

# HOSPITABLE MOVEMENT

Jasper Sterrenburg

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An impermanent housing solution within the Dutch peat polders,  
taking care of the terminally ill

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Delft University of Technology

Architecture



# Hospitable Movement

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## Abstract

Hospitable Movement is the result of a research and design-based search towards a form of temporary inhabitation of the Dutch Peat polders. Many of these polders are now dealing with subsiding peat and the release of greenhouse gas emissions by draining the landscape. A new way of cultivating the landscape is required, by raising the water level and changing to wetland agriculture. Changing the landscape in this rigorous way doesn't happen overnight, leaving the landscape unused in the process. A form of temporary housing is sought to fill in this gap of time, utilizing the precious landscape in its transition years.

By various means of research, varying from surveys, literature reviews, testing out variants, and calculations temporary hospice has been designed on a specific site. Even though palliative care is the outcome of this research and design project, many other forms of temporary housing can be applied to similar sites, enabling us to release pressure from certain housing problems, buying time in the permanent problem-solving process.

## Keywords

Hospice design, Demountability, Temporary housing, DIY, Dwelling

## Preface

In front of you lies the graduation project with which I, Jasper Sterrenburg will graduate on the Master of Architecture at the TU Delft. Since elementary school, I have been interested in the profession of architecture, from then on I took the long path continuing from middle school to vocational education, where I learned the practical aspects of construction to the bachelor's at the University of Applied Sciences of Avans to now the TU Delft.

From the start I have been interested in small to mid-scale buildings, this is why I was glad to see this studio in the polder of Midden-Delfland, most presumably asking for smaller-scale architecture due to the landscape. Additionally, I got into the resource group, enabling me to exploit the practical experience I had previously to come up with an architecturally and technically sound building.

In this final section, I would like to thank some people who have, with their input, improved the design and made the graduation project an enjoyable process. At first, my tutors from the TU Delft, Olv Klijn, Ruurd Kuijlenbur, and Alejandro Campos Uribe, helped me during the tutoring sessions on the topics of architecture, building technology, and research respectively. Then I would like to thank Mr. Bezemer, who gave me a tour of Hospice de Liefde, combined with valuable information on the running of a hospice. Finally, I would like to thank my colleagues at Bouwbedrijf Visser, who were willing to fill in the survey for research on DIY construction.

Jasper Sterrenburg

Delft, 2 July 2024

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## Samenvatting

Een groot deel van de Nederlandse polders bestaan uit veengrond. Om deze begaanbaar te maken zijn complexe systemen benodigd om het grondwater artificieel laag te houden. Deze lage grondwaterstand resulteert in het inklinken van de veengrond, wat daardoor veel stikstof en andere broeikasgassen uitstoot. Om deze uitstoot te voorkomen moet het niveau van het grondwater omhoog gebracht worden, waardoor onze bekende graslandschappen zullen veranderen naar moerasachtige gebieden. Voordat het polderlandschap is getransformeerd zullen er nog vele jaren verstrijken, dit laat deze gebieden in de tussentijd ongebruikt.

Hospitable Movement is een reactie op deze leegstand, zoekende naar een vorm van tijdelijke huisvesting door middel van onderzoek en ontwerpogaven. Vaak blijkt in de praktijk dat 'tijdelijke' huisvesting leidt tot permanente bewoning door verjaring, hierdoor is het belangrijk om een passende oplossing te vinden die ongebonden is met de locatie. Door het linken van de einddatum van het landschap en onze einddatum als mens is een hospice geselecteerd voor de tijdelijke bewoning van de veenpolder. De natuurlijke omgeving heeft hier als bijkomend voordeel bij dat natuur ontspannend werkt in stressvolle situaties.

Het ontwerpproces is te onderscheiden in drie stappen, allereerst is de globale organisatie van het programma behandeld. Hierbij waren loopafstanden binnen en buiten het hospice overwegingen voor het plaatsen van de ruimtes. De vervolgstap was het integreren van de natuur in het ontwerp door middel van zicht, buitenruimten, gebruikte materialen en het klimaat. Tot slot is onderzocht hoe het gebouw demontabel gemaakt kan worden, zodat het naar een andere locatie kan worden verplaatst als de grond onbewoonbaar wordt.

Om op het gebied van architectuur en bouwtechniek tot een verantwoord ontwerp te komen zijn onderzoeken verricht vanuit verschillende perspectieven, namelijk: locatieonderzoek, case studies, doelgroeponderzoek, zelf-bouw studie en een onderzoek naar losmaakbaarheid.

Het resultaat van dit ontwerpproject is een gebouw dat passend is georganiseerd, naar hand van ervaringsdeskundige, geïntegreerd in de natuur, waardoor de mentale voordelen benut worden en scoort het een 9,0 op de losmaakbaarheidsindex, waardoor het als een zéér losmaakbaar gebouw gezien kan worden.

## Summary

In the Netherlands, a large partition of the polders has peat soils requiring complex drainage systems to keep the groundwater artificially low. These systems consume energy, but more importantly cause the peat soils to subside, whilst in the process expelling nitrogen and other greenhouse gases. To prevent this from occurring the ground water level has to be risen, changing the well-known grasslands into wetlands. This process will take many years and will not be initiated right away, leaving the peat landscapes unused in the process.

Hospitable Movement is a response to these temporary vacant transition polders, searching for temporary housing solutions through research and design exercises. As is often the case many 'temporary' projects will end up permanent, sometimes because they are time-barred, in other cases because the projects are lost from sight. Finding a suitable target group is therefore essential, and should not be bound to the site. In linking the thought of having an end-date of the site to our end-date as humans, a hospice has been selected for the function of temporarily inhabiting the polder. An additional plus of building in the natural environment is the benefits nature has to offer to our mental health, in stressful times it helps us calm down.

The design of the hospice is based on three steps, firstly, the global organization of the program in which approach and walking distances inside and outside the hospice are optimized. Secondly, the inclusion of the natural environment into the spaces of the building is considered, looking into the views, climate, materialization, and outdoor spaces. Finally, the third factor of design is the demountability of the structure, enabling it to be moved to another site after the peat soil is not suitable for dwelling anymore.

To create an architecturally, and technically correct building, much research from various angles has been used to support the design process, naming: site analysis, case study research, target group research, DIY/self-building research, and research uncovering demountability.

The result of this design project is a building that is organized well, and efficiently for the function, integrated into the natural environment unlocking the potential of the mental benefits, and scoring a 9,0 on the detachability potential.

## Introduction

The Netherlands is known for its many polder landscapes, resulting from our inventive ways of water management. Although these complex systems found in our water management infrastructure are an element of national pride, they also raise some crucial problems. Draining groundwater from the peat soils, enables tractors and dairy to access the land, whilst keeping the water level artificially low, resulting in the soil subsiding and expelling nitrogen and other greenhouse gas emissions.

Because this current system is unsustainable, the way of cultivation has to be overhauled rigorously, resulting in our peat polders changing from grasslands to wetlands with new forms of agriculture. The transformation of the landscape will take many years for it to reach a new and more sustainable form of cultivation, leaving the landscape unused during the transition period.

Although this vacancy during the transition years might seem problematic it can also raise new opportunities, new forms of temporary housing can for instance be introduced, utilizing otherwise lost space. The goal of this research and design project is to find this form of temporary housing within the context of the Dutch peat polders, looking at a specific site in Midden-Delfland. Furthermore, finding the right type of occupant, building form, and building methodology are elements that should be addressed in such a project, resulting in the following research question:

*What building types, methods, and target groups are suitable for impermanent housing solutions in the Dutch Peat Polders?*



figure 01 - Covers of research booklets

## Reading Guide

During the first phase of the design project, much research from various perspectives has been conducted creating a scope feeding the design to create an all-round and complete project. For the means of readability, all the research is documented in additional booklets (figure 01,) that go into further detail on specific topics.

During the first weeks of the design project, exploring Midden-Delfland was important for selecting a site and getting a feel for the overall surroundings and architecture in the area. During these weeks the whole Midden-Delfland area was explored, photographed, and documented in the first booklet (*01 - Photo Report Midden-Delfland.*) Once the site was finally selected, a more detailed analysis (*02 - Site Analysis*) was conducted to get a grip on the most important characteristics that could feed the design.

With the site and an overall view of the polder clear, the search for a target group meeting the initial ideas set out in the research plan started. Firstly, through case studies (*03 - Case Study Research*), an exploration was made to find the target group, look into detachable buildings, and explore the possibilities of DIY construction. Once the target group was selected, further research was carried out to understand their requirements for a building in booklet *04-People & Program.*

Moving towards the technical aspects of the project, research has been conducted on how to measure detachability (*05 - Measuring Demountability*), describing the formula and how to use it in practice. This research combined with a literature review and survey on the feasibility of DIY construction (*06 - Voluntary Self-Built Movement*), was used as input for detailing in booklet *07 - Prototype Research.* Finally, in the last booklet (*08 - Design Process*) the complete design process from start to finish has been documented, showing how the design has evolved from start to finish.

In this thesis booklet, references in the text will be made if certain information results from the research done in the mentioned booklets. These booklets are found in the Appendix and will allow curious readers to dive deeper into the literal base of the design.



## Peat problematics

In the Netherlands, we have a saying: *Het hoofd boven water houden* (keeping the head above the water.) This means keeping the cause alive, even despite trouble or hard times, and keeping the courage to continue<sup>1</sup>. In most cases, the saying is used to describe a financial situation, for our peat polders, however, this saying can be interpreted quite literally.

The Dutch have a long-lasting history of protecting themselves against the water and reclaiming otherwise uninhabitable land from the sea and lakes<sup>2</sup>. Once this land is reclaimed, the following challenge is to keep the land inhabitable by draining the water and keeping the water level artificially low. To realize this, complex systems (figure 04) of waterways and pumping stations are utilized, consuming energy and valuable resources. This practice is carried out in almost every peat polder in the Netherlands enabling our tractors and dairy to access the land.

The defensive approach the Dutch have been using to protect themselves against the water is now turning the tide, requiring a new approach for our water management systems to be future-proof. The Dutch now know that by pumping out the water, the peat landscape subsides and releases CO<sup>2</sup> and nitrogen emissions<sup>3</sup>. The impact of these emissions is far greater than what the average dairy farm emits<sup>4</sup>, which is not considered in the recent public debates concerning Nitrogen emissions by dairy farms in the Netherlands.

To prevent the land from further subsidence, one option is to increase the water level in such a way that this is level with the surface level of the ground<sup>5</sup>. This way the peat soil will not be subsiding, which also results in the landscape being unusable for our current way of cultivation.



figure 03 - Peat polders in the Netherlands

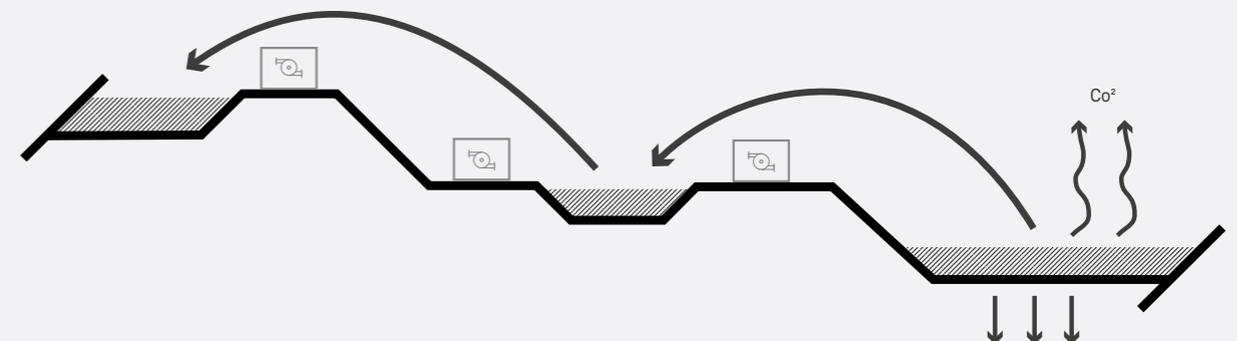


figure 04 - Complex drainage systems

## Midden-Delfland

Our current way of draining the water is by the means of electric pumping stations as shown in figure 05. In this case, the station pumps water from the ditches to the boezem system seen behind the building in the form of a dike. Figure 06 clearly shows the effect of the drainage, looking from the boezem towards the polder a decline is seen.



figure 05 - Electric pumping station



figure 06 - Boezem with lower polder

Traces of historic ways of water management systems in the landscape are still to be found within the polder of Midden-Delfland. In some places, traditional windmills are still preserved, mostly located near bodies of water or boezem systems that are now unused. In other parts of the polder, the obsolete windmills have been demolished or transformed into dwellings, further supporting images of this are found in the site analysis booklet.



figure 07 - Traditional windmill

# National Productive Park Delftland

As a response to the problems concerning the peat polders in Midden-Delftland, ZUS together with Flux and Sweco have developed a masterplan as part of the Redesigning Delta program. Within the documents ZUS criticizes the many complex systems needed to keep the polder dry, consisting of 160 km of embankments and 122 different waterlevel sections. Currently, the peat polders subside around 1 cm per year, with ZUS estimating that by 2100 some areas of the land have subsided more than 60 cm.

To overcome the problems of the subsiding lands, a newly designed boezem system and different usage of the soil are proposed in the New National Productive Park Delftland (figure 9.) The current boezem systems will be expanded giving it more space, changing to blue-green infrastructures between the urban environments surrounding the polder. By doing this so-called boezembuffers are introduced, used as water storage, acting as a sponge during periods of heavy rain. In these parts of the plan, indicated in light green, the harvested material will be reed or other wetland products.

In other parts of the peat grasslands (darker green) the existing dairy farms make place for new ways of cultivation, such as elephant grass, cattail, reed, and willows. These areas are more accessible than the boezem buffers, whilst still being categorized as wetlands. In the north of the plan, the clayground is suitable for planting trees in the form of a production forest, this function goes hand in hand with the already important recreational purpose of the plan. Finally, in the south and north bordering Delft nature zones are introduced, primarily for animals, whilst also suitable for recreational purposes.

All in all, with the National Productive Park Delftland, ZUS is aiming to reduce the emitted nitrogen and CO<sup>2</sup> emissions, whilst also enabling new forms of agriculture and wetland production to keep the value of this polder alive.

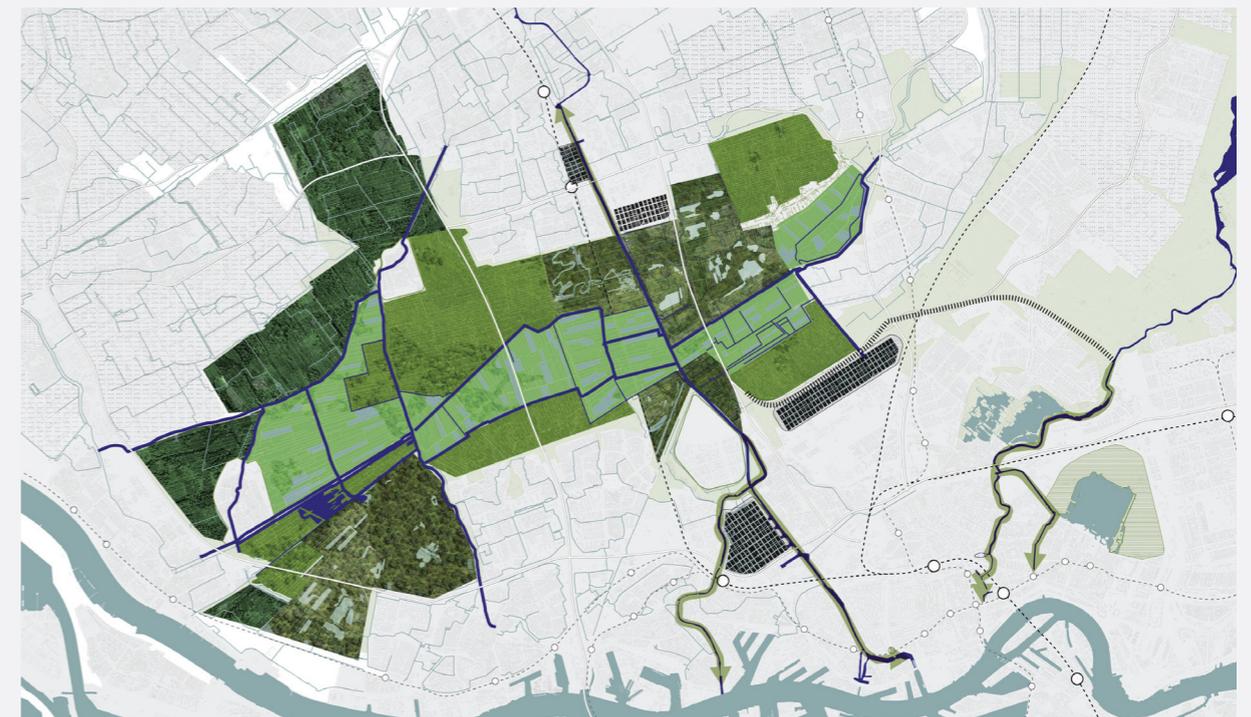
Source: ZUS [Zones Urbaines Sensibles], Flux, and Sweco, *National Productive Park Delftland*<sup>6</sup>.



## NATIONAL PRODUCTIVE PARK DELFTLAND

REDESIGNING DELTA

ZUS [Zones Urbaines Sensibles]  
Flux  
Sweco



# The Masterplan

As a group of four students a masterplan within the plan of ZUS was developed, focusing on the aspect of building resources. As indicated by the red dot in figure 11, the chosen site for the masterplan is located near Vlaardingen where the boezem Vlaardingervaart meets sub-boezem de Zweth. Furthermore, the site borders three zones indicated by ZUS as boezembuffer, wetlands, and a natural reserve.

As seen in figure 10, the site has changed drastically compared to its current state. The illustration shows the new National Productive Park Midden-Delfland around the year 2100, in which polder has been transformed and most of the grasslands have made a place for new ways of cultivation, like cattail, reed, elephant grass, and flax.

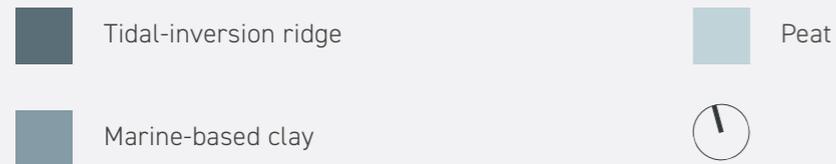
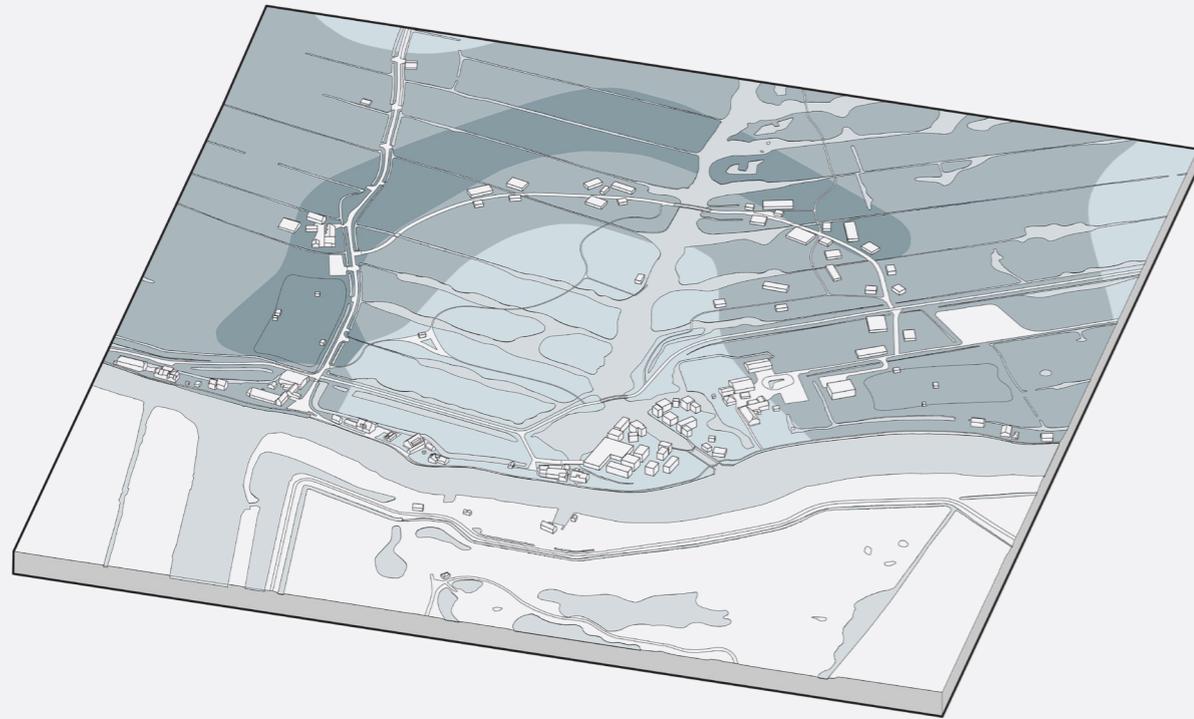
The water level has risen, so that large parts of the polder area at now almost level with water occasionally showing signs of flooding. The water of the Zweth has expanded into the existing blocks of cultivated polder landscape and is now the primary means of transpiration of goods from the polder to the city. Instead of making a dike, resulting in many wasted resources, a lock is added converting the site to a transshipment point. Barges with harvested products from the polder will be brought to this transshipment point, where they are stored and later transported to Vlaardingen or Delft for production purposes.

The new ways of production in combination with the transportation of these goods lead to a new settlement, that will take the form of a resource-based community. On the transshipment point, a dense development will be realized by combining storage and transshipment with dwelling. Farmers, seasonal workers, a care farm, and other inhabitants will settle on a ridge of sand, enabling them to keep dry feet whilst still enjoying the rural landscape and living close to the production areas, resulting in a circular development

For further information on the site and masterplan, please revert to appendix 02 – Site Analysis.

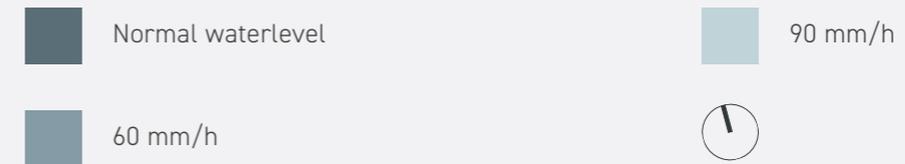
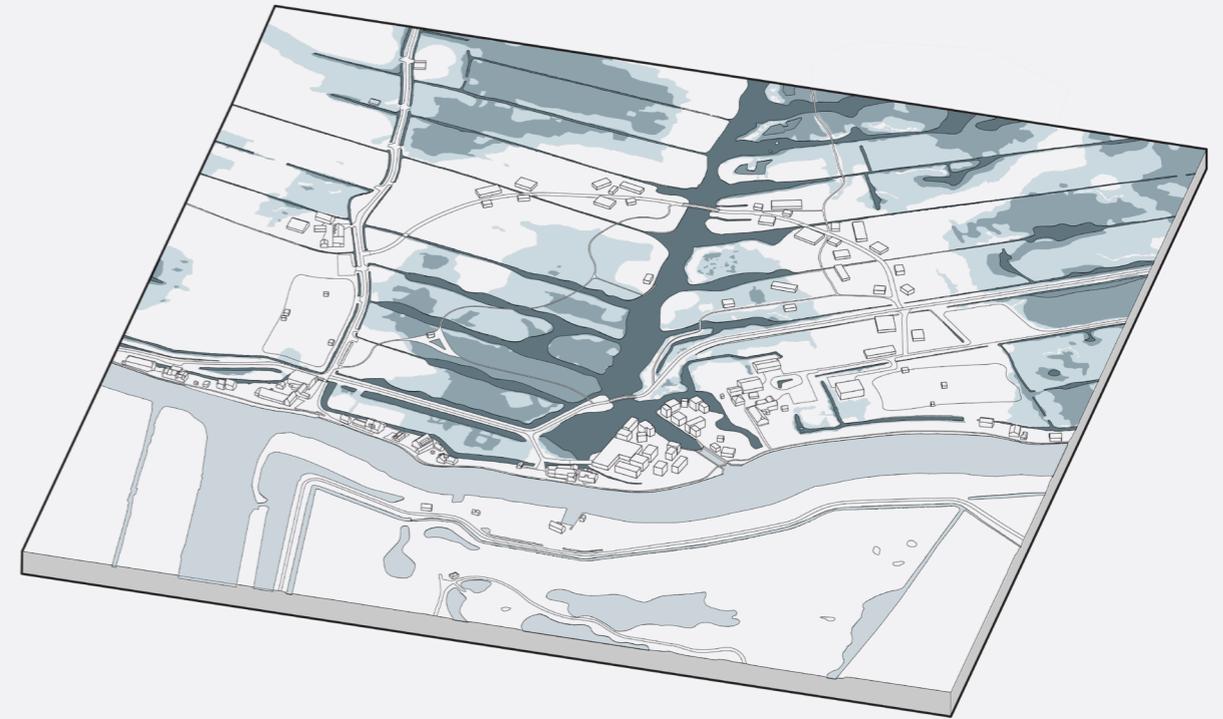


## Soil conditions



The site contains, against most expectations, not a vast amount of peat soil, only the central part closest to the Zweth consists of peat with a small layer of clay on top. Bordering this peat soil is marine-based clay, which is a result of the sea previously intruding into the landscape and dropping heavy particles. This is especially true on the tidal-inversion-ridge, which consists of rigid sand and clay soils. For construction, the most suitable soil types would be the inversion-ridge and marine-based clay, this is also directly related to the location of the buildings in the masterplan.

## Water influence



According to the plan of ZUS, the Zweth is part of a water buffer, designed with a precipitation of 90 mm per hour in mind. The cities around Midden-Delfland will use the boezembuffers for the storage of 8.000.000 m<sup>3</sup> of water which is the volume of 3.200 Olympic pools. This amount of water will cover the complete buffer area of Midden-Delfland with 420 mm of extra water, resulting in the Zweth becoming 3 meters below NAP<sup>7</sup>. A large part of the surrounding polder and masterplan will therefore be flooded, as seen in the diagram. It is to be noted that 90 mm/h of rain is an exceptional amount and rarely occurs, although the frequency is expected to rise<sup>8</sup>.

## Tidal inversion ridge

As discussed on the previous page, various soil conditions are present on the site. This is not only visible on the map (figure 12) but also on the site itself. As seen on the photograph on this page there is a clear height difference when looking along the bicycle path.

The raised bump in the distance is the beginning and east side of the tidal inversion ridge, clearly illustrating the present height differences and thus hinting at the underlying soil types.



## Current water level

During a site visit in the fall season after a period of rain, the lower parts of the site and surroundings were showing some signs of flooding or high levels of groundwater. It should thus be kept in mind that although the site changes towards the year 2100, flooding can already happen without the polder changing into the proposed boezembuffer.

Having a groundwater level this high means that the accessibility of the lower parts of the site is greatly reduced to the extent that walking on the soil is not comfortably possible.

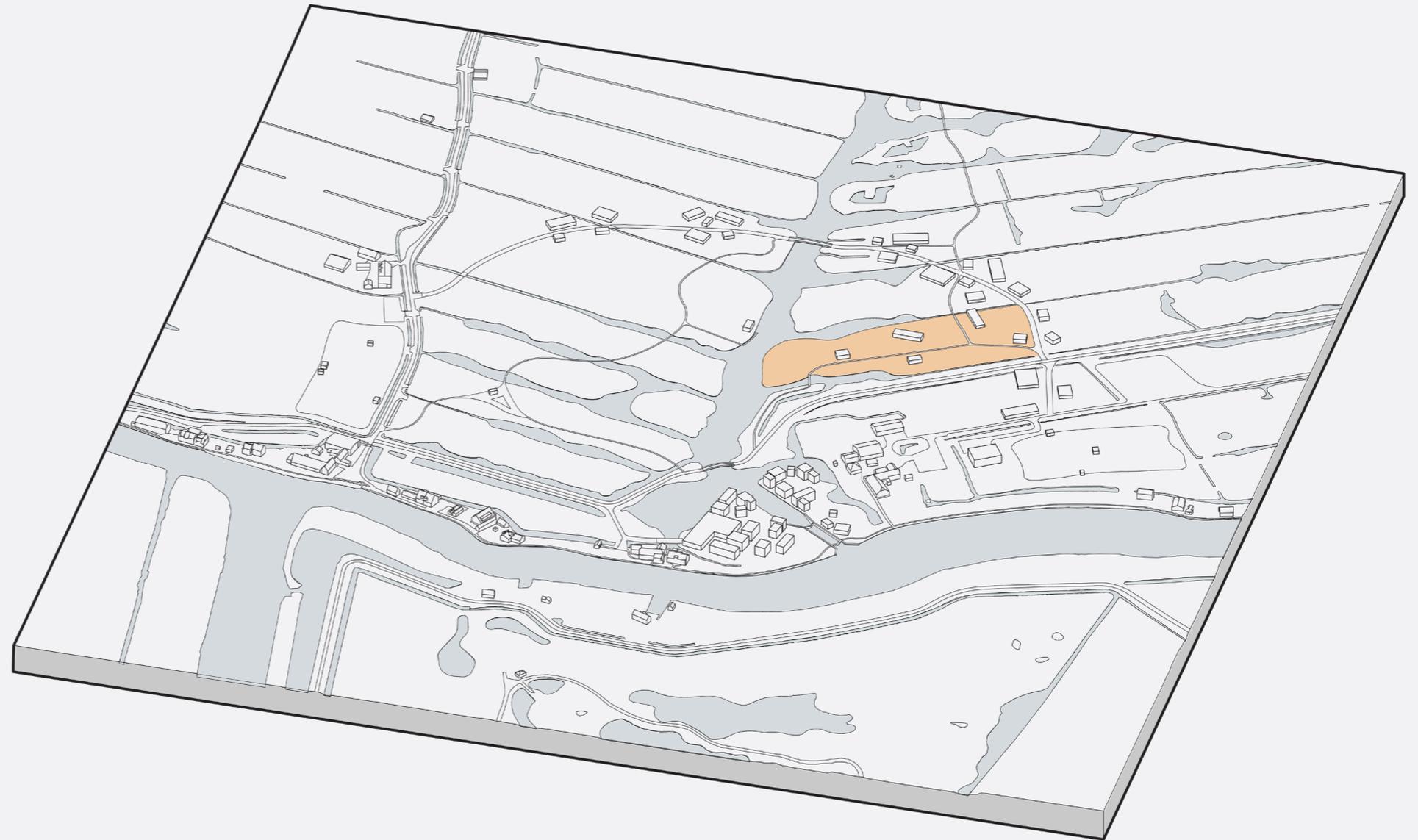


figure 15 - Photograph of partly flooded polder

## The site

The site that has been selected for the development of the design project knows many features, as covered in the previous pages. It has all types of soil conditions, varying from clay to peat to sand, and therefore varying heights are noticeable, which will result in the possibility of parts of the location being flooded. This location can therefore be an example of how to deal with multiple conditions in one plot, which makes the building adaptable to multiple situations in the future.

The selected site covers in total an area of 10.750 m<sup>2</sup> in other words 1.7 soccer fields. The area makes up 6% of the total masterplan area, covering 173.375 m<sup>2</sup>. The ratio of dry- versus wetlands is roughly 1 to 3, making the predominant soil condition wetlands.



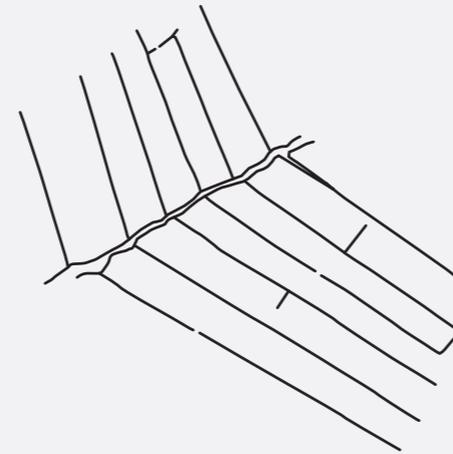


## Target group

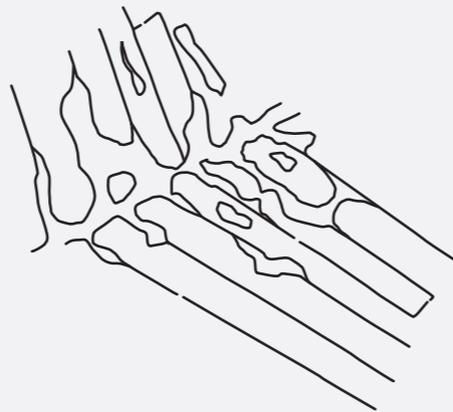
With the analysis of the site and the plan of ZUS combined, the statement can be made that the site we currently know as a polder will change to a wetlands area in the future. Despite this being a target that is commonly accepted, the timeline is still relatively uncertain. It can for instance take 5, 10, maybe 20 years before the transition to wetlands finally can occur due to extensive and complex processes on government level.

The fact that the plot will be unoccupied and semi-written-off presents an opportunity to temporarily inhabit the site. For now, temporary housing of some sort is proposed until the water level rises to a level that is not feasible to dwell, then the building has to move to another similar location.

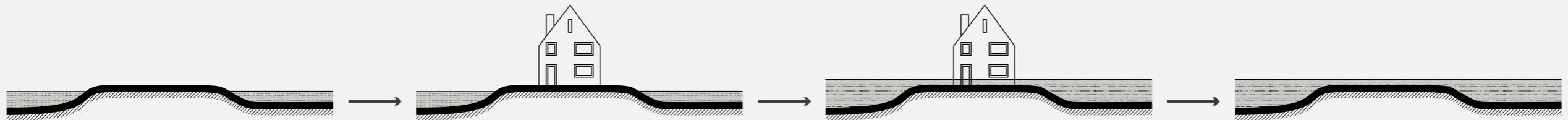
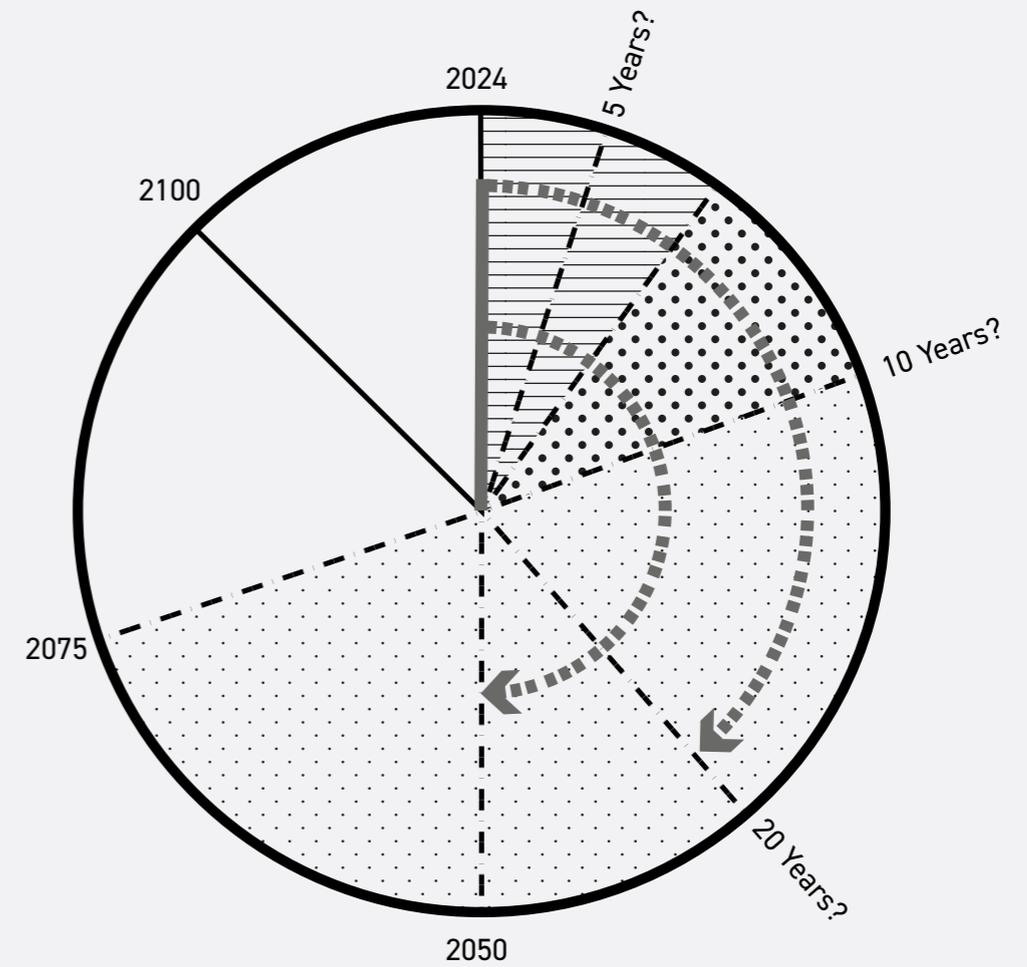
This brings up the question what target group will be able to live temporarily in this environment?



Polder



Wetlands



## The permanently impermanent

The search for a target group initially started with the idea of housing a CPC (Collective Private Commissioning.) In that case, the city administration would lease the ground for a certain period, after which they have to leave for another location supplied by the government. Although this could be a feasible solution when looking through cases of so-called flexible or demountable projects, such as the Auenweide in figure 19, the This flexibility mostly leads to optimized and faster construction. Furthermore, this temporary housing then often becomes more permanent to the extent no one will move from the site.

A similar thing can be said for the industrial prototype house in the bottom image. In essence, this house is modular, doesn't have a big impact on the site, and is most probably easy to remove. This indicates that also the method of the building doesn't per se influence the temporality of the structure itself, in other words, we have to deal with the human factor as well.

For further details on the cases, please refer to Appendix 03 – Case Study Research.



## A contemporary Datsja?

Back in 1994, there was already talk of redeveloping some agricultural lands to production forests or natural environments. These 'green stars' within the Randstad would add a vast area with a high recreational value close to the cities. The concept of the plan is to eliminate the need for dwellings with a garden in the city by allowing those dwellers an additional dwelling in these areas.

The result of these constraints was the Datsja, a self-supporting holiday or weekend home, of around 40 m<sup>2</sup> with a garden of 100 m<sup>2</sup>. Contact with nature was one of the most important elements of the building incorporating much glass in the design. The buildings should be founded on prefabricated concrete plates, and have a free plan with a movable core inside.

Just like the previous example in figure 20, the Datsja has some essential non-permanent features, like the foundation and the lack of a connection to utilities. It is however again the function that makes the building rather permanent, especially considering the users live in the cities in houses without gardens.

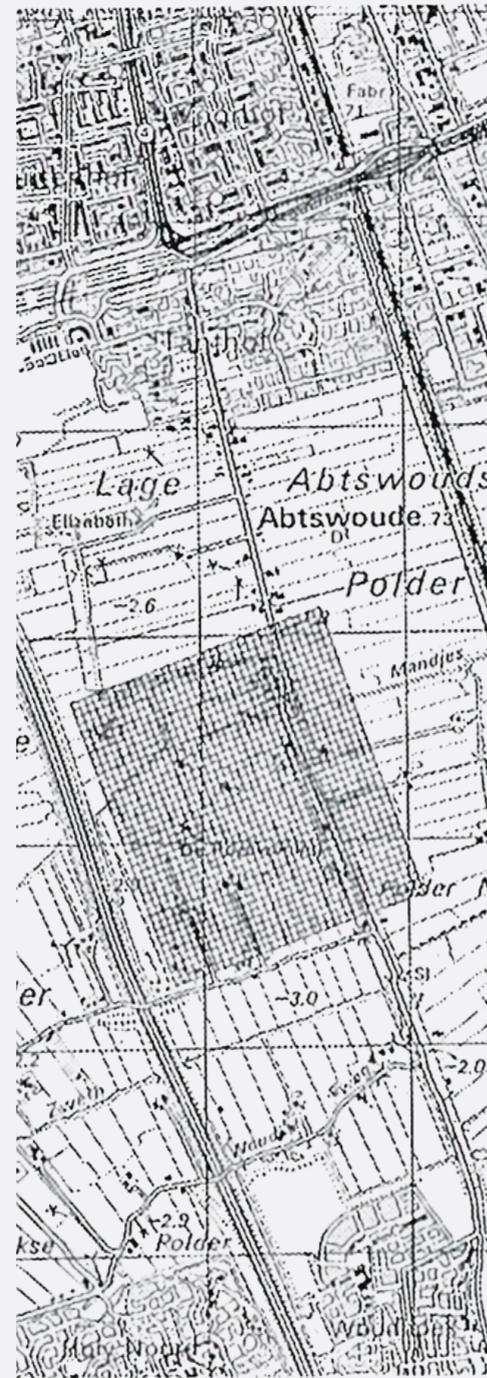
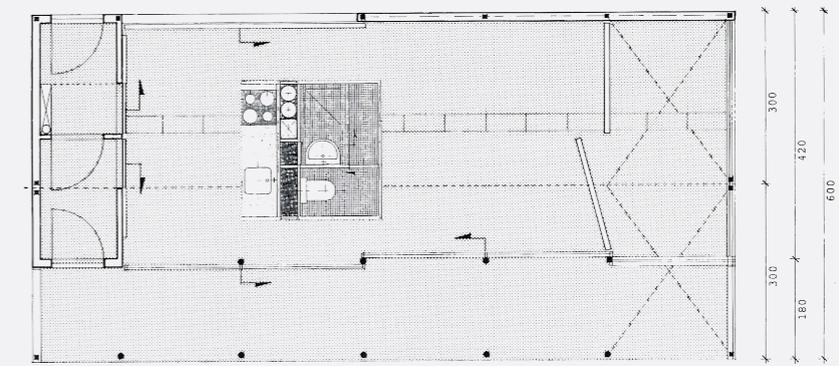
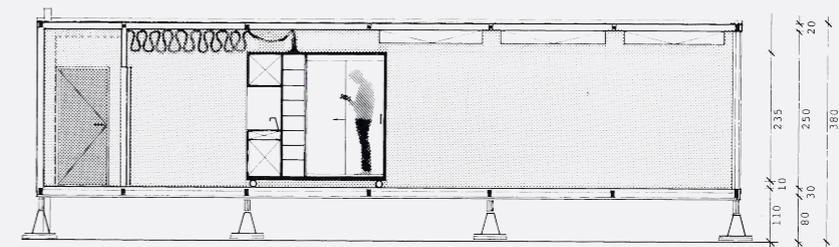


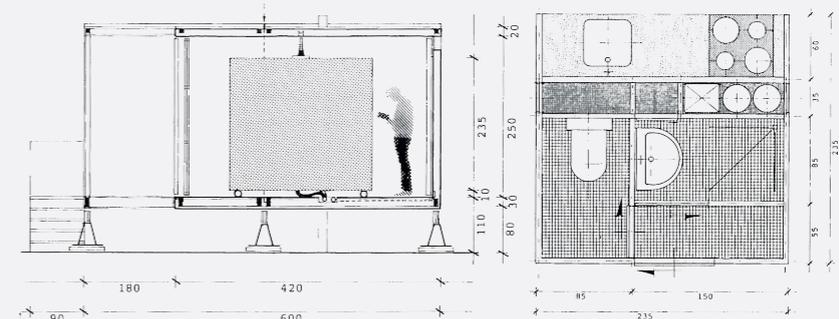
figure 21 - Datsja planning in Midden-Delfland



Plattegrond



Langsdoorsnede



Dwarsdoorsnede en verplaatsbare kern

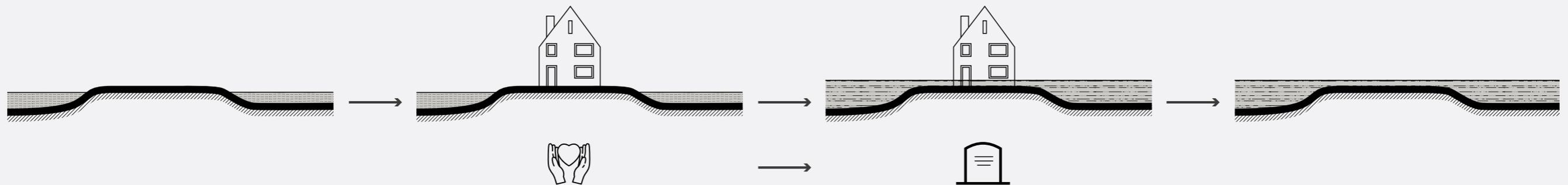
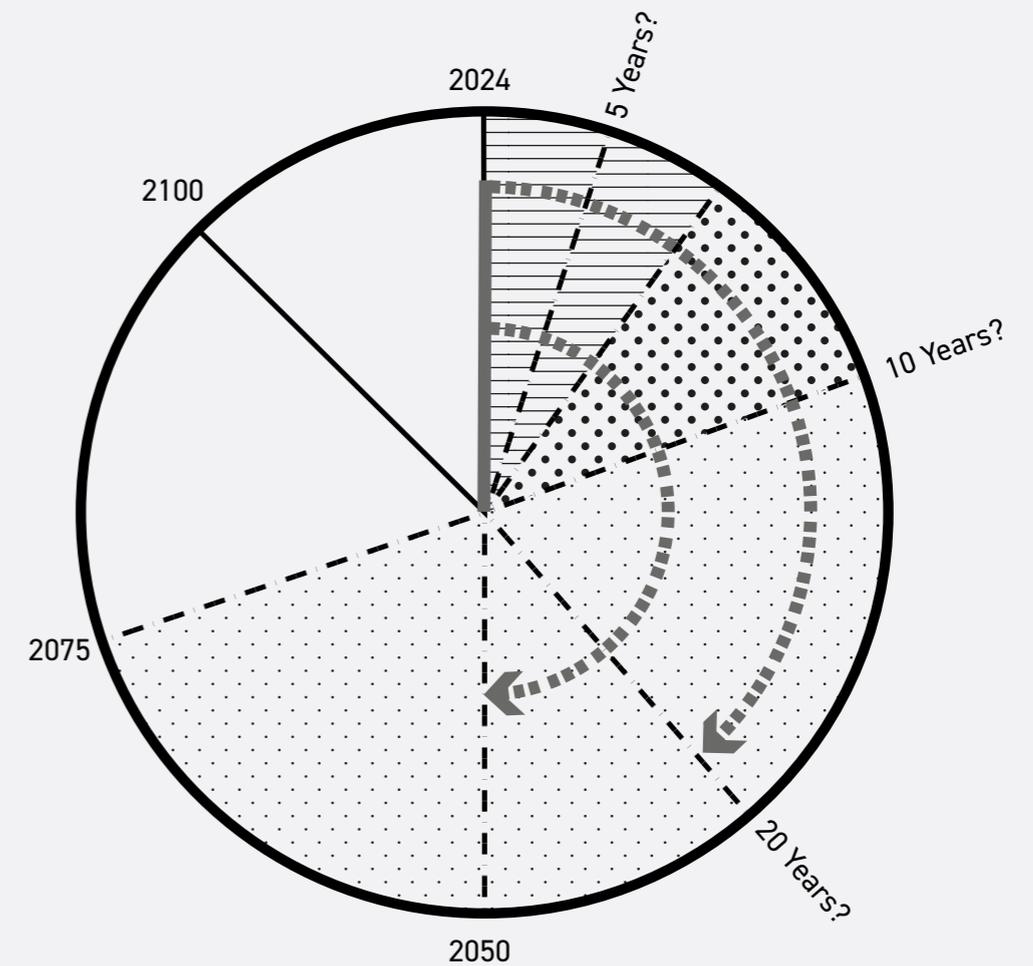
figure 22 - Datsja design by KAW Architecten

## A hospitable movement

Seemingly, most so-called temporary projects tend to become permanent during the time of use, presumably because the project becomes time-barred. Because this is intrinsically linked to the target group occupying or using the building, a matching target group that fits the temporary nature of the building should be chosen.

It could be stated that the site in its current form eventually enters a new phase, after which the plot becomes uninhabitable and needs to be used for another purpose. This change of phase or the endpoint of the site can be reflected in us as humans and our existence. During our lives we are also living towards a certain endpoint, a new phase, death, marking our temporary existence on this earth.

When linking this way of thought to building a hospice can be a very suitable program for the temporary nature of the site, creating a close match between the building, nature, and the human. Because of this reasoning, a hospice will be made for this design project.



## Natural benefits

With the selection of a hospice for the building program, the natural environment becomes even more beneficial for the target group. Research has proved in the way of many reports that the incorporation or presence of nature around humans has physical and mental healing capabilities. A Japanese research conducted to discover the effects of greenery on humans revealed that the stress hormone was reduced by 15% in comparison to non-greenery environments. Furthermore, this same research measured an increase in overall parasympathetic activity by 56%, which increases when a person is feeling calm. In addition, the sympathetic activity was reduced by 20%, further supporting the fact that a person feels less stressed in the presence of nature.

Including the presence of nature in architecture is nothing new, for instance at the tuberculosis sanatorium in Finland designed by Alvar Aalto. This design was based on the knowledge during the first years after the discovery of the Tuberculosis virus, there was a strong belief that there was a rehabilitative effect achievable by exposing the patients to light and air. This is also why outdoor areas were created for patients to truly take in the natural light and air<sup>10</sup>.

More recently the mental effects of healing by nature have become increasingly popular and implemented. This is especially the case for hospitals, such as the Khoo Teck Puat Hospital in Singapore. This building is based on biophilic aspects incorporated into the design, also called biophilic design. According to the book *14 Patterns of Biophilic Design* biophilic design refers to "biophilia", which is our innate biological connection with nature.<sup>11</sup>

Reflecting upon the function of the hospice the natural environment will meet the aims of the biophilic hospital of Khoo Teck Puat, in reducing the stress levels of the patients and making life as comfortable as possible during their stay.



## The Program

To gain more insight into the program of a hospice, a literature review was carried out in combination with a visit to a hospice in Rotterdam, Hospice de Liefde. In essence is a hospice a building where terminally ill will spend the last three months of their lives. In most cases the staff of the hospice will take over the care for the patients from the caregiver, relieving them during the last period of the partner's life. Furthermore, during the visit to Hospice de Liefde, the interviewee kept repeating that a hospice is a home-like, low-care environment, not a hospital. The Dutch name "bijna thuis-huis" supports this, directly translating to Almost home-home.

In the case of the 6-bedroom Hospice de Liefde in Rotterdam, a total amount of 120 volunteers is needed to keep the organization up and running. Roughly half of this amount are nurses, whilst the other half do jobs, such as building maintenance, gardening, administration, or cooking. Only two persons are on the payroll, which are the coordinators. In addition to the voluntary nurses, there is always one professional nurse on site, responsible for the medical treatment (only medicine.) This professional nurse is then supported by two volunteers.

The main reason for the sheer amount of volunteers needed has to do with the funding a Hospice receives. During the first two years, there is no government funding, so the hospice has to work with fundraising in combination with the fee patients pay for their stay in the hospice. After the two years, the government will source half of the cost, the patients a quarter, and the other quarter through funds.

It can be stated that running a hospice is quite hard because of the funding, finding volunteers, and supporting general practitioners. This was also the case for the visited hospice, which took them 8 years of preparation before the construction finally started. Impact on the building level can thus be made by making an economically efficient building in construction and using resources.

For further details on the program please refer to Appendix 04 – People & Program.

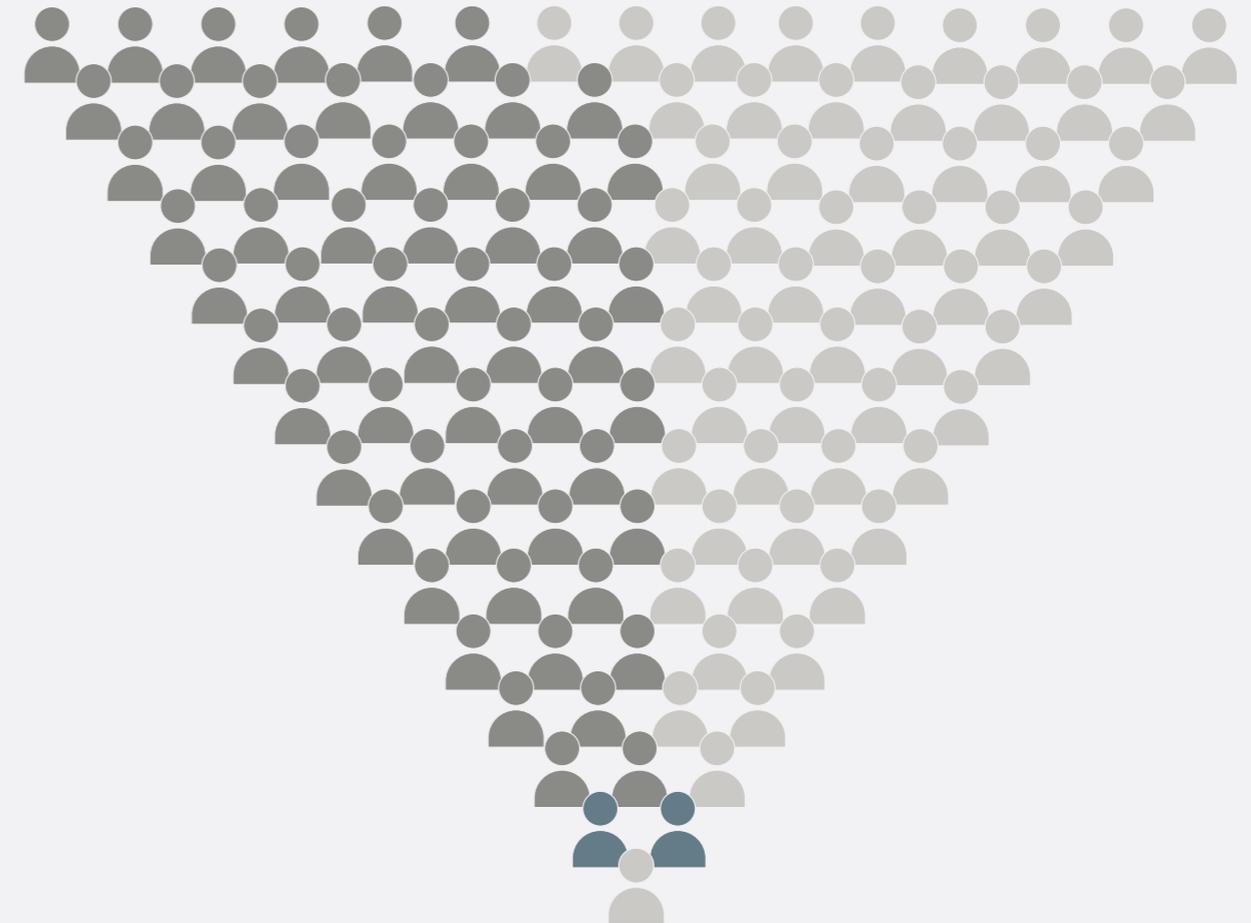


figure 26 - Volunteers Hospice de Liefde

## Reference hospices

To create a program that can be used during the design process two similarly sized rural-based hospices were analyzed in the case study booklet. The first hospice is Hospice de Liefde, which was also visited, and the second hospice is Hospice Het Tweede Thuis.

Both hospices have a floor area of around 650 m<sup>2</sup> excluding circulation zones. Hospice de Liefde has an area of 575 m<sup>2</sup>, whilst het Tweede Thuis has 675 m<sup>2</sup> of floor area. Both hospices are containing 6 bedrooms for 6 patients.

Most functions in both hospices are identical, such as a shared kitchen, livingroom, and ritual space by means of public space. Staff areas like linen storage, a launderette, and a nurse's office are also identical for both hospices. The only difference in the hospices is the addition of a night watch close to the rooms in Hospice de Liefde, which is lacking in the other case.

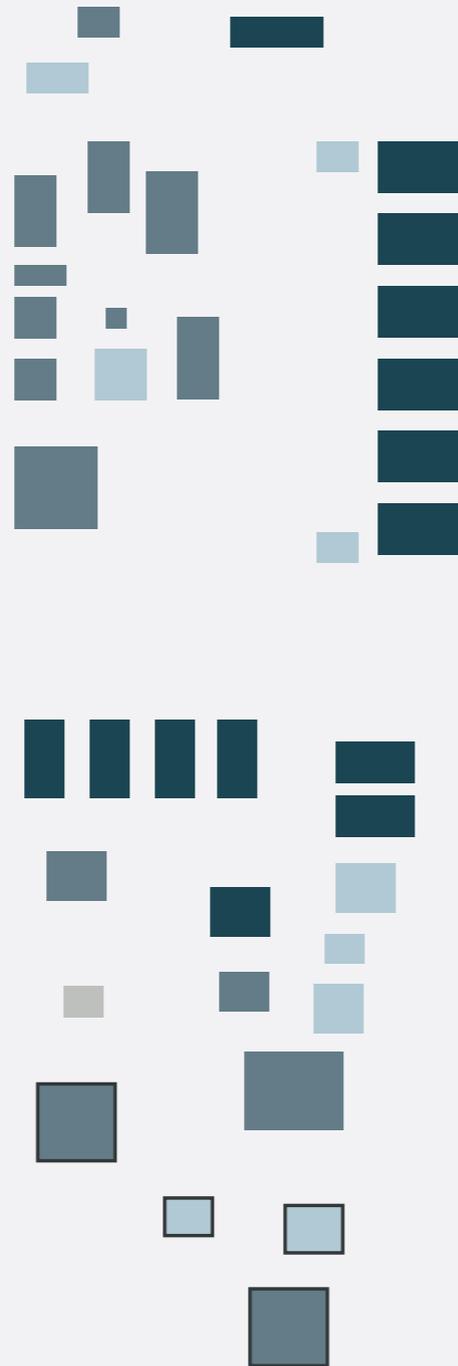


figure 27 - Diagram of room layouts



T-figure 28 - Hospice de Liefde

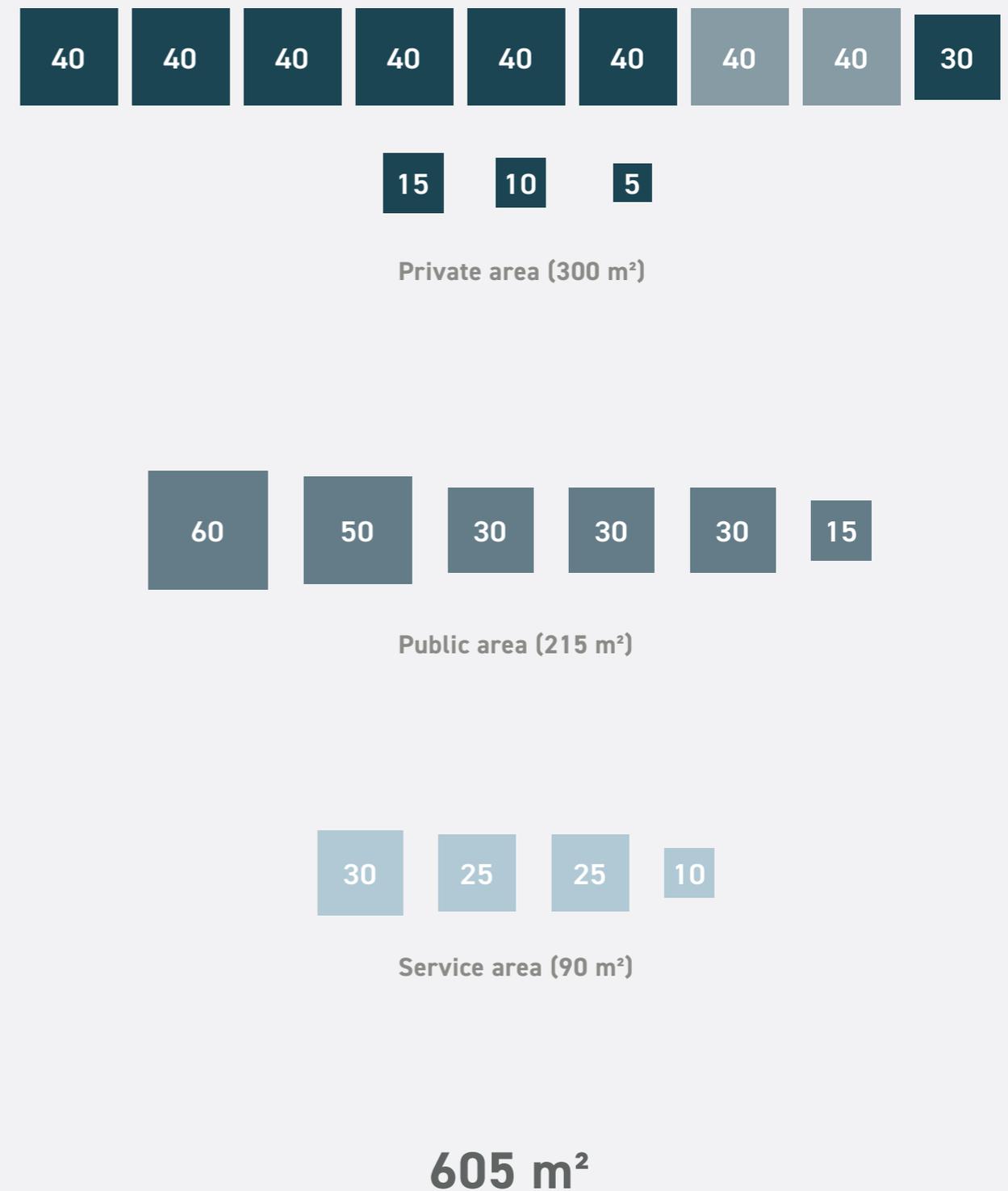
B-figure 29 - Hospice het Tweede Thuis

## Spatial requirements

By combining and comparing the spatial requirements of both hospices in the previous page, the following program has been formulated. The hospice will be designed with six patient's rooms all being 40 m<sup>2</sup>. These rooms are supported by a shared living room of 30 m<sup>2</sup>, a kitchen, and a diner of 50 m<sup>2</sup> with an accompanying family room of 30 m<sup>2</sup>.

The staff will need an entrance room, combined with a reception of 30 m<sup>2</sup>, office space of around 40 m<sup>2</sup> combined, and a meeting room of 15 m<sup>2</sup>. Furthermore, building supplies of 30 m<sup>2</sup>, a launderette of 25 m<sup>2</sup>, building service systems of 25 m<sup>2</sup>, and a building maintenance storage of 10 m<sup>2</sup> are taken into account.

For further details please refer to Appendix 04 - People & Program

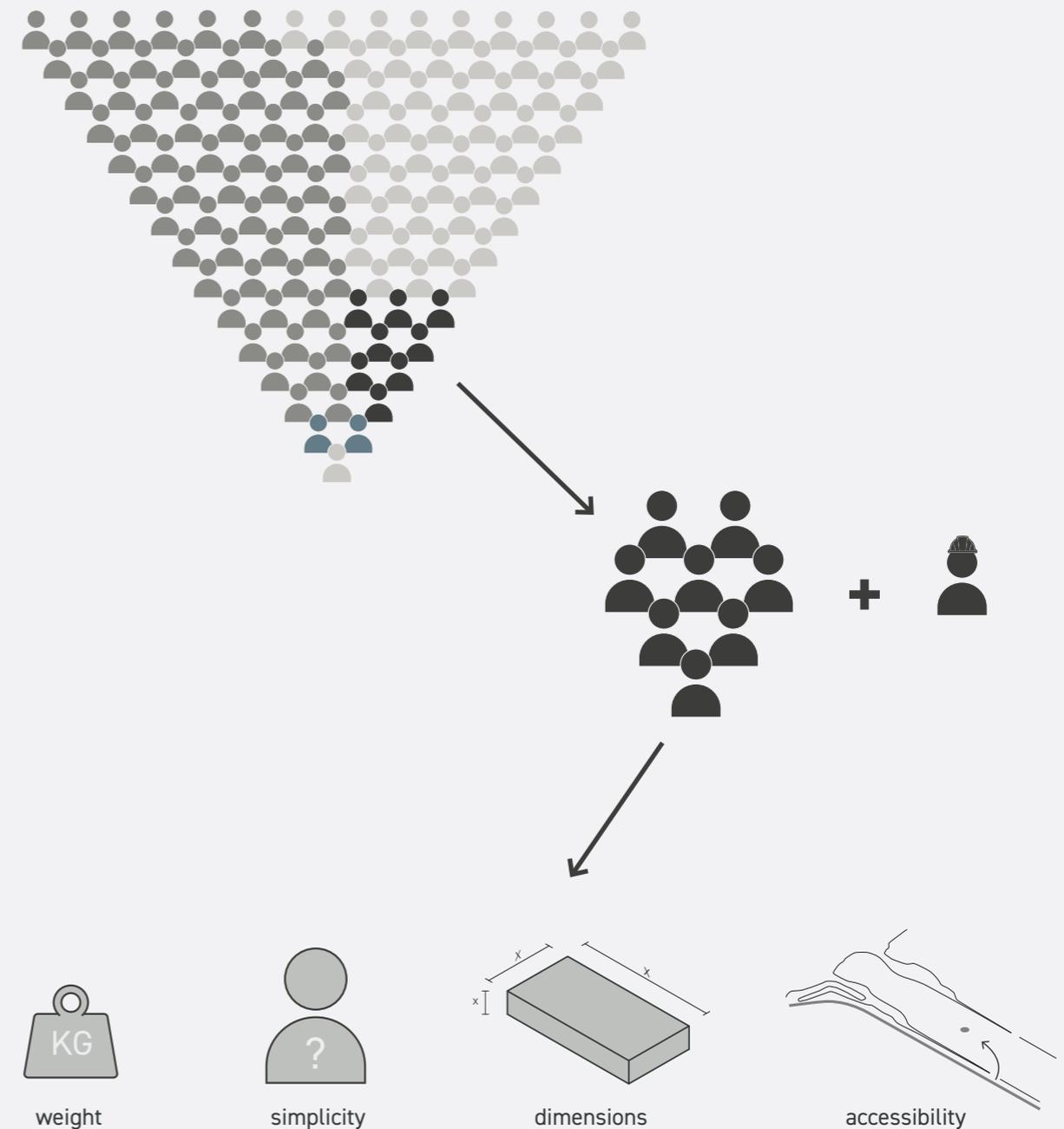


## DIY & Demountability

As discovered with the research into the program the building needs to be efficiently and economically built to minimize construction cost making the hospice more feasible. This combined with the knowledge that an average hospice has a large base of volunteers, including ones specialized in building maintenance leads to the following proposal.

To achieve a cost-effective assembly, and later disassembly, of the building the group of building maintenance volunteers will do the construction under the supervision of an experienced carpenter or contractor. This way only one person needs to be paid for, whilst he could also be working on a voluntary basis.

This way of working will result in some constraints that will affect the building's composition. Aspects that should be considered during the design phase are the knowledge of the volunteers, the simplicity of the construction, the weight and size of building elements, and the accessibility of the site. A big crane and truck can for instance not be moved on the peat soils, so small transportation is essential.



## DIY & Demountable references

Building demountable or building as participatory housing i.e. built by the client is not uncommon in the realm of architecture. Some historic examples of this are the SCAL demountable pavilion, designed by Jean Prouvé, and the participatory housing project by Walter Segal.

### SCAL demountable pavilion

The demountable pavilion by Prouvé was developed as an easy and quick building to arise in case of wartime. The buildings could function as a war office or as barracks for troops. The whole building was lightweight, with all elements being structural and prefabricated. In addition, the building could be raised by three people in roughly 4 days. Because the group that constructed the building often varied Prouvé drew assembly manuals showing the construction order<sup>12</sup>.

### Participatory housing

Another approach was taken by Walter Segal who designed his buildings in conjunction with the future owners of the house, who were also going to build that structure themselves. After deciding on the floorplan and facades, Walter often drew detailed manuals of the construction process like Prouvé, whilst also offering construction classes to his clients<sup>13</sup>.



## Self-built survey

To gain further insight into the DIY-ability of the volunteers working for the future hospice a literature review and a survey were used. Within the literature review the context for the survey was explored and categorized into three elements: preparation, construction feasibility, and materialization. Based on these three elements, colleague carpenters working at a contractor were interviewed, reassuring a practical look at DIY construction.

### Preparation

Before one starts to build, the structure needs to be prepared in the way of drawings, structural calculations, etc. Through the survey, all the interviewees recommended contacting an advisor of some sort, who can make drawings, structural calculations, and an overall design concept. This was the case even when stated that the DIYers could draw themselves.

### Feasibility

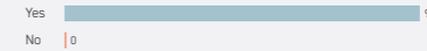
The only way the project can be feasible for a DIY approach is with the supervision of a carpenter, according to the interviewees. Even then special attention should be given to the structural and building physics-related elements due to the lack of knowledge. It should be noted that under the supervision of a professional, all work can be carried out.

### Materiality

Materials should be easy to work with, even though they might be less durable, such as wood façade panels or structures. Preferably prefabricated elements should be utilized, making the construction process easier to understand with fewer parts making up the building. The two main materials recommended for the construction of the building were wood and steel elements. Wood for ease of use, and steel for the ease of assembly by nuts and bolts.

With this input given through the research in Appendix 06 – The Voluntary self-built Movement, the design should be makeable, also by lesser experienced voluntary based workers.

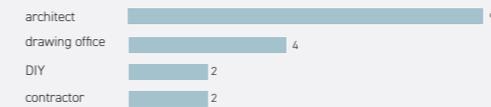
**Q1**  
Would you recommend a self-builder to contact an advisor as preparation before they start building? (architect, technical engineer, structural engineer, etc.)



**Q2**  
If yes, what type of advice or products would you recommend getting before starting a DIY building project, and who would you recommend asking?



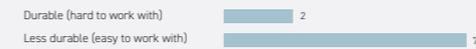
**Q3**  
Expecting the self-builder knows how to draw, would you recommend them designing their building themselves or have it done by an architect?



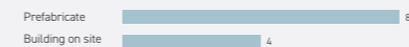
**Q8**  
What materials would you recommend the self-builder for creating easy to assemble, demountable, and reusable buildings without a footprint?



**Q9**  
Would you recommend to the self-builder harder to process but more durable or easier and less durable materials requiring more maintenance?



**Q10**  
Would you recommend building assembling a building in prefabricated elements, or build a demountable building on site?



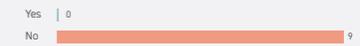
**Q11**  
What particular building techniques/methodologies would you recommend for this, keeping in mind that the building needs to be disassembled?



**Q12**  
If the self-builder wants to find information, where would you recommend them looking for? (books, speaking to professionals, social media, etc.)



**Q4**  
Would a self-builder be able to build all parts (foundation, structure, facade, etc.) of a building themselves, knowing that they don't have a lot of building experience?



**Q5**  
What parts of a building would a self-builder be able to complete themselves in a DIY fashion, and why?



**Q6**  
What parts of a building requires expert knowledge, and would you recommend to be executed by a contractor, and why?



**Q7**  
Would a self-builder be able to execute these building parts under supervision and support from a professional/carpenter?





# Hospice Design

The building design process can be characterized by three conceptual steps that combined make up the design. The process started by selecting a way of organizing the building scheme, this generic layout is then further detailed by the means of including nature into the design. Finally, the temporary housing is realized through the demountability concept. These three elements will be used to explain the building design in the following chapters, working from a preliminary design up to the final product.

## Building organisation

The first major step in the design process is the selection of a building scheme. The main consideration for selecting the scheme is organization and routing in- and outside the building. Aspects such as building supplies, patient routing, staff logistics, and visitor routing were considered.

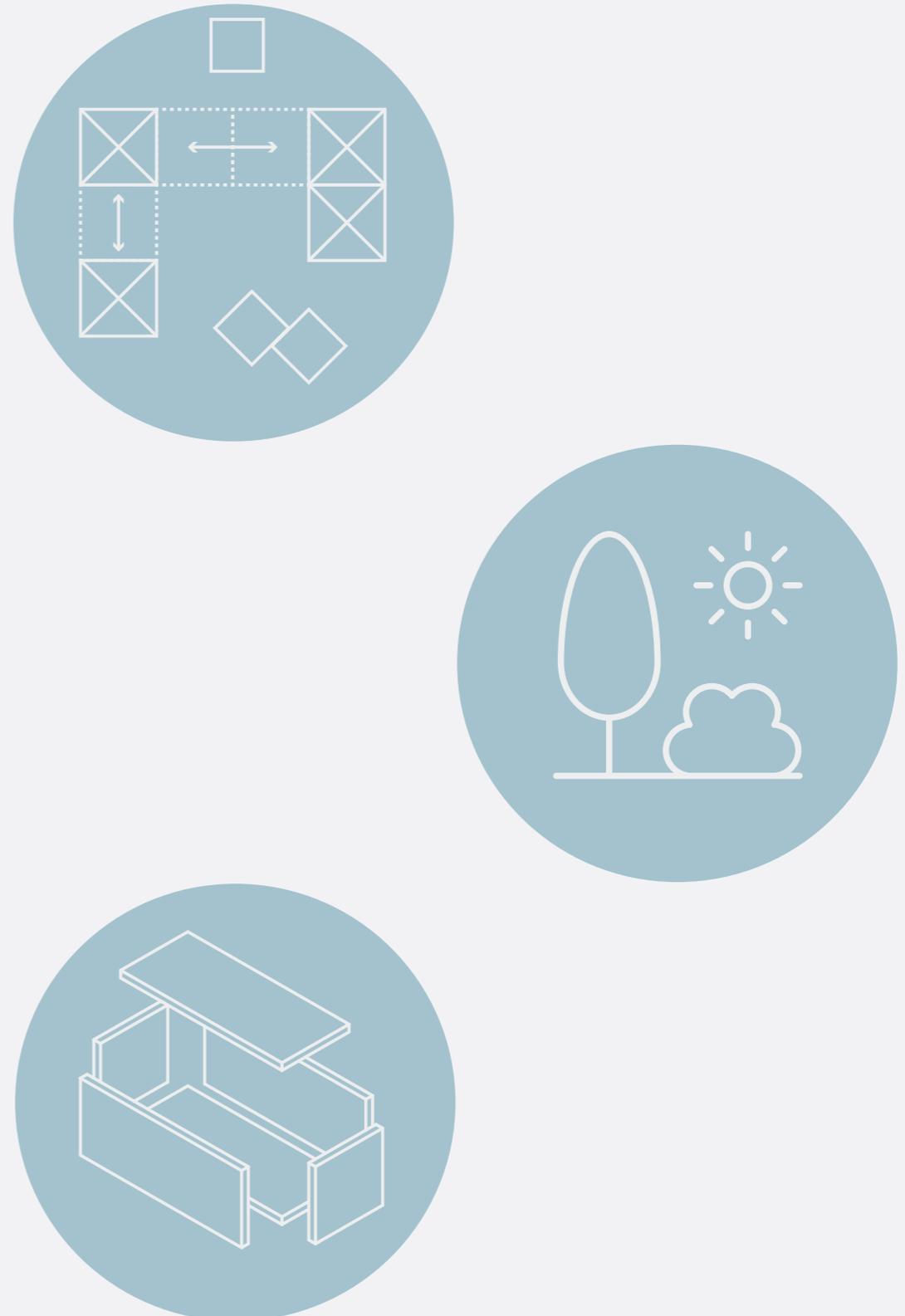
## Nature inclusion

As covered in the case study research, natural aspects can be used to reduce the stress levels of the patients. Important elements of consideration for this concept are views, outdoor space, climate, and natural light.

## Demountability

Because the building has to be disassembled, and later reassembled on another site, the demountability of the structure is another conceptual element, primarily affecting considerations in the technical realm. The influence of this concept is noticeable in the structure and detailing, or otherwise general construction of the hospice.

In the following chapter the design process is documented, for further information please refer to Appendix 08 – Design Process

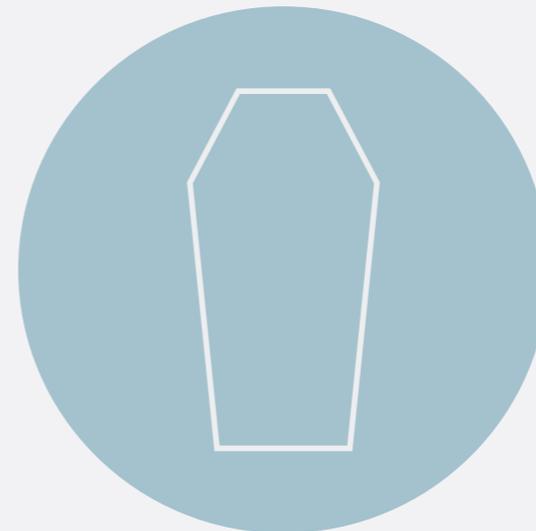
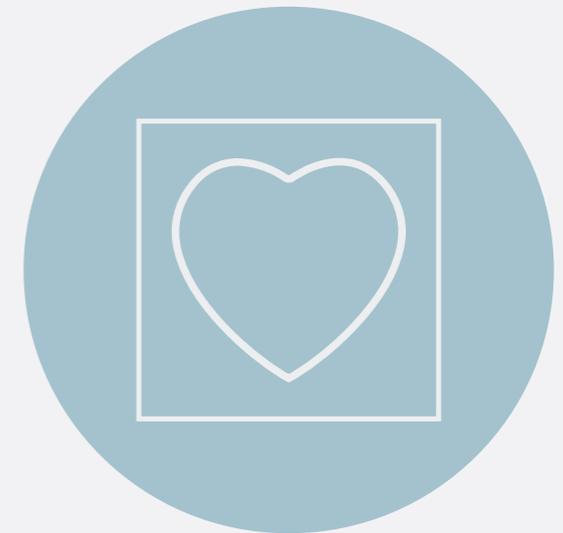


## Building organisation

During the initial design phase, it was found that the program of the hospice could be divided into three clusters. The patients' rooms in combination with a night watch represent the first cluster. In this cluster, privacy, acoustically and visibly should be guaranteed by separating this from the public functions of the ensemble.

Connected to the palliative cluster is the central heart of the ensemble. This building contains the public spaces of the hospice, such as the living room, dinner, and kitchen. Furthermore, all the staff functions, for instance, the nurses' office, launderette, etc, are housed within this cluster. The entrance and several other functions are also housed in the central heart. Because this cluster is centrally placed within the ensemble, certain flexibility and the possibility to adapt to other sites is essential.

The final cluster is the ritual space, this is a standalone building, again connected to the central heart. This cluster houses the ritual space in combination with some storage and installations. Once patients have deceased, they will be moved from their room to this space. Here loved ones will be able to say their goodbye before the deceased is moved to a funeral home.

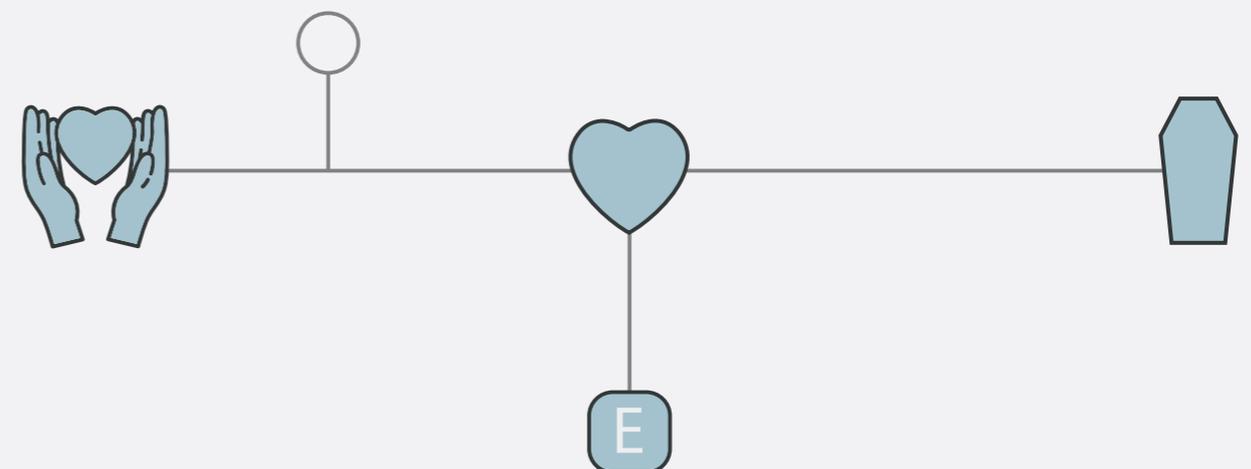
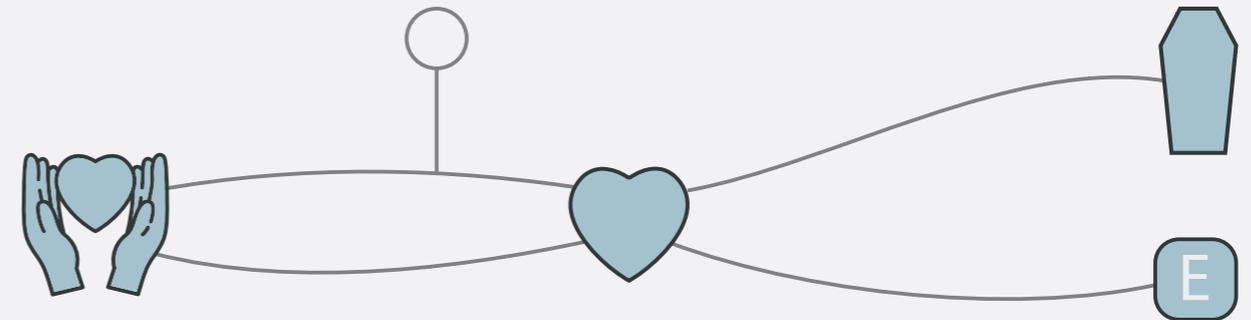
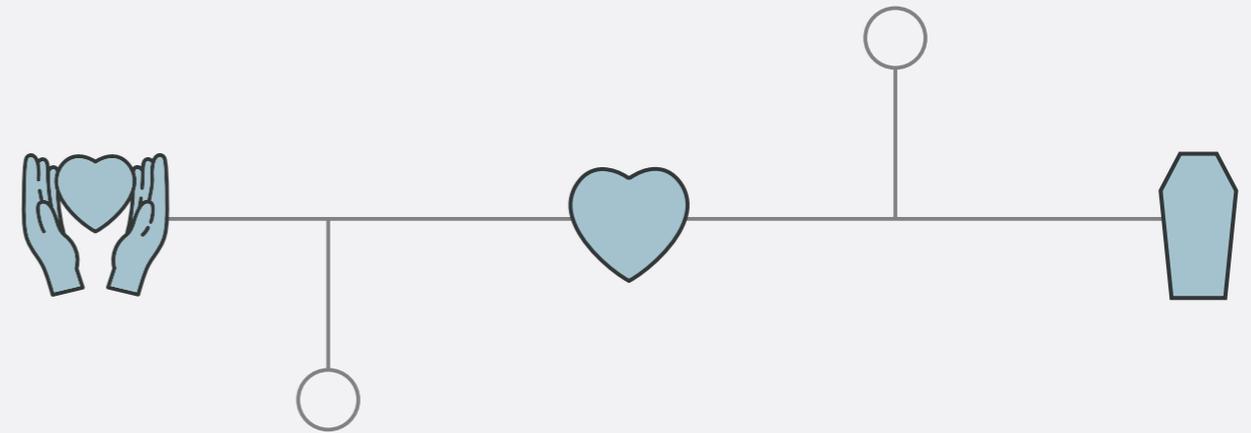


## Building scheme exploration

With the three clusters defined, possible and logical building schemes were explored by the means of models and sketches, finally being narrowed down to three options for the building composition. The first option takes the central heart literally and places it centrally in the scheme. From this central position, the building branches out to the palliative cluster and ritual space, offering the possibility of attaching more elements to the branch in the future.

The second scheme represents the journey the patient is taking. One will enter the building, and reach the central heart after a clear separation. From then on the patient will circle between the palliative cluster and the central heart until they have deceased. Then the circle will be completed with the patient being moved to the ritual space.

The final composition is organized in a start-heart-end way. Whilst still being based on the circular thought of the second diagram, the palliative cluster is now seen as an integral part of the central heart, making the representation less present and also less confronting.

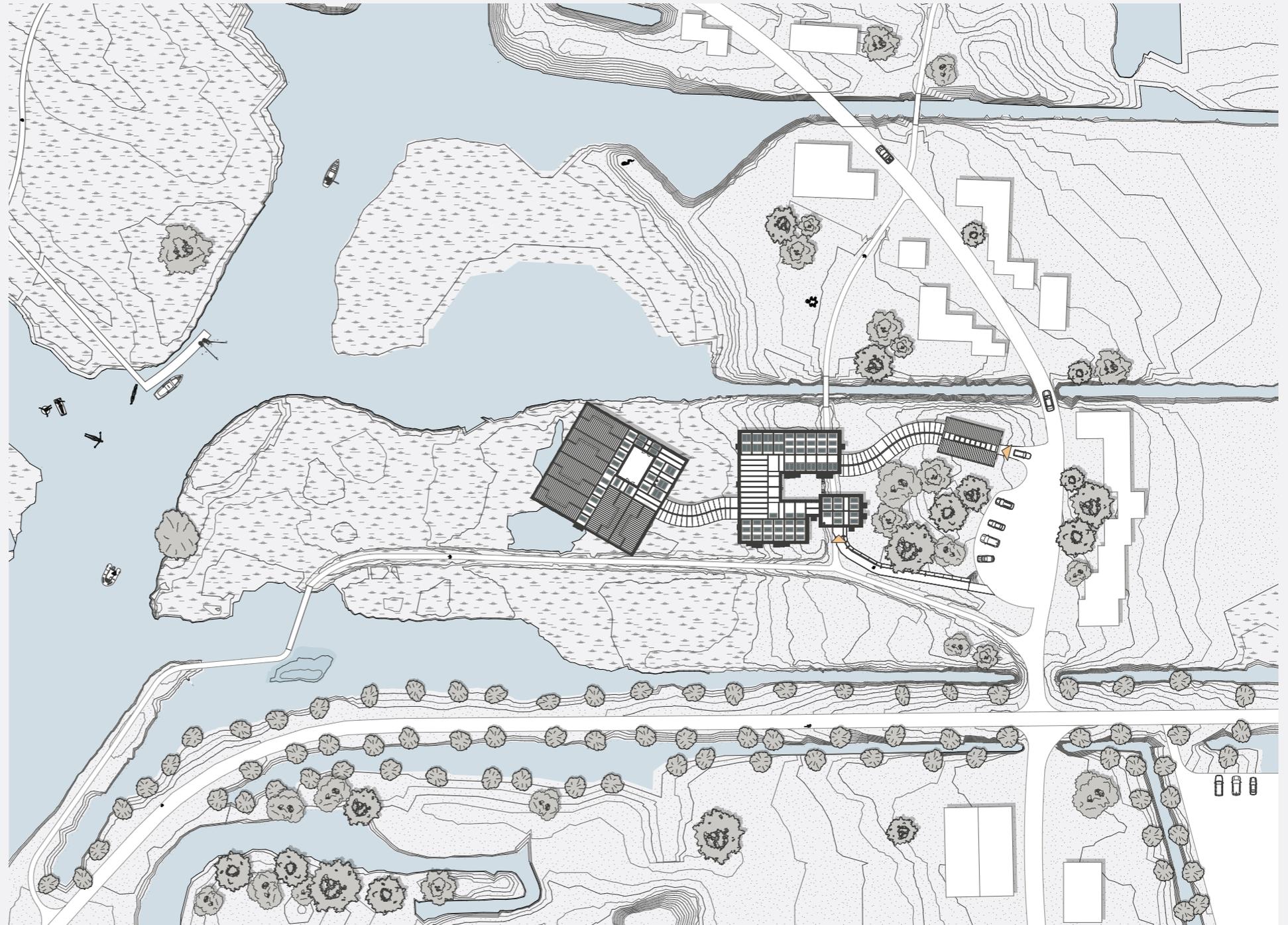


## Final building organisation

As seen on this site plan, the final organization of the building can be described as a hybrid solution, combining aspects from all three building schemes described on the previous page. In essence, the building can be seen as a three-cluster setup, with the central heart in the middle and the palliative cluster and ritual space on either side. Although the entrance is attached to the central heart, it is still pronounced by moving it slightly off the main mass.

Organizationally, the entrance and ritual space have both been closely situated to the parking space on the ridge. Both clusters have an entrance, ensuring optimal privacy in the ritual space and efficient routing towards the living room and palliative cluster. The ritual space is placed close to the main access road, enabling it to be easily reachable by funeral cars.

Two of the three clusters have been placed on the higher ridge, enabling them to be accessed conveniently. The palliative cluster is placed further on the lower peat soil, which can also be prone to flooding as indicated on the site drawing.

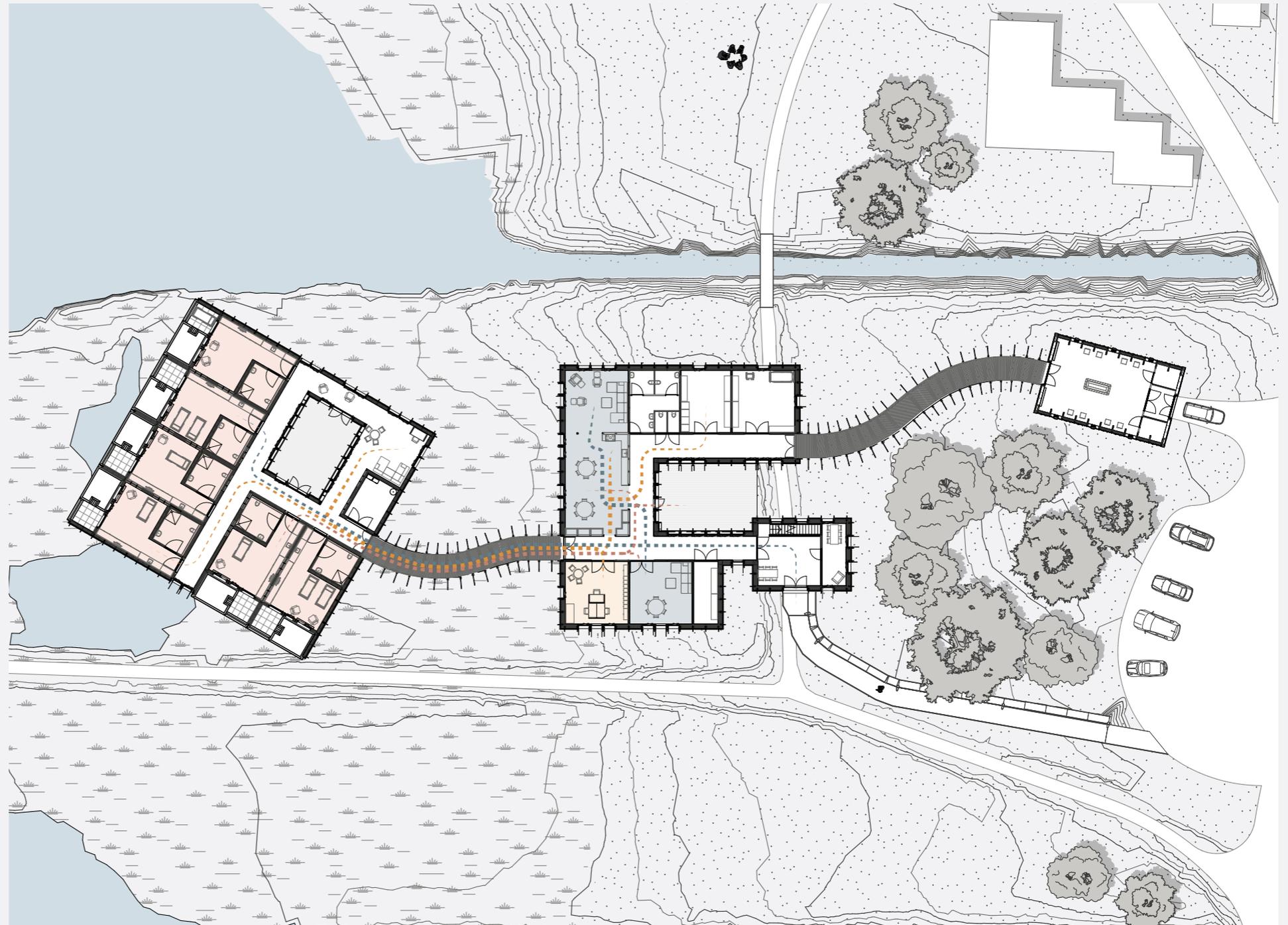


## Horizontal organisation

During the design of this building scheme, organization or otherwise circulation principles of staff, guests, and patients were an important consideration. In the development of the cluster plans all rooms are placed carefully to optimize walking distances and orientation throughout the building.

While visiting Hospice de Liefde the interviewee stressed that nurse logistics (orange) should be efficient, because during the day they cover lots of miles between the kitchen, office, and the palliative rooms. This resulted in the nurses' office being placed in between the two, bordering the kitchen and diner area, making for efficient routing.

A similar route is taken by the patients (red,) who have their primarily used spaces on the west side of the building, closest to the palliative cluster. Furthermore, for relatives (blue) visiting the patients in their rooms or the common family room, the route is reduced to a straight line from the entrance towards the palliative cluster.



## Natural inclusion

With the organization principles of the project determined, the second conceptual element of the design is meant to strengthen the connection with the surrounding environment. The goal of this connection is to utilize the benefits nature has to offer for the patients in the hospice, primarily as a means for stress reduction and mental health improvement.

The natural inclusion in the building is found through various aspects and elements within the ensemble. Each cluster has its characteristics, and thus all have their individual interpretation of the concept. Common factors throughout are the ingress of light, the building climate, views over the landscape, and outdoor spaces.

Instead of being a strictly controlled hospital, the hospice has to feel like a second home. This results in the patient being able to choose the amount of nature they want to take in. It is again this freedom that makes a hospice work.



## Central heart

The central heart can be roughly divided into three elements, the public area for the patients, staff areas, and storage areas. In addition to the organizational aspects described in the previous chapter, the room placement is also based on the views over the landscape. The kitchen, dinner, and livingroom are placed on the northern and western side of the building, overlooking the Zweth, whilst the service rooms are placed to offer shelter from the surrounding buildings. On the southern side, the nurses' room and familyroom are offered a view over the bicycle lane.

Besides for the views around the polder, the windows are also openable to let natural air and smell from the landscape inside the building. Additionally, for the patients to truly enjoy the outside air, a patio is placed in a convenient place, sheltered from the predominant southwestern winds. From the patio a view towards the east side of the building is framed by the ensemble of large trees and the ritual space, offering privacy from the inhabitants across the street.

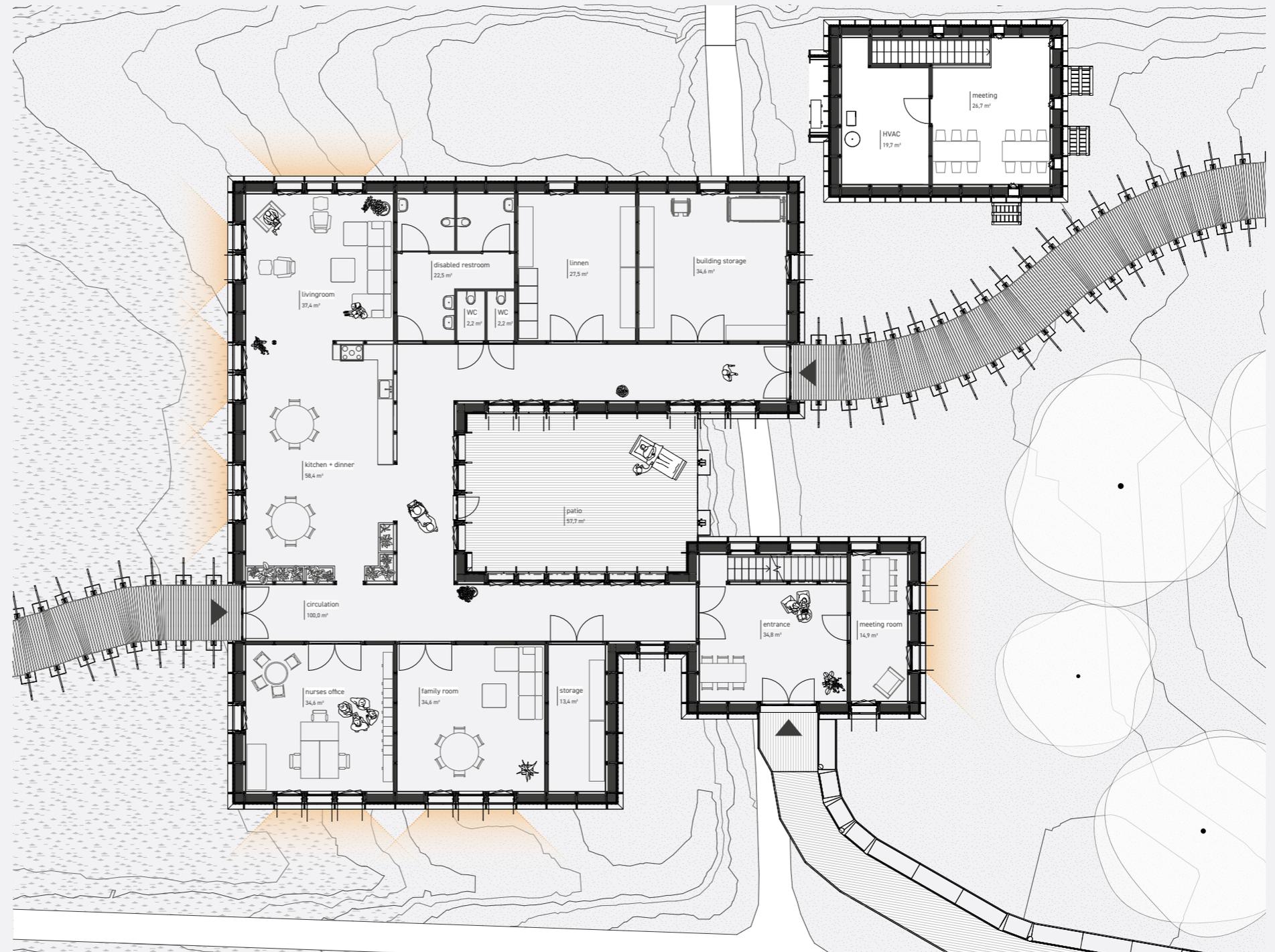
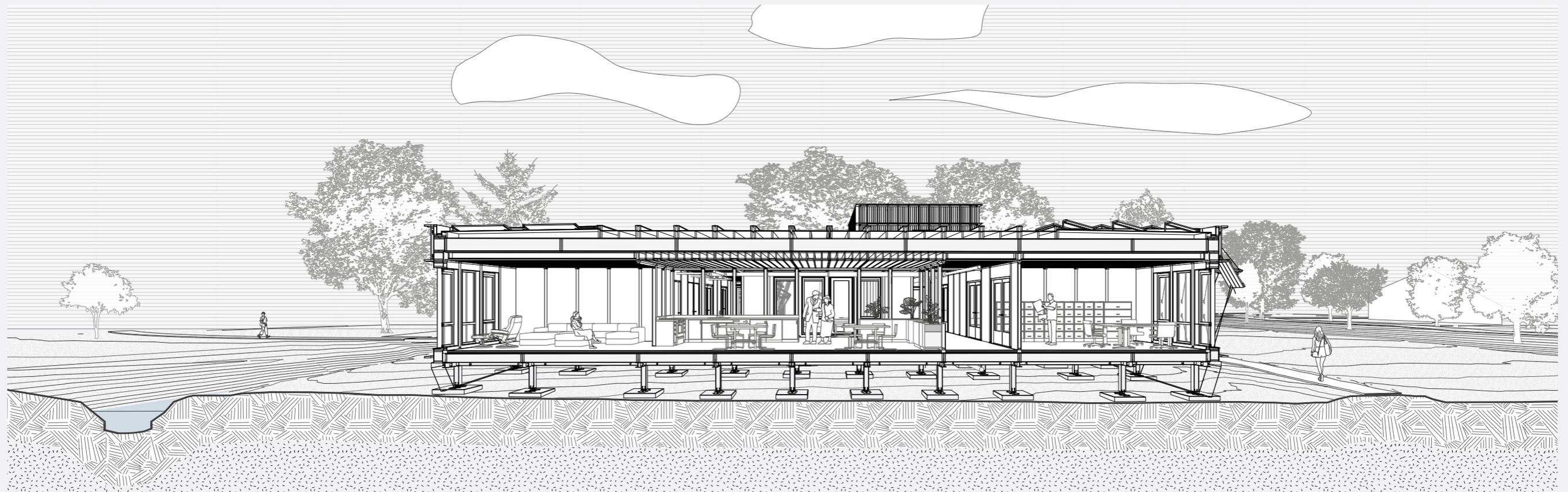


figure 43 - Central heart ground floor + first floor

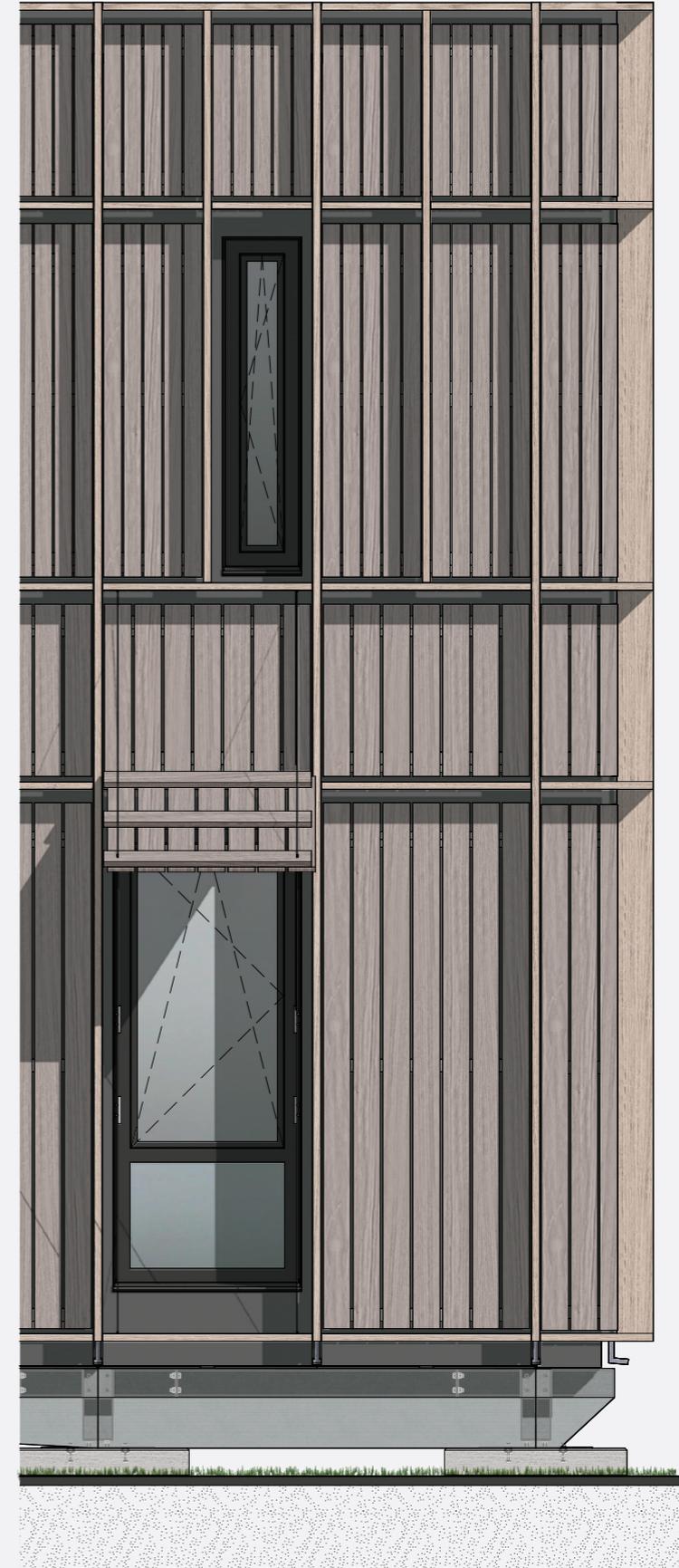


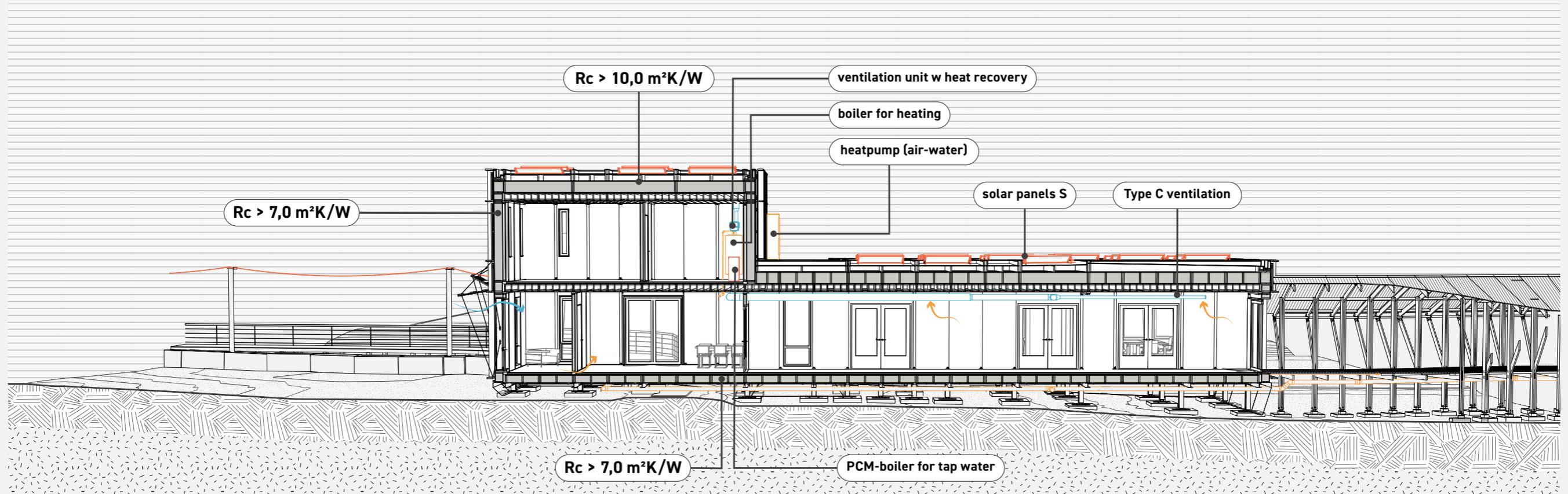
This section is taken through the livingroom, kitchen, and nurses office, looking towards the patio. Through windows on either side interaction with nature is supported as much as possible, offering views from all places in these rooms. In this section, it also becomes apparent that the building is lifted off the ground. The primary reasoning for this is creating a level ground floor plan for easy access and maneuvering through the building by people in wheelchairs or hospice beds. Excessive daylight ingress can be reduced by movable hatches in the façade, reducing heating up in the summer whilst still maintaining the views.

## Materiality

The façade and interior panels are, in almost all instances, made out of wood as a primary material. Based on the research in booklet 06, wood is also the most recommended material to work with because it is a forgiving material and easy to work with. The exterior is made out of a Larch wood raster, hinting at the demountability of the underlying panels. In between this wooden raster are prefabricated wooden panels that are hung on a French cleat system. Window systems are aluminum, to reduce maintenance, and for ease of use during construction. Sunshading is realized through movable panels on hinges, that is connected to a rope system on cleats outside of the window opening.

The interior represents the structure of the building, showing the hollow columns placed every 1200mm. In between these laminated columns made out of larch, are plywood panels, which are whitewashed or painted to have some neutral panels. The ceiling of the central heart is made out of Lignatur elements, which have in some instances perforations for acoustic purposes.





The climate of the building starts with the skin and especially the insulation layer found inside the skin of the building. Insulation values for the ground floor and exterior walls are 7.0 m²K/W or more, whilst the roof has an insulation value of 10.0 m²K/W or more. This results in thick layers of insulation consisting of wood fiber, adding mass for heat accumulation during warm days. The building is ventilated using system C, grasping allowing natural air to enter the building. The ventilation system uses a heat recovery unit to reuse exec heat that otherwise would be lost.

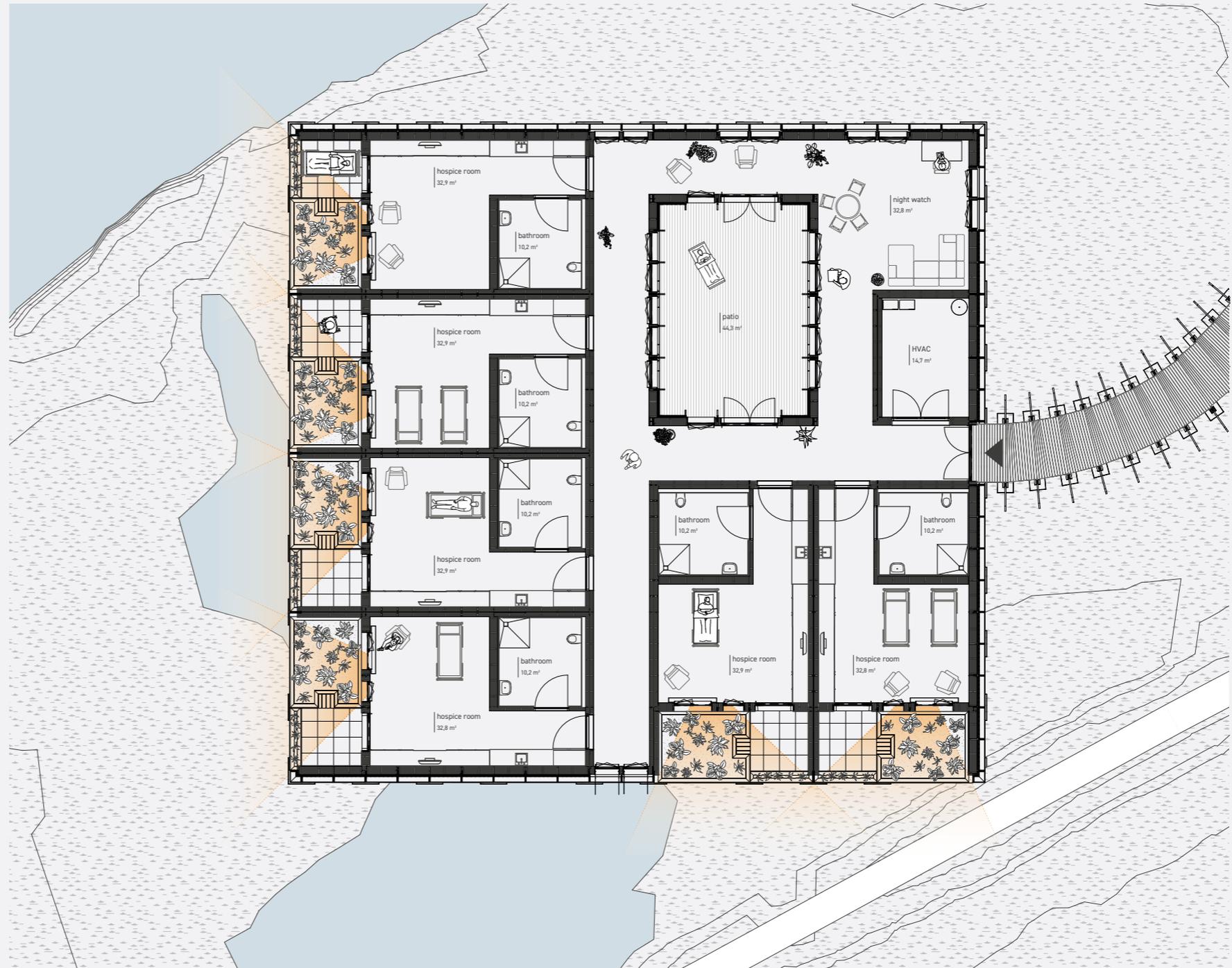
The water system is separated into two separate systems, one for heating the building and another for tap water. Energy for the heating system is generated by the recovered warmth from the ventilation system in conjunction with an air-water heat pump on the roof of the building. Energy for tap water is generated by PV panels and solar boilers attached to a PCM boiler, enabling the PV panels to be used in multiple ways.



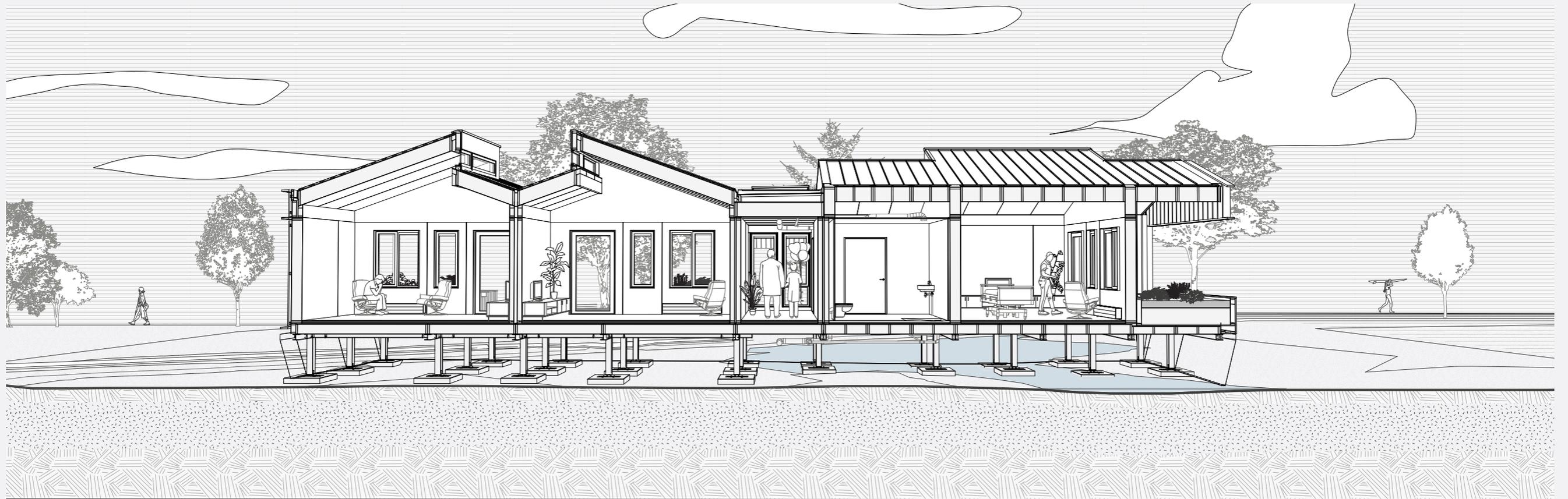
## Hospice Rooms

The main reason for the layout of the hospice rooms is again the views over the polder landscape. More than any other cluster in the ensemble the view is the essential and deciding factor since the patients will be taking in this view for many hours during the day. The rooms facing the north (left in the drawing) overlook the sub-boezem the Zweth, and the polders/park on the other side of this boezem. The west-facing rooms overlook the bicycle lane and often see cyclists and pedestrians coming by in the distance.

Besides the view another outdoor patio area is placed in the heart of the building, always offering a sheltered outdoor space from all wind directions. Furthermore, even if the patients cannot reach the central heart anymore due to worsening conditions, they can still enjoy shared outdoor space close to their rooms.



## Section



This section shows the perspective of the hospice rooms in perpendicular and longitudinal directions. Starting from the left to the right, the perpendicular sections of the hospices reveal a roofing light. Again offering a view of the sky, where the patient can look at the constantly changing surroundings and be aware of the current state of the climate. Going to the right side of the corridor in the longitudinal section, the first thing that jumps out is the private outdoor space with the inclusion of a planter. The main motive for this planter is the framing of the view with some cultivated natural elements, instead of just a grass landscape. Having a cultivated planter was also much appreciated in hospice de Liefde.

## The palliative room

The palliative room is a relatively spacious, but simply organized room. It consists out of three sections, from left to right a private outdoor space, the bed area itself in the middle, and a sanitary room combined with a small sink in the hall.

Because every person is different, this is also reflected in the design of the palliative rooms. Some persons might like looking at the natural environment, whilst others may look towards the wall and sky through the roof light. Spatially both options are possible by moving the bed and furniture around without harming the functioning of the room.

Even when patients need privacy but still want to enjoy the natural air from the landscape, each hospice room has its private outdoor area. The outdoor space is made in such a way that a hospice bed can fit in the space, whilst still offering a seat for a relative. This seat is integrated into the planter, which offers a place for cultivated plants to place some color in the green grassland polder world.



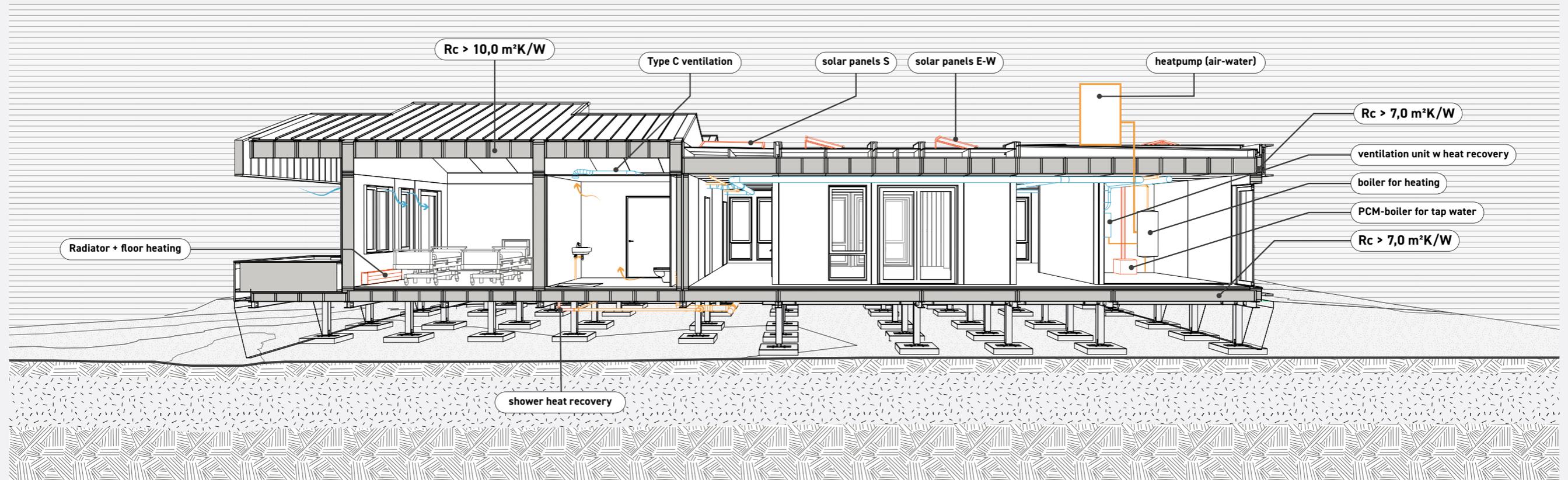


## Materiality

The main material of the hospice rooms is wood for the interior and exterior walls. The closed walls of the hospice are just like the central heart, creating unity across the ensemble. The raster that follows the outlines of the building is continued on the top of the palliative cluster in the form of a wooden raster, acting as sun shading. The planter on the ground floor is subtly extruded outwards of the façade to highlight this element in the design. In between the exterior walls and roof, the outdoor space is clad with biobased composite panels in a light grey color, creating a lighter space. The roof of the cluster is made out of ClickZinc panels, based on easy assembly.

The interior of the hospice rooms is also primarily made out of wood panels, the coupling of the elements however is not visible in this case. A cleaner and more peaceful interior is strived for, with the underlying thought of reducing stimuli. The bathroom is fitted out with demountable sandwich panels, including HPL in a light grey color.





Just like the central heart, the insulation values are 7.0 m<sup>2</sup>K/W for the ground floor and walls and 10 m<sup>2</sup>K/W for the roof. All elements of the skin use wood fiber insulation for the benefit of having thermal mass. The ventilation system again utilizes the type C system with a heat recovery unit feeding the boiler system for heating. During warm summer periods the windows in the patio can be left open during the night to expel warm air without danger of people breaking into the hospice.

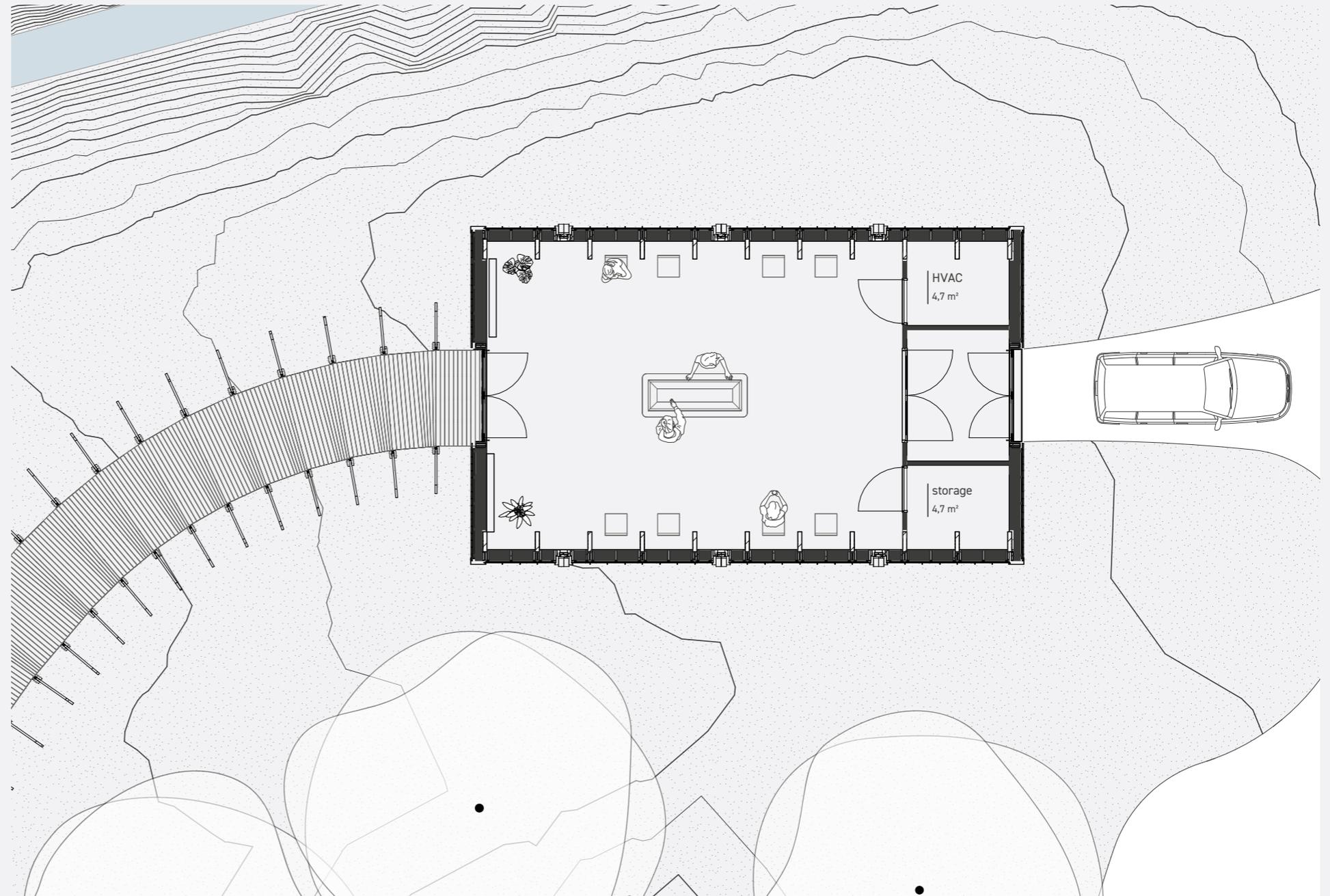
The warm water system is separated into two systems, one for the tap water and another for heating. The energy for the heating is generated by the recovered warmth from the ventilation system in conjunction with an air-water heat pump. The heating is distributed through floor heating and through a small low-temperature radiator to react to quick changes in temperature because of openable windows. The tap water is warmed up by a PCM boiler connected to PV, and solar boiler panels.



## Ritual space

The connection with the natural environment is visually reduced in this final building of the hospice. The ritual space is primarily meant for contemplation and saying goodbye to loved ones before they are moved to a funeral home or religious building. The only visible element is the sky breaking into the space through a roof light, shedding light over the coffin of the deceased.

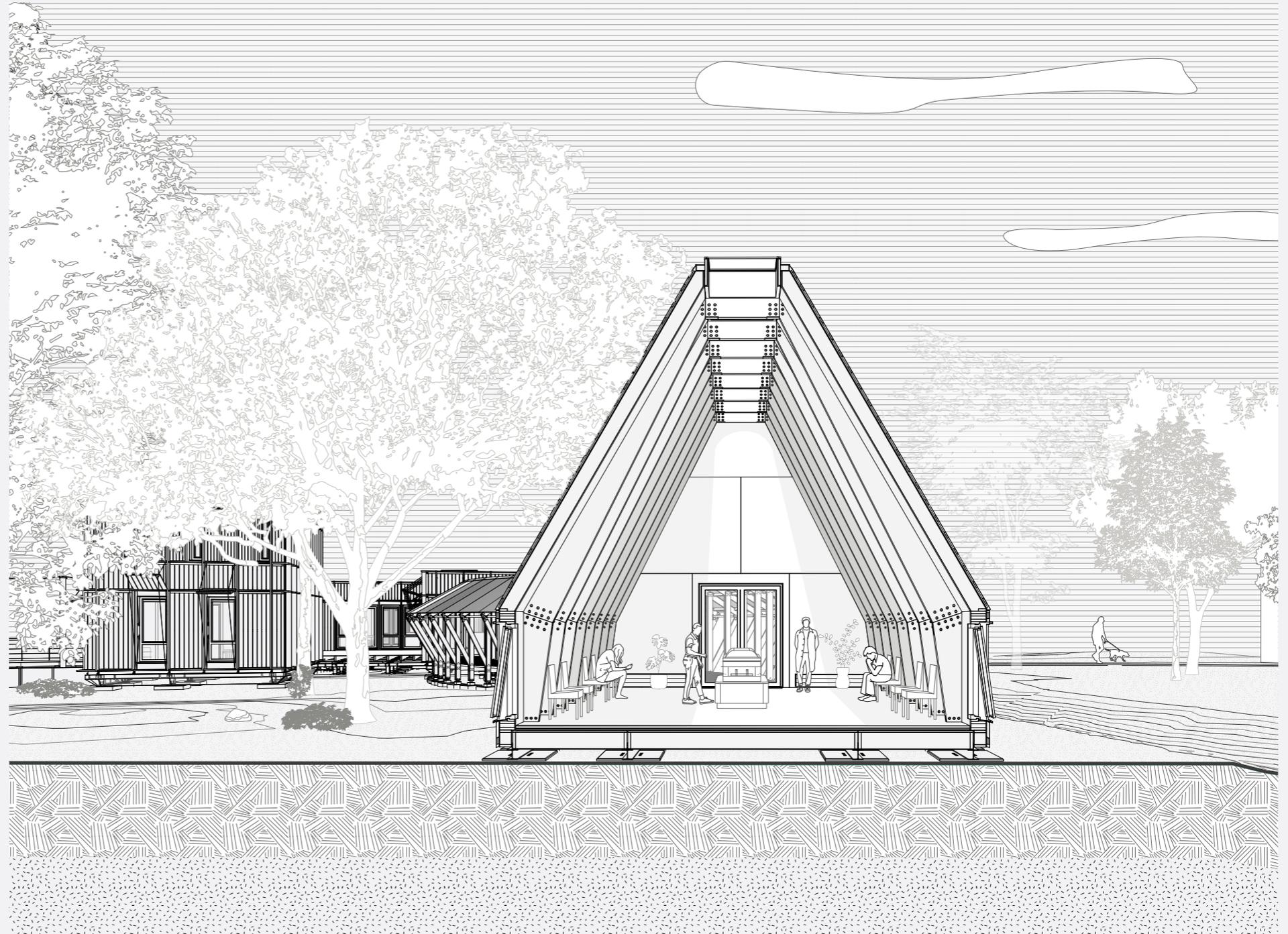
Instead of the visual connection, another way of connecting to the natural polder environment is the blind hatches in the façade, letting in outside air and smells into the space connecting to the deceased one more time.



## Section

As discussed with the plan the main feature of the ritual space is the monumentality of the space. The main visible feature in the section is the roof light in the centre. This roof light is meant to shed light over the floor of the space whilst highlighting a coffin if present. Also shown in the section are the openable panels which enable the family of the deceased to let in the outside air and smells of the polder site.

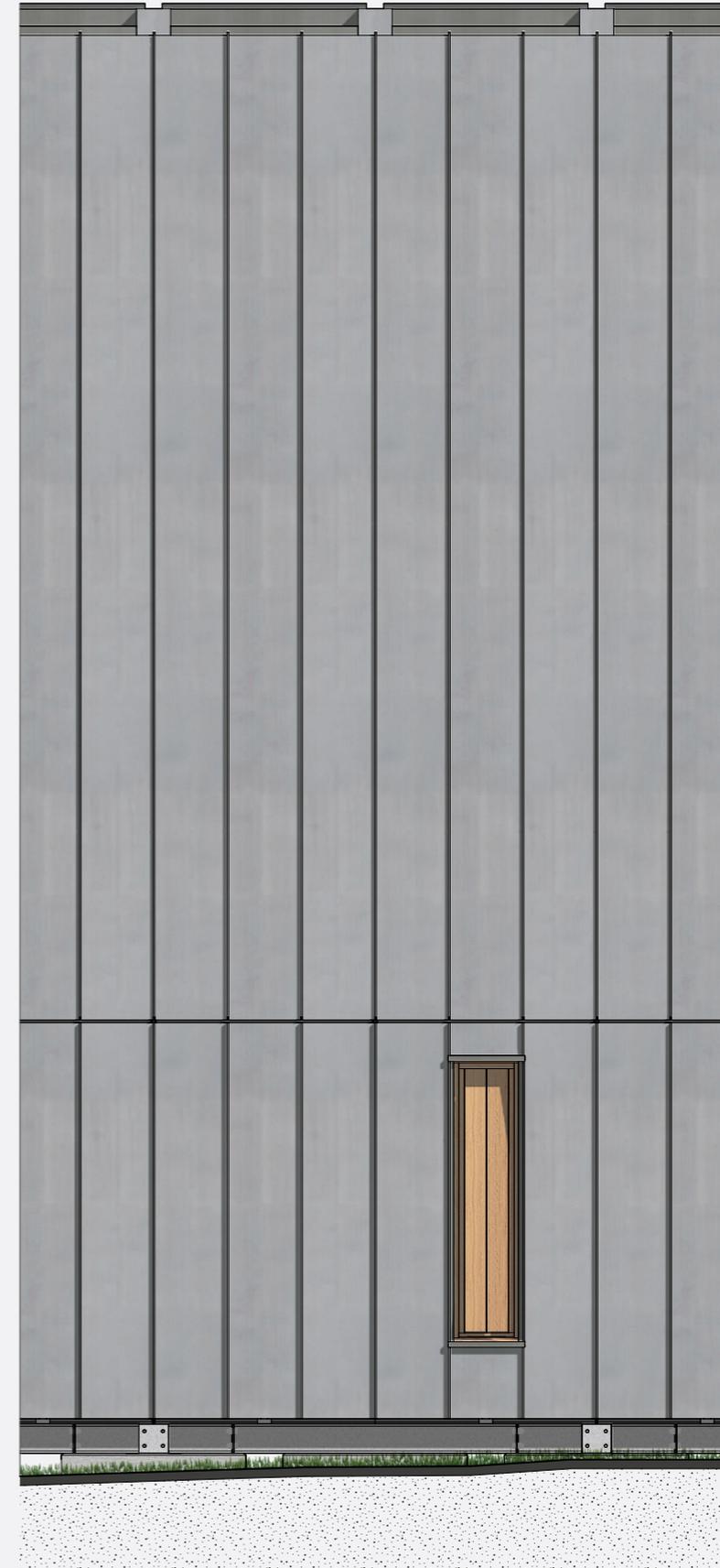
Climatologically, the space can be seen as some sort of in-between space. Because of the openable windows, and the time the space is used, the space doesn't constantly need to be heated up to 22 degrees. The space will be heated by radiators to quickly respond to sudden changes in climate, fed by an air-water heatpump. Insulation values are 6.0 m<sup>2</sup>K/W or higher around the skin.



## Materiality

In opposition to the other clusters, the ritual space has a different materiality. The main reasoning behind the change in materiality of the façade is again the aimed monumentality of the cluster. The building should represent a beacon, standing for a clear indication to the patients of the hospice of what the endpoint will be. The openable hatches in the façade are made of contrasting oak frames and panels, adding wood tones, and linking to the other buildings. Further wood cladding is found at the entrance sides of the ritual space where larch cladding similar to the other clusters is added.

The main features of the interior for this cluster are the glu laminated trusses supporting the roof and interior panels. The inside of these panels are clad with plywood sheeting that stay exposed throughout the space.





## Corridor

With all the natural aspects of the three clusters being covered the final one is the connecting element, making them accessible on the same plane of the ground level. The corridor is largely based on the natural inclusion of outdoor air and temperature since it is an outdoor space. Through this space, the patients, staff, and visitors will be experiencing the changing climate from minute to minute, and day to day.

The corridor is made out of wooden trusses, left in sight with a corrugated steel roof panel on a beam system. The main function of the roof is to protect the patients of the hospice during periods of light rain. If further shelter is sought, then a roll waterproof cloth can be rolled down the truss to close the space from water but not the outdoor climate. This way the users will have the purest experience of nature possible when traveling between the clusters.

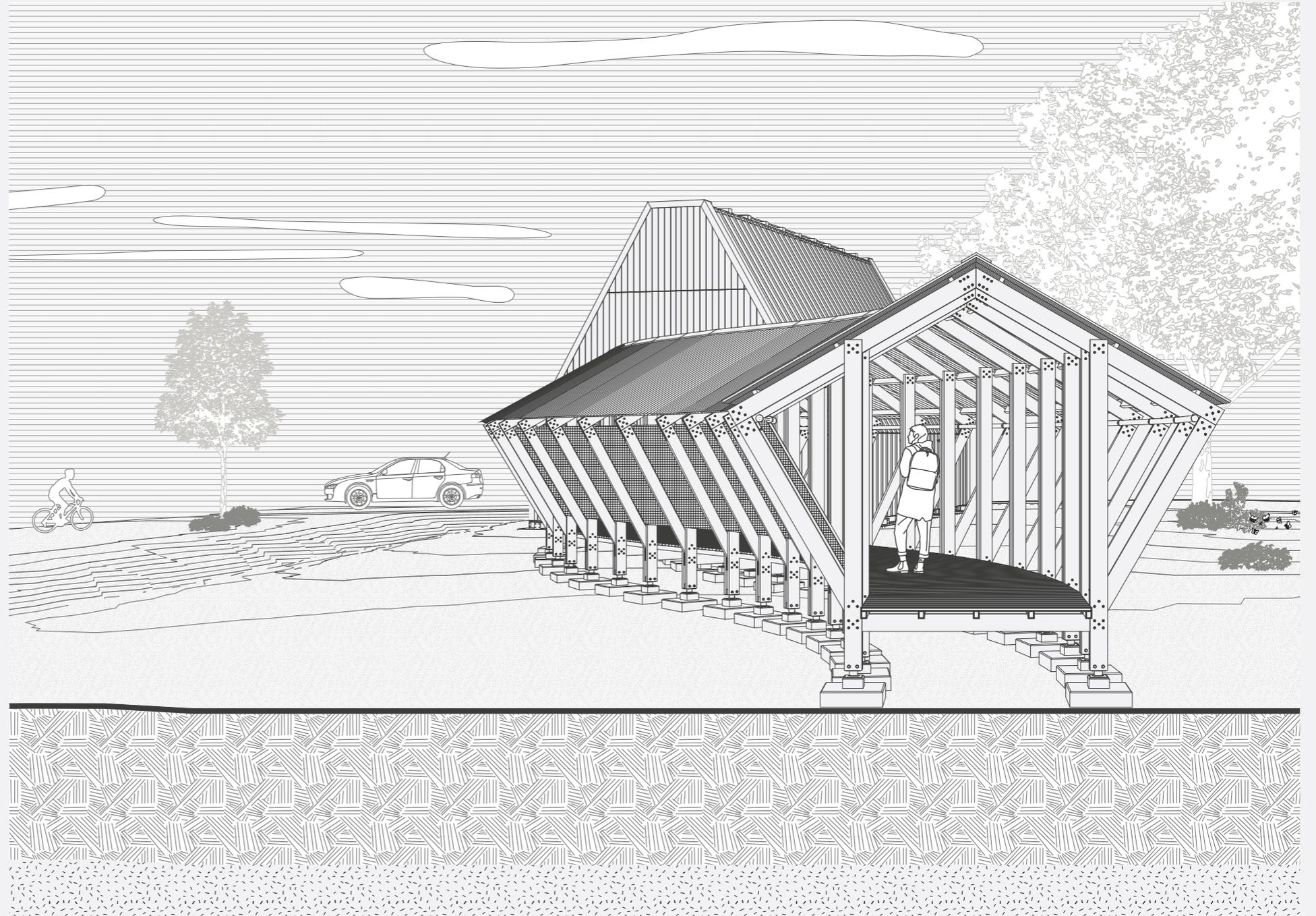


figure 59 - Corridor section



## Demountability

With the architectural concept, ambitions, and the final design being covered, now the jump is made to the technical realm. As we now know, this hospice building is built for temporary occupancy of a certain site up until the date the water level has risen thus far the soil is not suitable for dwelling anymore. The consequence of building this way is that the building has to be designed in a de- or rather remountable way. Additionally, construction will primarily be carried out by less experienced voluntary workers supervised by a carpenter.

Although simplicity is hard to measure, the demountability of the building can be tested along the design process, whilst working in variants to find an optimal solution. In this final concept, the results of the demountable structure are described and tested to see how well the building scores on the detachability index.



## Measuring demountability

To calculate the demountability, or in this case called detachability, a formula resulting in a disassembly potential is used. The formula consists of four elements that each have different parameters to test the connections, accessibility, independency, and edge geometry of elements. Each of the four aspects has a table of values that the designer can choose from when reflecting on the design details. These numbers are in a range of 0.10 to 1.00 and reflect the effectiveness or amount of potential that is in certain aspects of the product or element. After deciding the scores for the products or elements the following steps are used for the calculation of the project.

### Potential of the product or element

At first, the disassembly potential of the connection (DPC) and the potential of the composition (DPcp) are calculated by taking the average score of the two factors it has been based on, as prescribed in the previous chapter. This score already reflects the potential of the product or element and can serve as a moment of reflection.

### Potential per layer of Brand

Once the potentials of the products and elements are calculated the next step is to calculate the potential disassembly per layer of Brand (DPI<sub>n</sub>), it is therefore essential that one knows which element belongs to which shearing layer. This is done by taking the average of all elements and products whilst also incorporating the Environmental Cost Indicator of these products and elements into account. This way the most unsustainable materials are having the biggest impact on the calculation. Again this could be a moment of reflection on the technical design.

### The potential of the building

Finally, the potential of the building is calculated by taking the average of the shearing layers, whilst again keeping the Environmental Cost Indicator incorporated in the calculation. This is the final calculation and reflects the total disassembly potential of the building. After this number is known one can reflect on the goals they have set beforehand and find ways to improve if needed.

For further information please revert to Appendix 05 - Measuring demountability

Connection accessibility (CA)	Score
Freely accessible without additional actions	1.00
Accessible with additional actions that do not cause damage	0.80
Accessible with additional actions with fully repairable damage	0.60
Accessible with additional actions with partially repairable damage	0.40
Not accessible - irreparable damage to the product or surrounding products	0.10

Independency (ID)	Score
No independency - modular zoning of products or elements from different layers.	1.00
Occasional independency of products or elements from different layers.	0.40
Full integration of products or elements from different layers.	0.10

Geometry of product edge (GPE)	Score
Open, no obstacle to the (interim) removal of products or elements.	1.00
Overlapping, partial obstruction to the (interim) removal of products or elements.	0.40
Closed, complete obstruction to the (interim) removal of products or elements.	0.10

Connection type (CT)	Score	
Dry connection	Loose (no fastening material) Click connection Velcro connection Magnetic connection	1.00
Connection with added elements*	Bolt and nut connection Spring connection Corner connections Screw connection Connections with added connection elements**	0.80
Direct integral connection	Pin connections*** Nail connection	0,60***
Soft chemical connection	Caulking connection Foam connection (PUR)	0,20
Hard chemical connection	Adhesive connection Dump connection Weld connection Cementitious connection Chemical anchors Hard chemical connection	0,10

#### Disassembly potential of composition

$$DP_{cp_n} = \frac{2}{\frac{1}{ID_n} + \frac{1}{GPE_n}}$$

Where:

DP<sub>cp<sub>n</sub></sub> = disassembly potential of the composition of element n:

ID<sub>n</sub> = independency of product or element n;

GPE<sub>n</sub> = product edge geometry of product or element n

#### Disassembly potential of connection

$$DP_{c_n} = \frac{2}{\frac{1}{CT_n} + \frac{1}{CA_n}}$$

Where:

DP<sub>c<sub>n</sub></sub> = disassembly potential of the connection of n product or element n:

CT<sub>n</sub> = type of connection of product or element n;

CA<sub>n</sub> = accessibility connection of product or element n.

#### Disassembly potential of product or element

$$DP_{p_n} = \frac{2}{\frac{1}{DPC_n} + \frac{1}{DP_{cp_n}}}$$

Where:

DP<sub>p<sub>n</sub></sub> = disassembly potential of product or element n.

DPC<sub>n</sub> = disassembly potential of the connection of product or element n.

DP<sub>cp<sub>n</sub></sub> = disassembly potential of the composition of product or element n.

#### Disassembly potential per layer of Brand

$$DPI_n = \frac{1}{\sum_{i=1}^l ECI_n} \cdot \sum_{i=1}^l ECI_n \cdot DP_{p_n}$$

Where:

DPI<sub>n</sub> = disassembly potential of a Layer of Brand n;

DP<sub>p<sub>n</sub></sub> = disassembly potential of product or element n;

ECI<sub>n</sub> = Environmental Cost Indicator of product or element n.

#### Disassembly potential of building

$$DPb_n = \frac{1}{\sum_{i=1}^l ECI_n} \cdot \sum_{i=1}^l ECI_n \cdot DP_{p_n}$$

Where:

DPb<sub>n</sub> = disassembly potential of building n;

DP<sub>p<sub>n</sub></sub> = disassembly potential of product or element n;

ECI<sub>n</sub> = Environmental Cost Indicator of product or element n.

## Unit of measurements

Building with a less experienced crew requires another approach than designing for a professional group of carpenters. This combined with the present challenges of building in softer peat soil results in some restrictions that have to be considered in the design. Besides the building process needing a simple order of construction and simple-to-understand connections, the size and weight of the elements used have to be restricted as well. This primarily has to do with the accessibility and the soil conditions found at the site. Heavy vehicles will not be able to drive on the peat soils.

To keep elements within a standard unit of measurement a trailer and trailer crane have been selected. (figure 60) Besides keeping the elements of the building manageable, the transport of the elements and handling of the crane can be executed by someone able to drive a caravan.

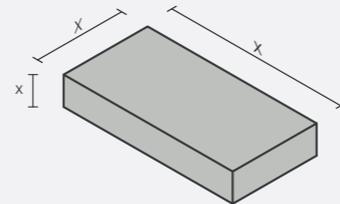
Finally, to minimize waste of materials the standard size for elements is based on the standard plywood sheet (1220 × 2440 mm)



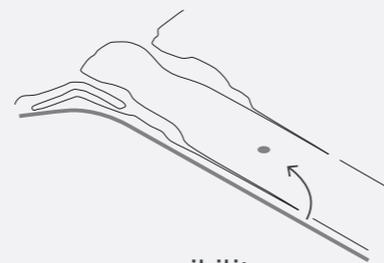
weight



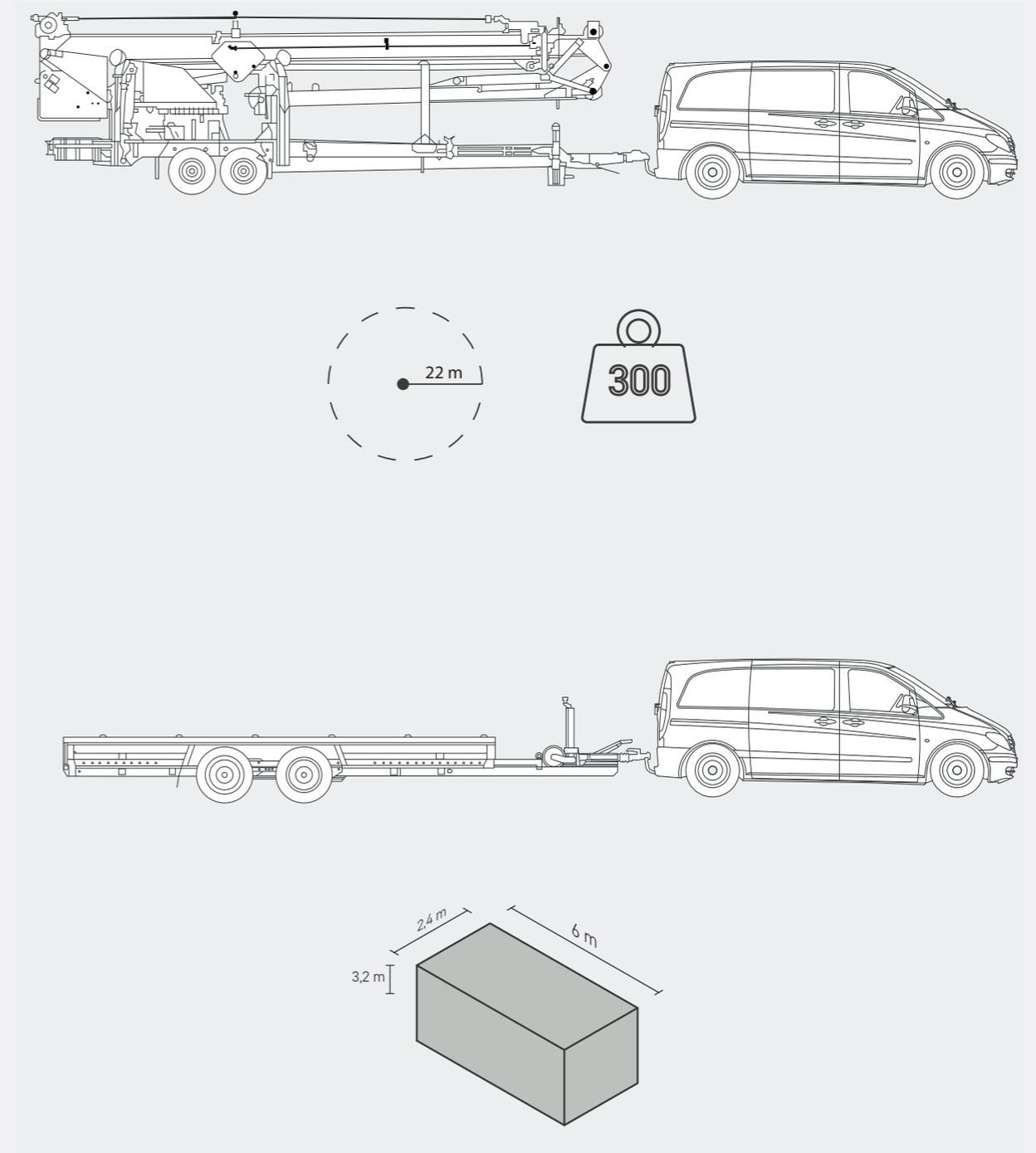
simplicity



dimensions



accessibility

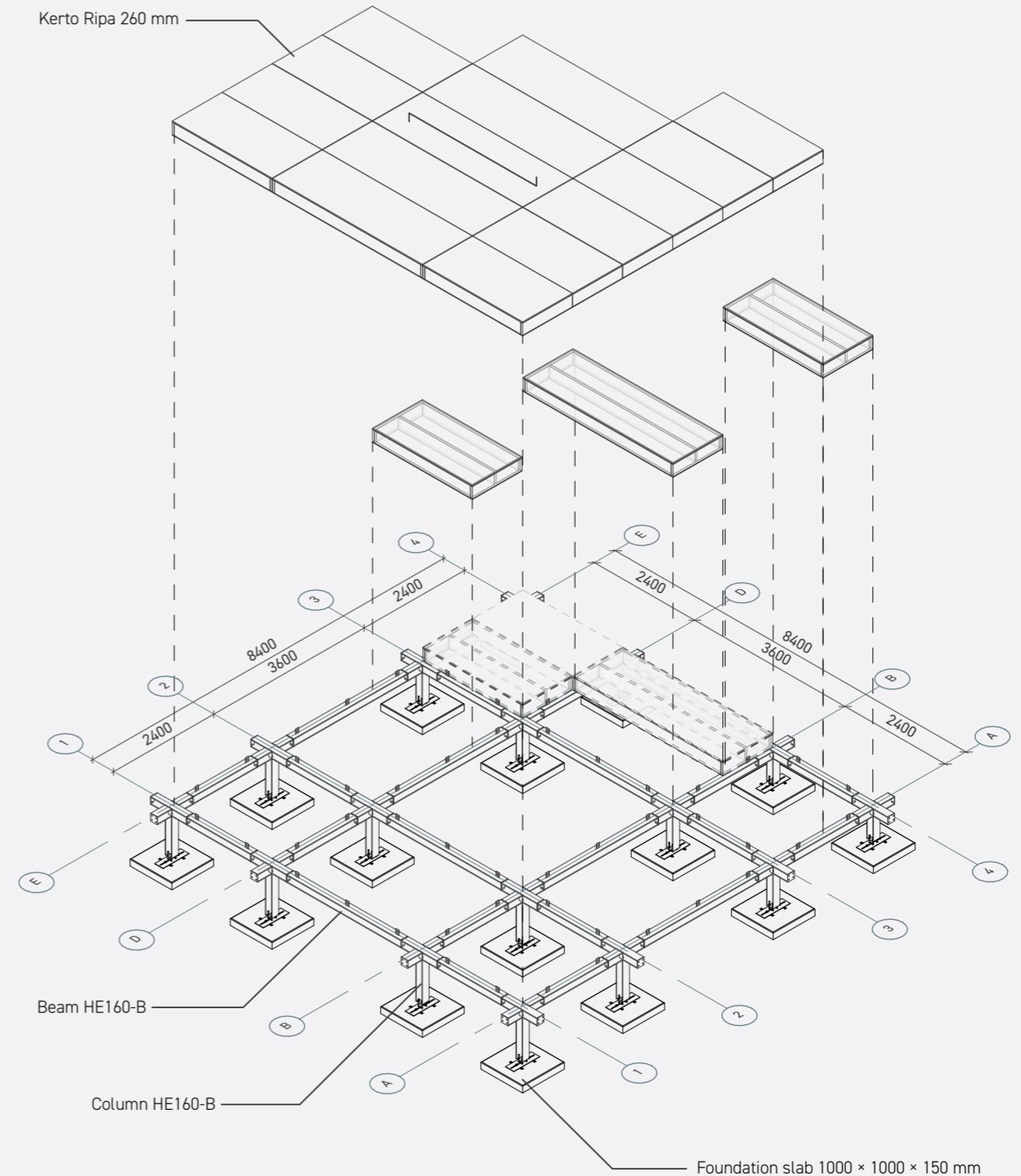
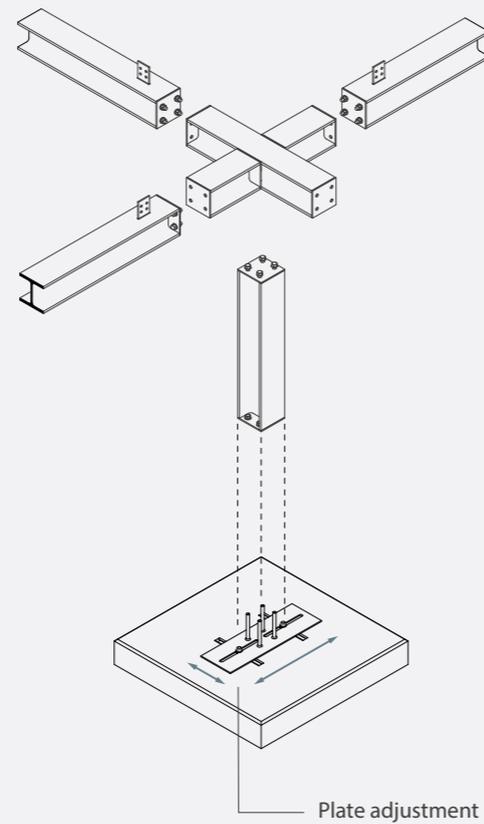


## Structural foundation platform

A common denominator for the structure of the building is a steel platform creating a level field on which the rest of the building can be placed. The steel platform first touches the ground via the means of precast concrete plates, with integrated adjustment possibilities. This way the concrete plates can be placed within a square of 300 mm, making for easier placement.

On top of these concrete plates are galvanized steel columns, resting on threaded rods enabling them to be placed on the exact height needed for the ground floor to be level. Additionally, this levelling can also be done later as an adjustment in the case one of the plates subsides into the softer soil. On top of the columns are 4-way linking elements that allow expansion of the foundation in four directions. The galvanized steel beams (HE160-B) are then attached to these linking elements, creating a grid of steel supporting beams for the floor elements.

The floor elements are in all cases made out of Kerto Ripa elements with a thickness of 260mm plus 8 mm of cempanel on the bottom and 25mm of LVL on top. Per field, the elements are attached to lips welded to the beams and to one another.



## Structure central heart

The first element that is connected to the Kerto ground floor elements is a wooden socket utilizing steel angles and screws. The spacing of these sockets is realized by wooden elements of standard sizes, called the lower-beam. Prefabricated wooden hollow columns are slid onto the sockets and bolted in place, whilst simultaneously being connected via top beams. The columns and beams are shaped with recesses, allowing for the façade and interior panels to be easily connected.

With the column and beam structure standing closed façade panels are inserted inside the frame to add stability to the whole wall structure. Once the structure is stable enough the roofing panels, made out of Lignatur elements are attached using steel angels and screws. By connecting the elements the roof becomes one structural surface increasing stability.

In the case of two stories, the process of placing sockets, lower beams, columns, top beams, façade elements, and then the roof structure will be repeated once more.

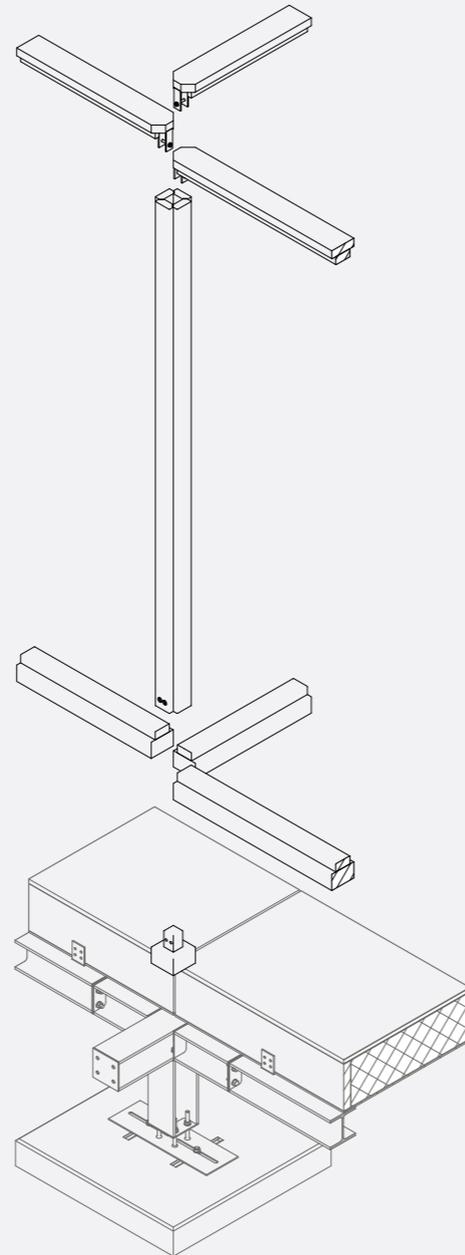


figure 67 - Structure column central heart

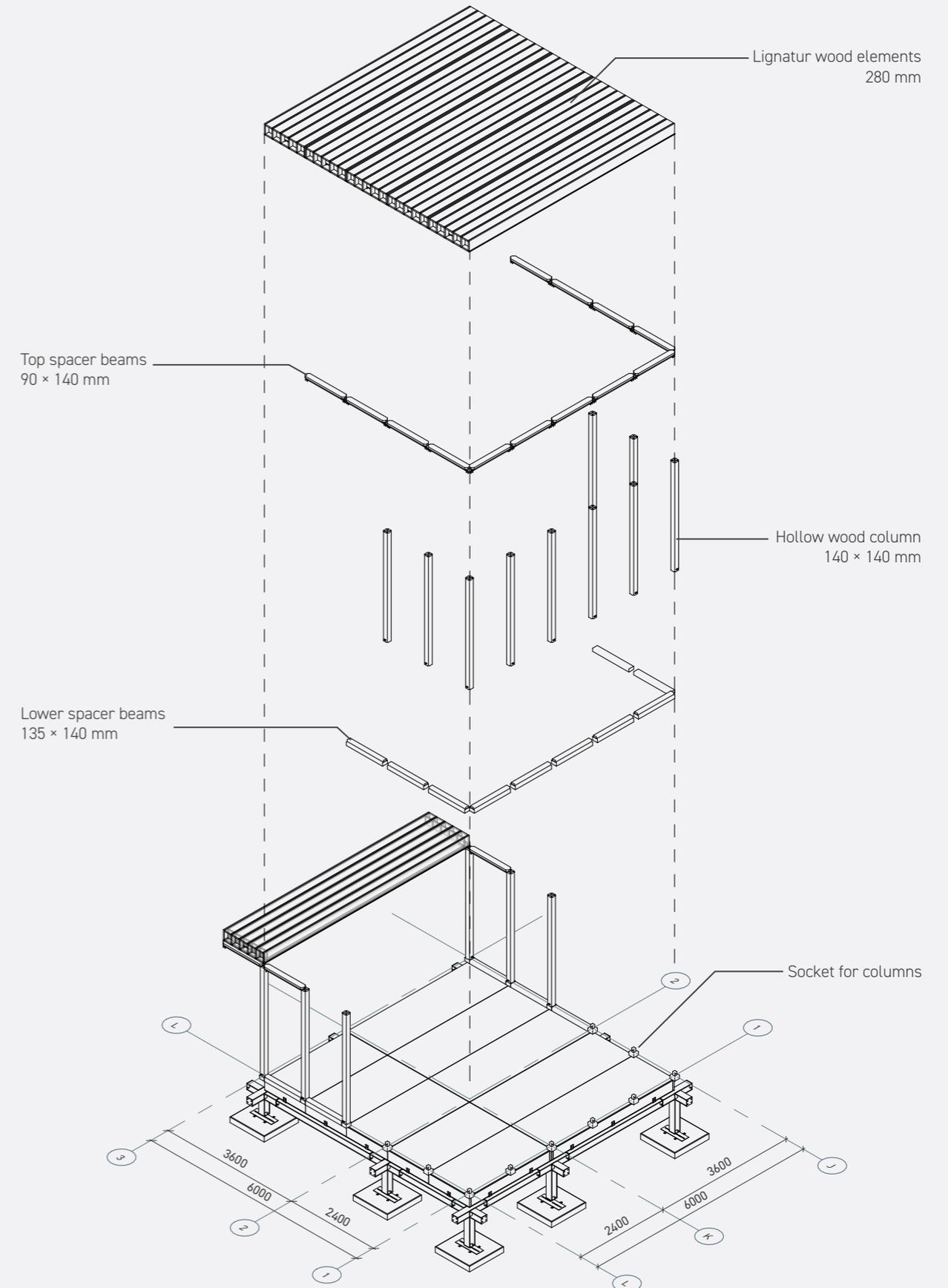


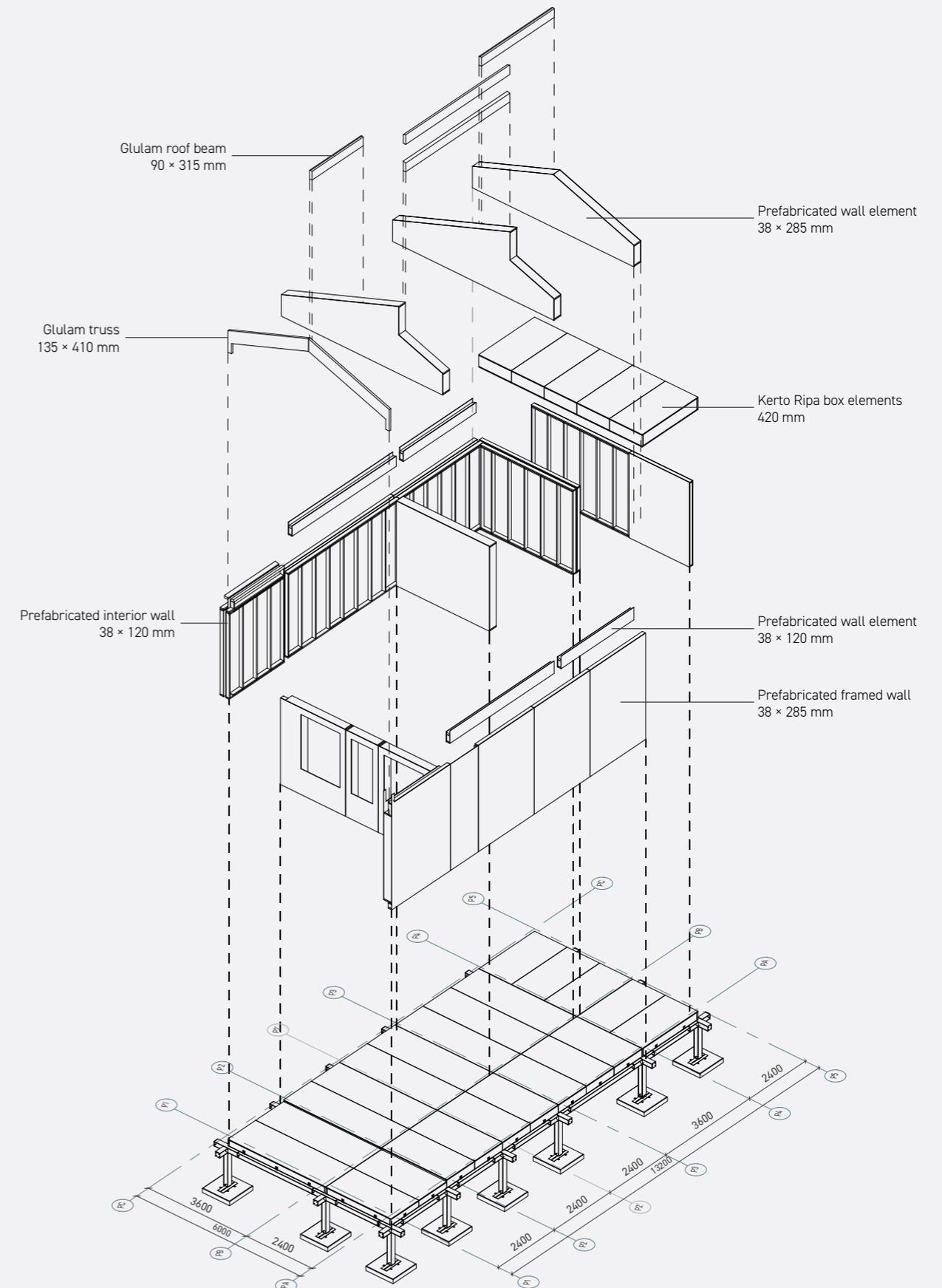
figure 68 - Structure of central heart

## Structure hospice rooms

Compared to the central heart the structure of the hospice rooms is quite different. This primarily has to do with reasons of privacy, especially acoustic privacy. Whereas the central heart has exposed columns between the rooms, the hospice rooms utilize a prefabricated framed element. This way the palliative rooms can be seen as separate boxes, minimizing the transfer of sound through the structure.

Framed elements with a maximum width of 2400 mm are used for façade and interior frames, allowing for a quick assembly using steel angles and screws. Strips of plywood left out on the interior parts of the walls enable quick and flush connection of elements by linking them with a strip of plywood.

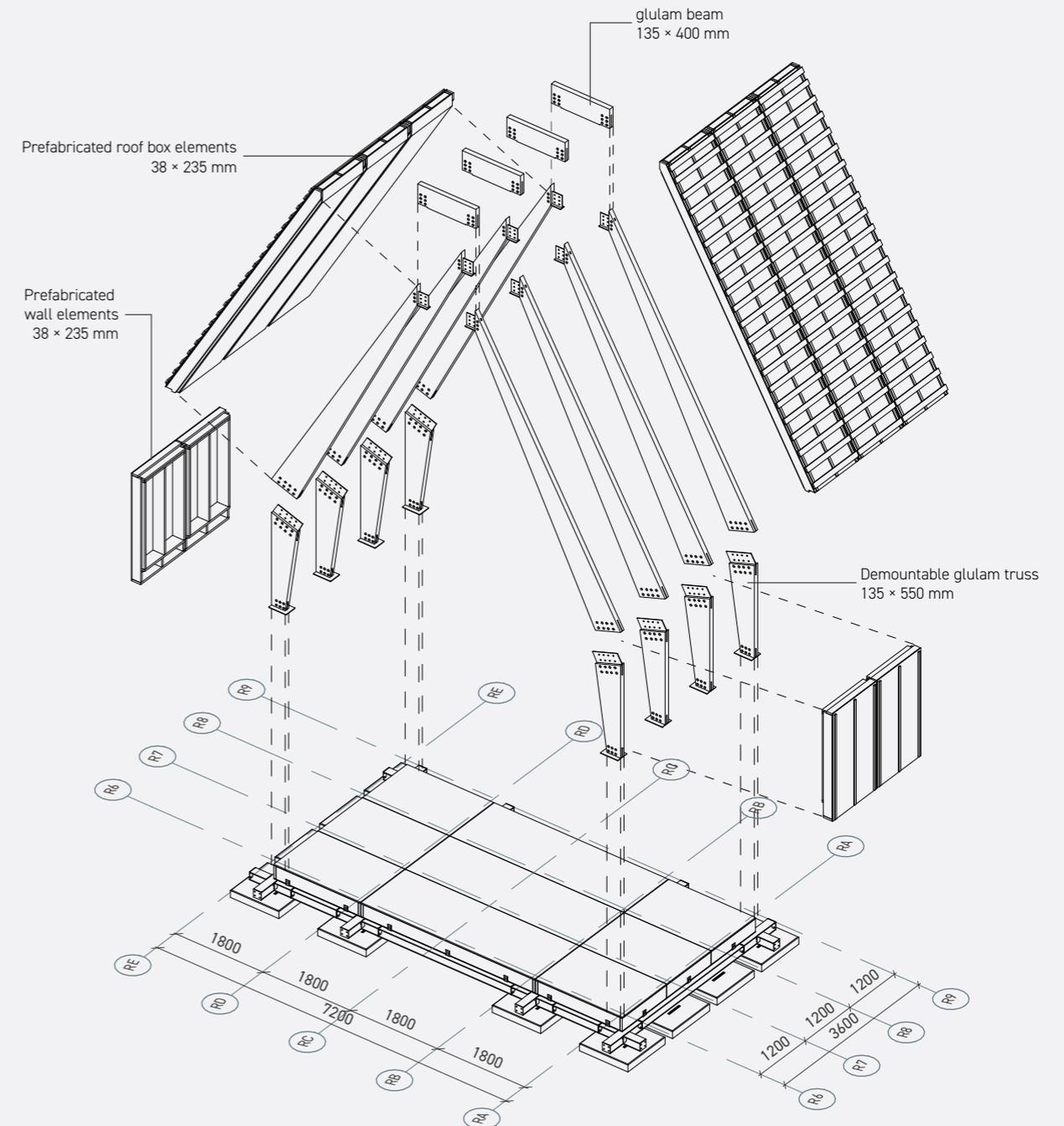
Once the walls are placed the room-spanning top elements are placed, directly outlining the roof. These elements act as the sides for the dormer or roof light found in the rooms. On the private outside space, a wood truss is used, because insulation is not needed in this case. All elements are connected with laminated beams afterward.



## Structure ritual space

The ritual space has again some differences compared to the previous two clusters. The main difference is found in the height and thus the heavier trusses required to span these heights. On top of the Kerto floors will be a reinforcement to distribute the weight of the trusses. These trusses are conventionally made out of one piece but in this instance made out of two parts due to size limitations by the means of transport. When both sides of the building have the trusses added a connection is made by a top beam.

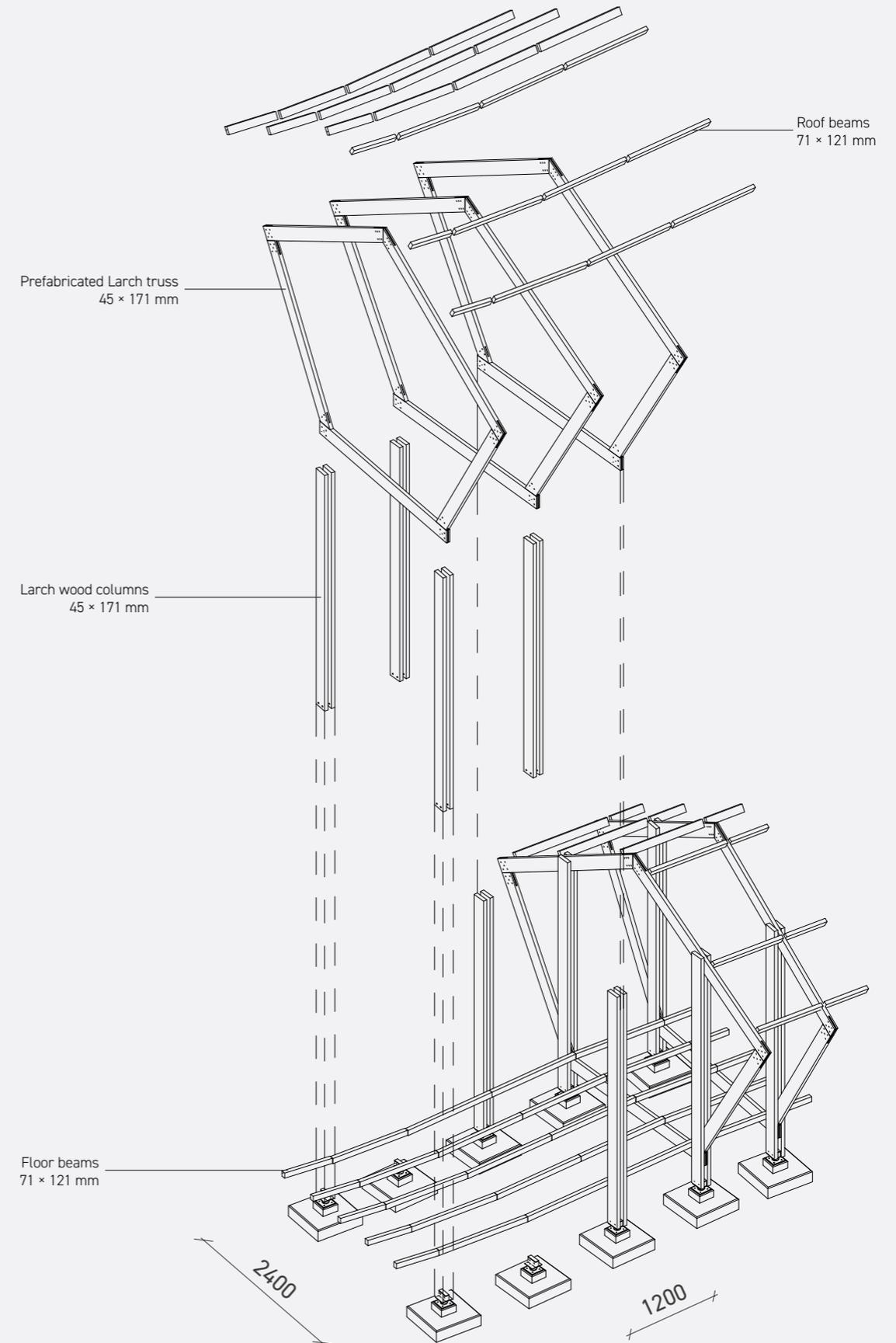
The trusses themselves ensure stability in their longitudinal direction, whilst they still need support in the perpendicular direction. Once one row of trusses is placed, stability is ensured by attaching the vertical façade panel connected to the ground floor. Later further rigidity and stability are ensured by attaching the other façade panels. This way the skin has a double function of acting as a stabilizing component, just like in the other clusters.



## Structure corridor

The structure of the corridor is slightly different compared to the other clusters it is connected to. The rigid steel frame has made a place for precast concrete plates with a steel connector on top. This steel connector can be adjusted in height by turning it around on a threaded surface.

Once the base of the corridor is in place and leveled, two wooden columns are attached to the foundation with prefabricated wooden trusses in between. After trusses have been placed, beams spanning the gap will be installed, which will later house the floor and roof elements.



## Skin central heart

After installing all panels containing the insulation layer onto the structure the façade can be further built up. Firstly, on top of the structural roofing elements the insulation panels of the roof have to be attached, closing the thermal layer of the skin. Thereafter the prefabricated and demountable roofing panels are attached followed by the downspouts. In front of these downspouts, a frame will be placed referring to the demountability of the building panels. In between these framed elements are French cleat-hung wooden panels, suitable for easy assembly. Finally, the sun-shading elements are placed within the wooden frame and rigged with the ropes so it will work.

On the interior of the building, plywood sheets are installed on the recessed columns, combined with wood fiber insulation that allows for a quick and easy method of assembly.

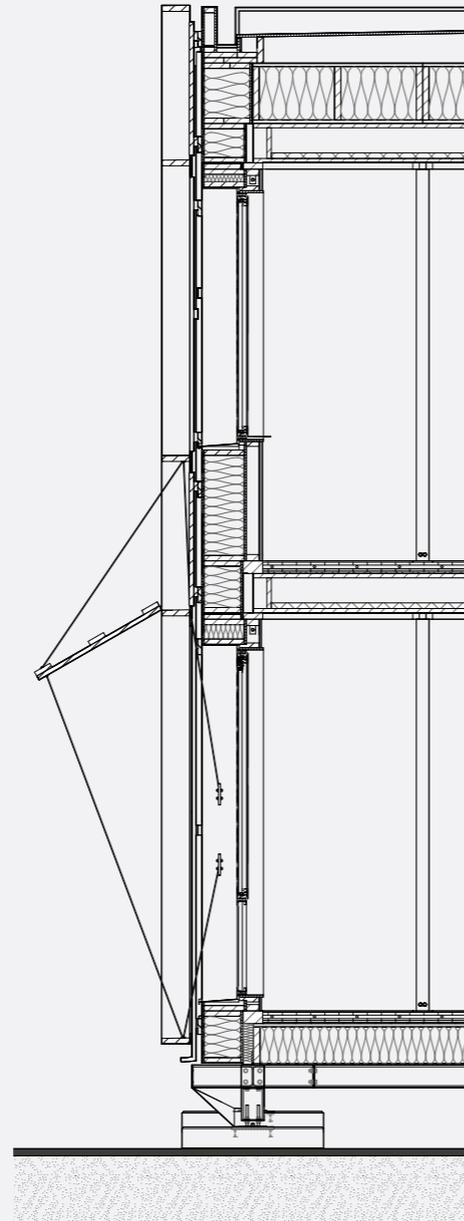


figure 72 - Central Heart fragment section

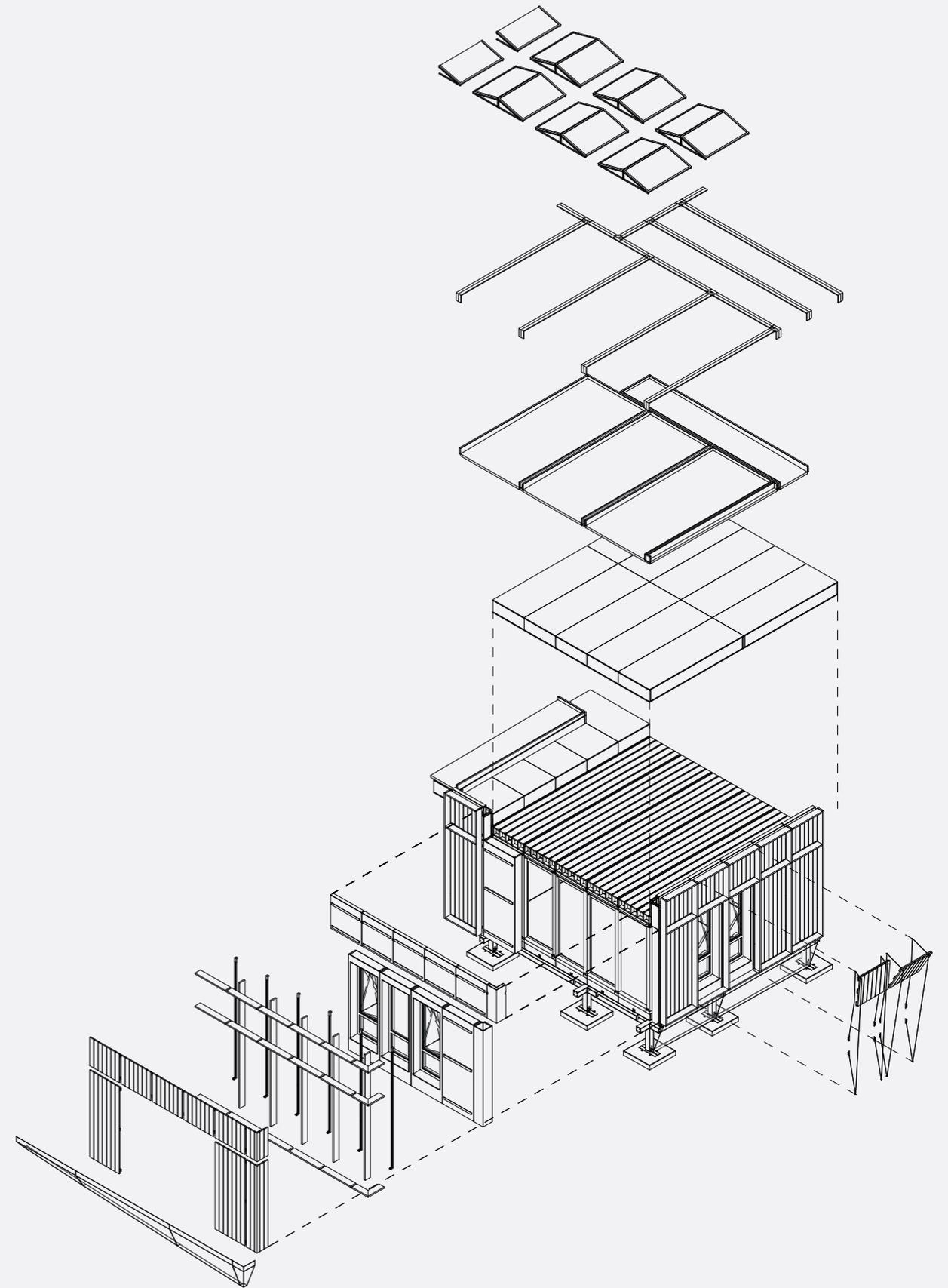


figure 73 - Central heart axonometric

## Skin hospice rooms

Again many of the façade systems found in the central heart are similar in this hospice room cluster. Flat roof elements, wooden frames, façade panels, and sun-shading elements are all directly transferred. Staying with the façade of the hospice rooms an addition is the biobased composite panels, which are prefabricated in form but attached in place by screws. The planter found in the private outdoor area of the room is prefabricated and lifted in place before the roof is made.

The shed and gable roofs of the palliative rooms are clad with ClickZinc, which are zinc plates screwed on one place and clicked in another for easy and fast assembly.

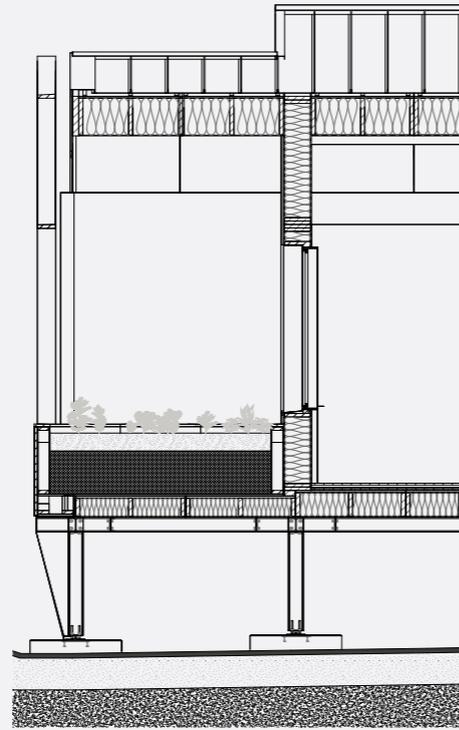


figure 74 - Hospice rooms fragment section

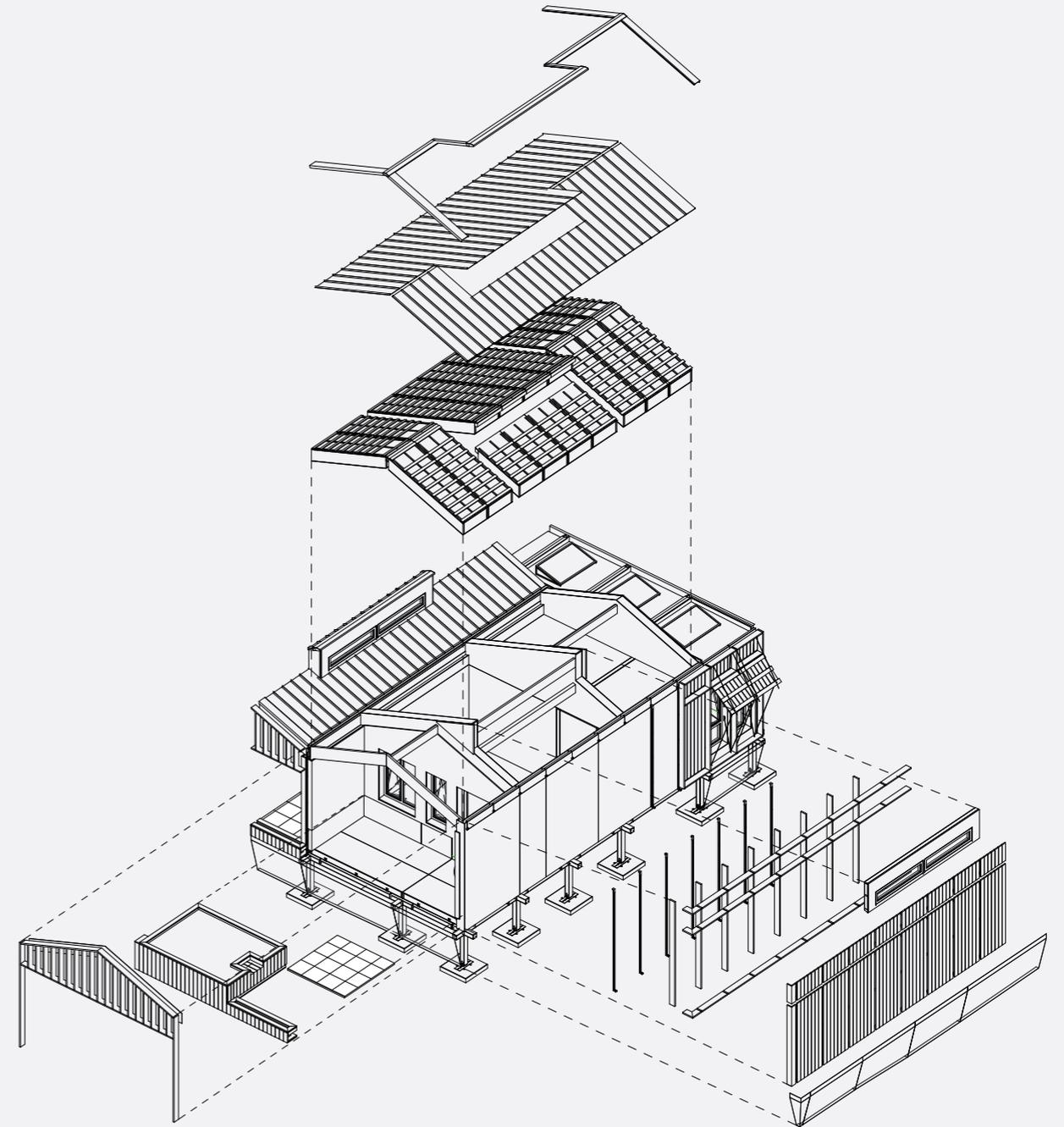


figure 75 - Hospice rooms axonometric

## Skin ritual space

The skin of the ritual space is probably the most efficient system of the ensemble. Once the prefabricated panels have been placed, the walls are firstly clad with KlickZinc, followed by the roof, making the whole watertight in a matter of a day.

The roof elements are prefabricated with roof lights or epdm cladding. The interconnection of the elements is realized by covering the seams of the panels with zinc lids.

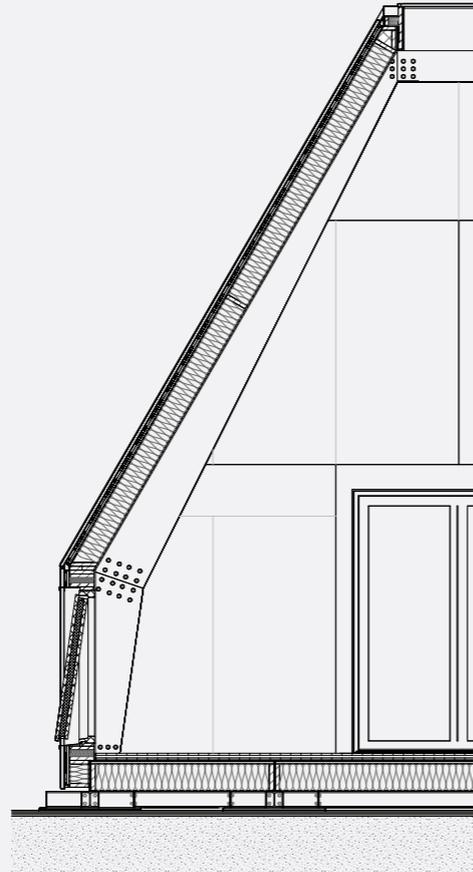


figure 76 - Ritual space fragment section

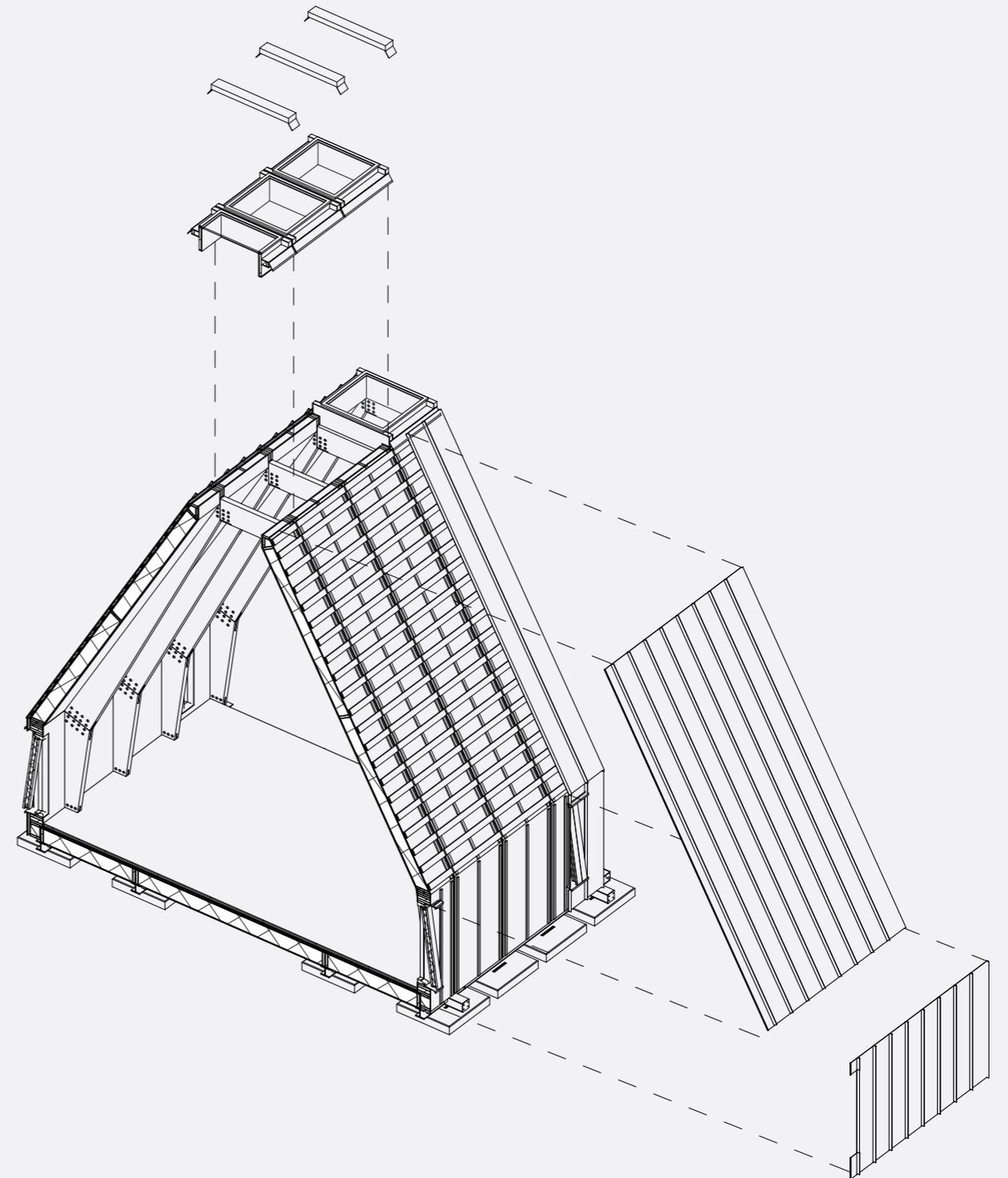
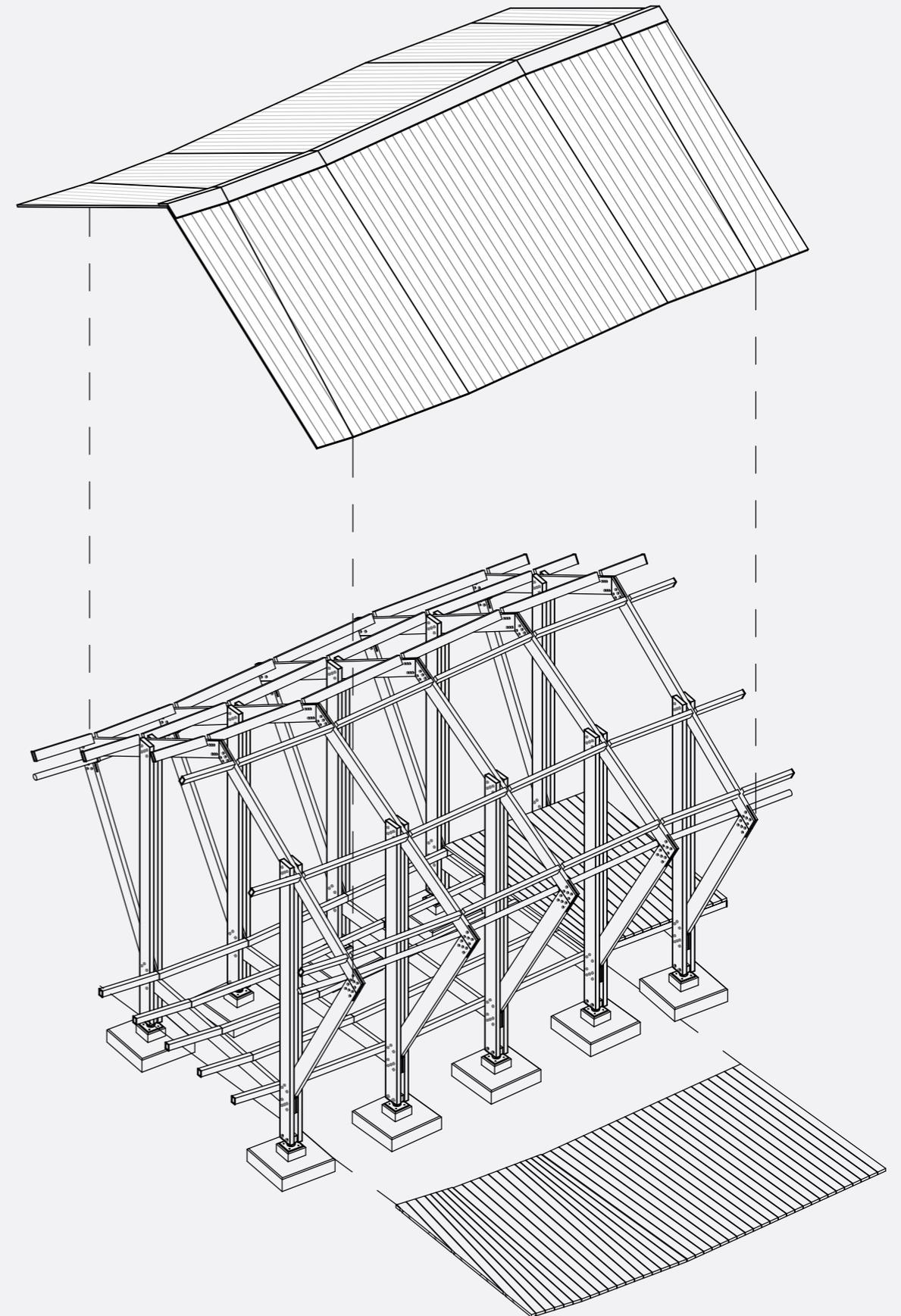


figure 77 - Ritual space axonometric

## Skin corridor

The corridor is the purest experience the patient, staff, and visitors will get of nature. This is also the primary reason for the skin being the least complex in comparison to the other building parts. On top of the wood trusses is a corrugated steel roof, which is screwed in place.

Whilst the corrugated steel plate is the only permanent means of skin in the corridor another movable element is added to keep out the rain in times of excessive precipitation. This element is simply clicked in place by some buttons.

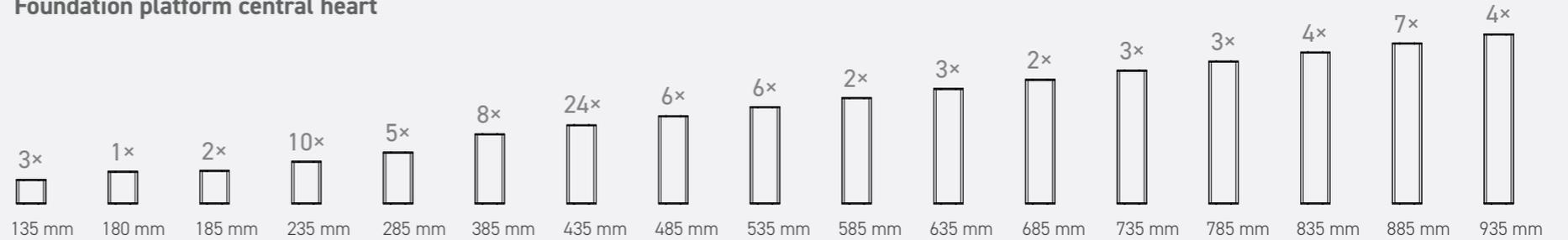


## List of parts

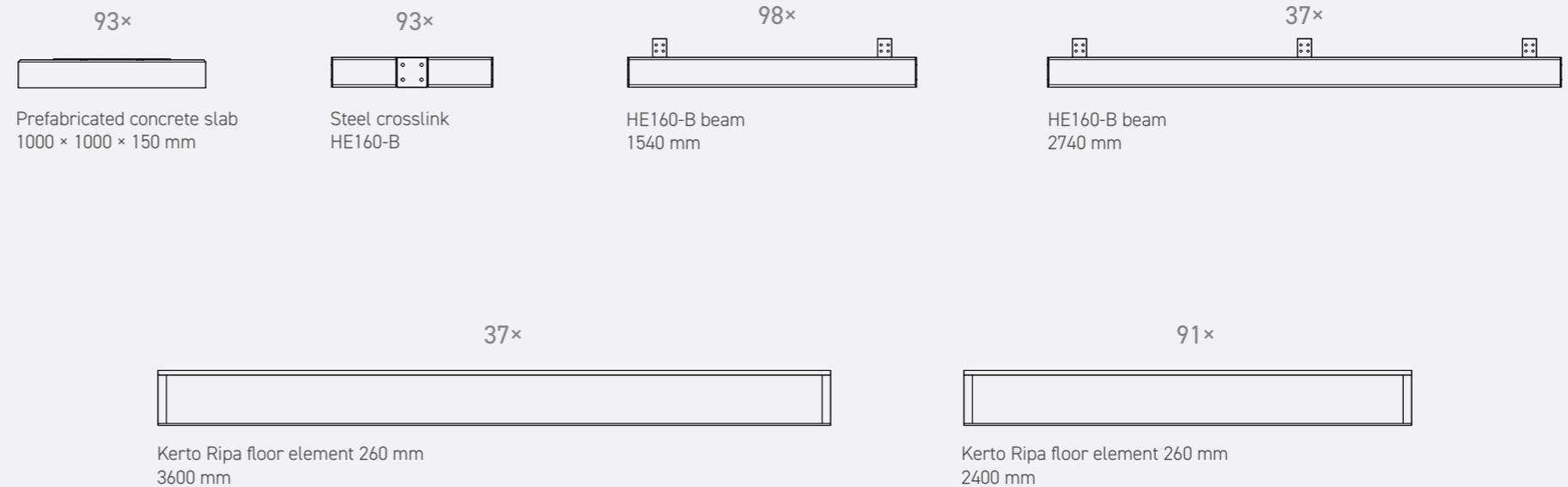
For calculating the detachability potential of the building, the ECI (Environmental Cost Indication) has to be calculated first. To calculate the ECI, a basic list of materials consisting of the material, amount, volume, weight, and length is needed, as shown in the figure on this page. With this data, the ECI per element can be calculated and combined, which will later be placed into the detachability potential calculation.

On this spread, all the materials used in the foundation structure of the central heart are drawn. In total the ECI for this structure is €2305,39, which is significantly higher than for instance the Kerto floors, coming in at €0,02 for the central heart. A higher cost means more impact on the environment, and will thus affect the detachability score more than an environmentally friendly material. It is especially important to make the elements that have high ECI the most demountable.

### Foundation platform central heart



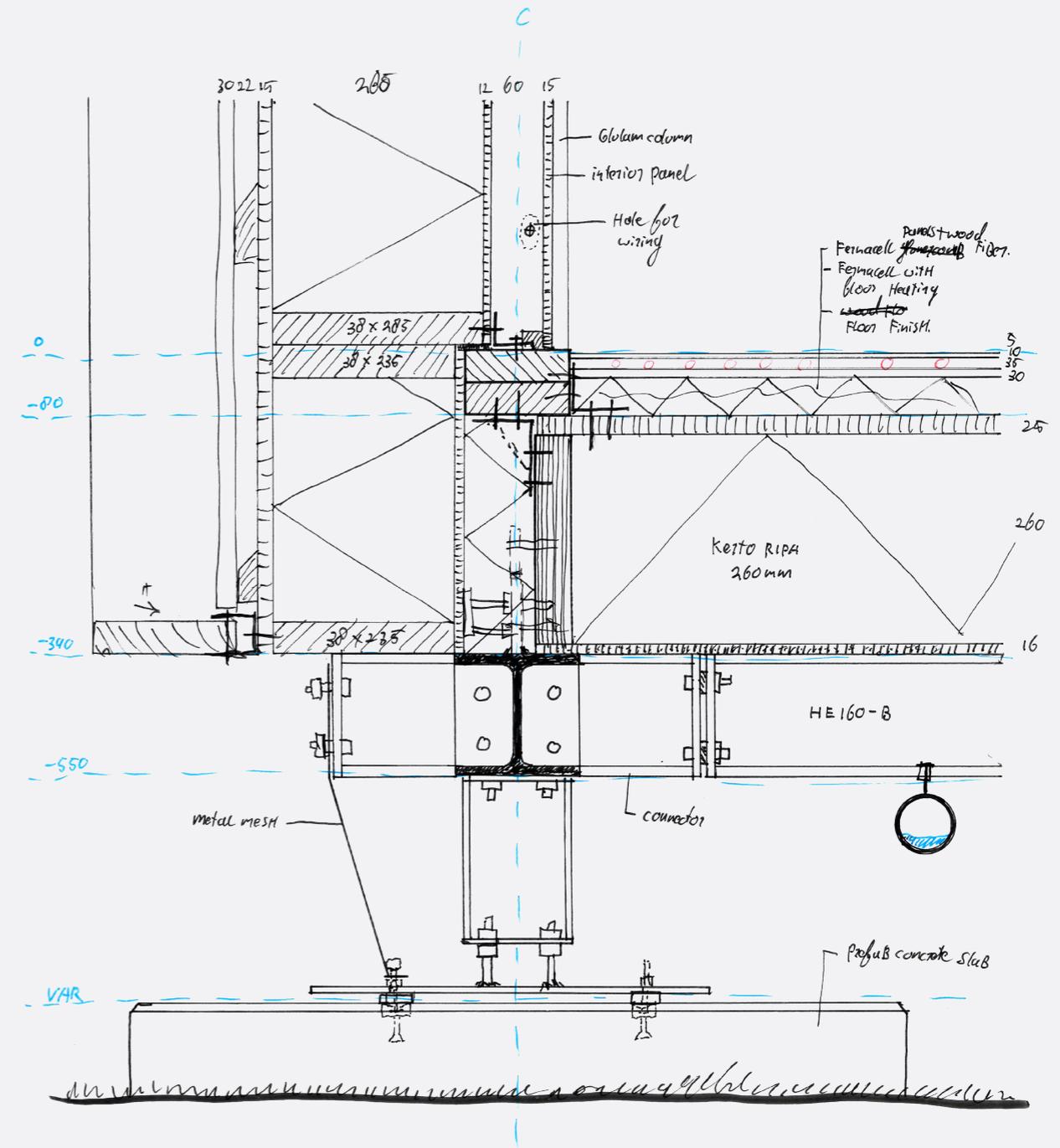
Foundation columns  
HE160-B



## Example detail

During the development of the project, details, as shown on this spread, were made to test out the demountability potential. The details were drawn in order of construction to think about the accessibility of connections and also the reversed order of the disassembly in the moving phase.

Whilst evaluating the detachability index of this detail most elements scored well, except the services and screed floor. Both elements are impacted by the independency factor, reducing the score of the complete detail. Nonetheless, this detail scores an 0,82 on demountability, which is good considering all the elements included in the drawing.



## Demountability indexation

Now all the building clusters have been calculated individually, the opportunity arises to determine the disassembly potential over the complete project.

At first, the individual clusters are summarized and calculated based on the four layers. After that, the layers of the clusters are combined, forming an overall score per layer for the complete ensemble. Finally, these combined layers are transferred into the building disassembly potential and complete environmental cost indication (ECI.)

Overall, the final building score (0,9) means that the building can be perceived as very demountable, resulting in a 9.0 on a scale of 10. Not only does the building score well on average, also the individual clusters have scored between 8.9 and 9.5 as seen below:

- Central heart 0,89
- Hospice rooms 0,90
- Ritual space 0,93
- Corridor 0,95

Project data	
project name:	Hospitable Movement
project number:	AHD-24
client:	Hospice Vlaardingen
adress:	Vlietskade 1, Vlaardingen
date:	24-5-2024

Cluster Summary								
	central heart		hospice rooms		ritual space		corridors	
	ECI	DP	ECI	DP	ECI	DP	ECI	DP
structure	2.332,29	0,91	3.771,29	0,92	1.192,23	0,94	271,49	1,01
skin	2.017,22	0,94	1.773,64	0,94	475,29	0,94	1.126,14	0,94
services	305,38	0,60	290,75	0,60	64,38	1,00	28,80	0,53
space plan	858,24	0,80	520,66	0,73	247,85	0,84	0,00	0,00
building	5.513,13	0,89	6.356,34	0,90	1.979,75	0,93	1.426,43	0,95

Layer calculation		
Layer	ECI	disassembly potential (DP)
structure	7.567,30	0,92
skin	5.392,29	0,94
services	689,31	0,63
space plan	1.626,75	0,78

Building disassembly potential		
	ECI	disassembly potential (DP)
<b>Building</b>	<b>15.275,65</b>	<b>0,90</b>



# Future Scenario

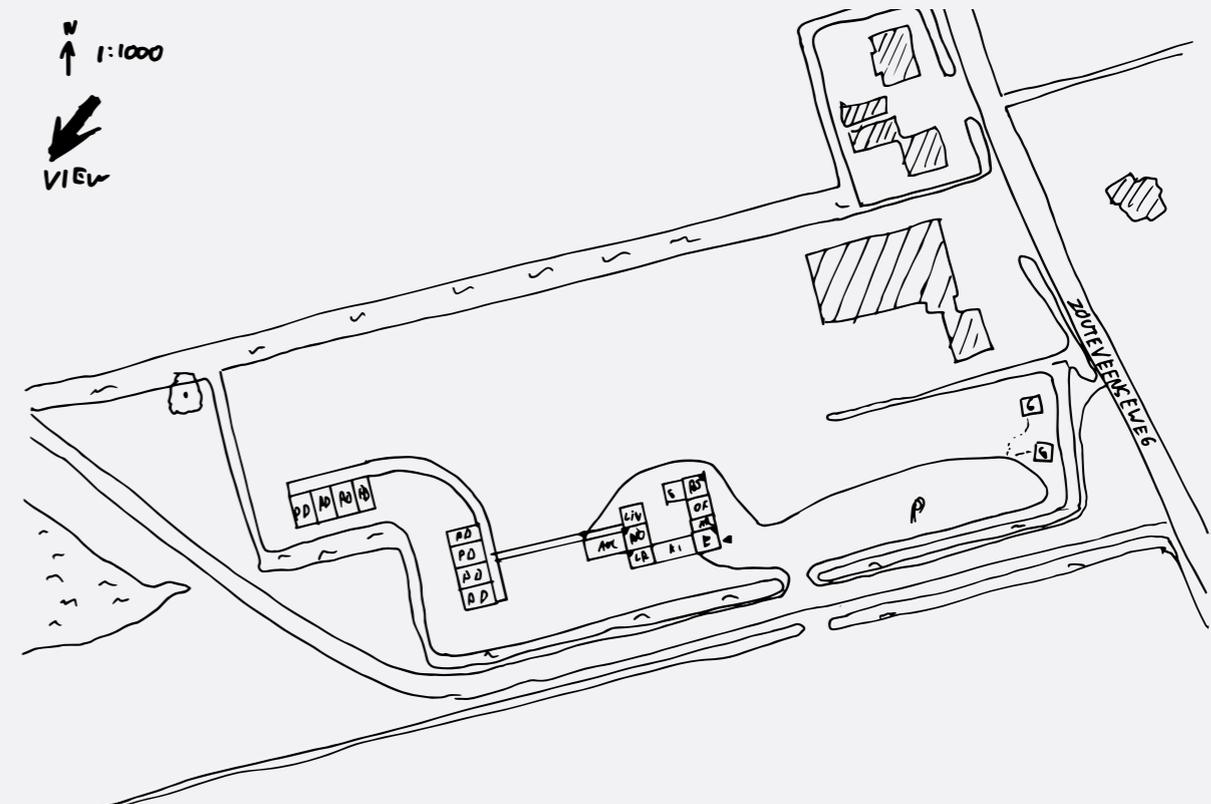
Once the building has to be moved in the future to a new and dry site, the building is designed to respond to different challenges another site has to offer. To test out this working design, the building is projected onto sits in the same polder, Schipluide, in the northern part of the Netherlands close to Schuitsloterwilde.

## Schipluide

The first selected site to project the building program is located in the same polder as the project, on the edge of Schipluide. As seen in the image the site is characterized by a directional view looking towards the open polder landscape, which is at a 45-degree angle compared to the plot. As a response to the site, the entrance is placed close to the little dam, splitting the ditch. Parking is located on the other side of the plot. The palliative dwellings are placed on the corner of the plot to maximize the view, whilst distancing itself from the bicycle lane for privacy. The corridor follows the curvature of the corner and the ditches near the palliative dwellings.

## Schuitsloterwilde

The final site is in the north of the Netherlands in a somewhat more remote location, offering a wide view over a lake. This lake is the Schuitsloterwilde, which is close to the small village Belt-Schuitsloot. In the case of this building an L-shaped figure is developed, offering shelter from the wind that comes from the lake on the North side or close to the West side with a view over the lake. Because the viewing angle over the lake is so wide, and there is plenty of space a fanned-out figure for the palliative dwellings is chosen. The guest houses are sheltered between a cluster of trees, offering privacy and a place for contemplation. The site is close to a bus stop, but it might be useful to offer more guesthouses because of the remote location.



## Conclusion

As a starting point for the research and design in this booklet, the initial research question posed in the introduction was as follows: *What building types, methods, and target groups are suitable for impermanent housing solutions in the Dutch Peat Polders?*

Throughout various angles of research and design a suitable target group has been found in the form of a hospice or palliative care, linking to the characteristics of the site and the future of the Dutch peat polders. Furthermore, solutions for impermanent construction have been found through testing various design options, utilizing the disassembly potential formula found during research. A suitable method in DIY construction under the supervision of a contractor has been selected after a literature review and survey filled in by professionals in the built environment.

The various angles of research result from the requirements, coming from the design process. It can thus be said that the research has been informed by information needed for proceeding in the design, after which the research informed the design process, a synergy between the two. Because of this approach, the research directions were clear, also visible in the results that matched expectations.

Even though this research concluded that hospice or palliative care was best for the impermanent housing solution in this Peat polder, other forms of temporary dwelling or inhabitation in the polder can be possible. Further research can be conducted to find these other forms of inhabitants, for instance, refugees from Ukraine or the African continent, seasonal workers in greenhouses or agriculture, or even starters in the housing market.

With the many present peat polders in the Netherlands, a lot of land will be offered the opportunity for temporary inhabitation instead of being just grasslands without any function. By inhabiting these areas with temporary housing such as the one proposed in the Hospitable Movement, breathing time can be created for the current problems concerning housing in the Netherlands, whilst working towards a more permanent solution.

## Reflection

From the start of the project, i.e. the finishing of the research plan I've been quite ambitious with the approach I took during the design and research process. I knew beforehand from my previous graduation project for the Bachelor (HBO) that I wanted to make multiple supporting booklets, covering the research in detail and summarizing that into an overall booklet covering research and design in a more concise and easier-to-read format. Back then this appeared to work quite well, so with that reference in hand I went to work on the research booklets.

With this previous experience in hand, I went to work, firstly analyzing the site once more, because I thought our group work was lacking certain essential information, such as soil conditions and site history. Parallel to this Case studies were researched and a touch later the target group was defined and also researched. Additionally, research was being done on the possibility of self-building and DIY construction. Because of this approach of doing much research in the first stages of the project, I had the idea that I was going 'off sync' compared to the other students who were starting with their designs in an earlier stadium, this was also something I noticed during the design meetings. Even though I had this feeling I continued working on the research, working less intensely on the design. My primary thought behind this approach was to let the research inform the design as much as possible, requiring fewer changes in the design down the road.

With around 60% of the research finished I started to work on the design, also because of feedback by the tutors that I should start. The approach seemed to work well if I reflect on this since the initial design phase went relatively smoothly with all the input I generated. With the design advancing nicely towards the P2 I started transferring back to the research a bit more, since the technical aspect of the building (building demountable) was not yet that far in the research. This was also planned because that information was needed later when the design transferred to a more technical phase. Transferring to this phase, literature review became less and less and research by design increased in the way of making variations on design and detail level.

Up to the P4 presentation around 95% of the research was finished, with the focus primarily on the design element. Because I can gain the most on the architecture part, I have put most of my energy into the architectural development of the hospice and a little less energy into the building technology. With the P4 presentation date closing in I shifted focus one week after the P3 presentation to the building technology part, which meant a lot of detailing trying to calculate the disassembly potential of the project. Finally, one week before P4 the presentation, booklet, and posters were made, which was a tight planning.

From P4 onwards the final part of the research was finished in calculating the detachability potential of the building finalizing the story. Then the focus shifted toward the representation of the project, which was also the feedback I received during the P4. This might have been the hardest but also most useful period of the design, really thinking about how to represent the atmosphere of the hospice.

Overall I found the graduation project inspirational and educational, I think I have improved my design capabilities, which was my goal at the TU. Now it is almost over, I am also relieved. Despite it being a fun project, it was also quite a time-consuming occupation, now I can go back to sailing!

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## **Appendix**

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**05 - Measuring Demountability**

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**07 - Prototype Research**

**08 - Building Design Process**

**09 - Set of Drawings**

