S.os made the design mostly on site in order to involve and learn from the community in many of the design decisions.

The *GreenHouse* was designed for the “Foundation for The New World”, formed in 1969 and one of the oldest intentional communities in The Netherlands. They own 10 hectares of land. Their ambition is sustainable self sufficiency, increasing awareness, ecological thinking and spirituality).

In the context of working for an intentional community, as ‘de Hobbitstee’ is, the design and build process has become a communal effort. This has not only made the designing and building into a widely spread and supported process, it also has created and enhanced a lot of long lasting cooperations that have increased the sustainablity of as well the community itself as it surroundings.

S.os worked closely with SUS ateliers from the initial concept of a mud house in a glasshouse to the definitive design and current monitoring and optimisation. Teachers and students were involved to develop models and calculations.

The core team has been assisted by dozens of ‘Wooffers’ some of whom have adopted the ideas and started building sustainable houses internationally.

The *GreenHouse* building proces has been a contemporary form of Barn raising, where all participants play a part and everyone learns and contributes. The completion of the house is thus not the only product, also knowledge, companies and tools have been developed.

de Bergkachel

Hoogrendement houtkachel

The mass heater production company has now relocated to the Hobbitstee.

Several Tiny houses were built on the site to host the helpers. These now are in use for guests that come to the community for education and leisure.

NIEUWBOUW COORDINATIE

SUPERUSE ontwerp — **EVA** planning — **STICHTING** zakelijk

BOUW
Huzur bouw | **Laurens** hout | Niek staal | Gossen techniek
→ Bouwbedrijf Laurens
→ Extern | Accomodatie

OOGST
SuperUse
Janneke
Gossen
→ Materiaal/Hobbit Scout Drenthe

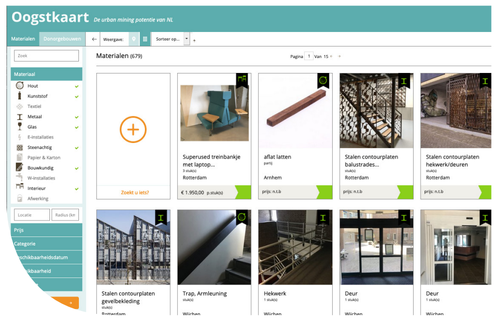
PR/CROWDFUND
Eva
Sharon
Gossen
→ Workshop Organisatie
→ Spiritueel | Duurzaamheid
Janneke Yoga | Ted MMA | Sharon Retraites

BOUWEVENTS WORKSHOPS

STEE
Laurens
→ Accomodatie Verhuur

FOOD
Maaike — Esther — Niek
Tuin | Eetcafe | Bakkerij
→ Lokaal Eten
tuin/eetcafe/bakkerij
Maaike/Esther/Niek

Superuse has been teaching the group how to go about harvesting waste materials, this knowledge is now published on the platform ‘Oogstkaart’.



The workgroup involved with crowdfunding and PR has founded an organisation that promotes circular economy in the region.

To be able to feed all the workers organic food; the existing gardens have been developed further, a bakery was set up, and Westerzwam, growing mushrooms on the kilograms of coffee (that were drunk to keep everyone going) was initiated.

This infrastructure now still is in use for communal dinners, bartering and trading food with neighbors and friends.

LOCATION, ORIENTATION, SIZE, SHAPE

ORIENTED ON SUN, SHADOW, WIND

Sun and shadow analysis, prevailing winds, were taken into account when locating the *GreenHouse* on the property.

The building is oriented 3 degrees east of solar south, and with a 25 degree inclination of the south facing technical roof to maximise direct solar gain in winter, PV solar power production and hot water production by solar tubes.

BIG HOUSE ?

To reduce energy use a house ideally is small, or tiny as is the trend.
In its current use the house seems big, but the design is made to be able to transform over time; a multi generation house.

COMPACT STRAIGHTFORWARD SHAPE

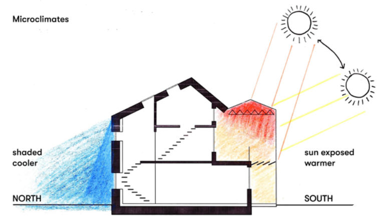
The building has a simple, unarticulated form to minimise outside surface.
The long facade facing the sun, with an narrow climatized core optimizes solar heat gain.

ORIENTATION, SIZE AND SHAPE CREATE MICROCLIMATES USED TO PASSIVELY CLIMATISE THE HOUSE

The *Green House* creates 2 microclimates:
- a shaded, colder northside, and
- a sun facing glasshouse on the south

The temperature difference between these, combined with the prevailing S-SW wind, creates a natural tendency for air to flow between them. This is used to ventilate the house with warm or cool air as needed.

Dense planting and an open water feature on the northside would make this micoclimate even cooler, further enhancing its cooling potential in summers.

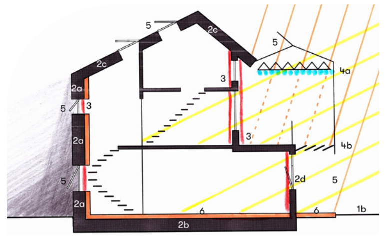


INSULATION, ZONING, BUFFERING

VERY WELL INSULATED ENVELOPE

Fixed insulation
a) Foundation: 2 x 10 cm reused PIR Rc 10
b) Walls: straw bales Rc 7
c) Roof: reused SandwichPanels Rc 9,6.
d) Windows: reused HR+ (U 1.6 Rc 0.6

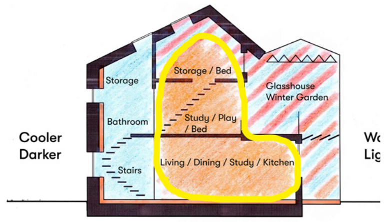
Movable extra insulation +Rc 1
shutters, thermal curtains, thermal plisse blinds add an extra Rc value of 1 to windows.



ZONING AND BUFFERING REDUCES HEATING, COOLING AND DAYLIGHTING NEEDS

Functions needing more daylight and warmth (living, dining, kitchen, study and play) are grouped and zoned towards the naturally daylit and warmer southside.
Functions needing less light and warmth (storage, hallways, stairs , bedrooms and bathrooms) are grouped and zoned toward the naturally cooler and darker northside and attic.

Core living and play spaces are buffered from unwanted heat gain or heat loss with the hallway/ staircase zone to the north, the glasshouse to the south, and the higher, attic space above.



GLASSHOUSE BUFFERS SOUTH FACADE FROM HEAT LOSS

The glasshouse reduces heat loss from the main house as windows are protected from cooling wind and rain. This increases the insulation value of the south facade by an additional Rc of 0.2.

In addition, the wind and rain protection provided by the glasshouse allows external thermal curtains Combined with individually managed internal thermal curtains the 2 layers of thermal curtains could add an additional Rc of 2 giving a total Rc of 4.2 for the south facade at night and while not using the space.

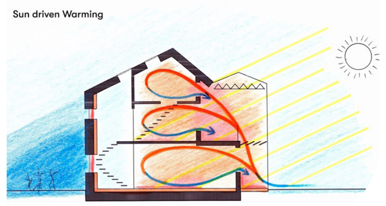
PASSIVE DESIGN

THERMAL MASS TO CAPTURE AND RELEASE STORED COOLTH AND WARMTH

30cm thick mud floor on 20 cm concrete foudation and 6cm thick mud layer over strawbales gives thermal mass. When appropriately exposed or shaded from the sun's rays, this thermal mass helps to stabilise the interior temperature by providing either slow release 'warmth' or 'coolth'.

GLASSHOUSE ACTS AS CLIMATE MACHINE FOR SUN DRIVEN VENTILATION, COOLING AND WARMING

When the sun shines, the air in the glasshouse warms quickly, creating a stack effect. The updraft of hot air generated can be used to move either warm or cool air through the house (depending on which window and door vents are opened or closed).
In this way the glasshouse acts as a climate machine for the main house.
All internal doors have ventilation grills and all windows have a ventilation and two settings to manually regulate the flow of air.

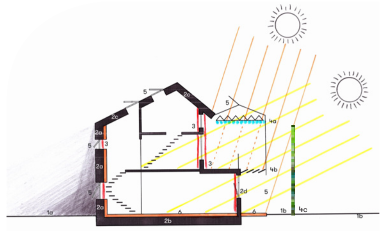


OPENINGS IN STRAWBALE WALLS ARE MINIMISED

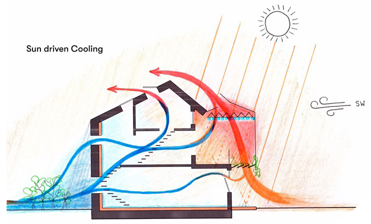
Windows on the north, east and west facades were minimised to limit heat loss.

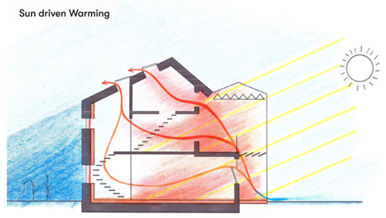
External thermal shutters for north, east, west windows are still to be fitted to reduce heat loss during winter nights and to limit condensation on the inside of these windows.

MOVABLE EXTERNAL SHADING TO LIMIT UNWANTED HEAT GAIN



4 Shading a) UV reflecting glasshouse fabric;
b) solar pergola; c) deciduous plantings;
6. Thermal mass (mud)
Dense but deciduous plantings to shade the glasshouse south facade is planned to reduce heat gain in the glasshouse in summer.

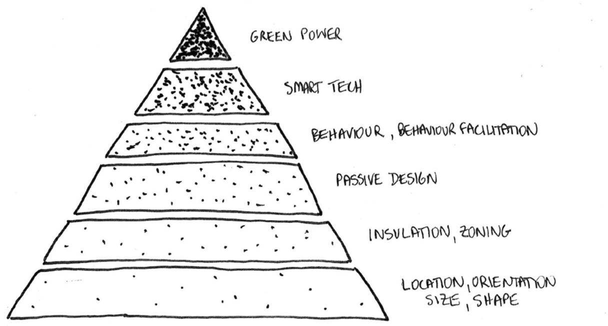




WINDOWS ARE PLACED STRATEGICALLY FOR VIEWS AND VENTILATION

Where windows were added in the north, east and west facades, they were strategically placed for views, daylight or ventilation.

Roof windows also provide for ventilation and light in key areas such as over the staircases and first floor bathrooms, and, to provide ventilation in split level bedroom/study infills on the first floor.



BEHAVIOUR FACILITATION

Automating the opening and closing of vents, flexible shading and curtains with sensors is being developed now by S.os.

With little embodied energy, automation with sensors could give large gains. A democtica steered thermal curtain on the south facade which decides whether to open to let sunshine in for additional warming, or to close to keep in collected solar gain, would greatly assist inhabitants with the harvesting of direct sun for passive heating.

Architects have the power to radically reduce a building's energy consumption by creating designs that consider climate and use, and include design strategies that minimise the need for high performance installation systems, electricity production, virgin resource and fossil fuel energy use.

(S.os adaption of the concept presented in DeKay, M., Brown, G.Z. (2014) Sun, Wind & Light. Architectural Design Strategies. 3rd Ed)

TECHNOLOGY

- De Bergkachel. Most of the year the house is passively climatised and comfortable. Only for the coldest days a super efficient mass heater (De Bergkachel) burns wood sourced from the property. They also make hot water for bathroom use at these times.

- 2 x induction cookers
- 2 x coal filtered kitchen exhaust fan (minimise heat loss via kitchen ventilation in winter)
- 2 x quookers for kitchen hot water (more efficient than transporting hot water from hot water tanks)

ONGOING RESEARCH

The climate system is developed with Sus Ateliers (HRO) and is still being monitored. The *GreenHouse* serves as an educational prototype, and its systems are still being optimized.
Originally the climate machine was conceived as driven by solar chimneys. However, as the project was built the team postponed making those. Studying the flows of air, it was clear the glasshouse and the microclimates create enough tension to drive cooling and warming. For pre-warming and pre-cooling ventilation air two 50m groundpipes were designed. We are still researching how much they could improve the *GreenHouse's* energetic performance to decide if they are worth the effort/embedded energy.

GREEN POWER

- 16 solar PV panels provides the electricity for the *GreenHouse* as well as for a neighbouring house.

- 6 x solar tube panels close to the bathrooms provides bathroom hot water.

A sketch design for the *GreenHouse* was converted into a shopping list of building materials to be 'harvested'. A 'harvest team' made up of inhabitants and trained by Superuse then found and listed suitable material options. The final selection of materials to be used was based on design potential, price, transport distance, and sustainability. The design was then adapted and finalised for the selected materials. Most materials for the *GreenHouse* were found either on site or at neighbouring properties.

Since it was against their policy the local style council had to be convinced to allow insulating roof panels for the *GreenHouse*: the agricultural "barn" concept; the comparative ease of mounting the PV panels and Solar Tubes; and, the pleasing lines created by aligning the roofing panels with the vertical wooden cladding.

The plastic framed windows were combined with double glazing sheets sourced on 'marktplaats'. On north/east and west they are carefully detailed into the wooden facades. In the south facade detailing does not need to be waterproof since they are under the glass roof. This saves both labour, paint and kit.

2000m2 of plastic double glazed HR+ windows was available from the demolition of a neighbourhood of 166 houses renovated in 2006.

A mountain of mud was delivered to the site by a neighbor a few years earlier but never put to use.

The mud became the thermal mass. 30cm mud thick flooring and at least 6cm thick mud interior plastering of strawbales. The exterior of strawbales was also plastered with 2cm of mud to protect the straw from rodents.

A 24m agricultural Venlo glasshouse that came with a lot of extra material was adapted for residential use at the first floor level of the GreenHouse.

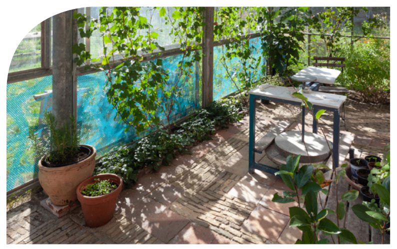
Douglas pine sourced from a local tree plantation. Douglas pine does not need treatment. It turns grey over time.

Douglas pine was used for the wooden cladding. Vertical cladding was chosen to align with the roof lines. This gives the house its more elegant look.

19 reclaimed 27 cmx 27 cm beams were already in the community's stock.

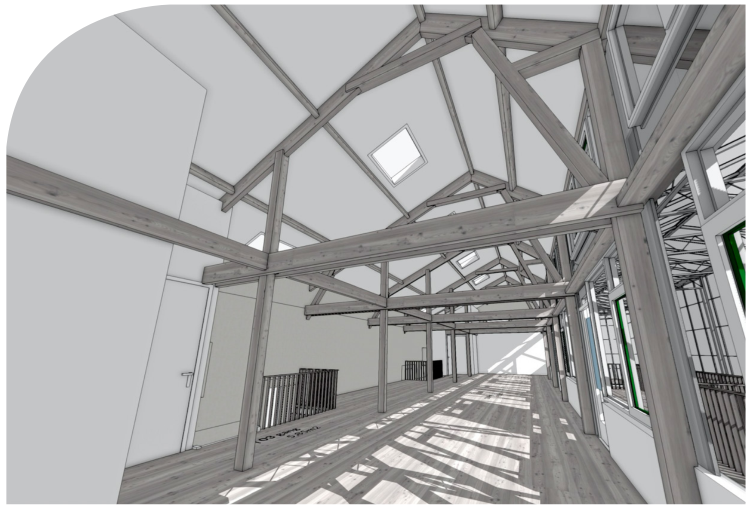
A design was made to optimise their use to construct the main wooden structure.

Mis-productions of hardened glass from the 'New Babylon' project in The Hague is used in the ground floor of the wintergarden.

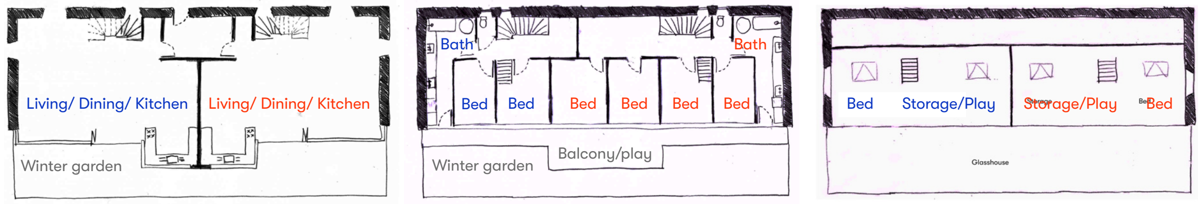


This blue patterned safety glass was placed low to not obstruct the view and to make a composition with the plants in the glasshouse.

Straw bales sourced from a neighbour farmer literally 500m up the road.



Current layout:



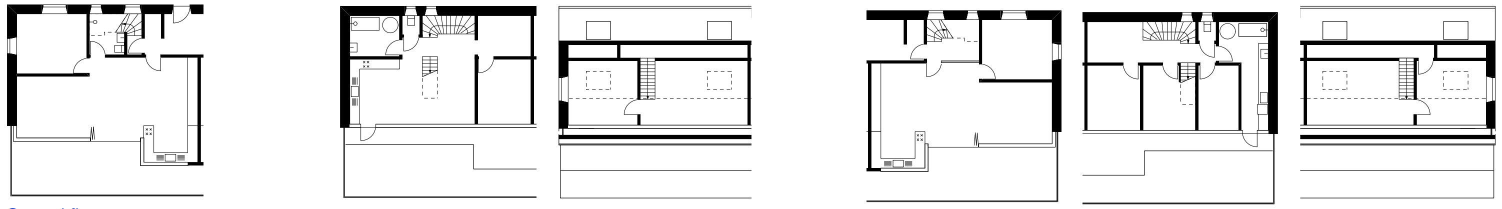
Ground floor

First floor

Attic

2 large family homes side by side that cover the ground floor, first floor and attic. With shared entrance and shared winter garden.

Many alternative layout options including:



Ground floor apartment

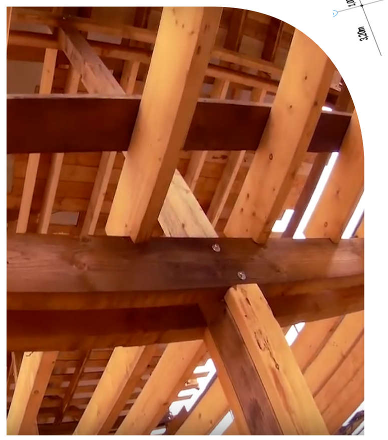
First floor + attic apartment

2 storey + attic living group

OPEN FLOOR PLAN

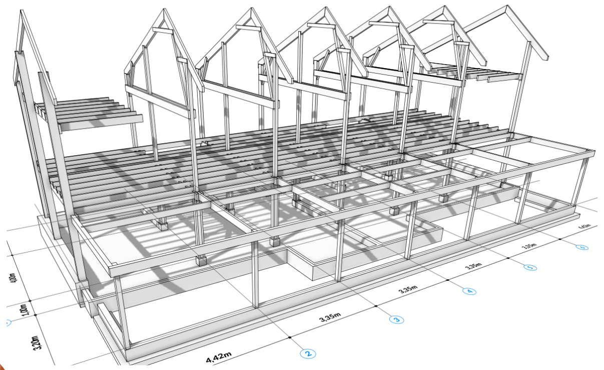
The house needs to be adaptable for different future living configurations. Hence the open wood structure was chosen as floorplans can be changed without damaging the structural integrity.

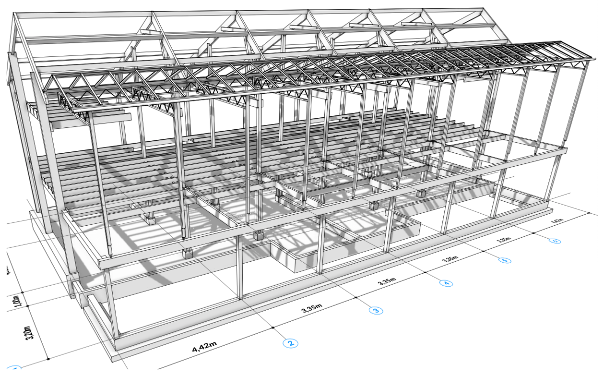
For the first floor we imagined a oversized three dimensional space that could be filled in over time by the children and parents with a maze like structure of small rooms, platforms and stairs, as seen often in squatted schools where the current inhabitants used to live. However, time pressures resulted instead in the extra height being used in its first incarnation to create a second attic floor.

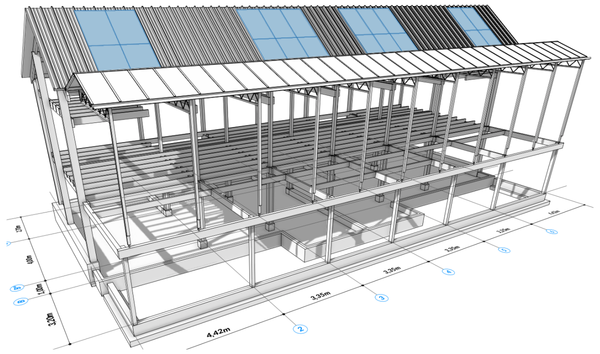


CONSTRUCTION

We found 19 x 9m long forgotten wooden beams on the property. With the constructor we developed a design for the main structure made up of 7 A-frames possible by cutting the beams at the local woodshop lengthwise into 4 and 3 pieces. The material limits meant the engineering had to be very resourceful and follow strictly the logic of forces, as would have been the case 100 years ago: a thicker column at the ground floor and thinner above, optimised roof structure by introducing diagonals for forces (de makelaar), while still being able to walk upright in the attic. Although this meant more (but joyful) manual labour, we all agreed it was worth it.







VENLO GLASSHOUSE

Our advisor for Glasshouses, Arjan Karssenberg, who has built several 'glasshouse-houses', advised us that it was near to impossible to reuse a glasshouse's structure for a house, because of the different building regulations for agriculture and housing. "You are better off designing a new structure to carry second hand glasshouse glazing". So here was a challenge!

The 24m long Venlo glasshouse that was sourced, luckily came with a lot of extra parts. After making an inventory of parts and with our engineer, Nico Plukkel, we managed to solve it quite simply. By hanging the glasshouse on one side to the house's wooden structure and removing the supporting columns on that side reusing these to double the columns on the south facade, doubling the amount of trusses and fitting safety glass in the roof the harvested glasshouse fitted the rules.

USING THE STRUCTURE AND ROOF AS BUILDING SITE

Straw has to be applied dry during the entire building process. The load bearing wood structure turned out to be useful. The roofs were first fitted on the structure and then the house was filled in underneath.