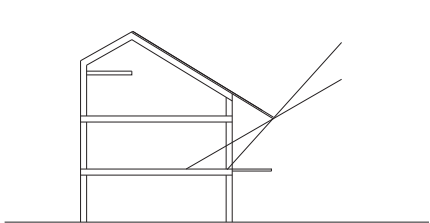
PV/heated area:

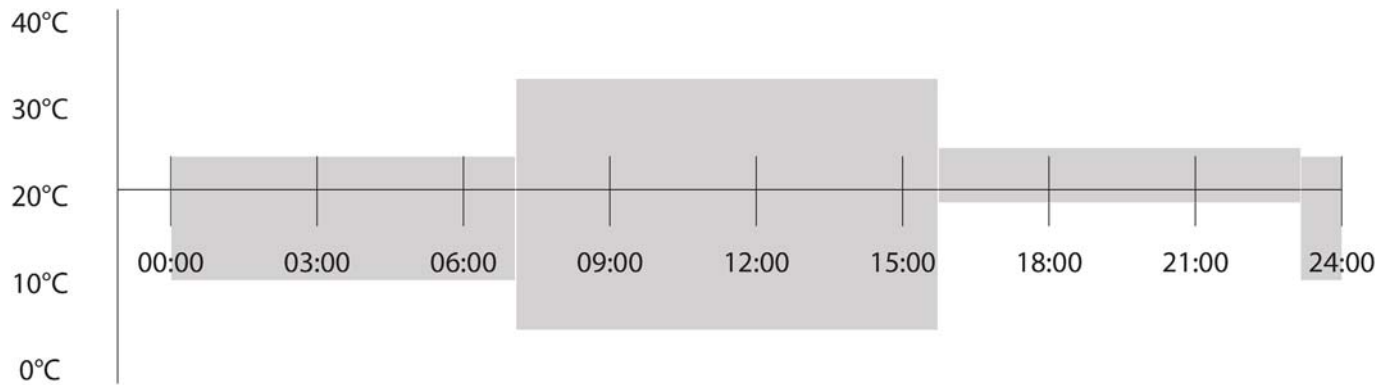
$$50/138=0,36$$



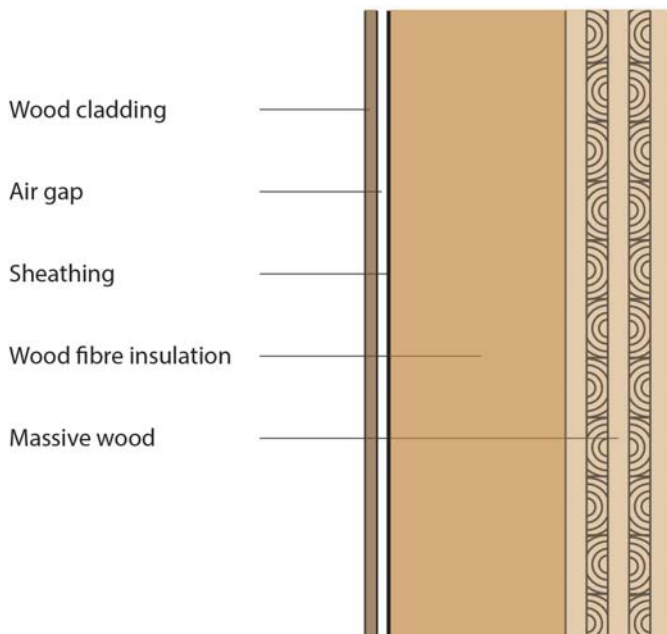
When the roof is steep, the production is better. However, the difference is not so big, and you get a bigger area for PV panels with a smaller angle







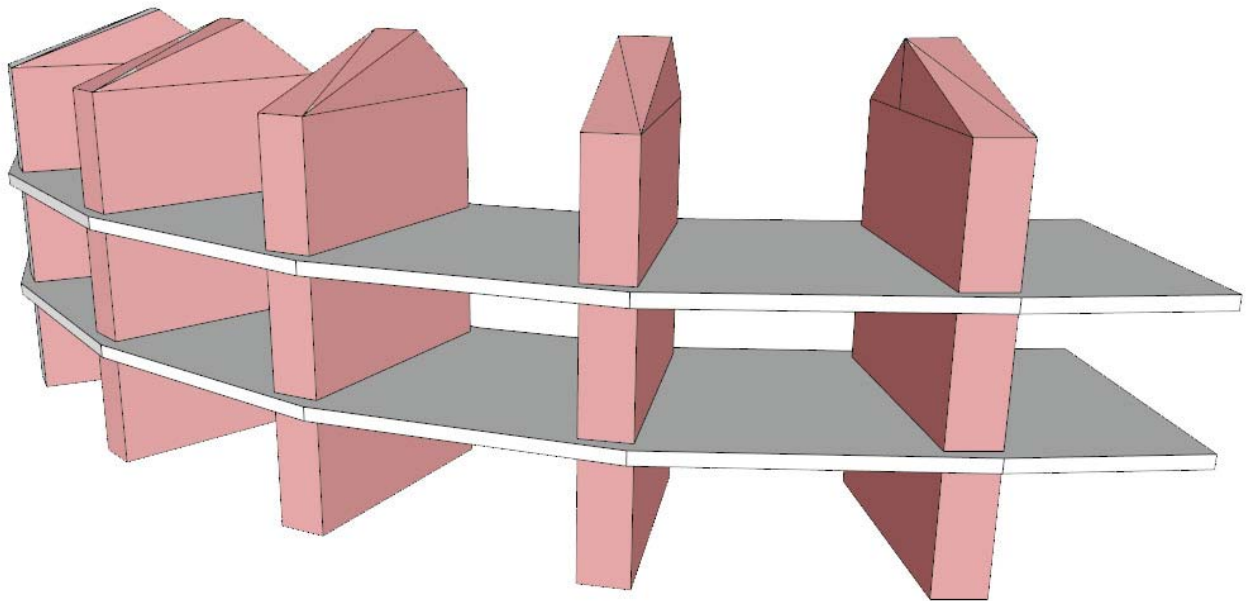
Typical day in a home. Work from 8-16, awake at home from 16-23, sleeping 23-07. When we are awake the temperature should be between 19-26 degrees. When we are away for work, the temperature can be anything, as long as it doesn't ruin the inventory. When we are sleeping we tolerate a much lower temperature.



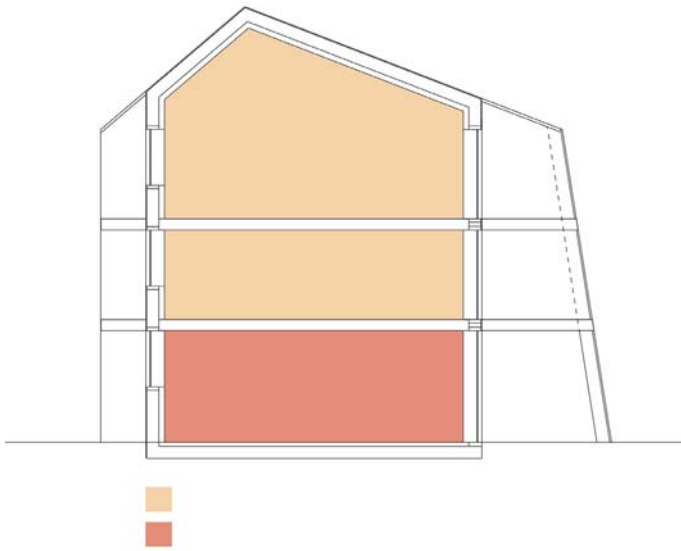
Having a light structure because there is only a period of time when the temperature has to be in the range we consider comfortable.

With a light structure the air can more easily be heated when the building is being used.

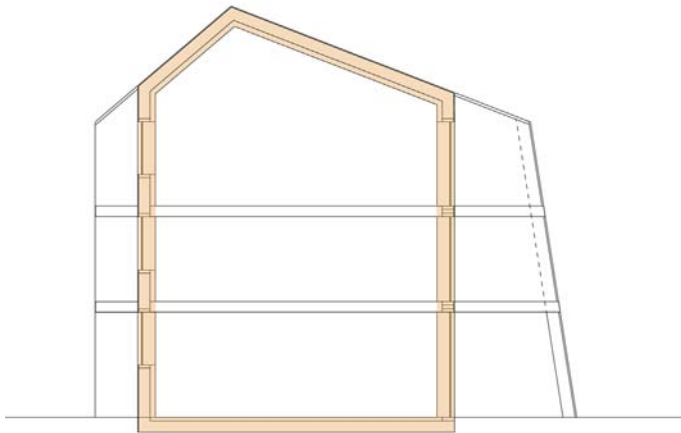
-> Wood can not store the same amount of heat as bricks or concrete.



Technical walls to reduce pipes. All technical is in this wall only. Negative; the rooms are not so flexible. Also the technical part is very big compared to the living area.



Public areas in the ground floor, residential in the floors above



Compact and highly insulated form to reduce heat loss.

---

## Where do we meet?

Work/school  
Stores  
Parks  
Library  
Bus/bus stop  
Cinema/theatre  
Museum  
Restaurants/cafes  
(Post office)  
Sports  
Concerts

## Can the meeting places of the city be interpreted to a meeting places for the residents of the building?

Common working space  
Common outdoor area/garden  
Shared book shelf  
Common kitchen/dining area/grill  
Movie-room  
Game-room

## Other possible meeting places:

Laundry room  
Mailboxes  
Bike parking  
Stairs/entrance

A lot of activities would be attractive, but then you also need a lot of people. Can other people than the residents also be included?

Having activities connected to the stairs/the way home, so that when you pass it you see if there are people.

## Concept:Materialism **Fighting materialism**

We live in a “use and throw away” society. How can we live to reduce how much we buy?

“The Bookshelf” -> a library, leave the book you finished (also book club?) (shop: change your books)

“The Closet” -> leave the clothes that are too small/big, changing events (shop: change your cloths)

“The Fridge” -> a kitchen/dining area, if you can't finish something before it expires/buy a spice you only need once (also cook together, christmas baking.. osv.. rentable area when they want bigger parties.)

Share wierd kitchen tools

“The Toolbox” -> workshop, shared tools, fixing broken things/making new ones

“The Washing machine” -> laundry room

Share car

*Nowadays people know the price of everything and the value of nothing - Oscar Wilde*

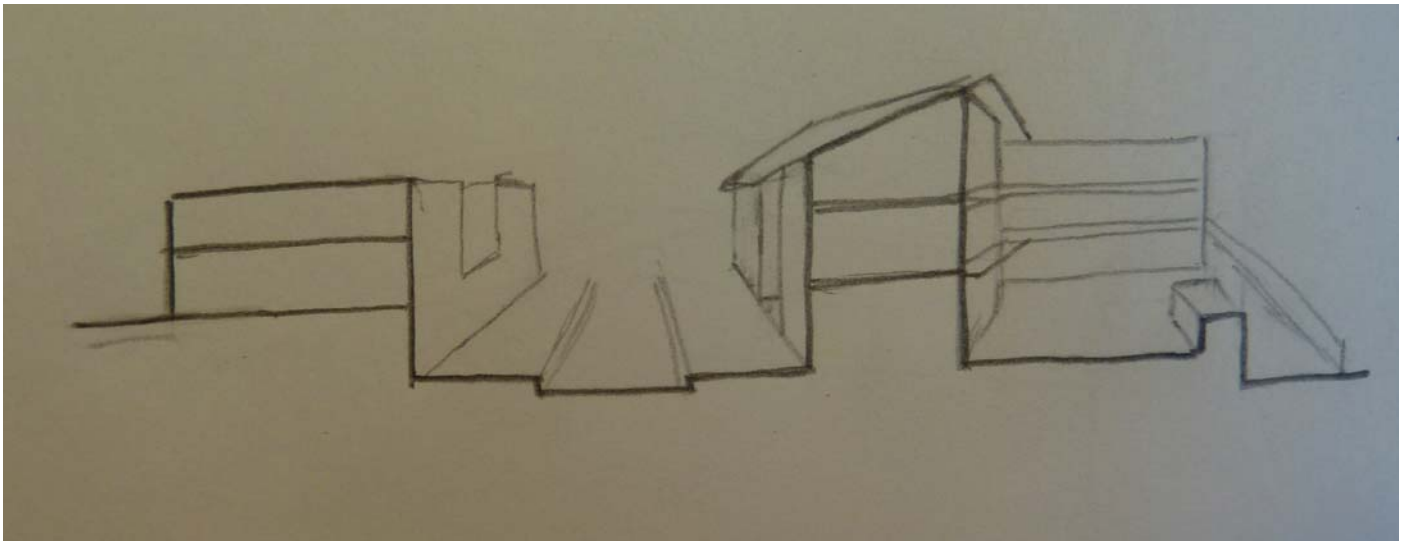
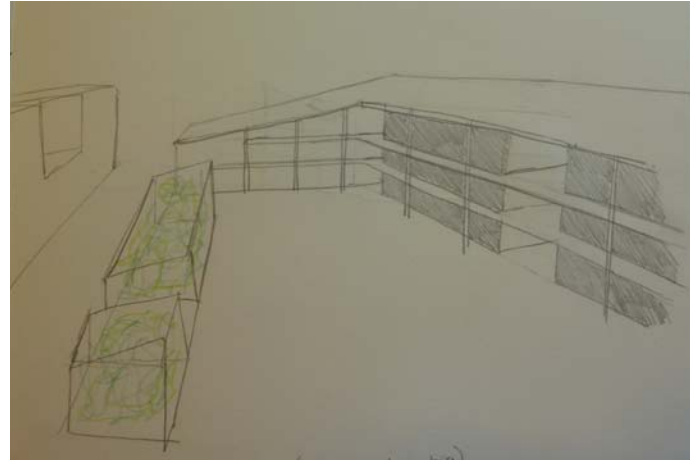


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I looked at the options of having a building next to the road, and having one pulled back to the north.

The one that is pulled back to the north creates a square in front of itself with good light conditions. However, it also creates a lot of shadow for the kindergarten. The square requires a lot more people to look active, and should be more programmed than the other option.

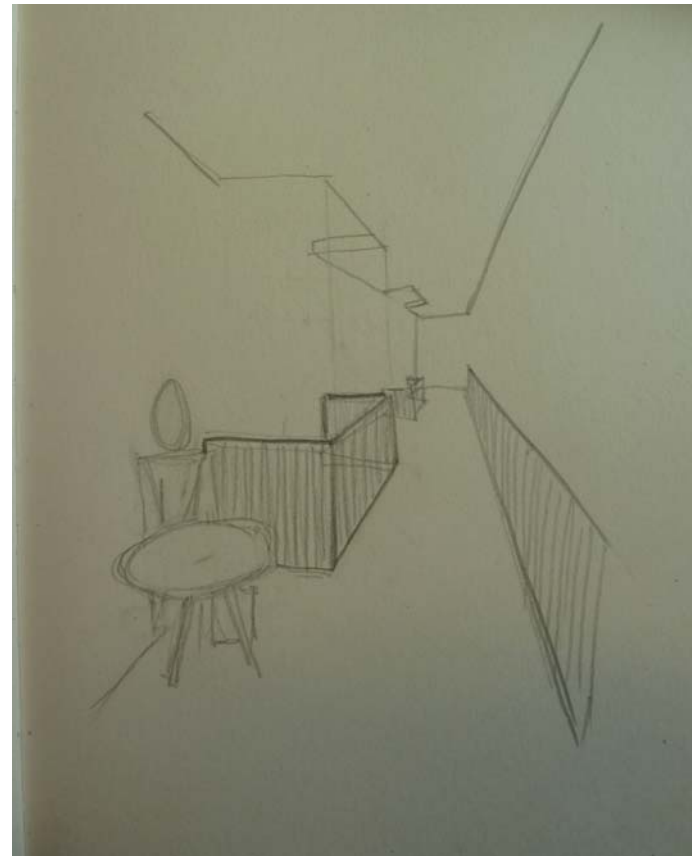
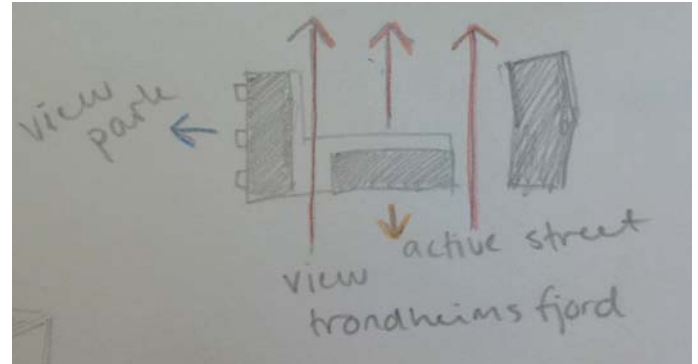
The option with the building next to the street defines the street. It also creates a more quiet backyard for the residents.

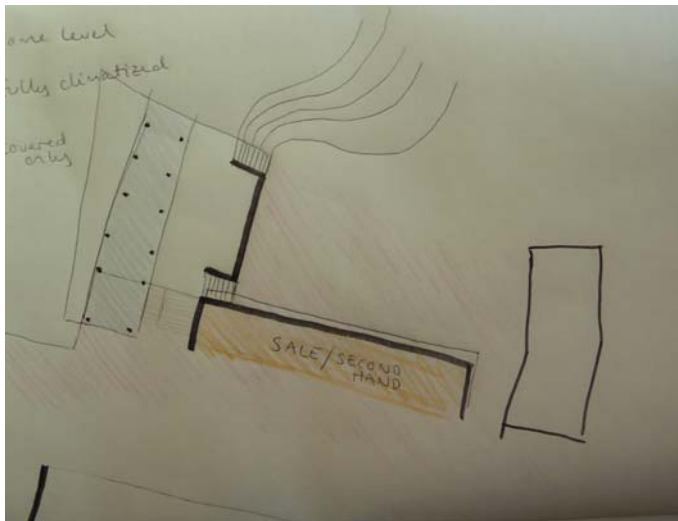


The ground floor should be where the residents meet the public. The “svalgang” where they meet each other.

In the ground floor facing the street, there is a second hand shop, where people can bring their clothes, books, dvds, furniture... Facing the park is a workshop, where people can fix broken things, make something new of something broken, recycle. The residents can have an own “garbage” bin for what can be made into something new.

The “svalgang” should be entered from the street to give some extra activity. When walking up the stairs they have a view to the silos on Ila. The “svalgang” will be pulled out of the facade, creating bridges to the entrance doors. In this way, they get a small private space in front of their door.





### **What is most important for my project?**

Problem: materialism, the use and toss society.

The building should be robust, have a long lifetime and be built from environmental friendly materials.

The inventory should be more flexible to fit different people, functions and trends. Should be recycled, reused or fixed.

Concept in few words

### **How can the building fulfil the concept (on all levels)**

Robust building that allows flexible use. Create a frame for individuality.

**How to make wood construction last for a long time?/** or be easy to change the parts that are rotten

Inventory that is reused, recycled, fixed. Gives variety and identity to the people. It can have a bigger value because of its history.

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## FLEXIBILITY

Houses can be flexible in several ways.

- Possible extension

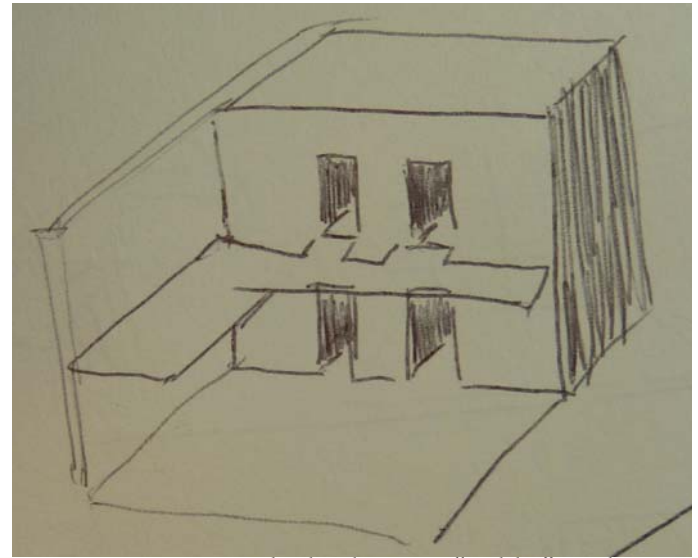
- Change function

- More functions in same room

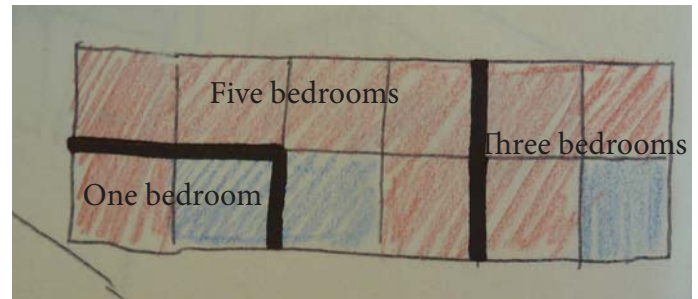
In a building there are some functions that will never be able to make easily moveable. Especially in a multi-story building. That is the functions that are directly related to pipes. (Kitchen/Bathroom/Technical)

To save pipes, the kitchen and bathroom are often made to a core

My **concept for flexibility** is to have a core that contains all pipes and cables. So that the other walls are free to be moved, and floor free to be removed.



Massive, Private to the back, open “public” to the front.



The top floors are bedrooms only. The bottom one a mix of bedroom and bathroom. The bedrooms can be divided depending on how many bedrooms one needs.

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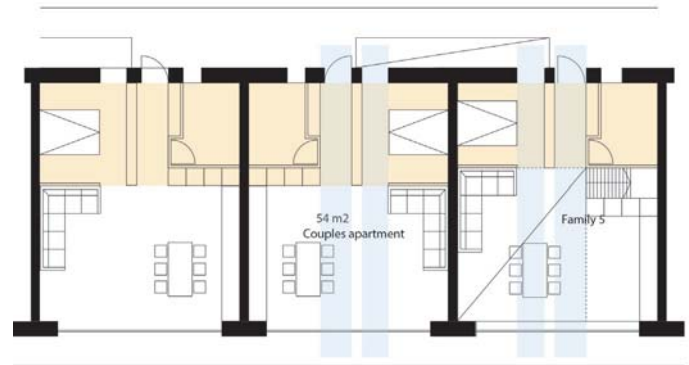
Bathroom, bedroom to north. They are the most private part of the home. and should be directed away from the road. Towards north they also have the morning sun when they wake up.

Open flexible area to the front (street/park).

Entrance from back. Balcony to south.

Water core shared by two apartments. Possible with natural ventilation.

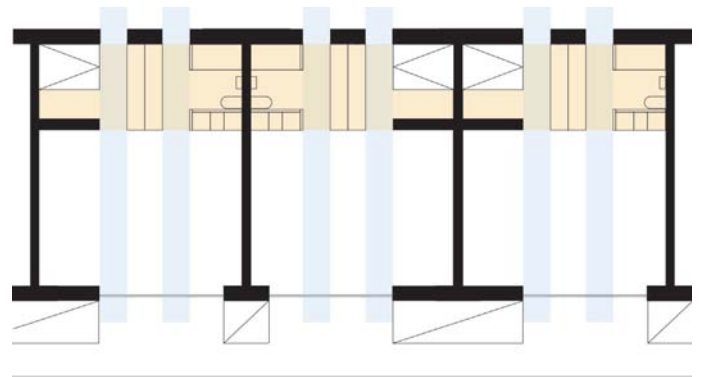
Possible to have stairs to a second floor with rooms for children.



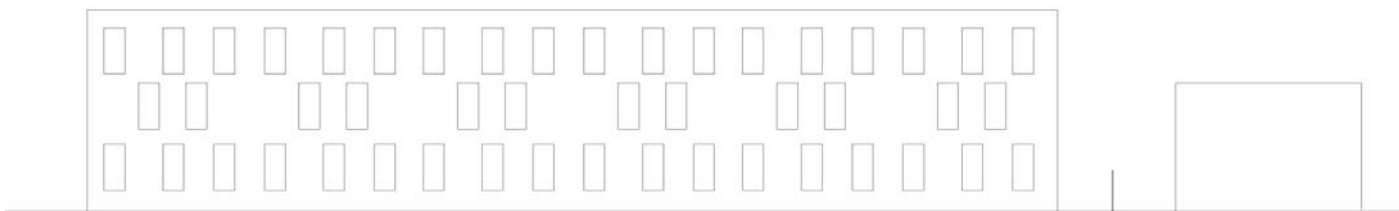
Other option is having the entrance from the front. The back becomes more private, but people walk in front of your living room..

Open flexible area to the front (street/park). Water core shared by two apartments. Possible with natural ventilation.

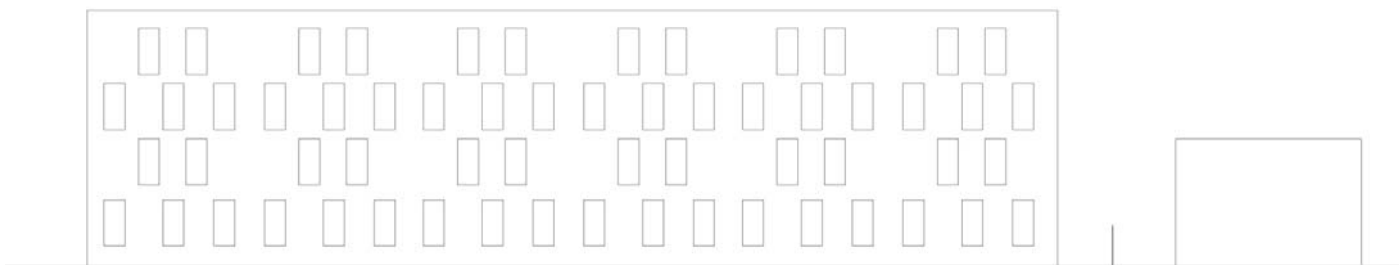
Kitchen area quite small







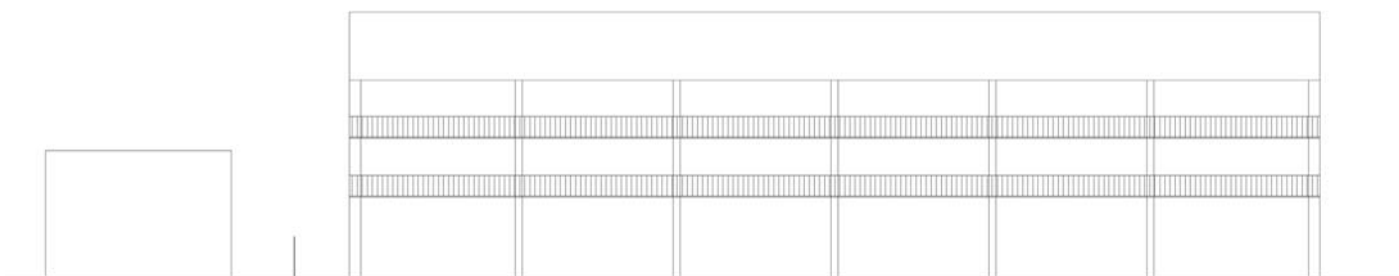
Fasade mot nord med 3 etasjer



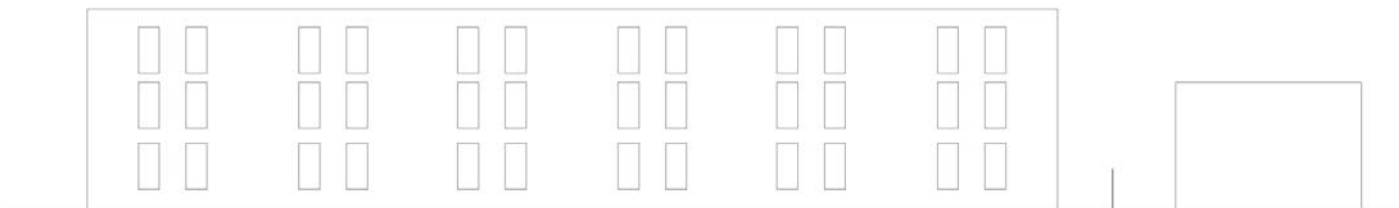
Fasade mot nord med 4 etasjer



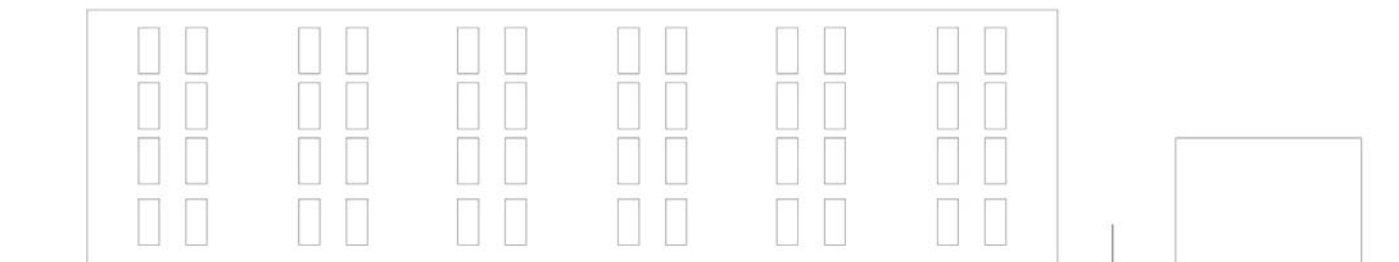
Fasade mot sør med 3 etasjer  
Flatt tak



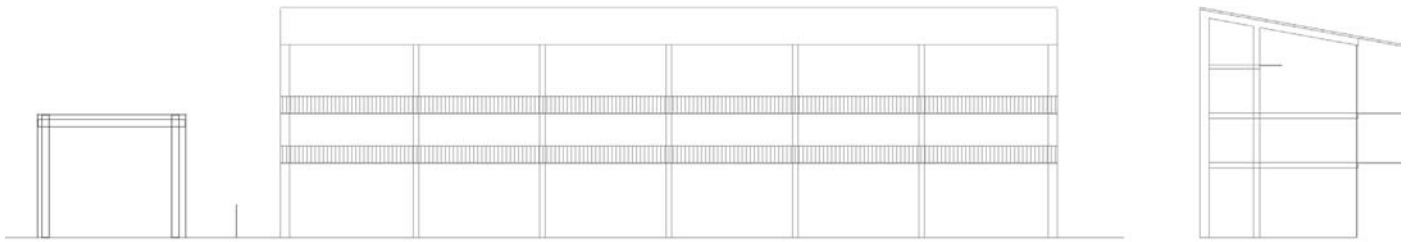
Fasade mot sør med 4 etasjer  
Skrått tak



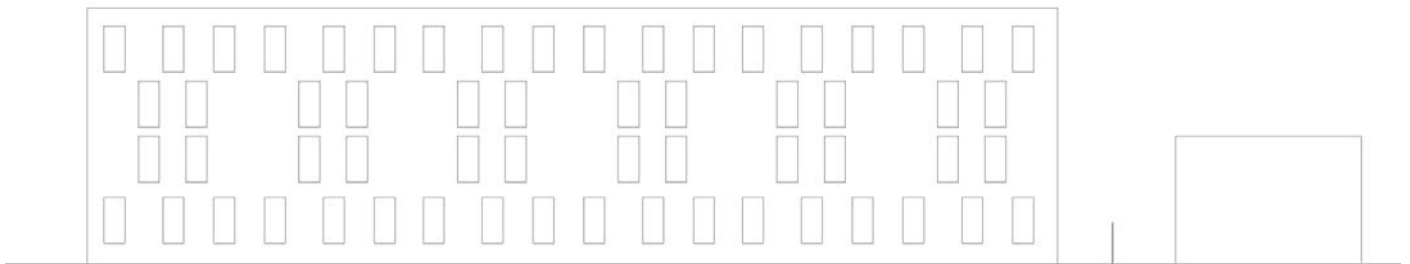
Fasade mot nord med 3 etasjer.  
Alle soverom like store



Fasade mot nord med 4 etasjer.  
Alle soverom like store



Fasade med tilhørende snitt



Fasade når leilighet i 2etg,  
familie i 3-4 etg

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Concept building:

closed, massive wall towards north, with openings for view towards the silos of Ila.

light, transparent wall towards south, for good sun conditions and to activate square

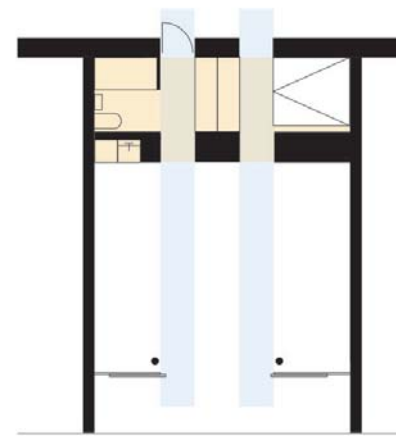
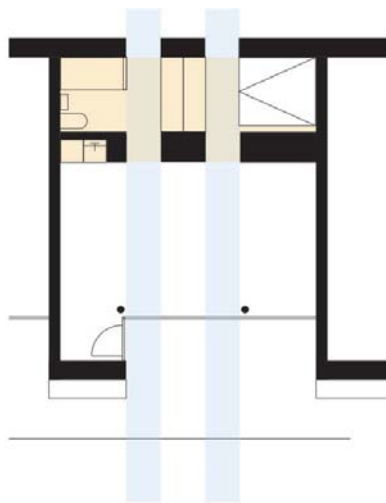
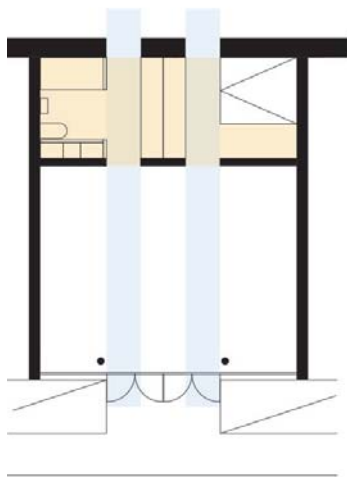


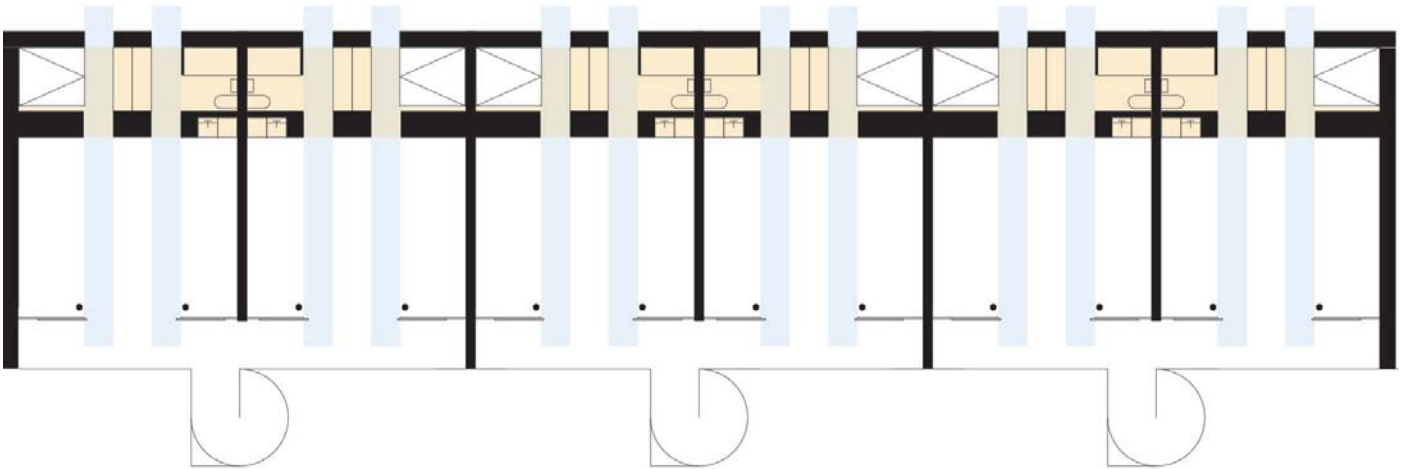
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At the moment the entrance is directly into the living room (option 1). It is made by a bridge from the entrance gallery, but it is not very private.

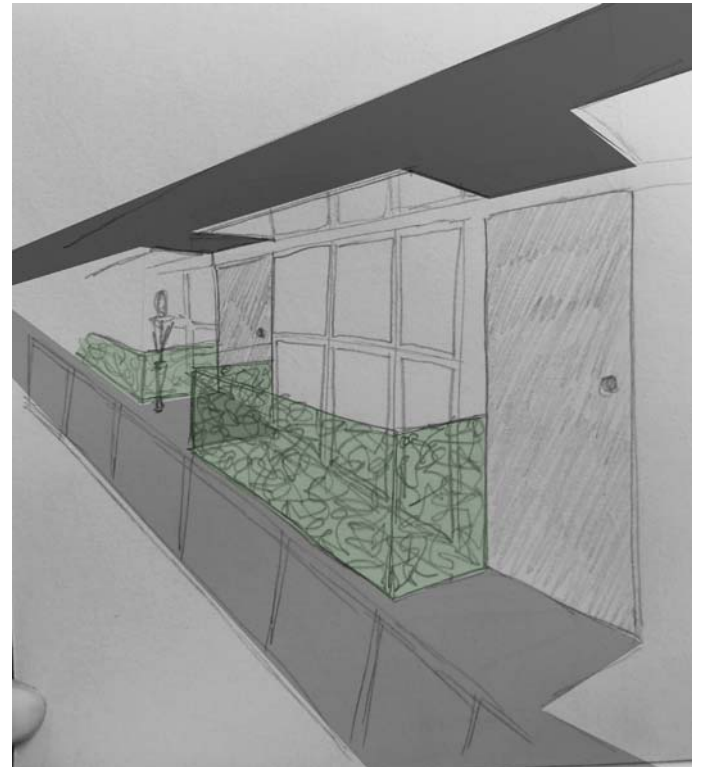
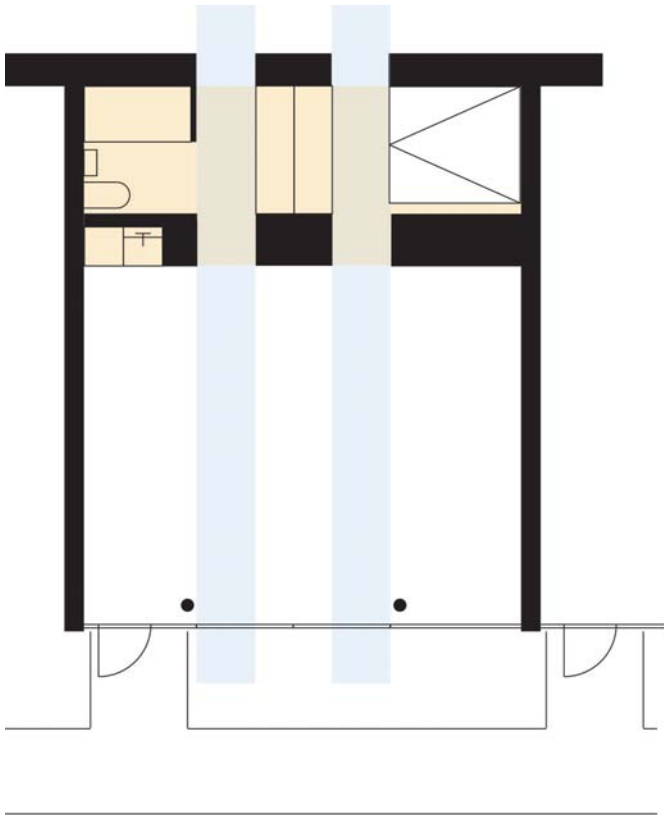
Another solution is making a small entrance area by pulling back part of the facade (option 2). It is ruining the simple shape of the apartment, but maybe it could work with more processing. However, it takes away the light look of the facade. (right sketch)

As I had earlier the entrance can quite easily be made from the back, next to the bathroom (option 3). However, then I need a gallery on the north side of the building, and it might ruin the massive look I want.



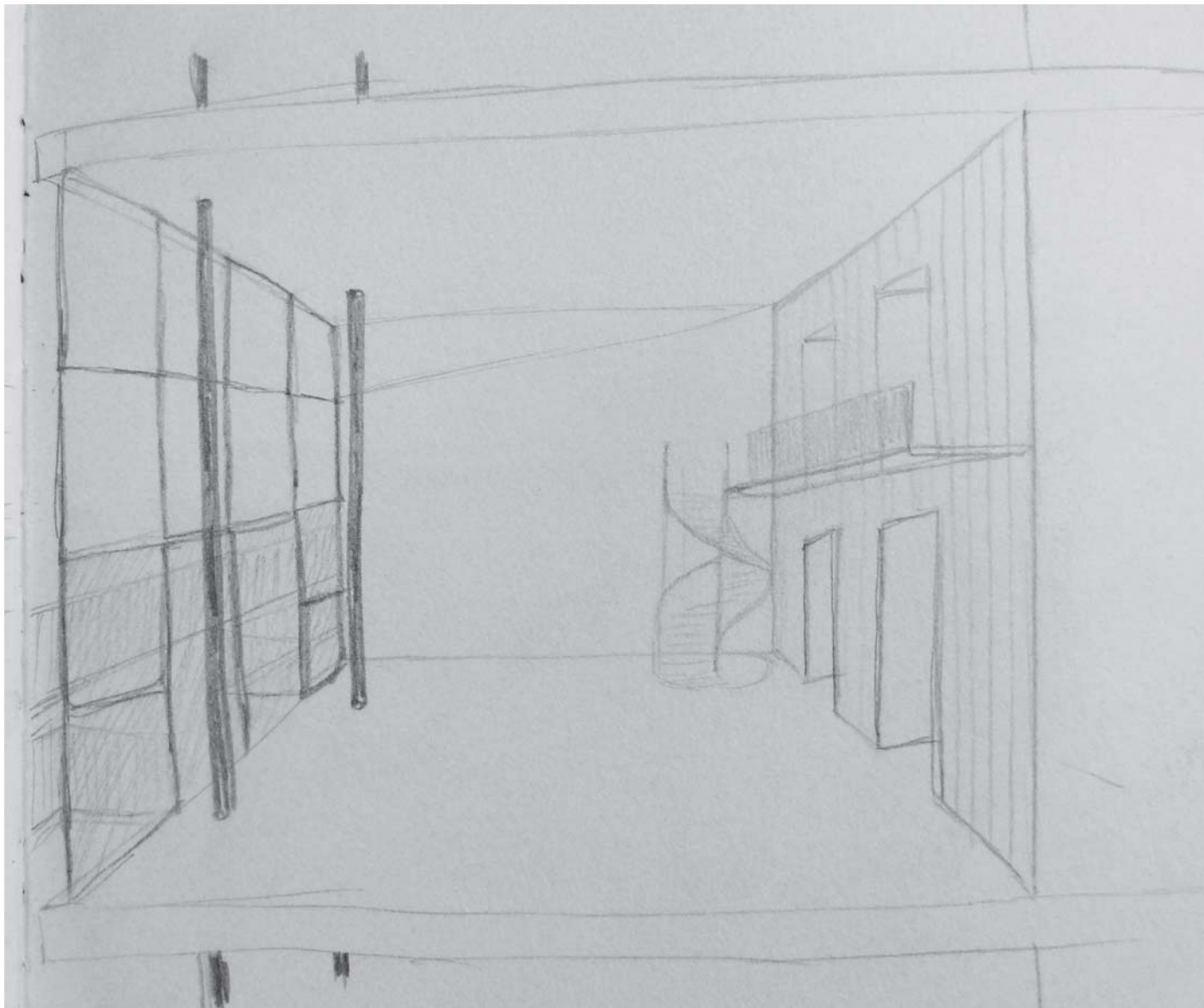


Entrance: Spiral stairs from street. Dividing the entrance to make it more private. But people get an even better view into your apartment when walking up to the next floor.



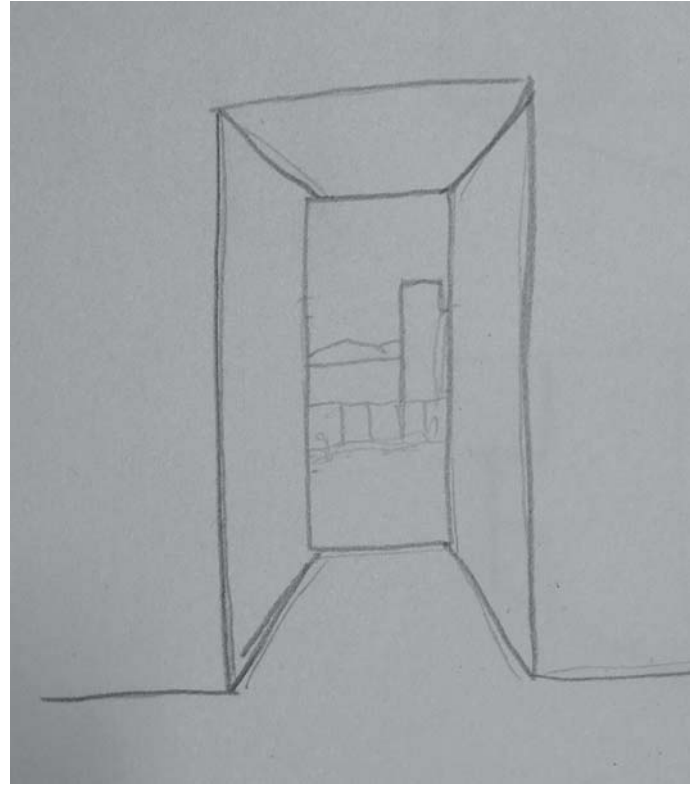
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Entrance: Bridge from gallery. The view into the living room is very good.. If the glazing is made translucent it would help, but then you also loose the view out.

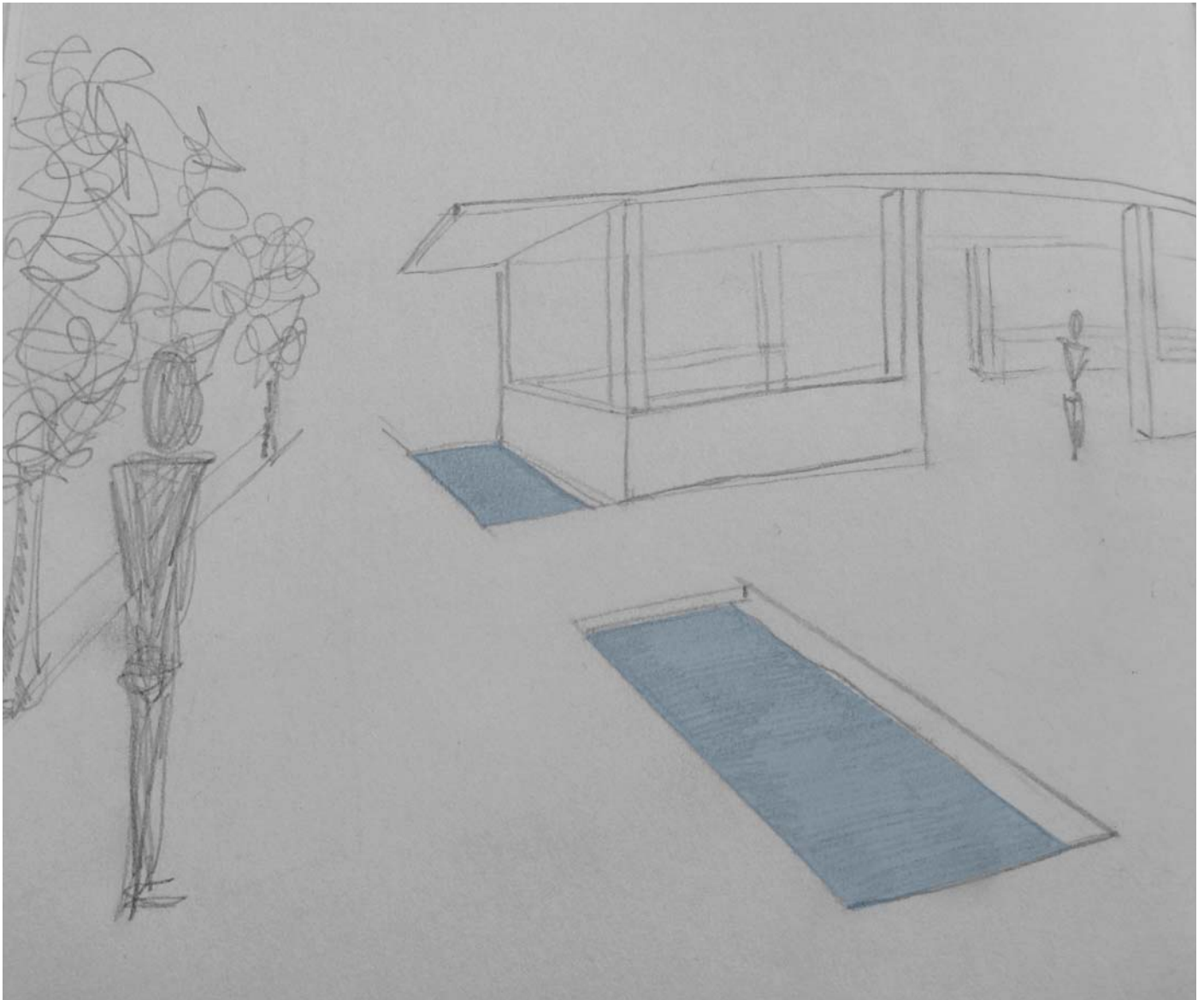


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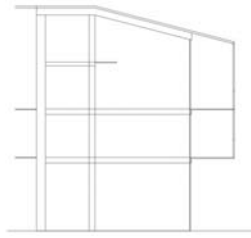
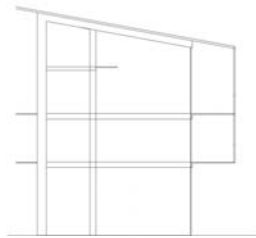
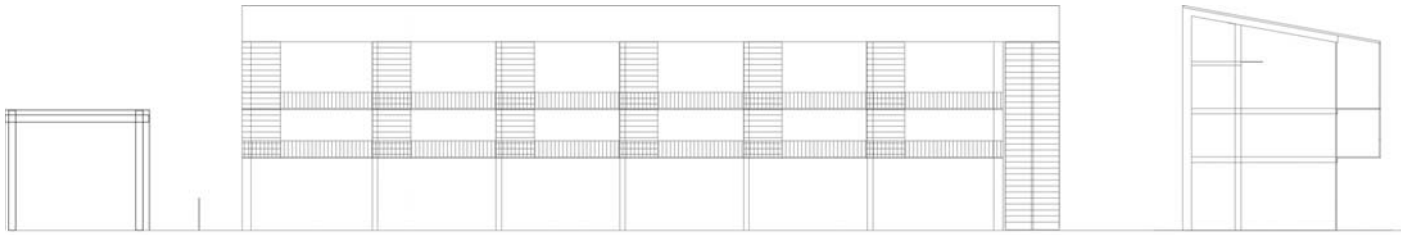
Massive private (bedroom and toilet) in back. (sketch left). Sight line through massive box towards fjord. (sketch right)





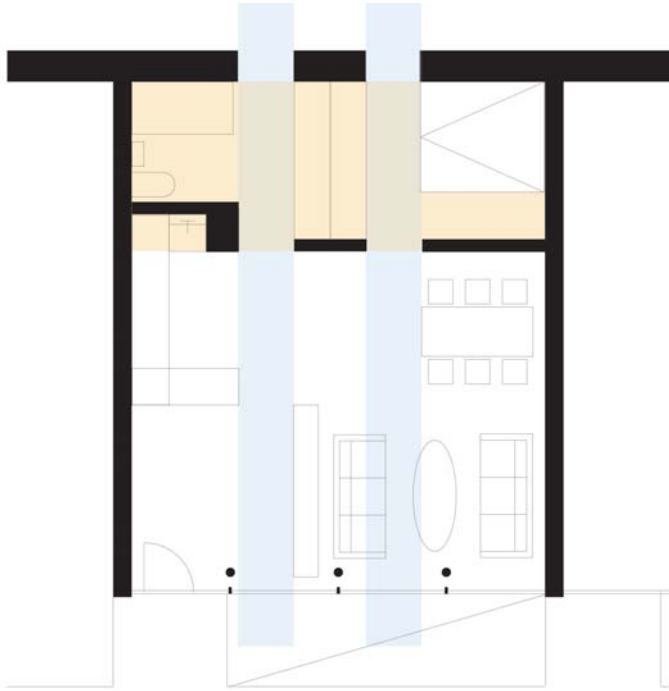


Water defining the site. Bridges over to the public square. As with the entrance.

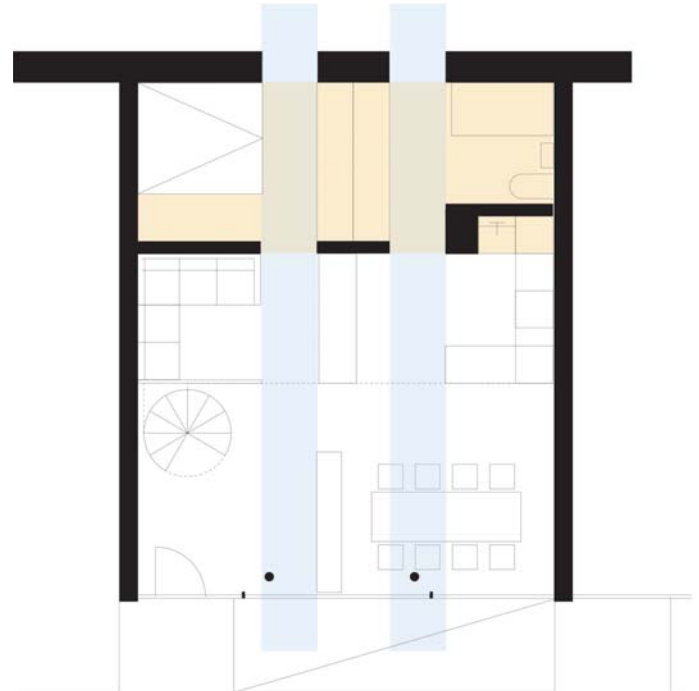


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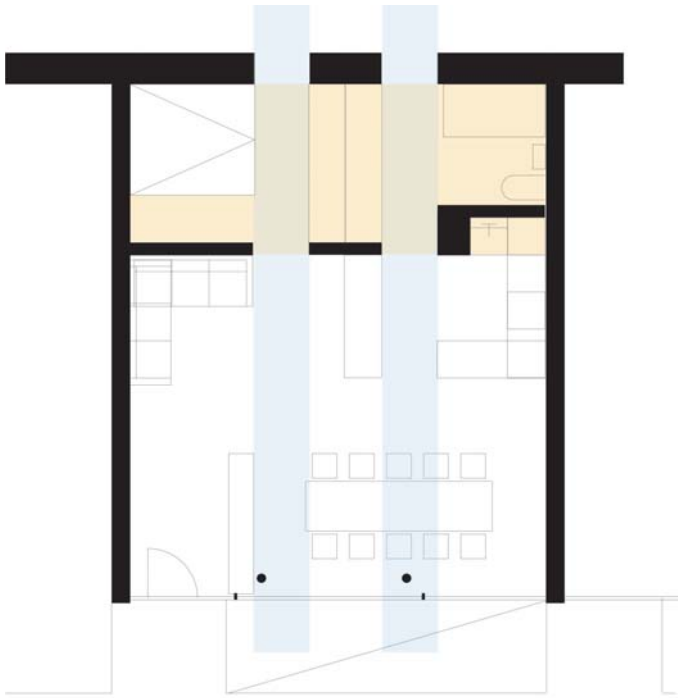
Flexible living areas, to fit different people



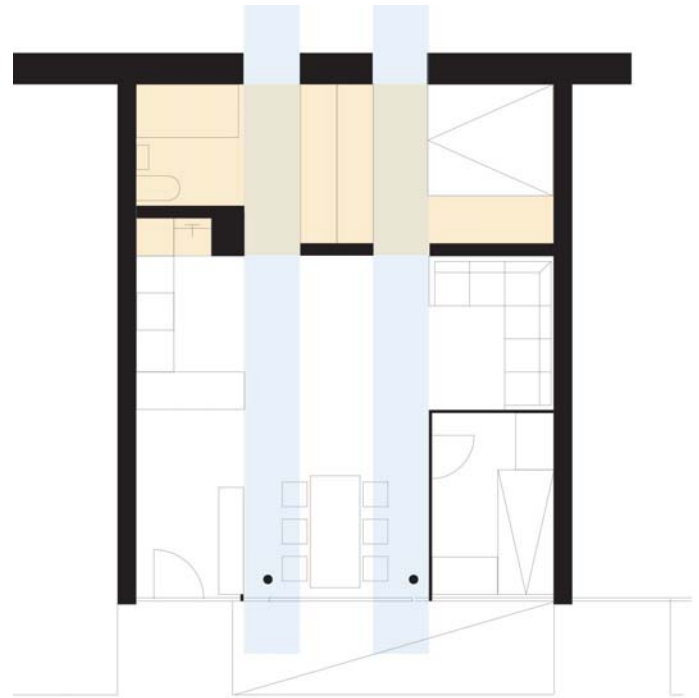
Living room area is the main priority.



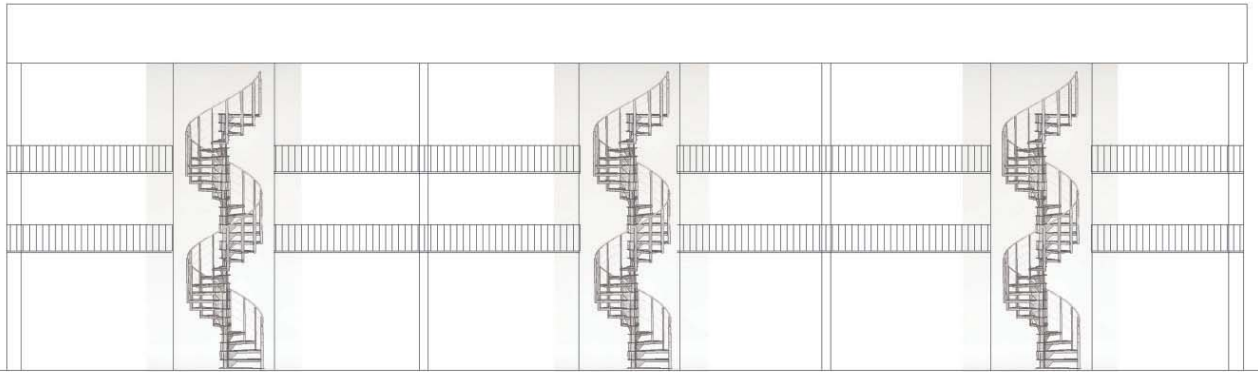
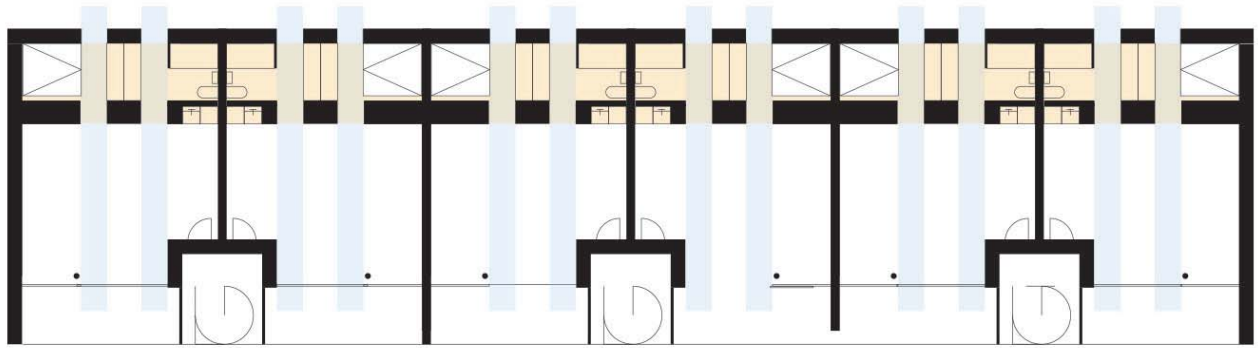
Kitchen and dining most important. For people who like to cook, and having guests for dinner. Double height for dining table. Stairs to second floor with bedrooms



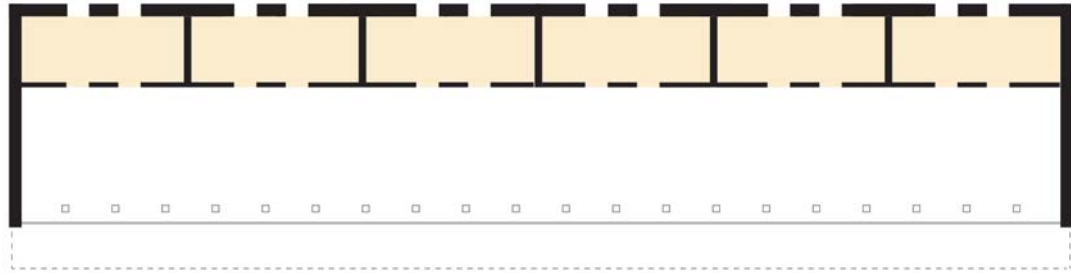
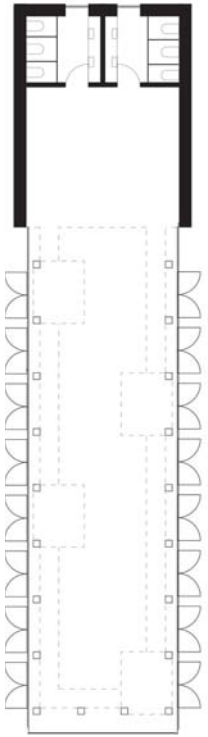
Kitchen and dining most important. For people who like to cook, and having guests for dinner. One floor only



Extra bedroom. Not optimal because it is towards south.

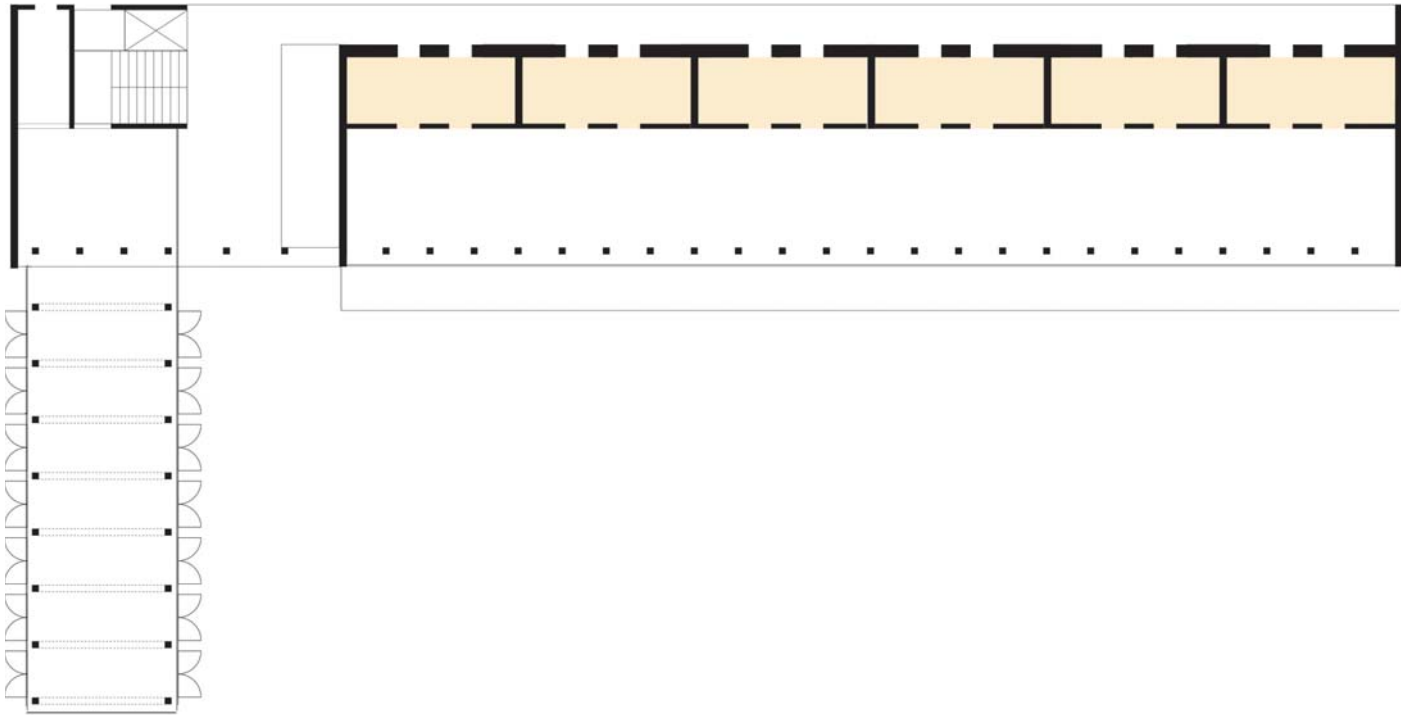


Avoiding the gallery entrance, but still having the entrance towards the street. Gives more privacy to the apartments. Each spiral stair is shared by four apartments.



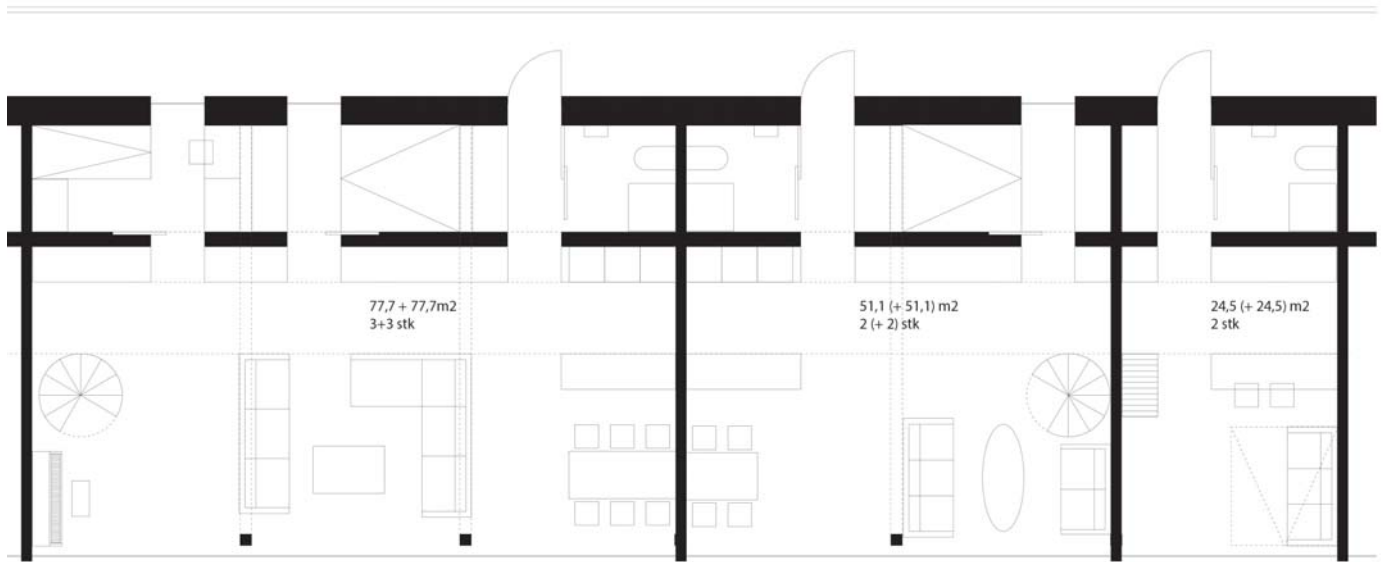
The workshop/common space building has the same massive back and open front as the apartment building. The light structure can be opened to both the square and the river.





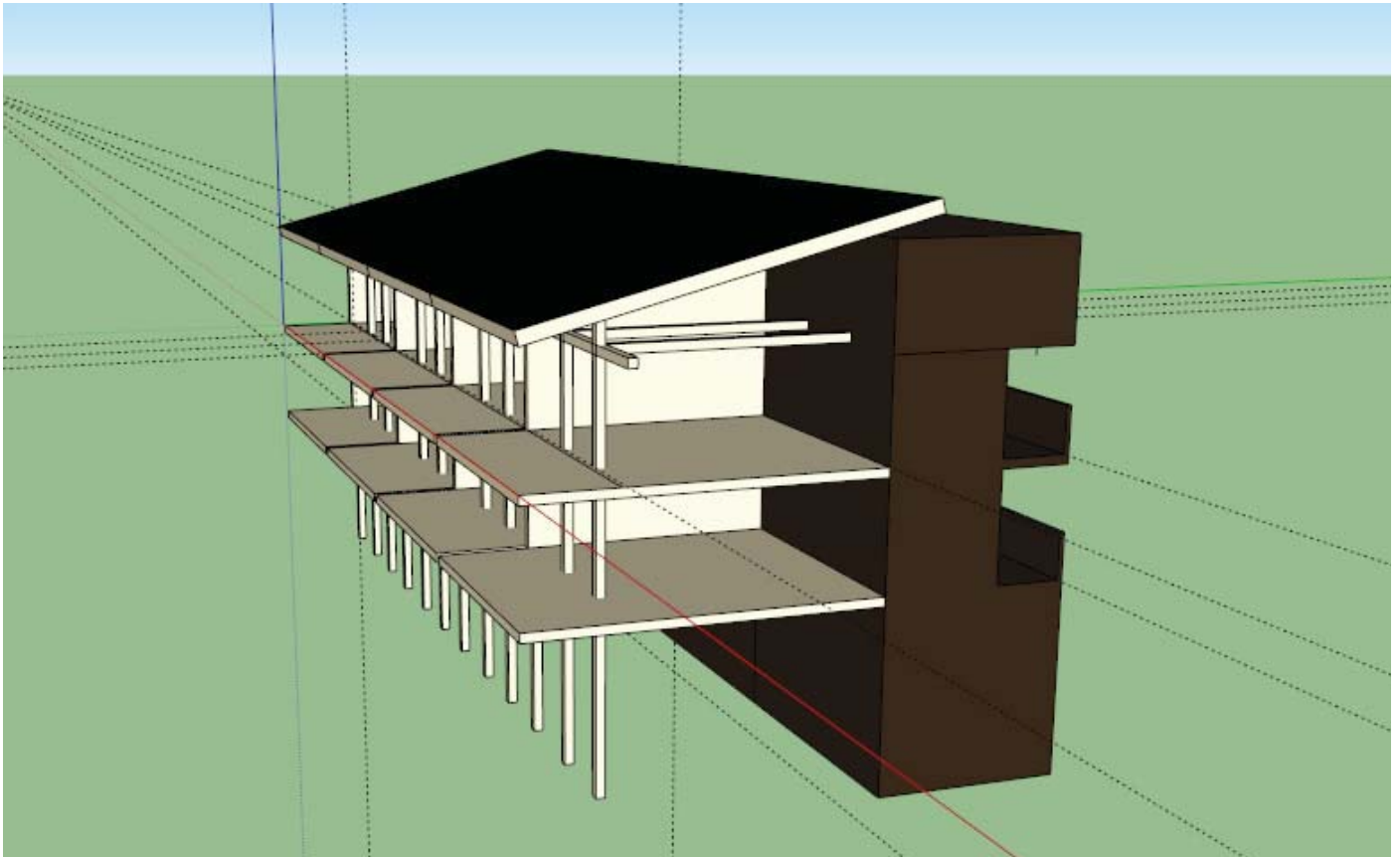
Wanted the entrance from the front to create activity on the square, but maybe by having private balconies there would be more activity. When people walk home, they are there for a short period only. However, the balconies would maybe not be used during winter..

The stairs and elevator should be close to the workshop, so that people have to pass it when they go home. Then they can see if something is happening, and it also becomes a safer space when people are regularly walking by.

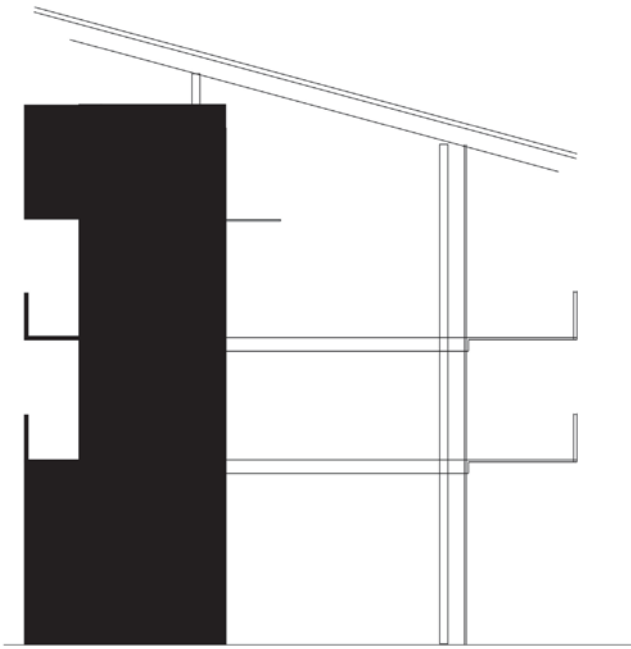


Grid in the building. Can have a small apartment in one cell, medium in two, or big in three.. Also flexible vertically.

The size of the grid is decided by the length of a bed+width of a door/hallway+length of a closet+width of a wall between two apartments. (200cm+90cm+60cm+30cm)



Structure with the massive part in the back(north) and open part in the front(south).

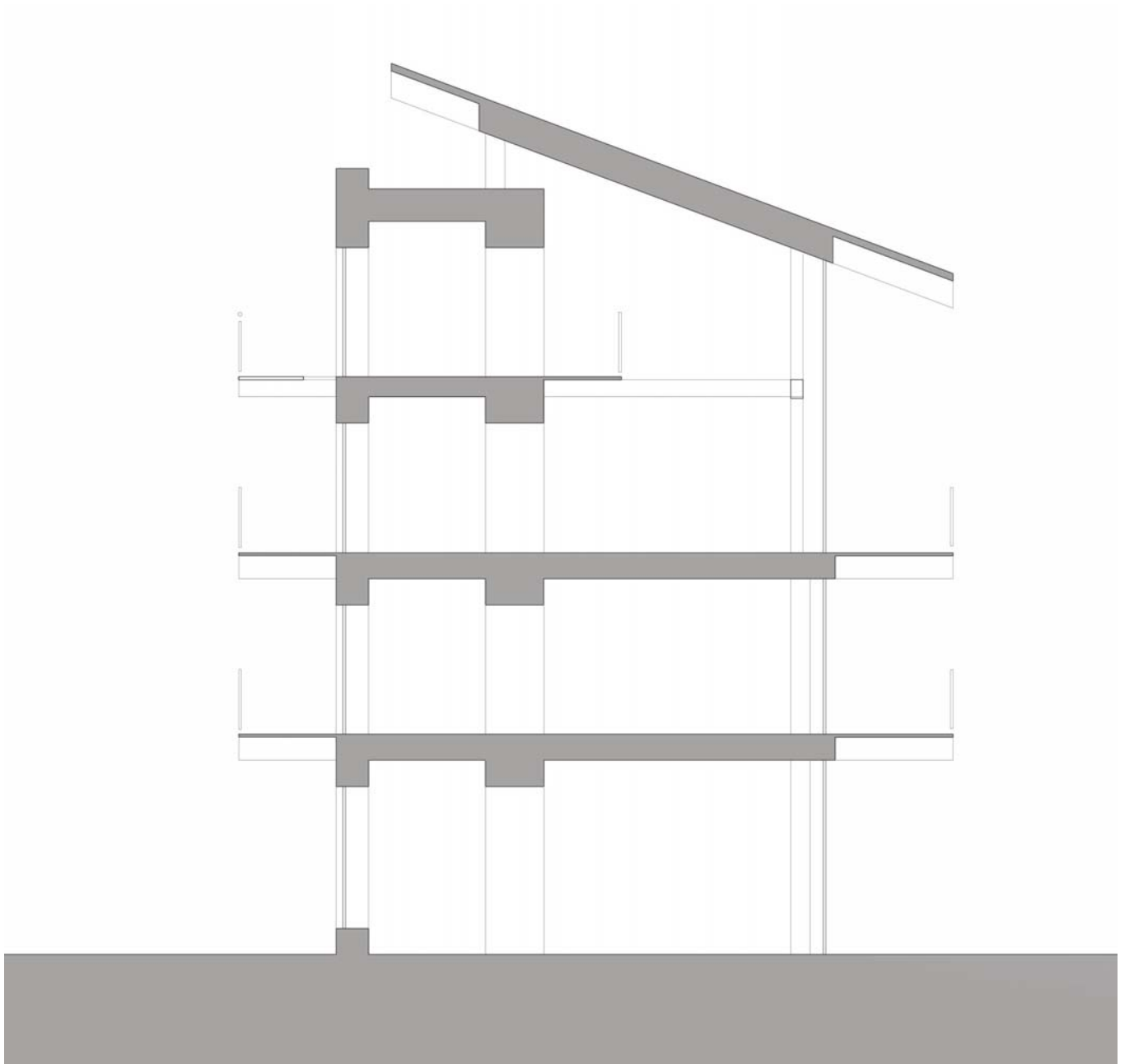


Concept section

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Having the entrance inside the massive core, compared to having a gallery entrance coming out of the massive core. The left one makes the rooms darker and requires more materials. It also makes an unnecessary space in the ground floor.

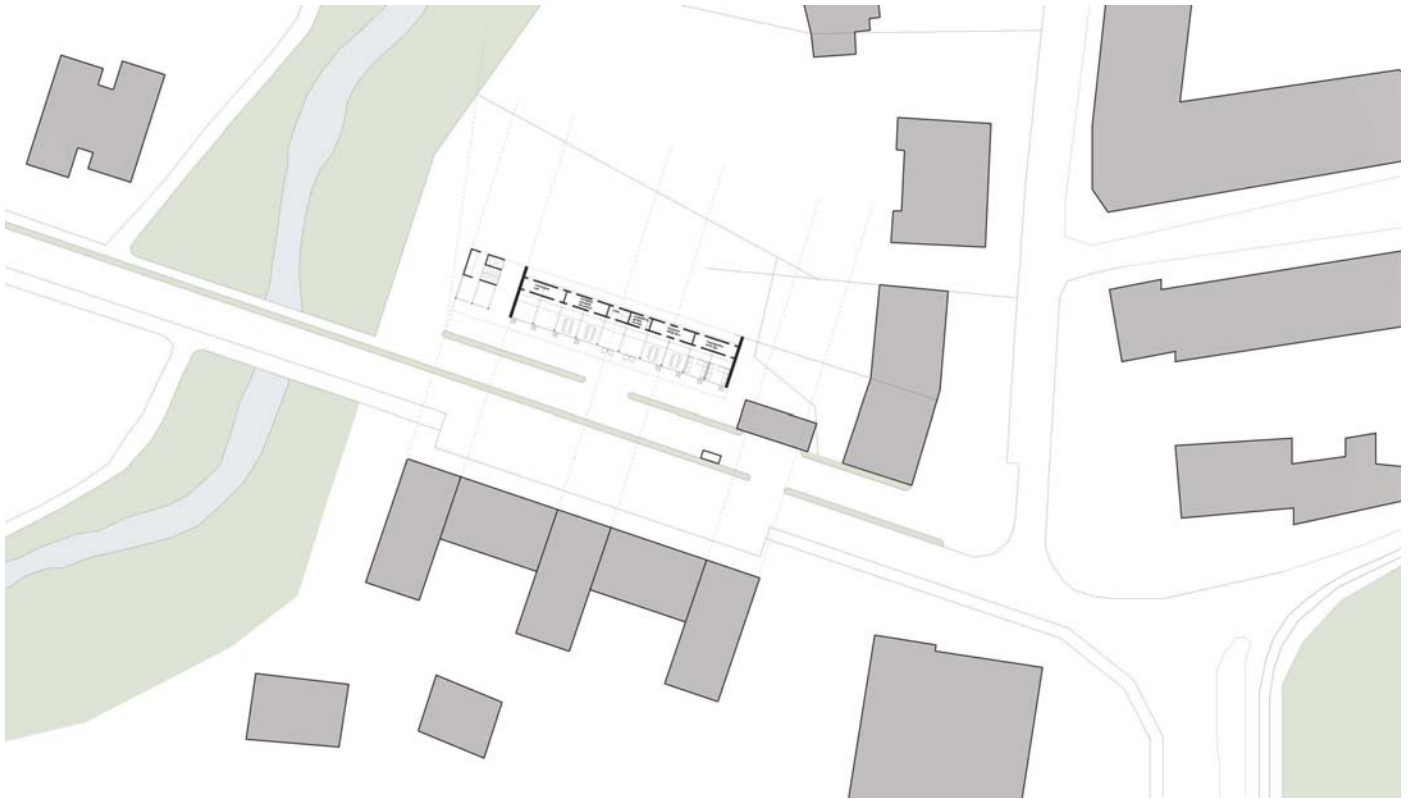








I wanted the volume towards the river to help define the square in front of the building. Originally as a workshop for fixing and recycling. Could also be a storage place for “garbage”. Things that can be reused. Could be like a symbol of everything we throw away, and also as a landmark for the place. Showing that “this is where you recycle”



When testing in model, I thought the square was too big. When there is no event on the square, it would look very empty. Also the building and the activity in the ground floor is far away from the street. Here I am trying to put it closer. I then loose the volume towards the park. The building then defines the street more than a square. This is also more like what I wanted in the beginning; to connect Ilaparken with Ilabekken.

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## Active systems

In Norway it is not enough to have passive solutions to achieve the comfort we require throughout the year. The technical systems can either be centralized or decentralized. For my building it might make sense to decentralize the technical, to follow the structure.

### The technical core must contain

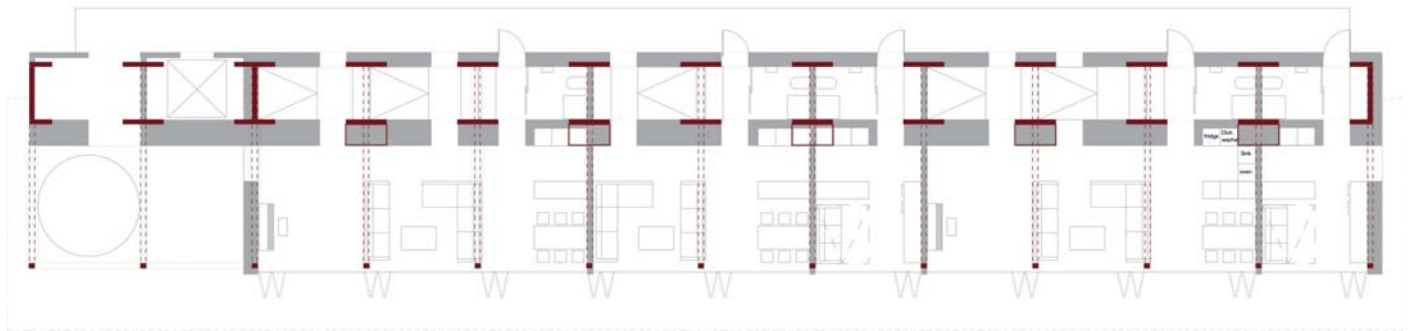
Hot and cold water pipes

Sewage pipes

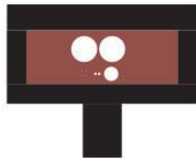
Cables for electricity

Pipes for fresh and used air

Additionally there have to be a tank for hot water and a device for heating. Active cooling can be avoided by shutting out the sun during summer and by sufficient natural ventilation.



1st, 2nd and  
3rd floor



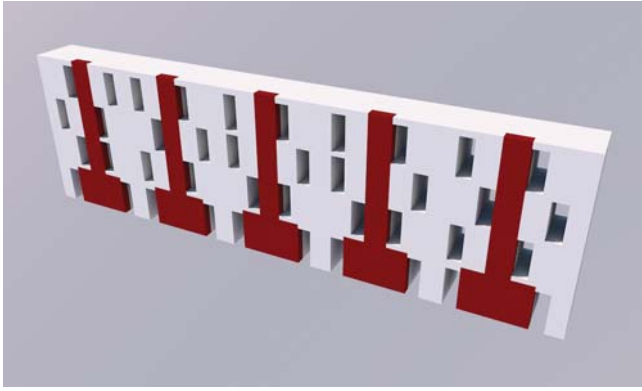
Ground floor

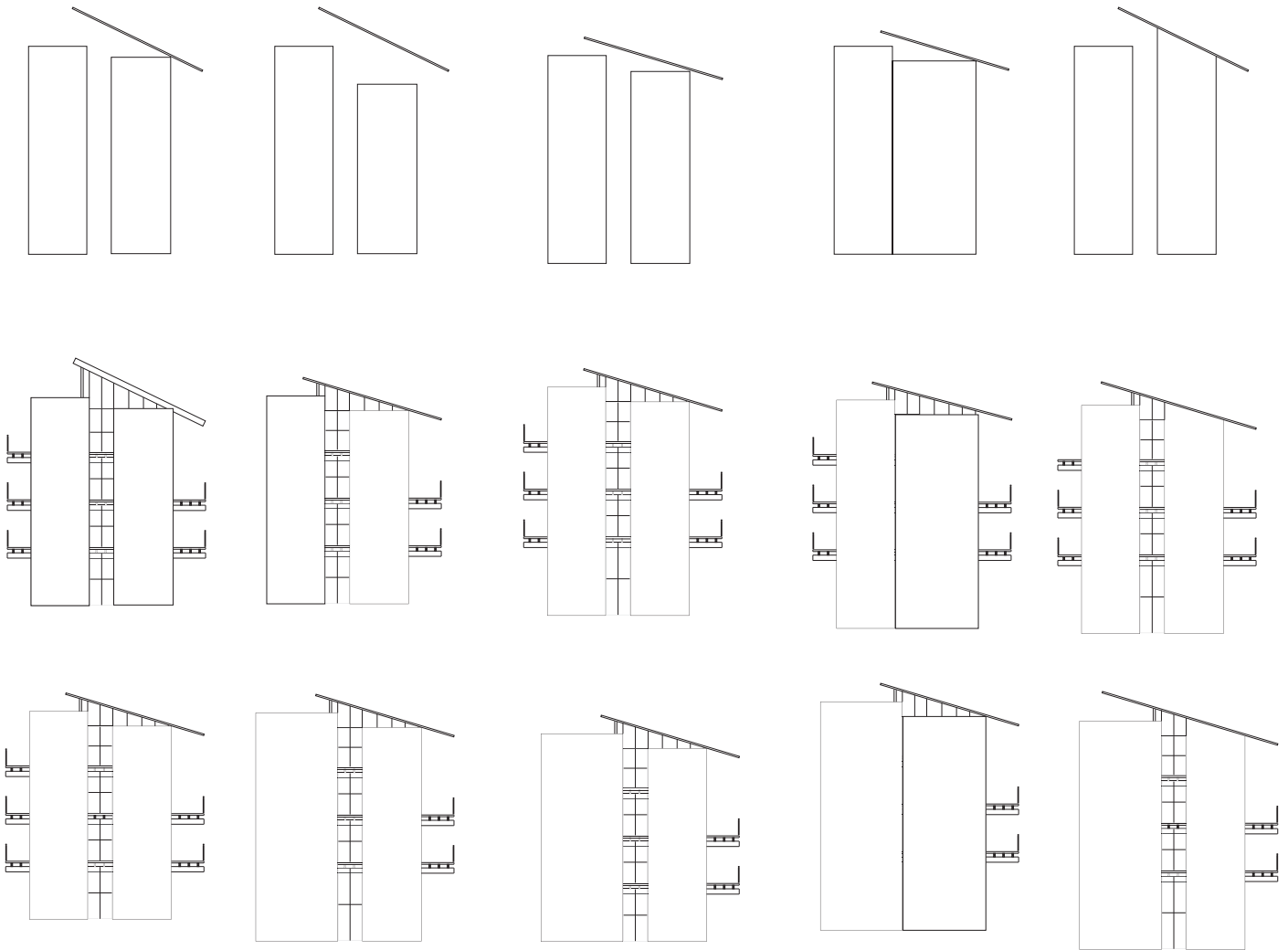


Reduce technical to a shaft in the massive part.  
In ground floor is the hot water tank and the heat pump.

If the air is heated and can be let in to the rooms through the technical core, the floors can be free from pipes for radiant heating etc.

Walls between apartments must be thick to reduce noise transmittance. In ground floor this is not necessary.



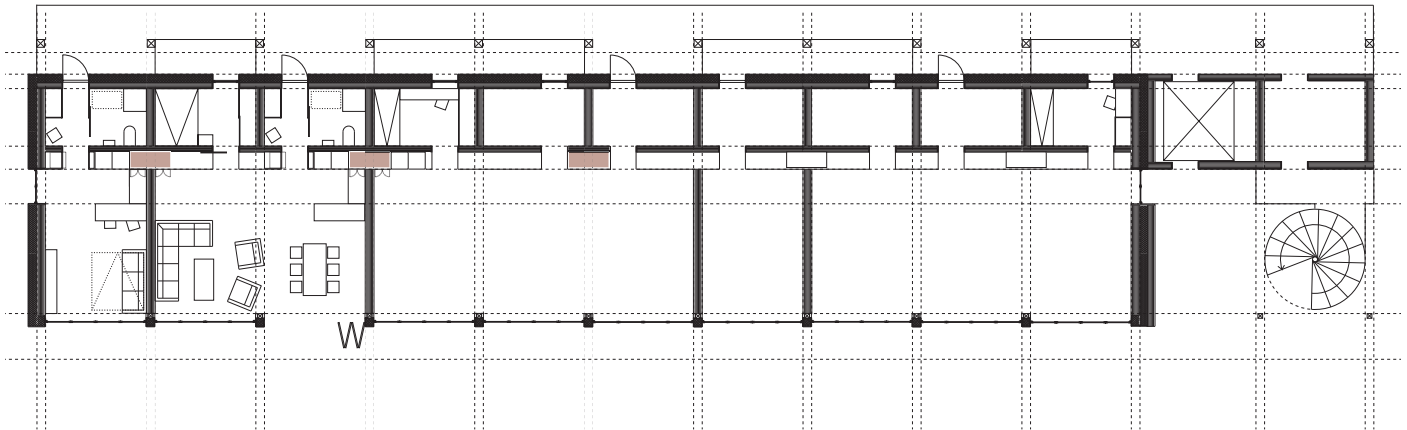
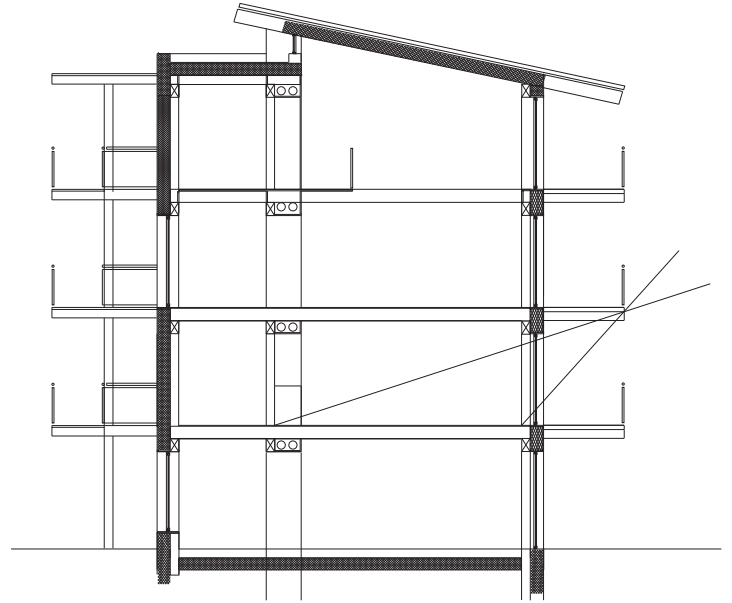
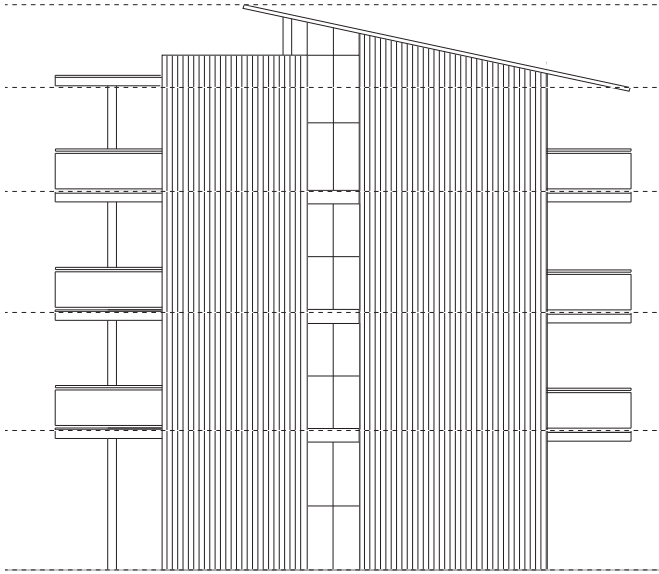


Facade studies. Want a slice of glass to emphasize the massive volume to the back. When you look in, you see the wall continuing.

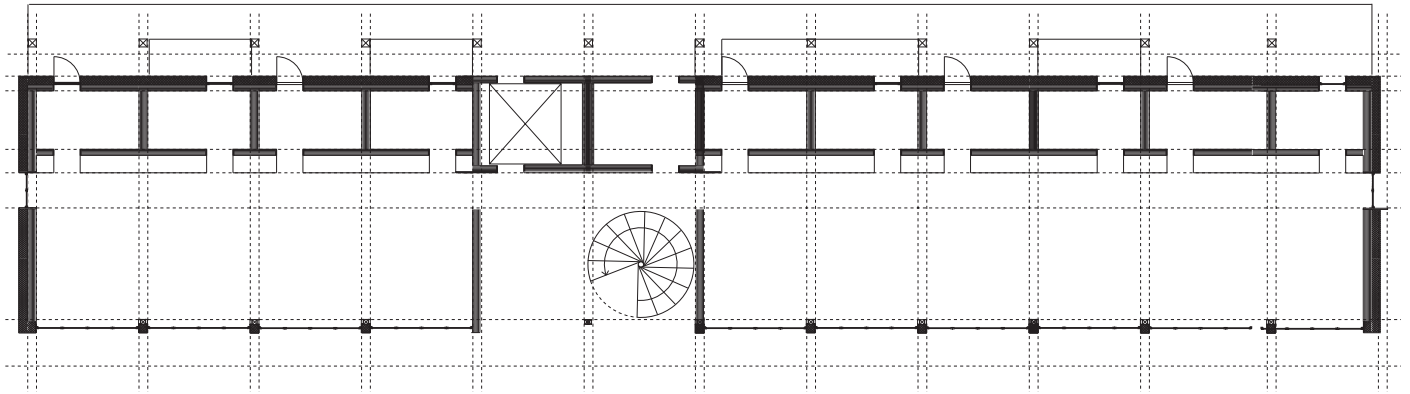
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Trying with wider entrance galleries, to give more private entrances, and at the same time creating outdoor spaces for the people who live there. Here they can enjoy the view together with their morning coffee.

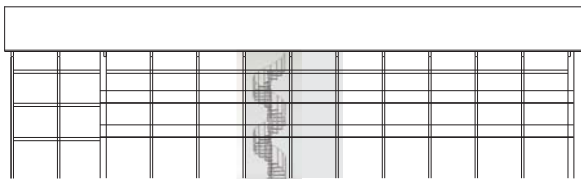
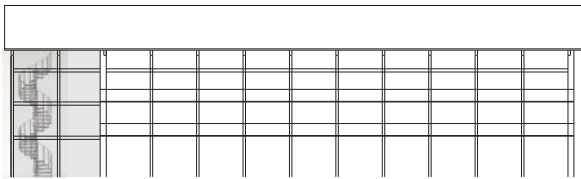
Kote 23

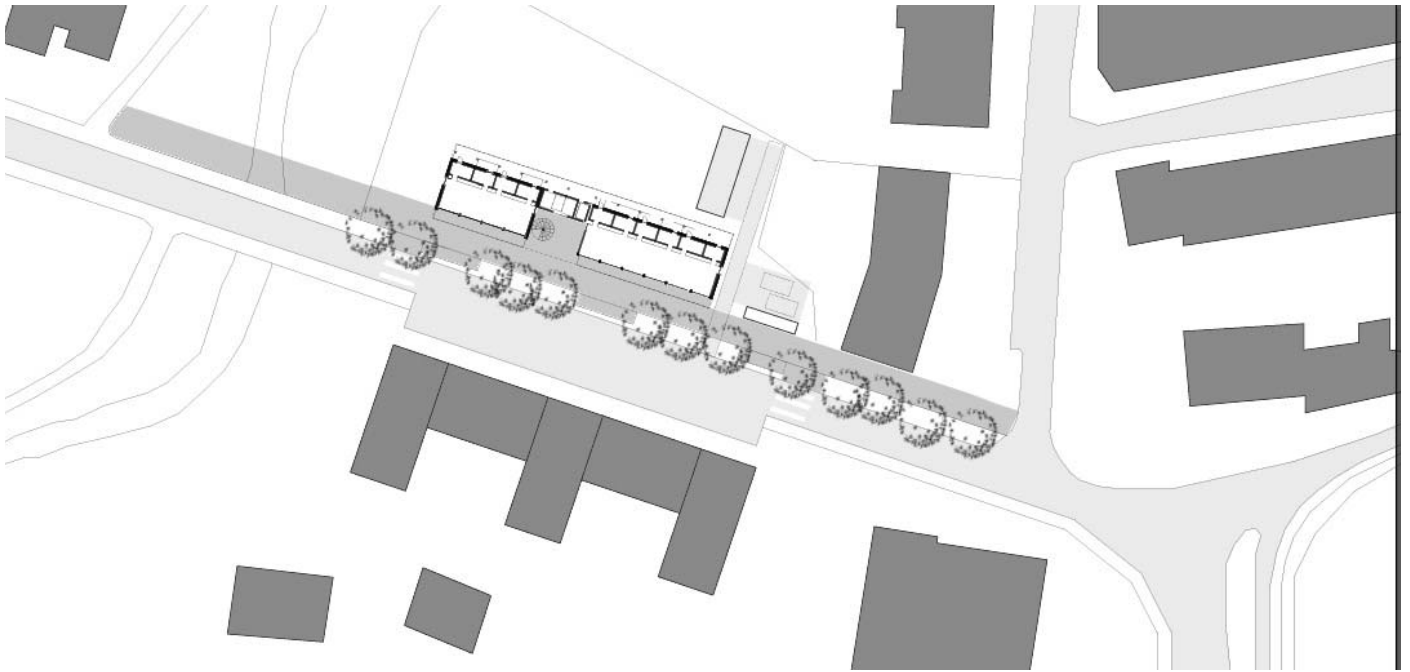




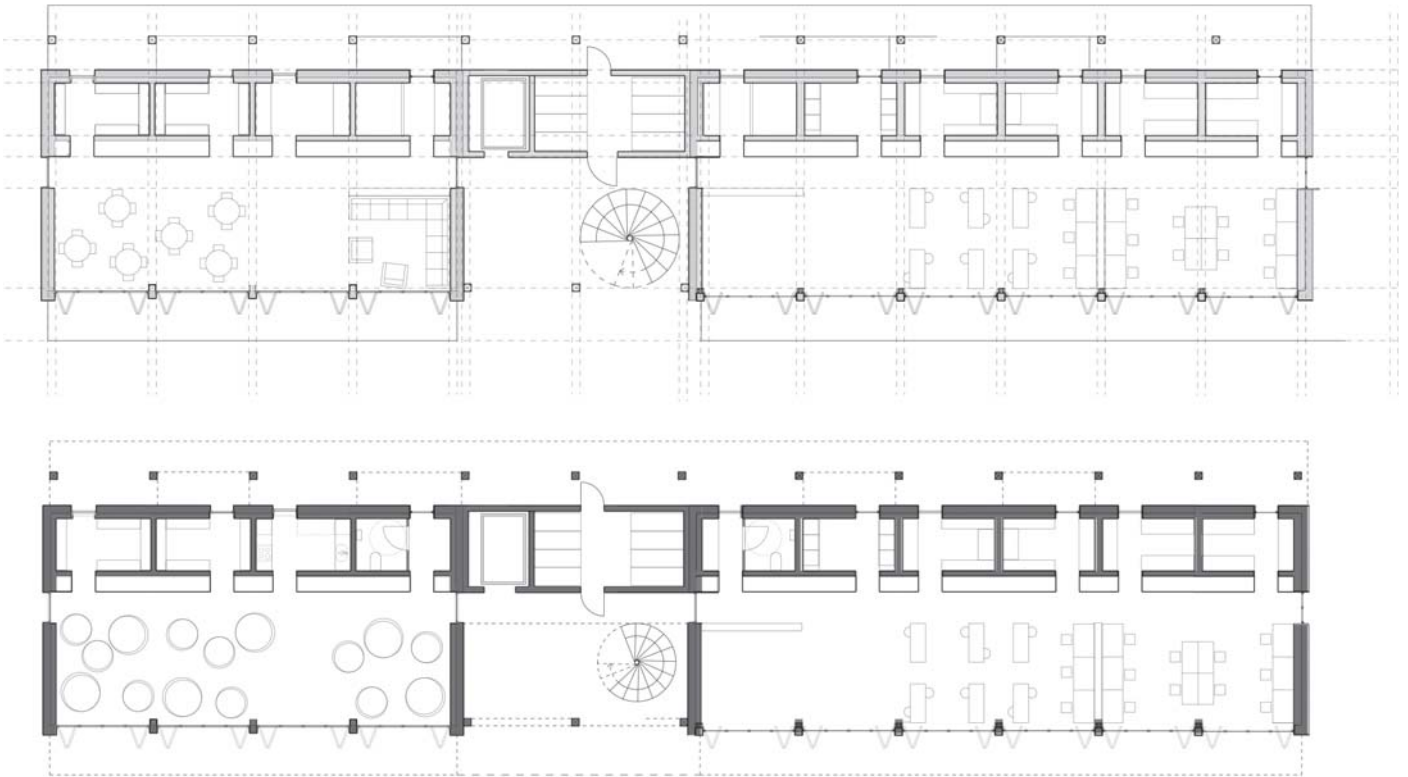


The entrance could be moved to the centre of the building. It would give more surface to the outside. Also gives less flexibility in changing the sizes of the apartments. However, the common areas/public areas in ground floor could be divided in noisy activities and quiet activities. The gallery entrance would also be more quiet because you share it with less people.



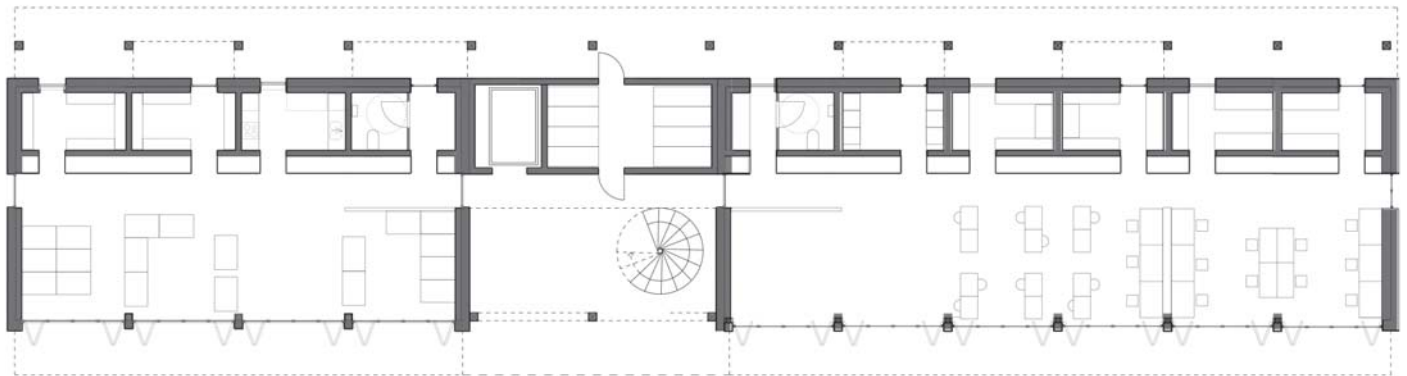
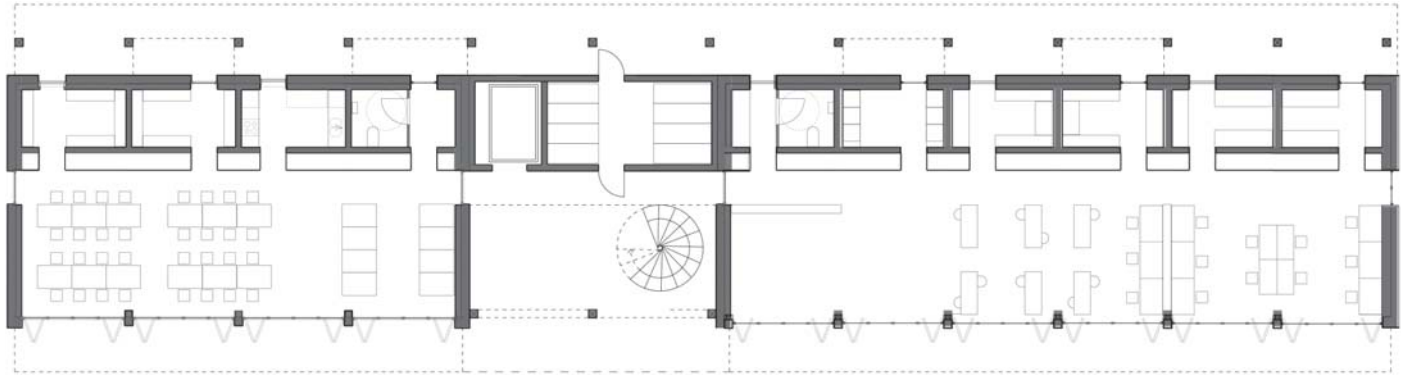


Making a wide sidewalk to connect Ilaparken and Ilabekken. Protect the sidewalk from the street with trees. Having openings in the trees for bikeparking. Here I put the bike parking opposite the housing across the street. However, here it would be better to have trees, to give more privacy between my apartments and the ones across the street.



The left side is a library, where people can leave their books, dvds and cds they dont want anymore. In return they can take some of the stuff that is there. This part can also be rented out. This part has both a kitchen and a toilet. At first I was thinking to have big couches or big chairs that look very comfortable. But then where would the furniture go if someone wanted to rent the room for a birthday or something? And where would the tables and chairs be hiding when not in use?





A more flexible choice is to use EUR pallets. It also fits the idea of recycling. They are 1200mm x 800mm and 600mm x 800mm. They can either be stacked for a bench, or lifted for a table.

