07 - PROTOTYPE RESEARCH

Prototype Research

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Abstract

As the name of this research already suggests, making prototypes to test demountability is the main goal of this booklet. Building on previous findings in booklet 05 measuring demountability, project details will be sketched and tested to find the most demountable solutions for the building.

The method used for this booklet is to sketch details based on the rough ideas of the building composition, redefining them in the process. This will be done for all the clusters in the building assembly, enabling them to be tested and adjusted based on the detachability potential. After some variants have been sketched and detailed, the building has been modeled according to the selected details. From this 3D model, the areas and volumes are used to determine the environmental cost indicator of the product, which is needed for the final calculation.

The final calculation turns out to be meeting expectations set during the sketch phase, scoring an average of 0,9 which means the building can be perceived as very demountable.

A side note still has to be given concerning the methodology of calculation. The formula is still prone to the subjectivity of the one filling in the form, the final score can thus be seen as slightly inaccurate and might fluctuate within a margin of .05 points.

Keywords

Demountability, Prototype, Architectural models, Scale models

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Formula

In this booklet, the disassembly potential will be calculated. This calculation is carried out according to the formula further described in booklet 05 Measuring Demountability. This formula is based on research done by Alba Concepts, and the Dutch Green Building Council[1]. To be complete, a quick explanation of the formula is added in this booklet as a reference for the calculations that will be found on the pages that follow.

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.

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 (DPln), 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.

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)	1,00
	Click connection	
	Velcro connection	
	Magnetic connection	1.00
Connection with added elements*	Bolt and nut connection	0,80
	Spring connection	
	Corner connections	
	Screw connection	
	Connections with added connection elements**	
Direct integral connection	Pin connections***	0,60***
	Nail connection	
Soft chemical connection	Caulking connection	0,20
	Foam connection (PUR)	
Hard chemical connection	Adhesive connection	0,10
	Dump connection	
	Weld connection	
	Cementitious connection	
	Chemical anchors	
	Hard chemical connection	

Disassembly potential of composition

$$DPcp_n = \frac{2}{\frac{1}{ID_n} + \frac{1}{GPE_n}}$$

Where:
$DPcp_n$ = disassembly potential of the composition of element n:
ID_n = independency of product or element n;
GPE_n = product edge geometry of product or element n

Disassembly potential of connection

$$DPc_n = \frac{2}{\frac{1}{CT_n} + \frac{1}{CA_n}}$$

Where:
DPc_n = disassembly potential of the connection of n product or element n:
CT_n = type of connection of product or element n;
CA_n = accessibility connection of product or element n.

Disassembly potential of product or element

$$DPp_n = \frac{2}{\frac{1}{DPc_n} + \frac{1}{DPcp_n}}$$

Where:
DPp_n = disassembly potential of product or element n.
DPc_n = disassembly potential of the connection of product or element n.
$DPcp_n$ = disassembly potential of the composition of product or element n.

Disassembly potential per layer of Brand

$$DPl_n = \frac{1}{\sum_{i=1}^{l} ECI_n} \cdot \sum_{i=1}^{l} ECI_n \cdot DPp_n$$

Where:
DPl_n = disassembly potential of a Layer of Brand n;
DPp_n = disassembly potential of product or element n;
ECI_n = Environmental Cost Indicator of product or element n.

Disassembly potential of building

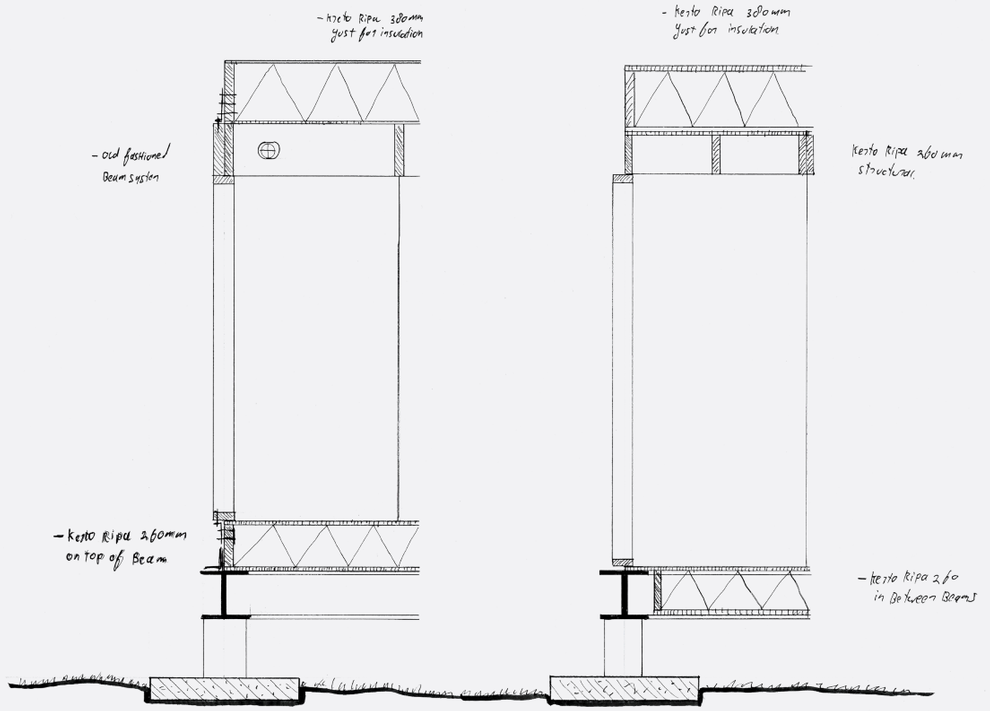
$$DPb_n = \frac{1}{\sum_{i=1}^{l} ECI_n} \cdot \sum_{i=1}^{n} ECI_n \cdot DPp_n$$

Where:
DPb_n = disassembly potential of building n;
DPp_n = disassembly potential of product or element n;
ECI_n = Environmental Cost Indicator of product or element n.

figure 01 - Formula for calculating demountability

Structural demountability

Central heart



This structure is based on a concrete slab with a standard measurement of 1000×1000×15 mm, on top of this plate, connected with nuts and bolts is a steel column. On top of the column rests a HE160-B, connected with nuts and bolts. On these beams, flanges are installed and used to attach the Kerto ripa floors, which are prefab elements. Continuing on top of these elements is a wood frame made out of glulam elements, connected with nuts and bolts. Finally, for the structure, another open Kerto ripa floor is used, connected to the frame. Beyond this structure, the skin layer of the insulation is added, in a similar way.

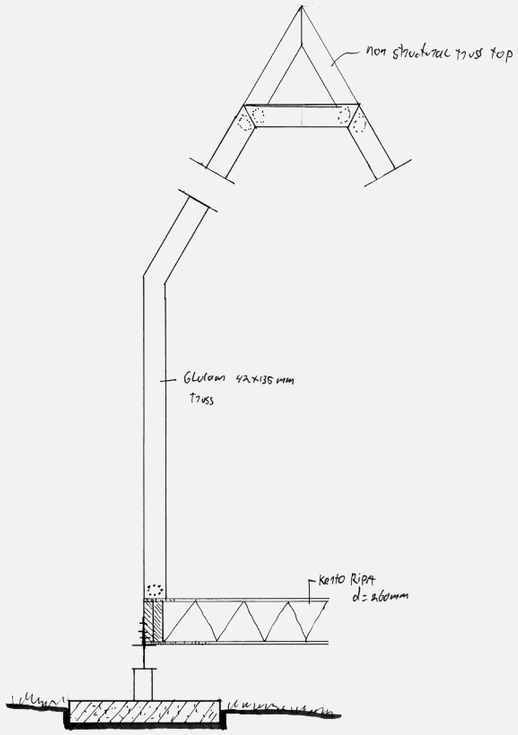
figure 02 - Structure Central heart (26-03-2024)

element | detail data			
project:	hospitable movement	detail:	Structure central heart
project nr.:	AHD-24	version:	1.0
date:	27-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,82**			**0,45**	**0,56**
1.1	Prefabricated foundation slab	1,00	0,60		1,00	0,40		0,65
1.2	Steel column foundation	0,80	1,00		1,00	0,40		0,69
1.3	HE160-B beam	0,80	1,00		1,00	0,40		0,69
1.4	Kerto Ripa floor, 260 mm	0,80	0,80		0,40	0,10		0,27
1.5	Wood frame wall	0,80	0,80		0,40	0,40		0,53
1.6	Opened Kerto ripa floor, 260 mm	0,80	0,80		0,40	0,40		0,53
Skin				**0,69**			**0,40**	**0,51**
2.1	Insulating Kerto Ripa floor, 380mm	0,80	0,60		0,40	0,40		0,51
2.2								
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,76**			**0,43**	**0,54**

table 01 - Structure central heart calculation

Ritual space



Just like the previous structural fragment, the ritual space is having its foundation made out of a prefabricated concrete plate, with a column, beam and ground floor system as described before. The floor elements however are changed slightly to accommodate the increased pressure of the wood frame that rests on top. This is completely connected with nuts and bolts. The frame is split up into multiple pieces to keep the elements easier to handle. On top an aesthetic element is added using a similar connection.

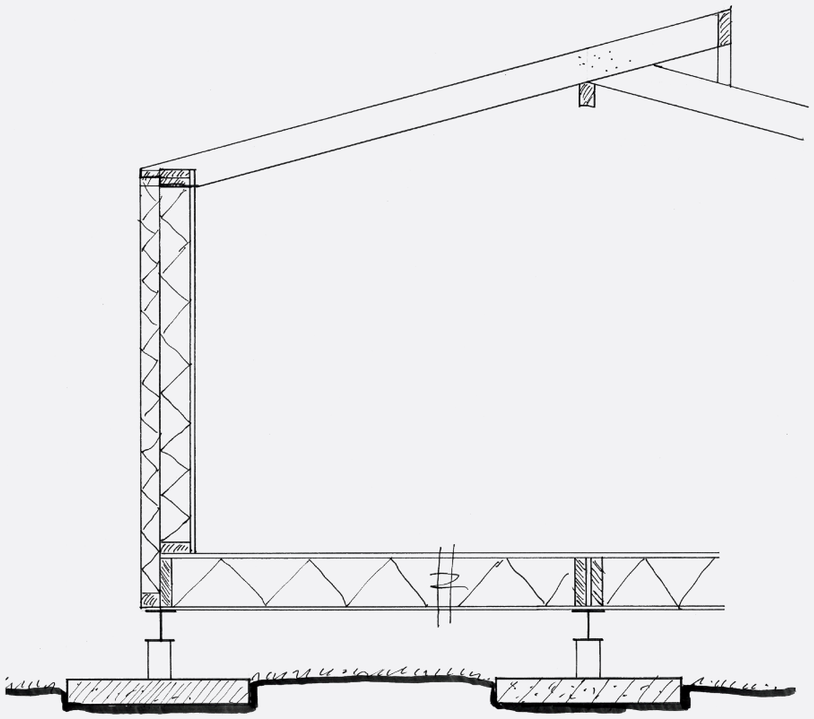
figure 03 - Structure ritual space (26-03-2024)

element | detail data			
project:	hospitable movement	detail:	Structure Ritual space
project nr.:	AHD-24	version:	1.0
date:	27-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,84**			**0,41**	**0,51**
1.1	Prefabricated foundation slab	1,00	0,60		1,00	0,40		0,65
1.2	Steel column foundation	0,80	1,00		1,00	0,40		0,69
1.3	HE160-B beam	0,80	1,00		1,00	0,40		0,69
1.4	Kerto Ripa floor, 260 mm	0,80	0,80		0,40	0,10		0,27
1.5	Wood frame	0,80	1,00		0,40	0,10		0,27
1.6								
Skin				**0,80**			**1,00**	**0,89**
2.1	Aesthetic frame on top of structure	0,80	0,80		1,00	1,00		0,89
2.2								
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,82**			**0,71**	**0,70**

table 02 - Structure ritual space calculation

Hospice rooms



Again the structure from the foundation to the ground floor elements are the same as the previous two fragments. On top of this floor however is a new insulating element in the form of a wood-framed wall, which supports the wooden roof frame using nuts and bolts. An additional frame for the skin is added to the wood frame structure, for achieving the required insulation values.

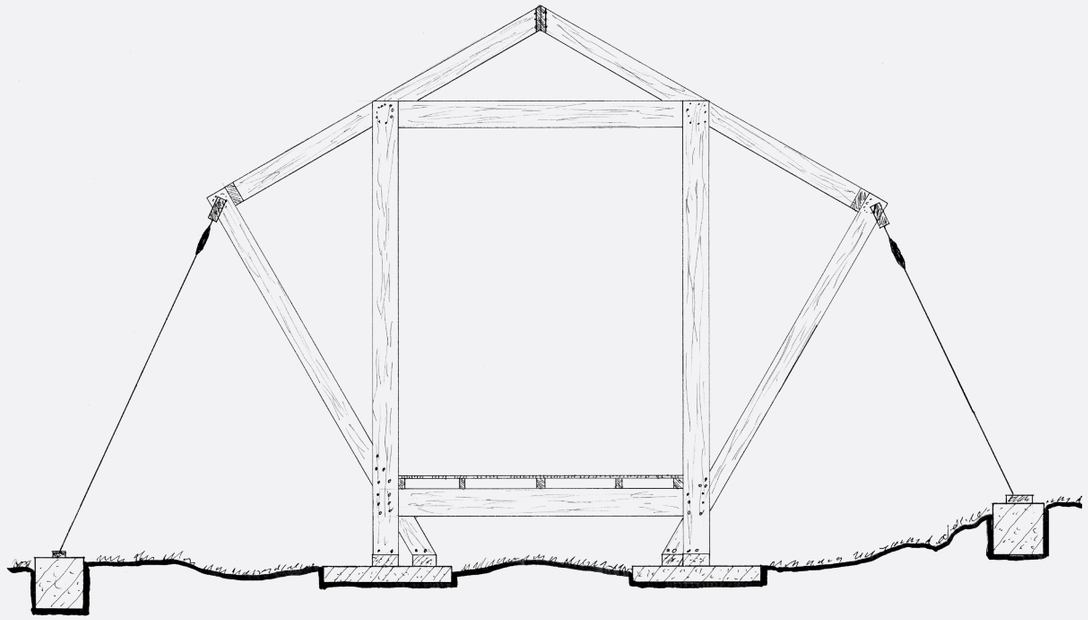
figure 04 - Structure hospice rooms (26-03-2024)

element | detail data			
project:	hospitable movement	detail:	Structure Hospice Rooms
project nr.:	AHD-24	version:	1.0
date:	27-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,84**			**0,43**	**0,54**
1.1	Prefabricated foundation slab	1,00	0,60		1,00	0,40		0,65
1.2	Steel column foundation	0,80	1,00		1,00	0,40		0,69
1.3	HE160-B beam	0,80	1,00		1,00	0,40		0,69
1.4	Kerto Ripa floor, 260 mm	0,80	0,80		0,40	0,10		0,27
1.5	Wood frame	0,80	1,00		0,40	0,10		0,27
1.6	Wood joists		0,80		1,00	0,40		0,67
Skin				**0,80**			**0,57**	**0,67**
2.1	Additional skin of insulation	0,80	0,80		1,00	0,40		0,67
2.2								
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,82**			**0,50**	**0,61**

table 03 - Structure hospice rooms calculation

Circulation



Foundation-wise this element is different from the previous three versions, with the weight of the system as the main cause. Again, the foundation consists of a concrete foundation with an additional spacer of concrete to elevate the wooden columns of the ground to prevent direct contact with the moist ground. Between the columns is the complete wooden frame that consists of many triangles for stability. Additionally, to prevent the wind from lifting the roof, tension cables are added to the frame for increased stability, all freely accessible.

figure 05 - Structure circulation (26-03-2024)

element | detail data			
project:	hospitable movement	detail:	Structure Circulation
project nr.:	AHD-24	version:	1.0
date:	27-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,86**			**0,66**	**0,73**
1.1	Prefabricated foundation slab	1,00	0,60		1,00	0,40		0,65
1.2	Wood columns	0,80	1,00		1,00	0,40		0,69
1.3	triangular prefab frame	0,80	1,00		1,00	0,40		0,69
1.4	Edge joists	0,80	1,00		1,00	0,40		0,69
1.5	Anchors	0,80	1,00		1,00	1,00		0,94
1.6								
Skin								
2.1								
2.2								
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,86**			**0,66**	**0,73**

table 04 - Structure circulation calculation

Circulation model

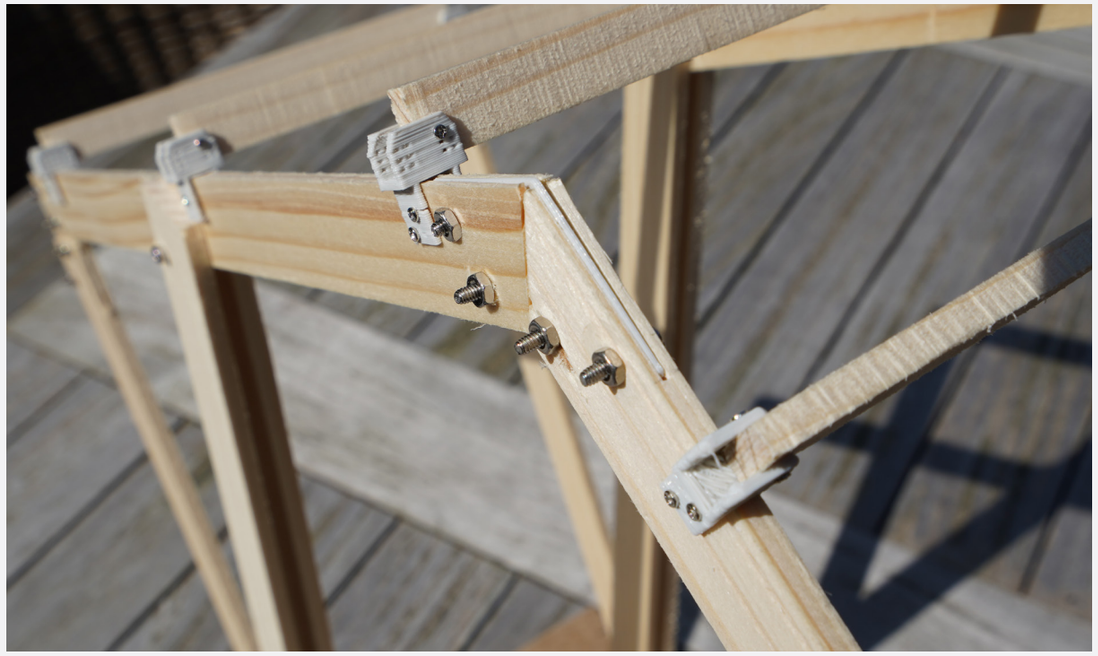


figure 06 - Roof beam joint

figure 07 - Foundation and floor beam joint

All structural elements are connected with steel plates that can be attached to the wood structure with nuts, bolts, and washers. A point of attention for now is the foundation, which now uses a thick steel structure, which can be optimized.

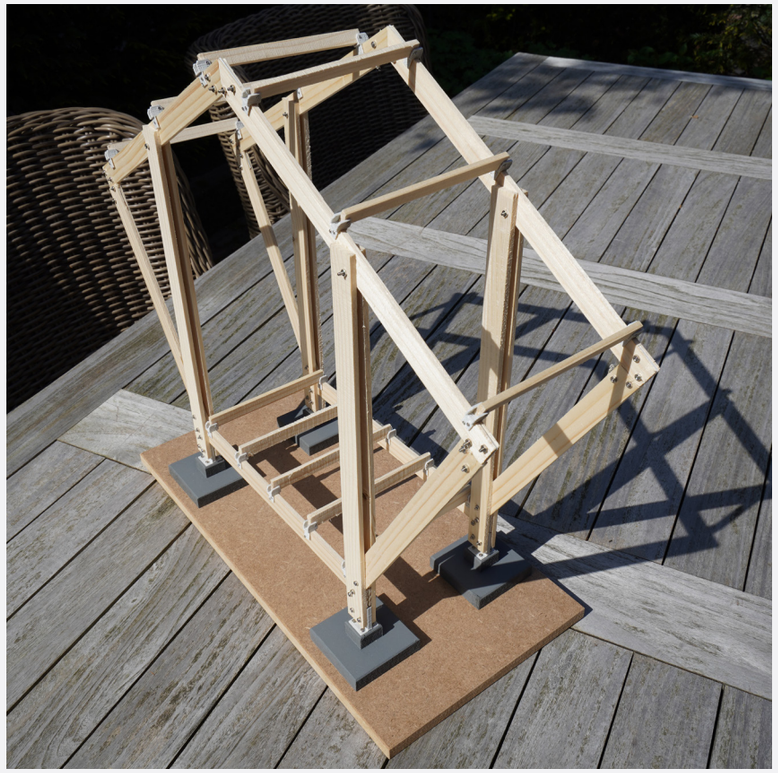


figure 08 - Corridor model overview

To test out the structural connections of the structure for the circulation, a model was made highlighting the structural connections. In comparison to the drawing on the previous page, the horizontal beam connecting the top of the columns was removed because the structure was already rigid enough whilst constructed, this also reduced the use of materials for the structure.

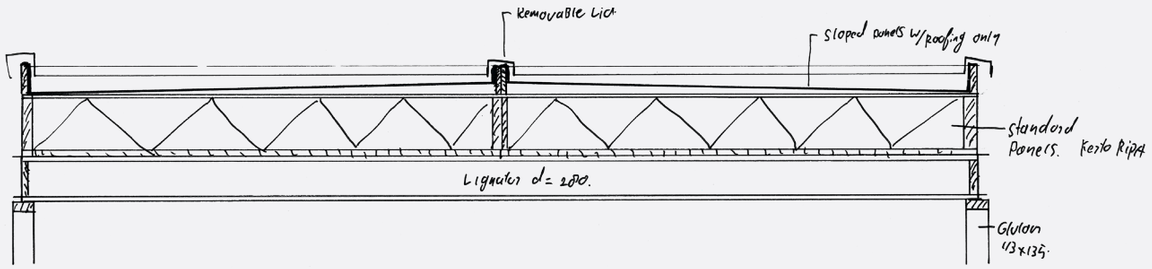
Final calculation corridor

ID	product/element description	ID load-bearing connection	Load-bearing connection	ECI	CT	CA	disassembly potential of the connection (DPc)	ID	GPE	Disassembly potential of the composition (DPcp)	disassembly potential (DP)
1.0	**Structure**			**271,49**			**1,03**			**1**	**1,01**
1.1	Precast concrete footing			333,96	1,00	1,00	1	1,00	1,00	1	1
1.2	Accoya wood column	1.1	Precast concrete footing	-29,25	0,80	1,00	0,89	1,00	1,00	1	0,94
1.3	Accoya truss element	1.2	Accoya wood column	-25,73	0,80	1,00	0,89	1,00	1,00	1	0,94
1.4	Accoya floor beams	1.3	Accoya truss element	-0,66	0,80	1,00	0,89	1,00	1,00	1	0,94
1.5	Accoya roof beams	1.3	Accoya truss element	-6,84	0,80	1,00	0,89	1,00	1,00	1	0,94
1.6											
1.7											
1.8											
1.9											
1.10											
2.0	**Skin**			**1126,14**			**0,89**			**1**	**0,94**
2.1	Wood plank floor	1.4	Accoya floor beams	10,77	0,80	1,00	0,89	1,00	1,00	1	0,94
2.2	Corrugated roof panels	1.5	Accoya roof beams	694,17	0,80	1,00	0,89	1,00	1,00	1	0,94
2.3	Sunscreen	1.3	Accoya truss element	421,20	0,80	1,00	0,89	1,00	1,00	1	0,94
2.4											
2.5											
2.6											
2.7											
2.8											
2.9											
2.10											
3.0	**Services**			**28,80**			**0,8**			**0,4**	**0,53**
3.1	PVC water pipe	1.3	Accoya truss element	28,80	0,80	0,80	0,8	0,40	0,40	0,4	0,53
3.2											
3.3											
3.4											
3.5											
3.6											
3.7											
3.8											
3.9											
3.10											
4.0	**Space Plan**			**0,00**							**0**
4.1											
4.2											
4.3											
4.4											
4.5											
4.6											
4.7											
4.8											
4.9											
4.10											

figure 09 - Corridor calculation

Flat Roofing

Option 1



The first option to create a demountable roof makes use of flat insulated panels (Kerto Ripa) without any slopes or roofing membrane attached to them, only a vapor open water-repelling barrier. On top of these roofing elements are sloped roofing elements that are stand-alone units, also prefabricated in a manageable size. The connections between the roofing elements are realized by placing a lid over the seams of the panels in place of the upstanding elements.

Of the two options, this one is the most demountable choice for the project.

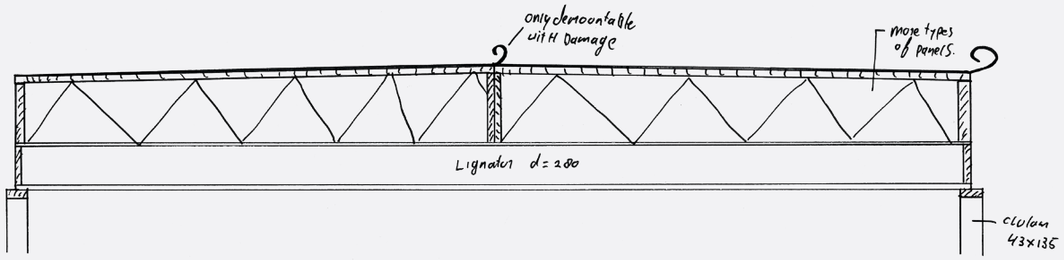
figure 10 - Flat roofing option 1 (22-04-2024)

element | detail data			
project:	hospitable movement	detail:	Flat roof option 1
project nr.:	AHD-24	version:	1.0
date:	22-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,70**	**0,75**
1.1	Glulam Column	0,80	1,00		0,40	0,40		0,55
1.2	Lignatur box elements	0,80	1,00		1,00	1,00		0,94
1.3								
1.4								
1.5								
1.6								
Skin				**0,87**			**0,86**	**0,85**
2.1	Kerto Ripa insulated floors	0,80	0,80		1,00	0,40		0,67
2.2	Sloped roofing panels	0,80	0,80		1,00	1,00		0,89
2.3	Lid for roofing panels	1,00	1,00		1,00	1,00		1,00
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total		**0,88**				**0,78**		**0,80**

table 05 - Flat roofing option 1 calculation

Option 2



This second option introduces Kerto Ripa insulated panels that integrate the slope to the elements themselves. This indicates that there will be more types of panels present within the project, and thus makes is possibly more complicated for the builders. To create a watertight seal, the roofing membrane that is attached to the Kerto Elements needs to be realized with a soft-chemical connection, which has to be cut open if the panels have to be removed, this means that the roofing always will be damaged during disassembly.

figure 11 - Flat roofing option 2 (22-04-2024)

element | detail data			
project:	hospitable movement	detail:	Flat roof option 2
project nr.:	AHD-24	version:	1.0
date:	22-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,70**	**0,75**
1.1	Glulam Column	0,80	1,00		0,40	0,40		0,55
1.2	Lignatur box elements	0,80	1,00		1,00	1,00		0,94
1.3								
1.4								
1.5								
1.6								
Skin				**0,27**			**0,57**	**0,37**
2.1	Kerto Ripa insulated, sloped with roofing	0,20	0,40		1,00	0,40		0,37
2.2								
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,58**			**0,64**	**0,56**

table 06 - Flat roofing option 2 calculation

Central Heart

The central heart of the building contains the largest volume of the three clusters the hospice is made up of. This also indicates that this building cluster will have the largest impact on material usage and thus the impact on the environment.

The cluster is characterized by the steel platform it rests on, founded on precast concrete plates with the absence of piles. On top of this sturdy platform is the biobased structure, primarily consisting of wood as a main material. The ground floor is made out of wood floor elements, containing insulation, functioning as the structure and skin of the building at the same time. On top of these floors is a wood framed system, that acts as a raster to connect the façade elements to. On top of this frame are again wood floor elements, supporting the second floor or roof structure. The roof is made out of smaller panels on top of the structural floor element.

On the following pages the most important details have been selected, covering almost all of the details of this building part. This way the demountability of the building can be calculated as accurately as possible, with the most impactful elements taken into account. Eventually when the details are nearly done a prototype model will be made to test out the design decisions.

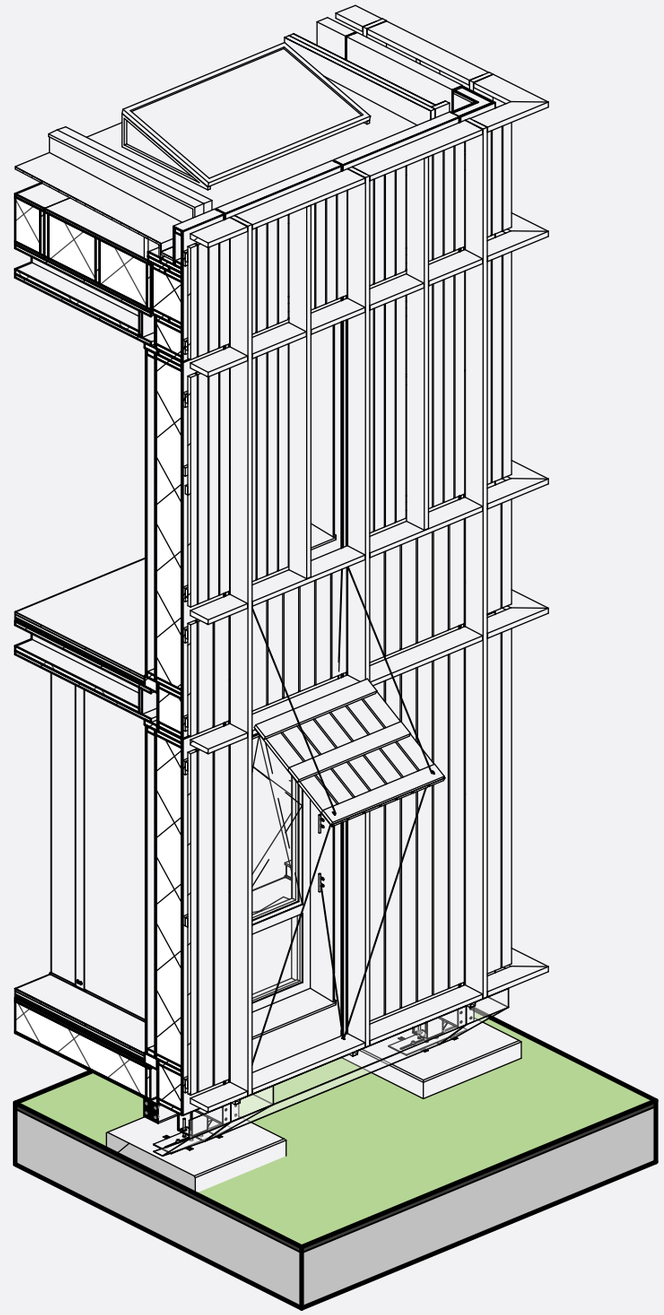
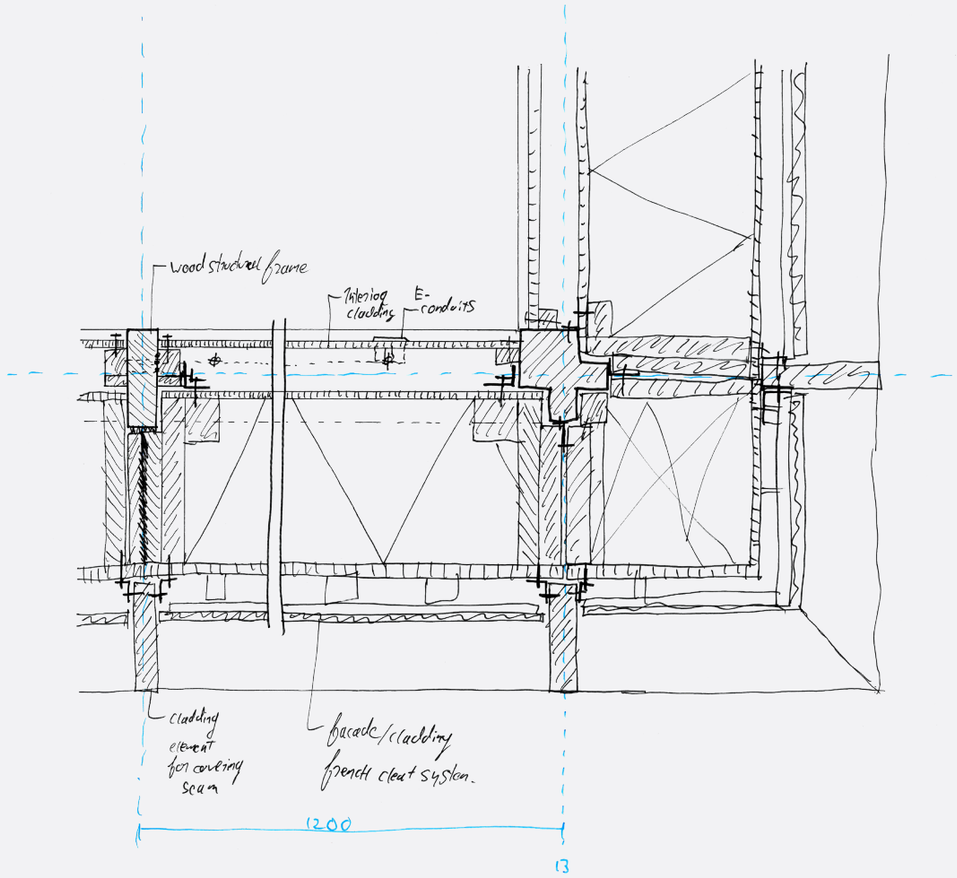


figure 12 - Central Heart fragment

Detail CH H.01



Shown in this detail is the corner element of the building with closed panels connecting to them. Overall this detail is in the right direction of meeting the ambition of the 0,8 score overall. The scoring could be increased by separating the electrical conduits from the structure, but this should be an aesthetical choice.

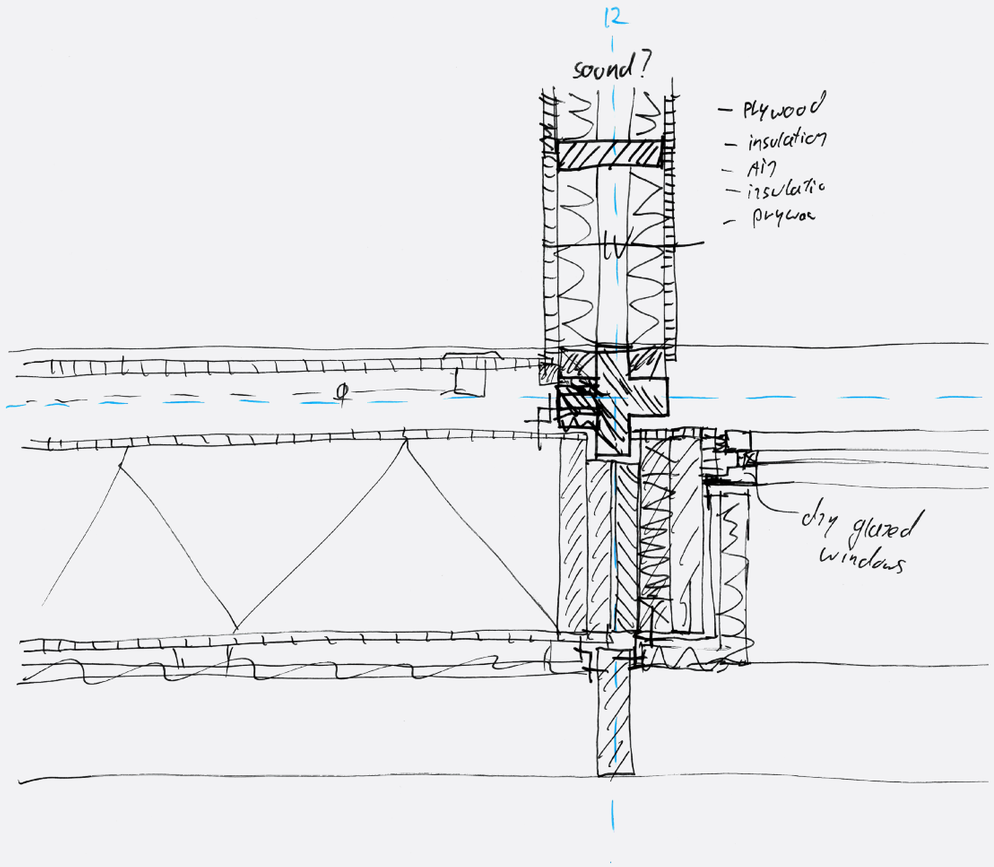
figure 13 - Detail CH H.01 (01-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH H.01
project nr.:	AHD-24	version:	1.0
date:	1-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,57**	**0,69**
1.1	Glulam column	0,80	1,00		0,40	1,00		0,69
1.2								
1.3								
1.4								
1.5								
1.6								
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**1,00**	0,94
4.1	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,87**			**0,79**	**0,81**

table 07 - Demountability index CH H.01

Detail CH H.02



The second horizontal detail shows the wall section combined with an interior wall and an opening in the façade. Points of attention for this detail to improve are the electrical wiring and conduits, the aluminum window inside of the prefabricated panel, and the columns. The latter now has many variants and forms, which might have to be reduced to a smaller amount or standard size, this is especially true for the corner and interior wall joints. Furthermore, with the aluminum window, half of the exterior wall has to be disassembled to replace the actual window.

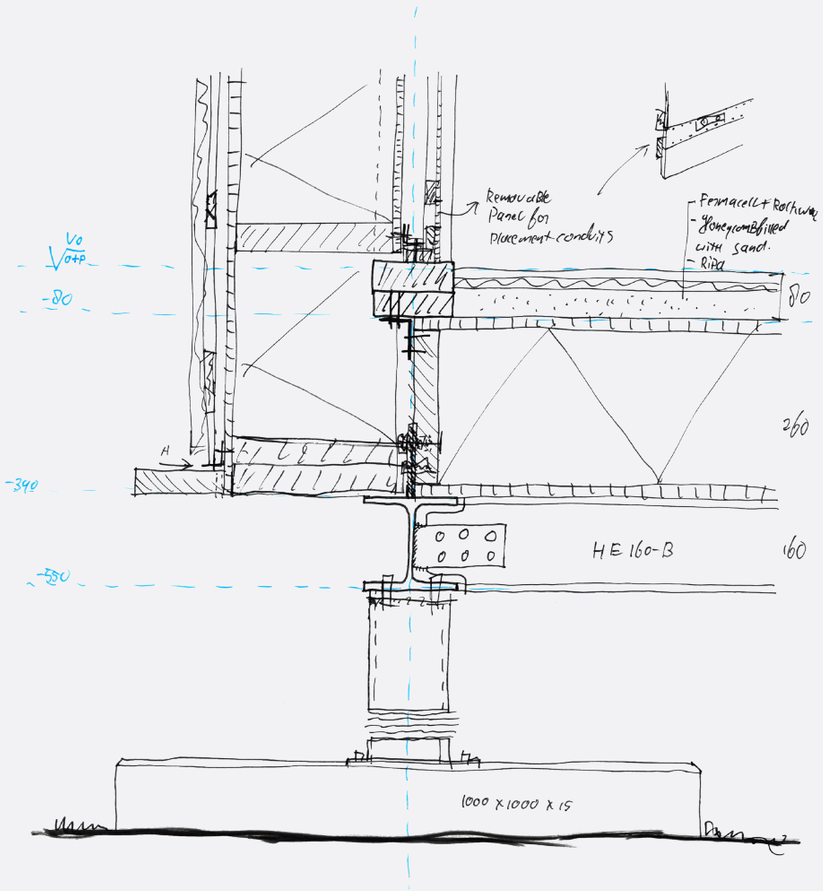
figure 14 - Detail CH H.01 (01-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH H.02
project nr.:	AHD-24	version:	1.0
date:	1-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,57**	**0,69**
1.1	Glulam column	0,80	1,00		0,40	1,00		0,69
1.2								
1.3								
1.4								
1.5								
1.6								
Skin				**0,84**			**0,91**	**0,87**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4	Prefabricated window panel	0,80	1,00		1,00	1,00		0,94
2.5	aluminium window	0,80	0,80		1,00	0,40		0,67
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**1,00**	**0,94**
4.1	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,87**			**0,76**	**0,80**

table 08 - Demountability index CH H.01

Detail CH V.04



This detail shows the assembly of the ground floor and connection to the foundation. The steel platform and detailing can be improved in the connection of the column to the concrete plate, which is now done through drilling and chemically fastening an anchor bolt. Also, the services can be reconsidered, they are now less accessible. Just as discussed in detail CH H.01 the electrical wiring can be an aesthetical consideration.

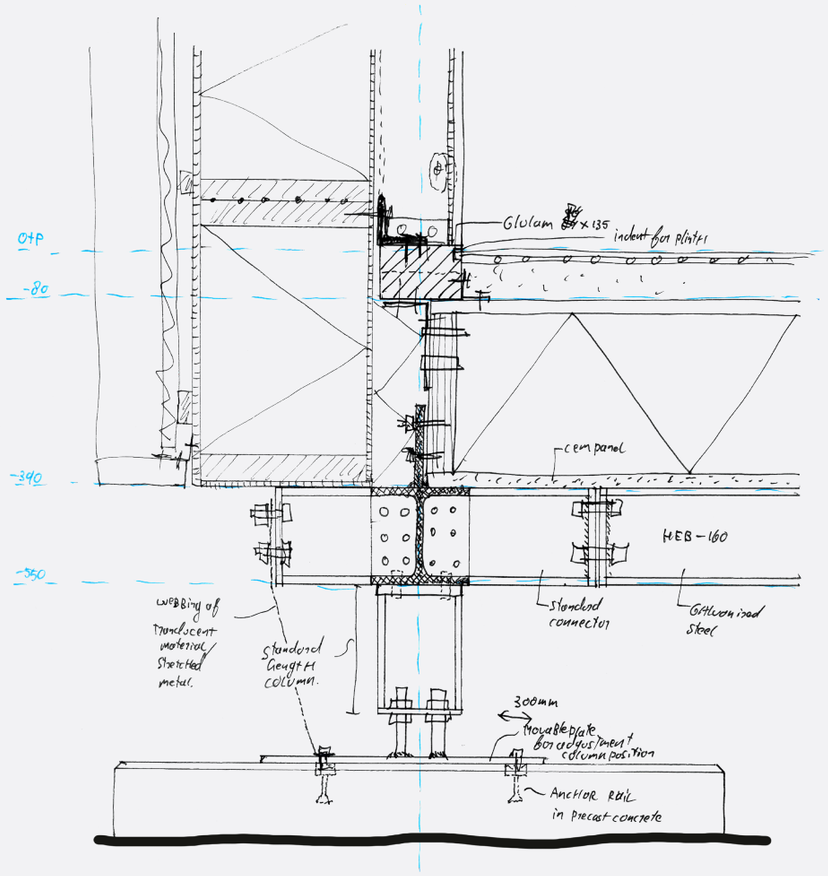
figure 15 - Detail CH V.04 (01-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.04
project nr.:	AHD-24	version:	1.0
date:	1-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,82**			**0,76**	**0,77**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,60	1,00		1,00	1,00		0,86
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Glulam floorbeam	0,80	0,80		1,00	0,40		0,67
1.6	Glulam column	0,80	0,80		0,40	0,40		0,53
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Floor heating	1,00	0,80		1,00	0,40		0,69
3.3								
3.4								
3.5								
3.6								
Space plan							**0,80**	0,83
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.4								
4.5								
4.6								
Total				**0,85**			**0,78**	**0,80**

table 09 - Demountability index CH V.04

Detail CH V.04



Compared to the previous version, this detail has increased its potential with a score of 0,01. The main changes are in the façade panels which now run in front of the structure, because of the small gain in demountability it makes and the decrease in ease of building this choice will be reverted to the previous model. In addition to the façade panels, the adjustable foundation system is now drawn, making exact adjustments and placement for the foundation slabs easier to manage on the site.

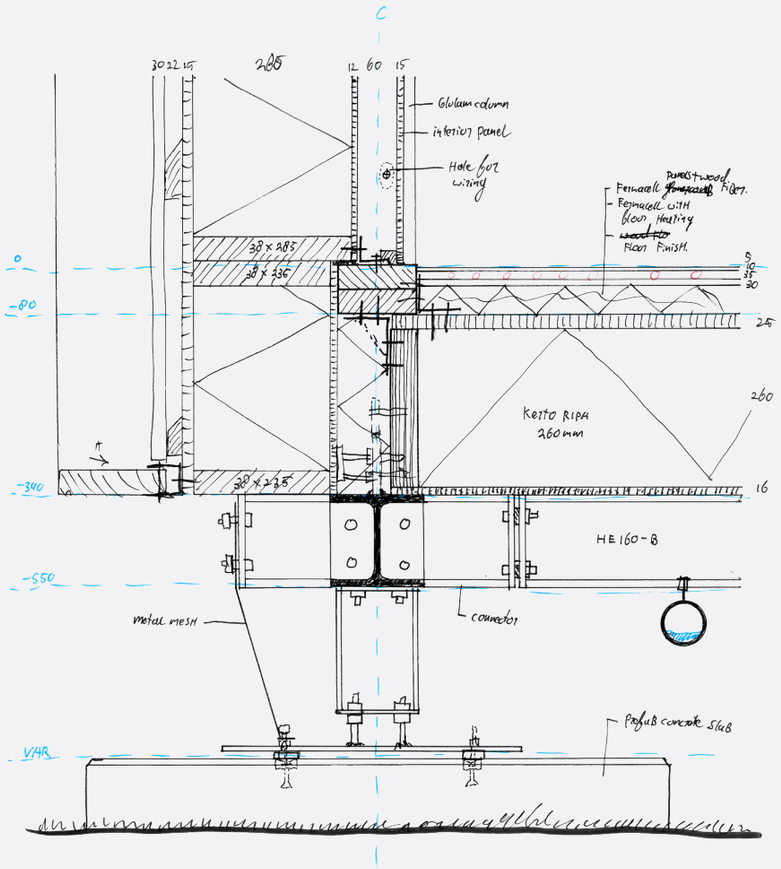
figure 16 - Detail CH V.04 (16-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.04
project nr.:	AHD-24	version:	2.0
date:	16-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,85**			**0,76**	**0,78**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Glulam floorbeam	0,80	0,80		1,00	0,40		0,67
1.6	Glulam column	0,80	0,80		0,40	0,40		0,53
Skin				**0,85**			**1,00**	**0,92**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4	Metal mesh for foundation	0,80	1,00		1,00	1,00		0,94
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Floor heating	1,00	0,80		1,00	0,40		0,69
3.3								
3.4								
3.5								
3.6								
Space plan							**0,80**	0,83
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.4								
4.5								
4.6								
Total				**0,86**			**0,78**	**0,81**

table 10 - Demountability index CH V.04

Detail CH V.04



In this final option, the façade system is reverted to the initial sketches of the detail, this has primarily been done because of ease of building requirements. Additionally, the building service layer has been expanded with the sewer system hanging on the bottom of the steel beams, this all resulted in the increase of the building demountability to a score of 0,82.

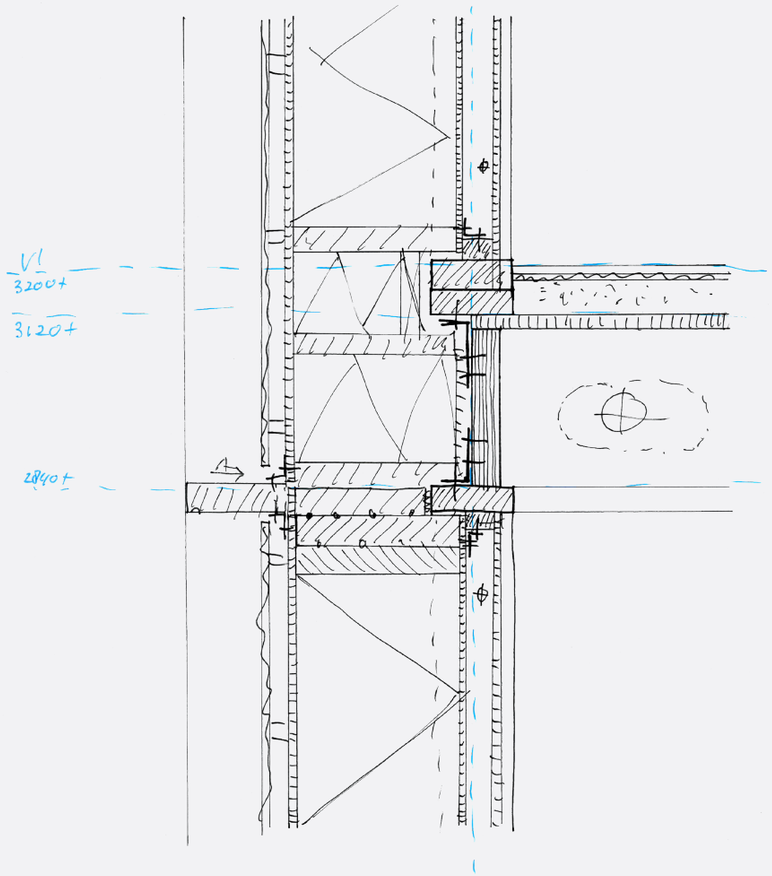
figure 17 - Detail CH V.04 (18-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.04
project nr.:	AHD-24	version:	2.1
date:	18-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,85**			**0,76**	**0,78**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Glulam floorbeam	0,80	0,80		1,00	0,40		0,67
1.6	Glulam column	0,80	0,80		0,40	0,40		0,53
Skin				**0,85**			**1,00**	**0,92**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4	Metal mesh for foundation	0,80	1,00		1,00	1,00		0,94
2.5								
2.6								
Services				**0,86**			**0,71**	0,76
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Floor heating	1,00	0,80		1,00	0,40		0,69
3.3	Sewer pipe	0,80	0,80		1,00	1,00		0,89
3.4								
3.5								
3.6								
Space plan							**0,80**	0,83
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.4								
4.5								
4.6								
Total				**0,85**			**0,82**	**0,82**

table 11 - Demountability index CH V.04

Detail CH V.05



Again this detail has a lot in common with the V.04 detail. A new addition to this detail is the addition of a floor system as a second floor or roof. An improvement can be made in the independence of the structure by separating the services from the structure, they now run through cavities through the Kerto floors. This also is the case for the services again, as previously argued.

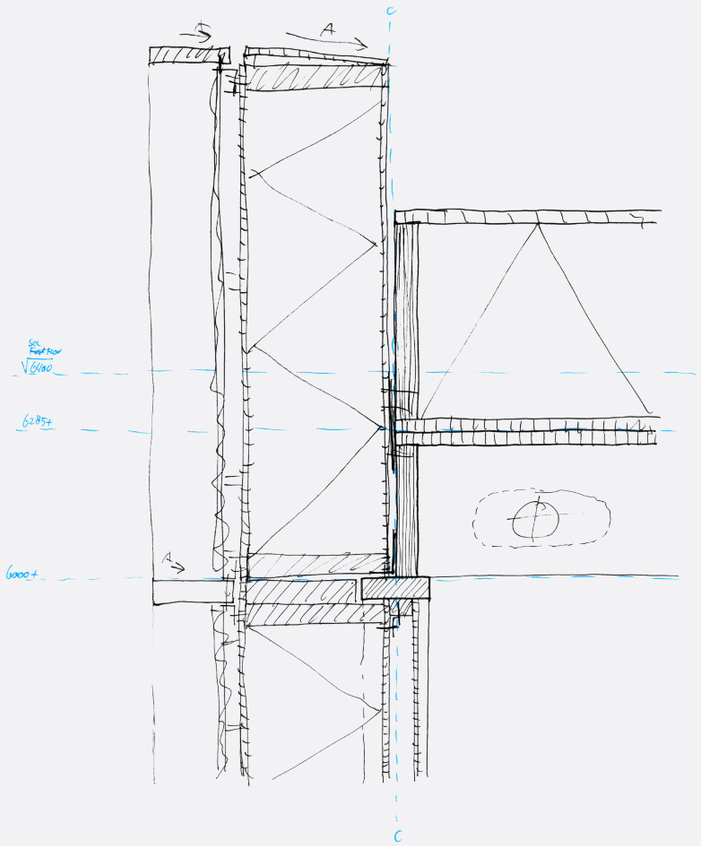
figure 18 - Detail CH V.05 (01-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.05
project nr.:	AHD-24	version:	1.0
date:	1-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,68**	**0,75**
1.1	Glulam column	0,80	1,00		0,40	1,00		0,69
1.2	Glulam top beam	0,80	1,00		0,40	1,00		0,69
1.3	Kerto open box element	0,80	1,00		0,40	1,00		0,69
1.4	Glulam bottom beam	0,80	1,00		1,00	1,00		0,94
1.5								
1.6								
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services				**0,86**			**0,51**	0,64
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Floor heating	1,00	0,80		1,00	0,40		0,69
3.3	Ventilation ducts	0,80	0,80		0,40	0,40		0,53
3.4								
3.5								
3.6								
Space plan							**0,80**	0,83
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.4								
4.5								
4.6								
Total				**0,86**			**0,75**	**0,78**

table 12 - Demountability index CH V.05

Detail CH V.06



Newly added to this detail is the roof structure, consisting of smaller elements consisting of insulated Kerto floors. The scoring can be improved by eliminating a roofing membrane that covers the entire roof, and dividing that into multiple elements, again services and indepency are other factors that should be considered.

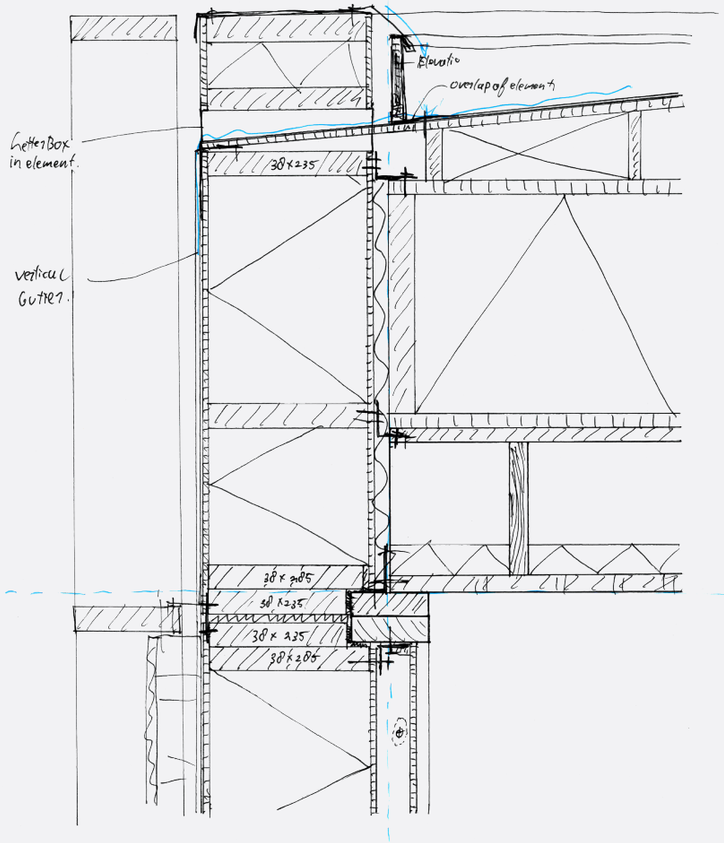
figure 19 - Detail CH V.06 (01-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.06
project nr.:	AHD-24	version:	1.0
date:	1-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,57**	**0,69**
1.1	Glulam column	0,80	1,00		0,40	1,00		0,69
1.2	Glulam top beam	0,80	1,00		0,40	1,00		0,69
1.3	Kerto open box element	0,80	1,00		0,40	1,00		0,69
1.4								
1.5								
1.6								
Skin				**0,72**			**1,00**	**0,81**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4	Insulated roofing elements	0,80	0,80		1,00	1,00		0,89
2.5	Roofing membrane	0,20	0,60		1,00	1,00		0,46
2.6								
Services				**0,85**			**0,49**	0,61
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Ventilation ducts	0,80	0,80		0,40	0,40		0,53
3.3								
3.4								
3.5								
3.6								
Space plan							**0,80**	0,83
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.4								
4.5								
4.6								
Total				**0,82**			**0,72**	**0,74**

table 13 - Demountability index CH V.06

Detail CH V.06



Compared to the previous version, this detail has made a massive step in the demountable aspect. The structure has changed by replacing the Kerto open box panels with Lignatur closed structural elements, that do not integrate the ventilation systems. The impact of independency has thus been reduced. Furthermore, the roofing system has been changed from a membrane that has to be cut to a demountable system for the roofing panels.

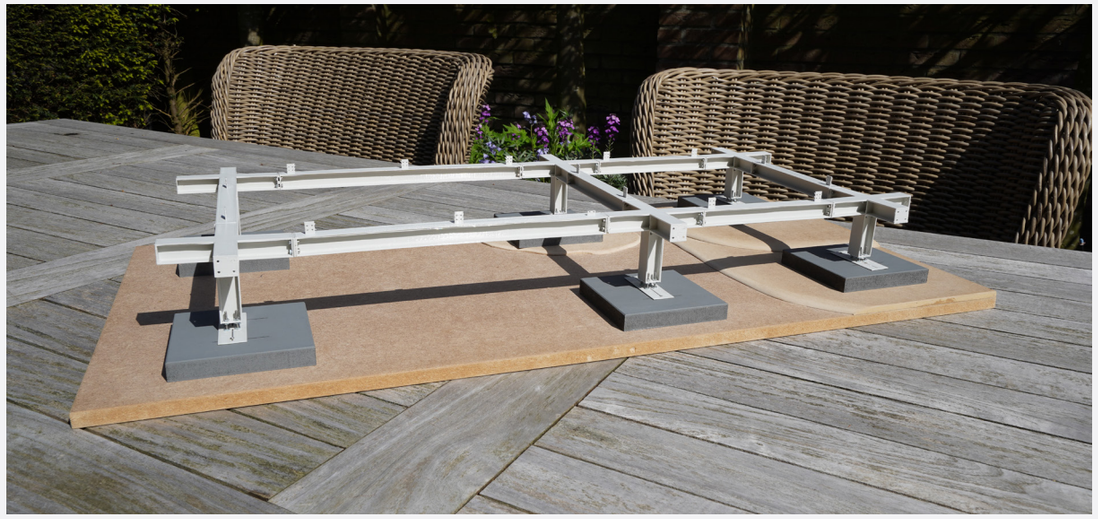
figure 20 - Detail CH V.06 (18-04-2024)

element | detail data			
project:	hospitable movement	detail:	CH V.06
project nr.:	AHD-24	version:	2.0
date:	18-4-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**0,71**	**0,77**
1.1	Glulam column	0,80	1,00		0,40	1,00		0,69
1.2	Glulam top beam	0,80	1,00		0,40	1,00		0,69
1.3	Lignatur box element	0,80	1,00		1,00	1,00		0,94
1.4								
1.5								
1.6								
Skin				**0,85**			**0,93**	**0,88**
2.1	Prefabricated insulated framed panels	0,80	0,80		1,00	1,00		0,89
2.2	aesthetical wood frame	0,80	0,80		1,00	1,00		0,89
2.3	Cladding	0,80	1,00		1,00	1,00		0,94
2.4	Insulated roofing element	0,80	0,80		1,00	0,40		0,67
2.5	Sloped roofing panels	0,80	1,00		1,00	1,00		0,94
2.6	Lid for sloped panels	0,80	1,00		1,00	1,00		0,94
Services				**0,89**			**0,79**	**0,82**
3.1	Electricity wiring	1,00	0,80		1,00	0,40		0,69
3.2	Ventilation (not drawn)	0,80	1,00		1,00	1,00		0,94
3.3								
3.4								
3.5								
3.6								
Space plan							**1,00**	**0,94**
4.1	Interior plywood cladding	0,80	1,00		1,00	1,00		0,94
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,88**			**0,86**	**0,85**

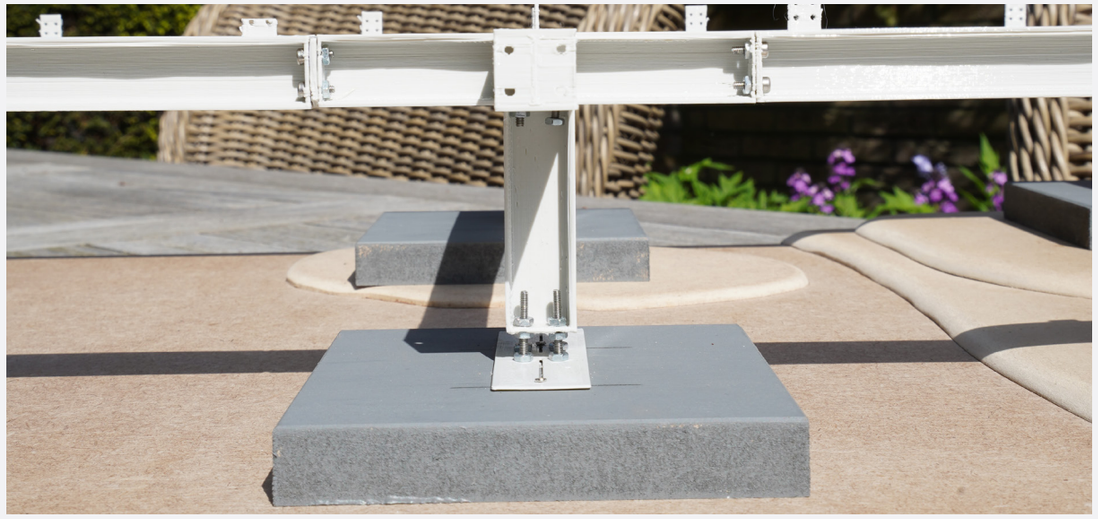
table 14 - Demountability index CH V.06

Foundation model



Overviewing this structure shows the elements spanning 2.4 or 3.6 meters, all beams have steel lips attached to them to connect the floor elements to them.

figure 22 - Overview of Central Heart foundation structure



By having the sliding track on the concrete plates, the steel structure can be adjusted allowing tolerances in the placement of the concrete.

figure 21 - Column, showing adjustability in precast plates

This foundation model is exactly constructed according to the details shown in CH V.04. All steel structural elements are connected with nuts, bolts, and washers, creating an easy-to-assemble and disassemble structure. On each column a cross-joint element is connected allowing the building to be expanded in four directions, making this element universally usable.

figure 23 - Overview of structural joints

ID	product/element description	ID load-bearing connection	Load-bearing connection	ECI	CT	CA	disassembly potential of the connection (DPc)	ID	GPE	Disassembly potential of the composition (DPcp)	disassembly potential (DP)
1.0	**Structure**			**2332,29**			**0,94**			**0,9**	**0,91**
1.1	Precast foundation plate 100 × 100 × 15 cm			1050,44	1,00	1,00	1	1,00	1,00	1	1
1.2	Steel column HE160-B	1.1	Precast foundation plate 100 × 100 × 15 cm	73,24	0,80	1,00	0,89	1,00	1,00	1	0,94
1.3	Steel crossjoint HE160-B	1.2	Steel column HE160-B	251,14	0,80	1,00	0,89	1,00	1,00	1	0,94
1.4	Steel beam HE160-B	1.3	Steel crossjoint HE160-B	399,31	0,80	1,00	0,89	1,00	1,00	1	0,94
1.5	Kerto Ripa ground floor elements	1.4	Steel beam HE160-B	531,26	0,80	1,00	0,89	0,40	1,00	0,57	0,69
1.6	Wood column base elements	1.5	Kerto Ripa ground floor elements	0,02	0,80	1,00	0,89	1,00	1,00	1	0,94
1.7	Wood columns	1.6	Wood column base elements	0,38	0,80	1,00	0,89	0,40	0,40	0,4	0,55
1.8	Floor beam between columns	1.5	Kerto Ripa ground floor elements	0,18	0,80	1,00	0,89	1,00	1,00	1	0,94
1.9	Top beam between columns	1.7	Wood columns	0,13	0,80	1,00	0,89	1,00	1,00	1	0,94
1.10	Lignature roof structure elements	1.9	Top beam between columns	26,19	0,80	1,00	0,89	0,40	1,00	0,57	0,69
2.0	**Skin**			**2017,22**			**0,89**			**1**	**0,94**
2.1	Prefab framed panel (closed)	1.7	Wood columns	352,32	0,80	1,00	0,89	1,00	1,00	1	0,94
2.2	Prefab framed panel (open)	1.7	Wood columns	52,37	0,80	1,00	0,89	1,00	1,00	1	0,94
2.3	Prefab framed top panel	1.10	Lignature roof structure elements	166,07	0,80	1,00	0,89	1,00	1,00	1	0,94
2.4	Zinc downspout	2.1	Prefab framed panel (closed)	422,92	0,80	1,00	0,89	1,00	1,00	1	0,94
2.5	Wood frame on facade	2.1	Prefab framed panel (closed)	80,76	0,80	1,00	0,89	1,00	1,00	1	0,94
2.6	Wood cladding	2.1	Prefab framed panel (closed)	0,82	0,80	1,00	0,89	1,00	1,00	1	0,94
2.7	Sunshading	2.5	Wood frame on facade	0,01	0,80	1,00	0,89	1,00	1,00	1	0,94
2.8	Kerto insulated roof elements	1.10	Lignature roof structure elements	477,55	0,80	1,00	0,89	1,00	1,00	1	0,94
2.9	Roof panels	2.8	Kerto insulated roof elements	464,40	0,80	1,00	0,89	1,00	1,00	1	0,94
2.10											
3.0	**Services**			**305,38**			**0,89**			**0,46**	**0,6**
3.1	Floor heating	4.1	Screed floor (dry system)	197,88	1,00	0,80	0,89	0,40	0,40	0,4	0,55
3.2	Ventilation system	1.10	Lignature roof structure elements	107,50	0,80	1,00	0,89	0,40	1,00	0,57	0,69
3.3											
3.4											
3.5											
3.6											
3.7											
3.8											
3.9											
3.10											
4.0	**Space Plan**			**858,24**			**0,97**			**0,7**	**0,8**
4.1	Screed floor (dry system)	1.5	Kerto Ripa ground floor elements	591,44	1,00	1,00	1	0,40	1,00	0,57	0,73
4.2	Interior wall panels	1.7	Wood columns	266,80	0,80	1,00	0,89	1,00	1,00	1	0,94
4.3											
4.4											
4.5											
4.6											
4.7											
4.8											
4.9											
4.10											

figure 24 - Central heart calculation

Hospice rooms

The cluster containing hospice rooms is the second largest cluster in the building ensemble, despite the volume this cluster is bringing some additional challenges in comparison to the central heart. Privacy for instance is more important, needing improved acoustics between rooms in comparison to the other two clusters.

The hospice rooms are just like the central heart, placed on a steel platform founded on precast concrete plates. On top of this sturdy but steel and concrete platform is again a biobased structure made out of wood. The ground floor is made out of wood box elements also containing wood-fiber insulation. On top of these floors are prefabricated wood frame elements, that are structural and also have an insulating function. The roofs are again made out of wood box elements that are insulated, covered with zinc elements that are screwed and clicked in place.

On the following pages the most important details have been selected, covering almost all of the details of this cluster. This way the demountability of the building can be calculated as accurately as possible. Eventually, when the details are nearly done a prototype model will be made to test out the design options in a real-world environment.

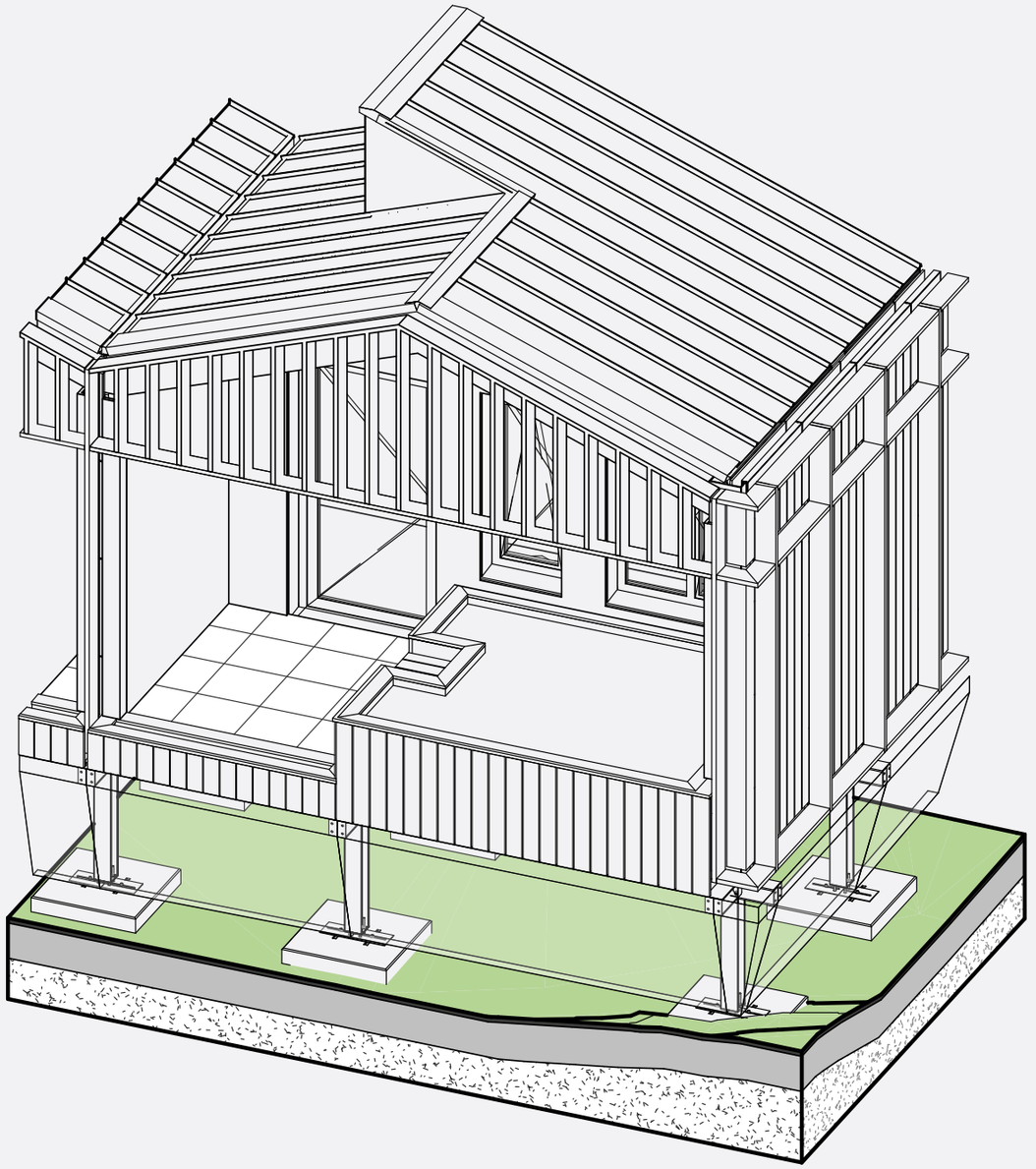
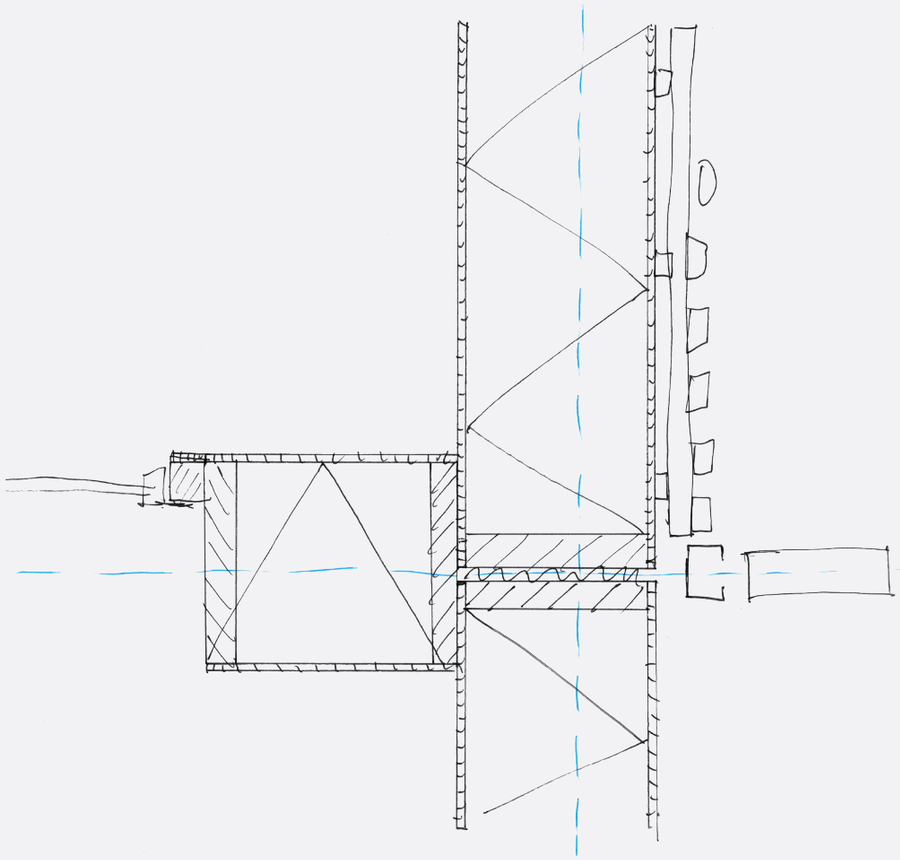


figure 25 - Hospice rooms cluster fragment

Detail HR H.02



The detail shows the outer façade of one palliative unit, it contains out of wood ramed elements that are prefabricated. The elements are attached to the ground floor with steel connectors and to one another to create stability in the frames. The façade is similar to the central heart. The interior finish of the wall has yet to be discovered, now connectors would be in sight which is not wished for, care should still be given to integrate installation walls in combination with an interior finish.

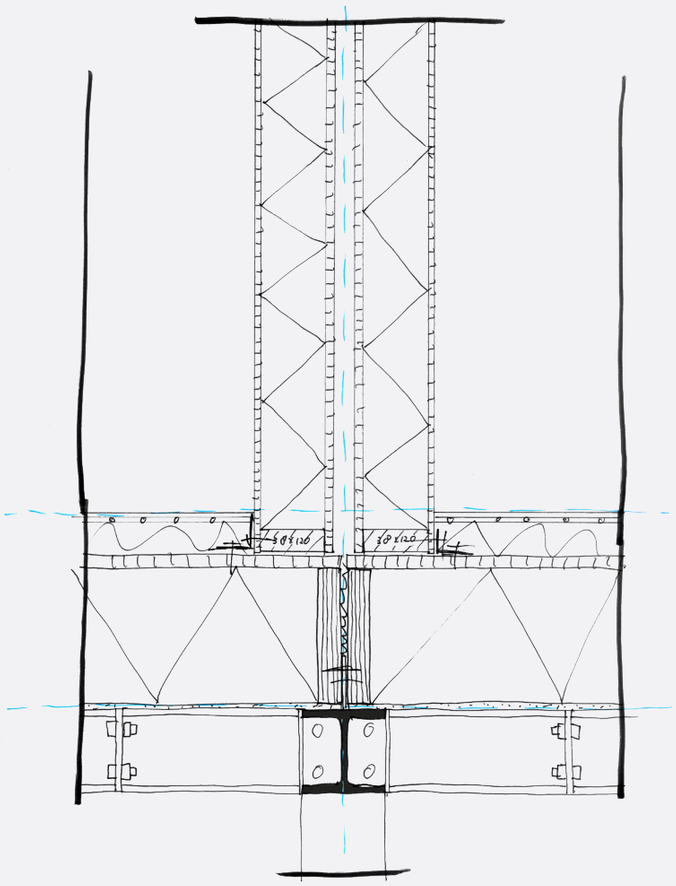
figure 26 - Detail HR H.02 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR H.02
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**1,00**	**0,89**
1.1	Prefabricated wood framed element	0,80	0,80		1,00	1,00		0,89
1.2								
1.3								
1.4								
1.5								
1.6								
Skin				**0,85**			**1,00**	**0,92**
2.1	Aluminium window frame	0,80	0,80		1,00	1,00		0,89
2.2	zinc gutter	0,80	0,80		1,00	1,00		0,89
2.3	Wood facade raster	0,80	1,00		1,00	1,00		0,94
2.4	Wood facade cladding	0,80	1,00		1,00	1,00		0,94
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,83**			**1,00**	**0,91**

table 15 - Demountability index HR H.02

Detail HR V.01



The detail on this page illustrates the ground-floor connection between two palliative units. The system of the central heart is not usable in this case due to the lack of sound insulation between those rooms. Two separately attached interior walls have been selected to meet the sound insulation requirements. These walls now do not have space for installations or electricity, which still have to be taken into account.

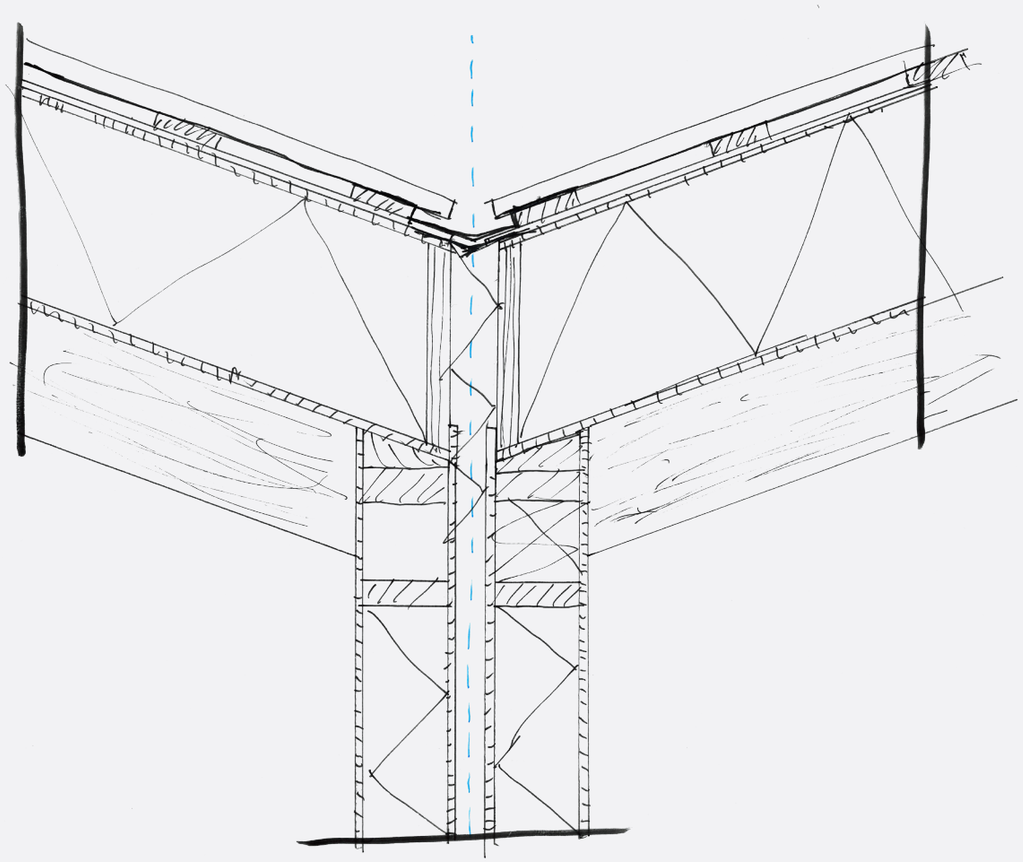
figure 27 - Detail HR V.01 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.01
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,85**			**0,83**	**0,83**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Prefabricated wood wall element	0,80	0,80		1,00	0,40		0,67
1.6								
Skin								
2.1								
2.2								
2.3								
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Floor heating	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**0,70**	0,78
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3								
4.4								
4.5								
4.6								
Total				**0,87**			**0,70**	**0,77**

table 16 - Demountability index HR V.01

Detail HR V.02



The top of the separating wall between the two palliative units has been detached for as much as possible. The wood frames are attached to the individual walls, which in their terms have the individual roof element attached. On top of the roof elements is a zinc roof system connected in the middle via a gutter.

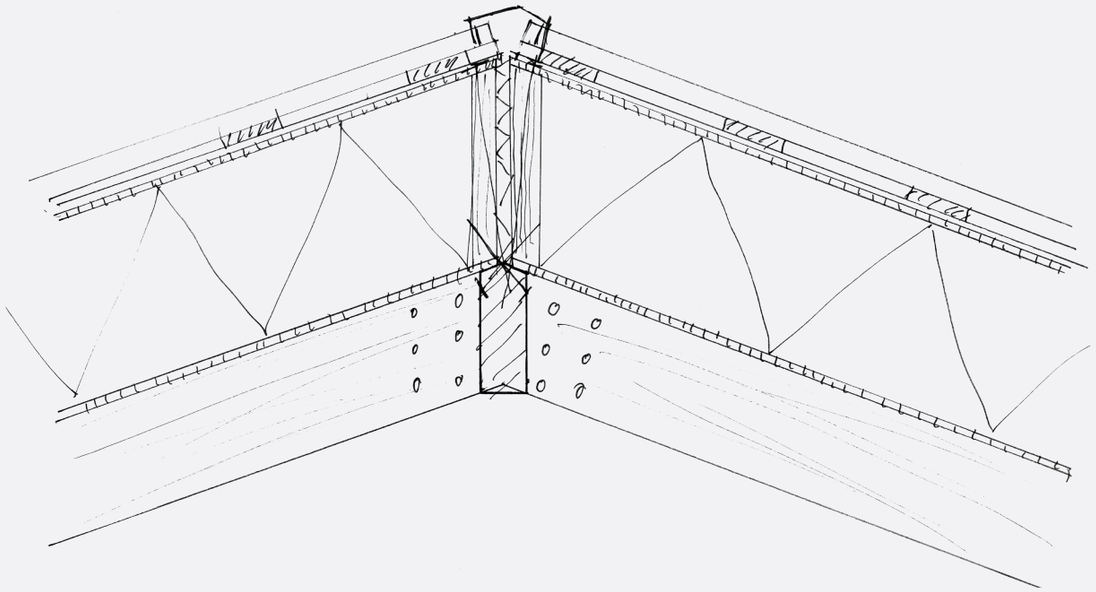
figure 28 - Detail HR V.02 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.02
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**0,86**	**0,82**
1.1	Prefabricated wood frame wall	0,80	0,80		0,40	1,00		0,67
1.2	Wood truss	0,80	0,80		1,00	1,00		0,89
1.3	Kerto ripa roof elements	0,80	0,80		1,00	1,00		0,89
1.4								
1.5								
1.6								
Skin				**0,95**			**1,00**	**0,97**
2.1	Zinc roof cladding	0,80	1,00		1,00	1,00		0,94
2.2	Zinc inner gutter	1,00	1,00		1,00	1,00		1,00
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,88**			**0,93**	**0,90**

table 17 - Demountability index HR V.02

Detail HR V.03



Again the top of the roof is relatively simple in construction, the frame is connected in the middle to one another and in the middle, a top beam is found supporting the wood box elements, containing the insulation layer. On top is a zinc roof covered with a zinc hood to make the whole water-tight.

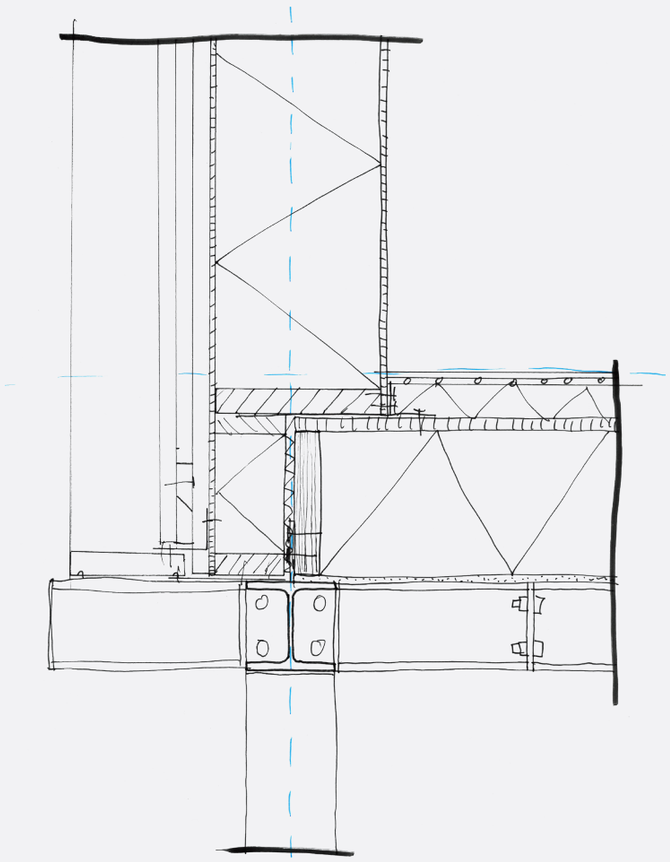
figure 29 - Detail HR V.03 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.03
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**1,00**	**0,89**
1.1	Wood truss	0,80	0,80		1,00	1,00		0,89
1.2	Kerto ripa box element	0,80	0,80		1,00	1,00		0,89
1.3								
1.4								
1.5								
1.6								
Skin				**0,95**			**1,00**	**0,97**
2.1	Zinc roof cladding	0,80	1,00		1,00	1,00		0,94
2.2	Zinc hood over cladding	1,00	1,00		1,00	1,00		1,00
2.3								
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,88**			**1,00**	**0,93**

table 18 - Demountability index HR V.03

Detail HR V.04



This detail illustrates the connection of the outer wall of a palliative unit to the ground floor. The ground floor is similar to the one of the central heart and thus scores the same. On top, the wood element is connected to the floor with a steel anchor. The façade is again similar to the one found on the central heart. Electricity and conduits have yet to be included in this detail but presumably require an installation wall of some sort.

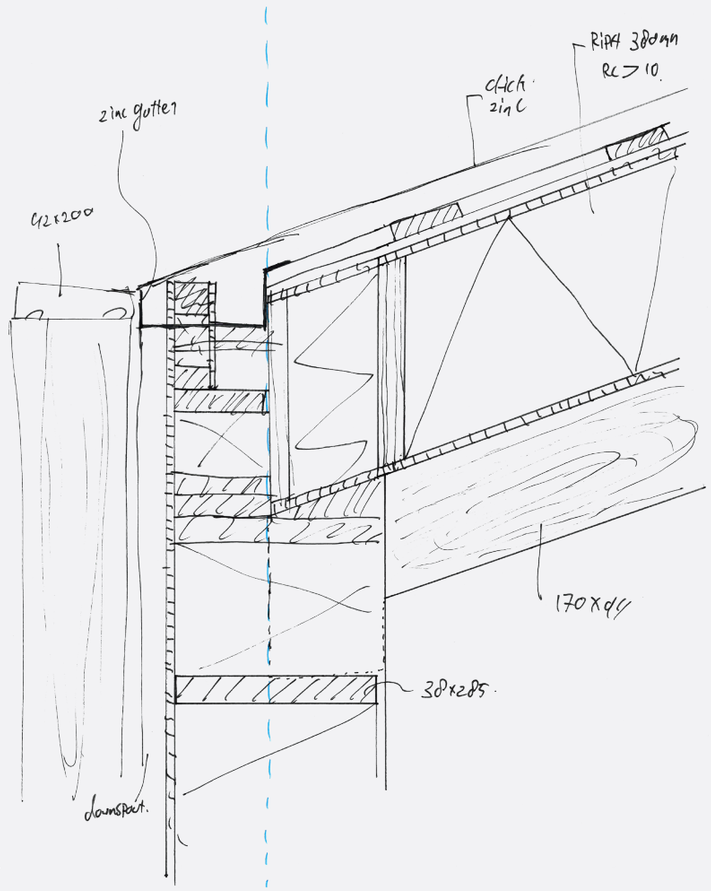
figure 30 - Detail HR V.04 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.04
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,85**			**0,83**	**0,83**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Prefabricated wood wall element	0,80	0,80		1,00	0,40		0,67
1.6								
Skin				**0,89**			**1,00**	**0,94**
2.1	Facade raster elements	0,80	1,00		1,00	1,00		0,94
2.2	Wood facade cladding	0,80	1,00		1,00	1,00		0,94
2.3								
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Floor heating	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**0,70**	0,78
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3								
4.4								
4.5								
4.6								
Total				**0,88**			**0,78**	**0,81**

table 19 - Demountability index HR V.04

Detail HR V.05



On the place where the wall meets the roof, the connection is similar to the one in detail HR V.02. The wood truss falls in between a notch of two framed walls, making for an easy registry which helps ease of building. The gutter is added on top of the wall and is connected to a similar type of downspout as found in the central heart building. Again the façade is similar to the one found on the central heart.

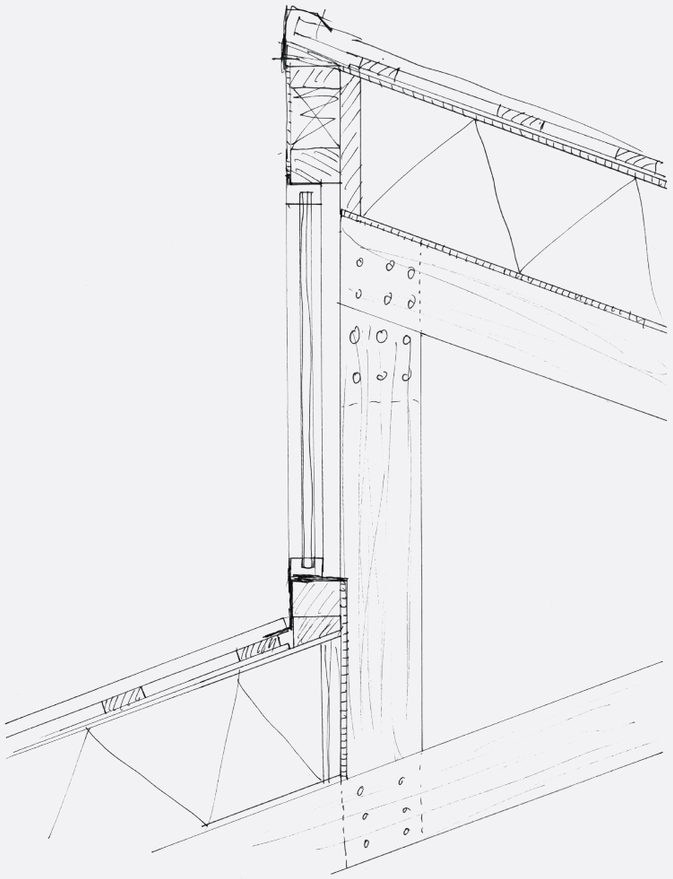
figure 31 - Detail HR V.05 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.05
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**0,86**	**0,82**
1.1	Prefabricated wood wall element	0,80	0,80		0,40	1,00		0,67
1.2	Wood truss	0,80	0,80		1,00	1,00		0,89
1.3	Kerto ripa box element	0,80	0,80		1,00	1,00		0,89
1.4								
1.5								
1.6								
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated dormer wall element	0,80	0,80		1,00	1,00		0,89
2.2	Aluminium window frame	0,80	0,80		1,00	1,00		0,89
2.3	Zinc roof cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total		**0,82**			**0,93**			**0,87**

table 20 - Demountability index HR V.05

Detail HR V.06



The roof light is connected to the insulated box elements, which are on their terms connected to the wood truss element. To keep the window as large as possible the window frame is recessed in the roof structure. The bottom sill of the window needs some further improvement in resessing. Furthermore, the detail is similar to the one of a dormer. The window frame is connected to a prefabricated wood-frame element connectable to the wood box elements.

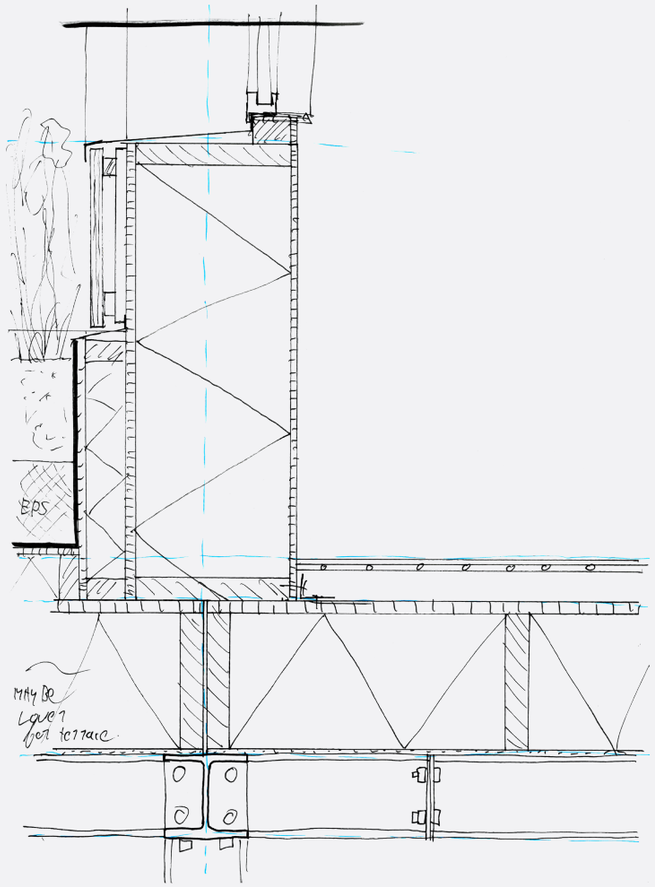
figure 32 - Detail HR V.06 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.06
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**1,00**	**0,89**
1.1	wood truss	0,80	0,80		1,00	1,00		0,89
1.2	Kerto Ripa box floors 380mm	0,80	0,80		1,00	1,00		0,89
1.3								
1.4								
1.5								
1.6								
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated dormer wall element	0,80	0,80		1,00	1,00		0,89
2.2	Aluminium window frame	0,80	0,80		1,00	1,00		0,89
2.3	Zinc roof cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,82**			**1,00**	**0,90**

table 21 - Demountability index HR V.06

Detail HR V.08



The bridging between the palliative unit and the terrace is shown in this detail. It shows the highly insulated wall element with the planter element located next to it. This planter is dry-placed and connected to the building, so no connectors are needed.

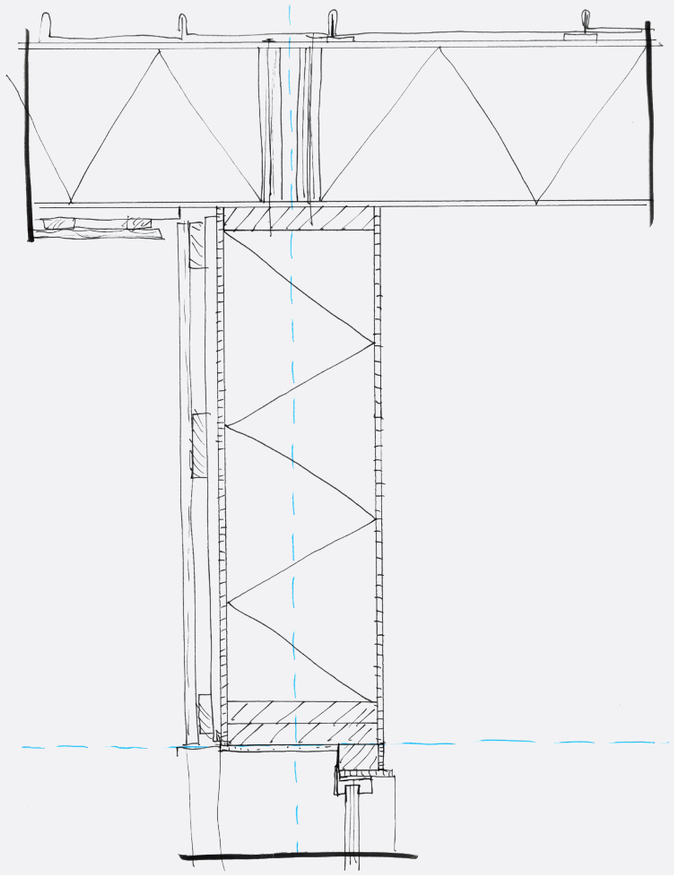
figure 33 - Detail HR V.08 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.08
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,85**			**0,83**	**0,83**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE14-A	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	0,80		0,40	1,00		0,67
1.5	Prefabricated wood wall element	0,80	0,80		1,00	0,40		0,67
1.6								
Skin				**0,93**			**1,00**	**0,96**
2.1	Aluminium window	0,80	1,00		1,00	1,00		0,94
2.2	Wood facade cladding	0,80	1,00		1,00	1,00		0,94
2.3	Planter	1,00	1,00		1,00	1,00		1,00
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Floor heating	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**0,70**	0,78
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3								
4.4								
4.5								
4.6								
Total				**0,89**			**0,78**	**0,82**

table 22 - Demountability index HR V.08

Detail HR V.09



Illustrated here is the connecting element between the palliative unit, terrace, and roof. The wood rame element is connected to the roof in some sort of way, which has yet to be defined. It is aimed to disturb the interior view minimally, so preferably with the absence of steel connectors.

figure 34 - Detail HR V.09 (06-05-2024)

element | detail data			
project:	hospitable movement	detail:	HR V.09
project nr.:	AHD-24	version:	1.0
date:	6-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,80**			**1,00**	**0,89**
1.1	Prefabricated wood framed element	0,80	0,80		1,00	1,00		0,89
1.2	Kerto Ripa box floors 380mm	0,80	0,80		1,00	1,00		0,89
1.3								
1.4								
1.5								
1.6								
Skin				**0,85**			**1,00**	**0,92**
2.1	Aluminium window frame	0,80	0,80		1,00	1,00		0,89
2.2	Wood facade raster	0,80	0,80		1,00	1,00		0,89
2.3	Wood facade cladding	0,80	1,00		1,00	1,00		0,94
2.4	Zinc roof cladding	0,80	1,00		1,00	1,00		0,94
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,83**			**1,00**	**0,91**

table 23 - Demountability index HR V.09

ID	product/element description	ID load-bearing connection	Load-bearing connection	ECI	CT	CA	disassembly potential of the connection (DPc)	ID	GPE	Disassembly potential of the composition (DPcp)	disassembly potential (DP)
1.0	**Structure**			**3771,29**			**0,92**			**0,93**	**0,92**
1.1	Precast foundation plate 100 × 100 × 15 cm			1073,00	1,00	1,00	1	1,00	1,00	1	1
1.2	Steel column HE160-B	1.1	Precast foundation plate 100 × 100 × 15 cm	169,73	0,80	1,00	0,89	1,00	1,00	1	0,94
1.3	Steel crossjoint HE160-B	1.2	Steel column HE160-B	256,54	0,80	1,00	0,89	1,00	1,00	1	0,94
1.4	Steel beam HE160-B	1.3	Steel crossjoint HE160-B	496,12	0,80	1,00	0,89	1,00	1,00	1	0,94
1.5	Kerto Ripa ground floor elements	1.4	Steel beam HE160-B	589,72	0,80	1,00	0,89	0,40	1,00	0,57	0,69
1.6	Wood frame wall panels exterior	1.5	Kerto Ripa ground floor elements	616,00	0,80	1,00	0,89	1,00	1,00	1	0,94
1.7	Wood frame wall panels Interior	1.5	Kerto Ripa ground floor elements	150,00	0,80	1,00	0,89	1,00	1,00	1	0,94
1.8	Kerto Ripa first floor elements	1.6	Wood frame wall panels exterior	420,10	0,80	1,00	0,89	1,00	1,00	1	0,94
1.9	Wood frame truss	1.6	Wood frame wall panels exterior	0,08	0,80	1,00	0,89	1,00	1,00	1	0,94
1.10											
2.0	**Skin**			**1773,64**			**0,89**			**1**	**0,94**
2.1	Prefab framed panel with window	1.5	Kerto Ripa ground floor elements	113,30	0,80	1,00	0,89	1,00	1,00	1	0,94
2.2	Zinc downspout	1.6	Wood frame wall panels exterior	244,86	0,80	1,00	0,89	1,00	1,00	1	0,94
2.3	Wood frame for facade	1.6	Wood frame wall panels exterior	0,36	0,80	1,00	0,89	1,00	1,00	1	0,94
2.4	Wood cladding facade	1.6	Wood frame wall panels exterior	0,36	0,80	1,00	0,89	1,00	1,00	1	0,94
2.5	Biocomposite panels HR	1.6	Wood frame wall panels exterior	258,00	0,80	1,00	0,89	1,00	1,00	1	0,94
2.6	Wood planter	1.5	Kerto Ripa ground floor elements	175,30	0,80	1,00	0,89	1,00	1,00	1	0,94
2.7	Roof panels	1.8	Kerto Ripa first floor elements	228,60	0,80	1,00	0,89	1,00	1,00	1	0,94
2.8	KlickZinc roof panels	1.8	Kerto Ripa first floor elements	752,86	0,80	1,00	0,89	1,00	1,00	1	0,94
2.9											
2.10											
3.0	**Services**			**290,75**			**0,89**			**0,46**	**0,6**
3.1	Floor heating	4.1	Screed floor (dry system)	188,37	1,00	0,80	0,89	0,40	0,40	0,4	0,55
3.2	Ventilation system	1.5	Kerto Ripa ground floor elements	102,38	0,80	1,00	0,89	0,40	1,00	0,57	0,69
3.3											
3.4											
3.5											
3.6											
3.7											
3.8											
3.9											
3.10											
4.0	**Space Plan**			**520,66**			**1**			**0,57**	**0,73**
4.1	Screed floor (dry system)	1.5	Kerto Ripa ground floor elements	471,76	1,00	1,00	1	0,40	1,00	0,57	0,73
4.2	Bathroom floor	1.5	Kerto Ripa ground floor elements	48,90	1,00	1,00	1	0,40	1,00	0,57	0,73
4.3											
4.4											
4.5											
4.6											
4.7											
4.8											
4.9											
4.10											

figure 35 - Hospice rooms calculation

Ritual Space

The ritual space is the final stop in the building we make in this booklet, but also for the patients living in the hospice. Of the three clusters, this is the smallest building, but yet the highest of the complete ensemble.

The ritual space serves as a beacon, also resembling the end of life with a different aesthetic and materialization. Just like the other two clusters, this building part rests on a sturdy platform of precast concrete plates, with a steel structure and Kerto floor elements on top. The main structure of the building element itself is a prefabricated wood truss in a large dimension because of the building's height. Connected to this truss are the façade and roof panels, which are also prefabricated. In this order this is the most simple building of the bunch.

On the following pages the most important details have been selected, covering almost all of the details of this building part. This way the demountability of the building can be calculated as accurately as possible, with the most impactful elements taken into account. Eventually when the details are nearly done a prototype model will be made to test out the design decisions.

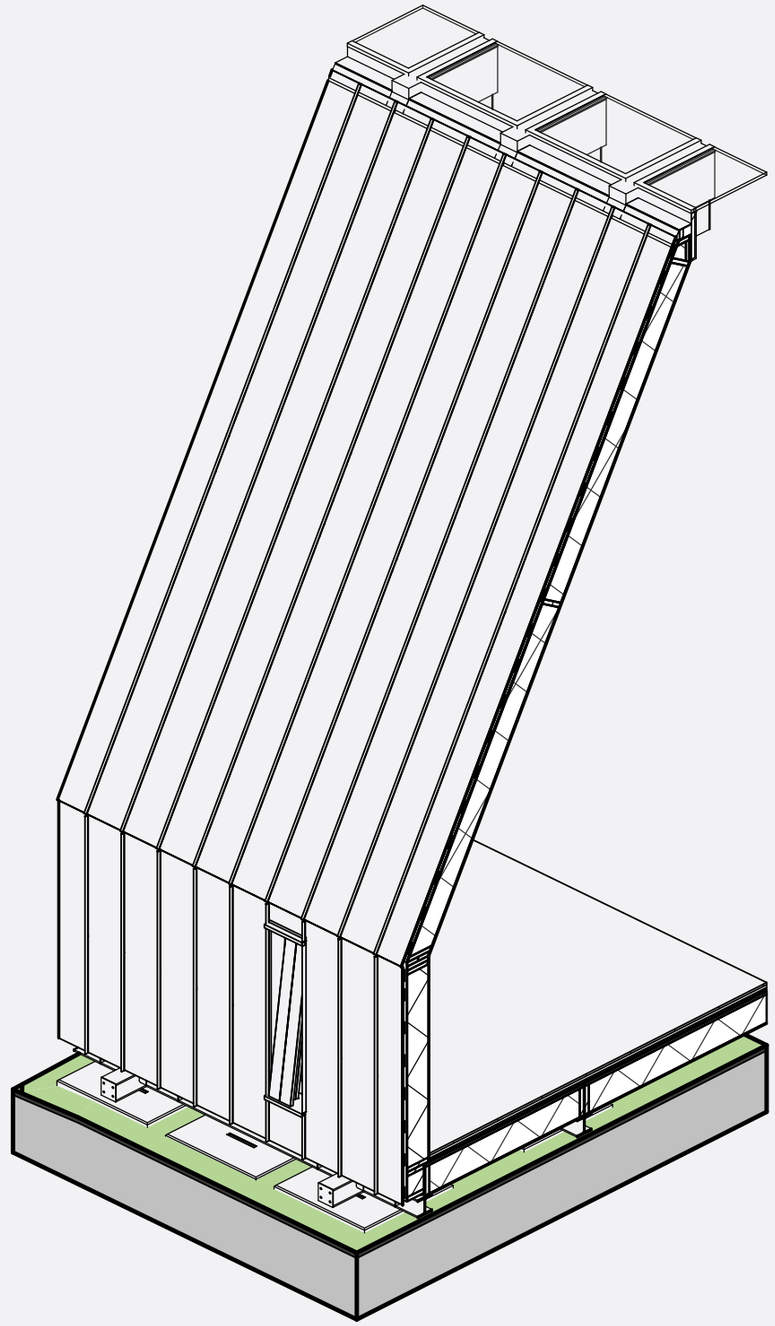
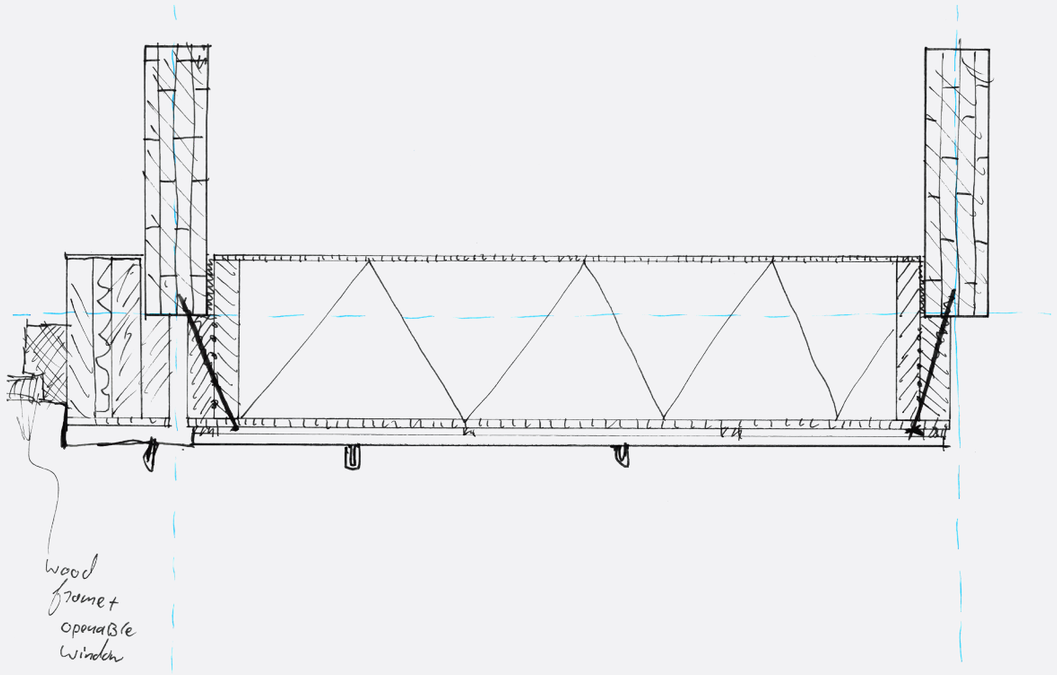


figure 36 - Ritual space cluster fragment

Detail RS H.01



Structurally this detail only consists of the wooden trusses, spaced 1200 mm apart. In between this distance, a façade panel is crewed in place with long wood screws. Covering these façade panels is a klick zinc system, which is attached with screws and a clicking system as a dry connection. On the left of the sketch is the start of a wooden façade panel which will be openable, this has yet to be explored.

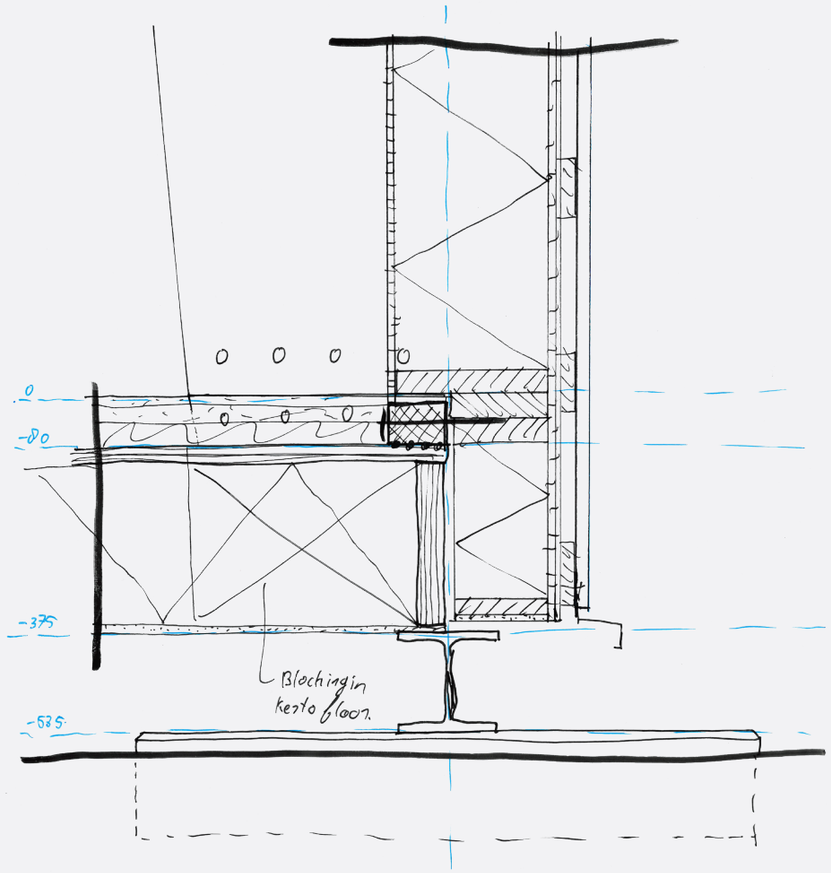
figure 37 - Detail RS H.01 (13-05-2024)

element | detail data			
project:	hospitable movement	detail:	RS H.01
project nr.:	AHD-24	version:	1.0
date:	13-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**1,00**	**0,94**
1.1	Prefabricated wood truss	0,80	1,00		1,00	1,00		0,94
1.2								
1.3								
1.4								
1.5								
1.6								
Skin				**0,80**			**1,00**	**0,89**
2.1	Prefabricated framed panel	0,80	0,80		1,00	1,00		0,89
2.2	Zinc facade cladding	0,80	0,80		1,00	1,00		0,89
2.3	Prefabricated framed panel with window	0,80	0,80		1,00	1,00		0,89
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,85**			**1,00**	**0,92**

table 24 - Demountability index RS H.01

Detail RS V.01



The foundation system with steel and concrete has been described in many details before. On top of the standard kerto floor is a hardwood laminated beam that is used to attach the prefabricated framed elements. Only the floor heating and the screed floor are hurting the calculation in this detail.

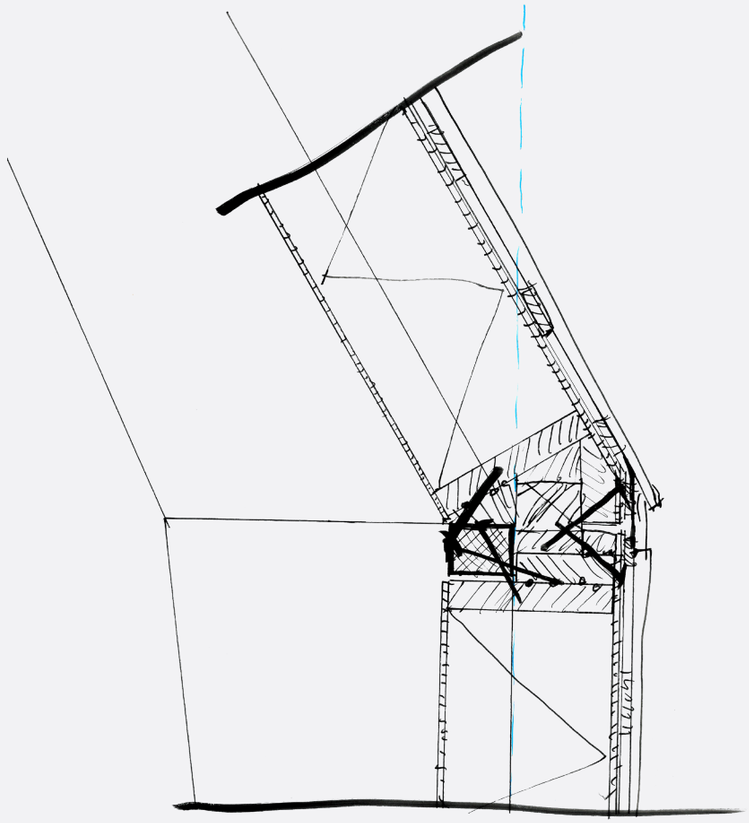
figure 38 - Detail RS V.01 (13-05-2024)

element | detail data			
project:	hospitable movement	detail:	RS V.01
project nr.:	AHD-24	version:	1.0
date:	13-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**1,00**	**0,94**
1.1	Precast foundation plate 100 × 100 × 15 cm	1,00	0,80		1,00	1,00		0,94
1.2	Adjustable column HE160-B	0,80	1,00		1,00	1,00		0,94
1.3	Steel beam HE160-B	0,80	1,00		1,00	1,00		0,94
1.4	Prefab Wood Kerto floor 260 mm	0,80	1,00		1,00	1,00		0,94
1.5	Prefab wood truss	0,80	1,00		1,00	1,00		0,94
1.6								
Skin				**0,80**			**1,00**	**0,89**
2.1	Prefabricated framed panel	0,80	0,80		1,00	1,00		0,89
2.2	Zinc facade cladding	0,80	0,80		1,00	1,00		0,89
2.3								
2.4								
2.5								
2.6								
Services				**0,89**			**0,57**	0,69
3.1	Floor heating	1,00	0,80		1,00	0,40		0,69
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan							**0,70**	0,78
4.1	Floating screed floor	1,00	0,80		0,40	0,40		0,55
4.2	Floor finish	1,00	1,00		1,00	1,00		1,00
4.3								
4.4								
4.5								
4.6								
Total				**0,86**			**0,82**	**0,83**

table 25 - Demountability index RS V.01

Detail RS V.02



This detail shows the corner made from the wall to the roof joint. Both elements are connected to the horizontal beam and the trusses on either side of the elements. Then the elements themselves are also connected, creating a stiff area. The cladding is zinc as with the other details.

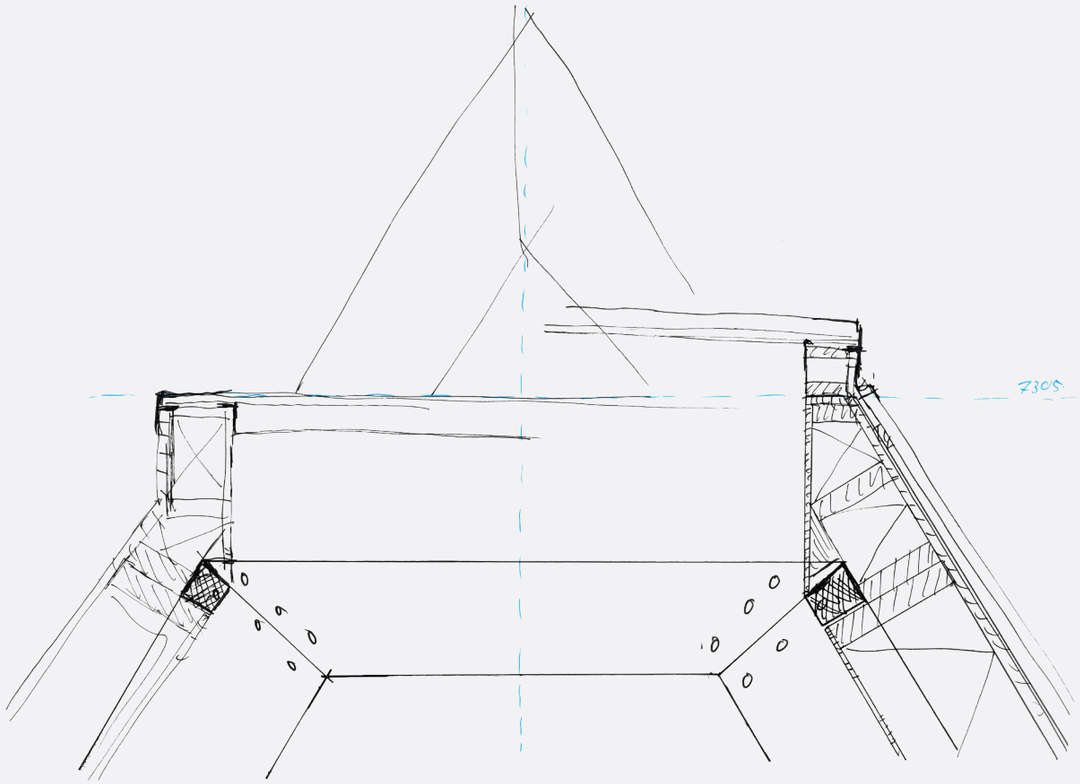
figure 39 - Detail RS V.02 (13-05-2024)

element | detail data			
project:	hospitable movement	detail:	RS V.02
project nr.:	AHD-24	version:	1.0
date:	13-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**1,00**	**0,94**
1.1	Prefab wood truss	0,80	1,00		1,00	1,00		0,94
1.2	horizontal wood beam	0,80	1,00		1,00	1,00		0,94
1.3								
1.4								
1.5								
1.6								
Skin				**0,83**			**1,00**	**0,91**
2.1	Prefabricated framed panel vertical	0,80	0,80		1,00	1,00		0,89
2.2	Prefabricated framed panel roof	0,80	0,80		1,00	1,00		0,89
2.3	Zinc cladding	0,80	1,00		1,00	1,00		0,94
2.4								
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,86**			**1,00**	**0,93**

table 26 - Demountability index RS V.02

Detail RS V.03



The roof element has two options, of which the left side is the preferred one. This element meets the rooftop heights, that were predetermined during the preliminary design phase. The top element of the roof panel integrates a skylight in a part of the roof.

figure 40 - Detail RS V.03 (13-05-2024)

element | detail data			
project:	hospitable movement	detail:	RS V.03
project nr.:	AHD-24	version:	1.0
date:	13-5-2024		

ID	Description	CT	CA	DPc	ID	GPE	DPcp	DP
Structure				**0,89**			**1,00**	**0,94**
1.1	Prefab wood truss	0,80	1,00		1,00	1,00		0,94
1.2	horizontal wood beam	0,80	1,00		1,00	1,00		0,94
1.3								
1.4								
1.5								
1.6								
Skin				**0,82**			**1,00**	**0,90**
2.1	Prefabricated framed panel vertical	0,80	0,80		1,00	1,00		0,89
2.2	Prefabricated panel with rooflight	0,80	0,80		1,00	1,00		0,89
2.3	Zinc cladding	0,80	1,00		1,00	1,00		0,94
2.4	Aesthetic wood top frame	0,80	0,80		1,00	1,00		0,89
2.5								
2.6								
Services								
3.1								
3.2								
3.3								
3.4								
3.5								
3.6								
Space plan								
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
Total				**0,86**			**1,00**	**0,92**

table 27 - Demountability index RS V.03

ID	product/element description	ID load-bearing connection	Load-bearing connection	ECI	CT	CA	disassembly potential of the connection (DPc)	ID	GPE	Disassembly potential of the composition (DPcp)	disassembly potential (DP)
1.0	**Structure**			**1192,23**			**0,95**			**0,95**	**0,94**
1.1	Precast foundation plate 100 × 100 × 15 cm			496,98	1,00	1,00	1	1,00	1,00	1	1
1.2	Steel crossjoint HE160-B	1.1	Precast foundation plate 100 × 100 × 15 cm	118,82	1,00	1,00	1	1,00	1,00	1	1
1.3	Steel beam HE160-B	1.2	Steel crossjoint HE160-B	97,28	0,80	1,00	0,89	1,00	1,00	1	0,94
1.4	Kerto Ripa ground floor elements	1.3	Steel beam HE160-B	126,95	0,80	1,00	0,89	0,40	1,00	0,57	0,69
1.5	Wood truss	1.4	Kerto Ripa ground floor elements	0,49	0,80	1,00	0,89	1,00	1,00	1	0,94
1.6	Wood frame wall panels exterior	1.5	Wood truss	147,27	0,80	1,00	0,89	1,00	1,00	1	0,94
1.7	Wood frame wall panels roof	1.5	Wood truss	204,44	0,80	1,00	0,89	1,00	1,00	1	0,94
1.8											
1.9											
1.10											
2.0	**Skin**			**475,29**			**0,89**			**1**	**0,94**
2.1	Wood frame wall with doors	1.5	Wood truss	24,86	0,80	1,00	0,89	1,00	1,00	1	0,94
2.2	Wood frame wall with wood openings	1.5	Wood truss	12,65	0,80	1,00	0,89	1,00	1,00	1	0,94
2.3	Closed roof panels	1.5	Wood truss	32,80	0,80	1,00	0,89	1,00	1,00	1	0,94
2.4	Roofpanels with rooflight	1.5	Wood truss	42,30	0,80	1,00	0,89	1,00	1,00	1	0,94
2.5	Wood cladding	2.1	Wood frame wall with doors	0,16	0,80	1,00	0,89	1,00	1,00	1	0,94
2.6	Zinc cladding	2.1	Wood frame wall with doors	362,52	0,80	1,00	0,89	1,00	1,00	1	0,94
2.7											
2.8											
2.9											
2.10											
3.0	**Services**			**64,38**			**1**			**1**	**1**
3.1	Radiators	4.1	Screed floor (dry system)	64,38	1,00	1,00	1	1,00	1,00	1	1
3.2											
3.3											
3.4											
3.5											
3.6											
3.7											
3.8											
3.9											
3.10											
4.0	**Space Plan**			**247,85**			**0,94**			**0,8**	**0,84**
4.1	Screed floor (dry system)	1.4	Kerto Ripa ground floor elements	115,45	1,00	1,00	1	0,40	1,00	0,57	0,73
4.2	Interior wall panels	1.4	Kerto Ripa ground floor elements	132,40	0,80	1,00	0,89	1,00	1,00	1	0,94
4.3											
4.4											
4.5											
4.6											
4.7											
4.8											
4.9											
4.10											

figure 41 - Ritual space calculation

Final calculation

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.

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)**
Building	**15.275,65**	**0,90**

figure 42 - Building disassembly potential

Conclusion

Based on the formula discovered and explored in booklet 05 – Measuring Demountability, this booklet was meant to utilize this formula and explore various forms of construction to generate the best possible solution for building demountable and remountable.

Through working in variants and reevaluating these variants to improve the final design, a very demountable building is the outcome according to the formula. With a score of 0,90, This building scores very well on the disassembly potential index.

A critical note has to be given on the used formula though. During the process, it seemed that this formula could be interpreted freely and the outcome thus depends on the one filling in the forms. This might also lead to so-called demountable buildings that are not that demountable after all. This is for instance seen at the demountable courthouse, which receives an 0,88 for the complete disassembly potential[2]. When they had to remove the building however someone was sawing open the concrete slabs[3], which does not seem that demountable after all compared to this project.

This is also acknowledged by the authors of the formula as well[4] and still requires working on further editions of the calculations. It should be stressed that when designing one has to keep considering demountability, also if this is contradictory to the formula.

Bibliography

1. Mike van Vliet, Jip van Grinsven, and Jim Teunizen, "Circular Buildings: Disassembly Potential Measurement Method 2.0," *Dutch Green Building Council* (Dutch Green Building Council, May 2021), 11–12.

2. Mike van Vliet, Jip van Grinsven, and Jim Teunizen, "Circular Buildings: Disassembly Potential Measurement Method 2.0," *Dutch Green Building Council* (Dutch Green Building Council, May 2021), 27

3. Circulaire BouwEconomie, "Demontage Tijdelijke Rechtbank Amsterdam - Met Timelapse," July 6, 2022, https://www.youtube.com/watch?v=082sq0rfhaY.

4. Mike van Vliet, Jip van Grinsven, and Jim Teunizen, "Circular Buildings: Disassembly Potential Measurement Method 2.0," *Dutch Green Building Council* (Dutch Green Building Council, May 2021), 30.

List of Figures

07 - Prototype Research

Hospitable Movement

2024

Jasper Sterrenburg

TU Delft

Advanced Housing Design