CIRCULAR DESIGN ATLAS

KLEIN AMSTERDAM

Architect(s):
SeARCH & De Groot Vroomshoop

Year:
2020

Location:
Amsterdam, The Netherlands

More info:
https://www.search.nl/works/klein-amsterdam/

Scales:
Buildings

Resources:
Biological

Design Approaches:
Modular Design

R-Strategies:
Repurpose, reduce

Aspects:
Design

TU Delft
BK Bouwkunde

Credits | Design: SeARCH | Photo: © Het Houtblad

The ‘Leren in de Tussenruimte’ foundation undertook a project to create a swiftly deployable school building for a residential area in Amsterdam North under development.

In 2020, this project was successfully completed. The design featured self-supporting wooden modules, collaboratively crafted by SeARCH and De Groot Vroomshoop. These modules share a common structural design, including floors and core components, yet offer diverse layouts. They seamlessly connect to form various spaces, such as classrooms. The modularity of this construction approach not only allows for easy adaptation to changing needs but also offers flexibility when it comes to relocating or repurposing the building. Recently, the school underwent an expansion. Unfortunately, in October 2023, the school had to be permanently closed due to challenges in maintaining the quality of education.

Layers of Change and Lifecycle Duration

SITE: The site materials, including the ´opgespoten zandpakket´ (sand layer) and concrete prefab foundation, have varying expected lifespans. The ´opgespoten zandpakket´´ is typically stable but can degrade over time due to environmental factors, with an expected lifespan of several decades to a century. The concrete prefab foundation is also durable, with a potential lifespan of over a century. These materials work for the shearing layer by providing stability and reusability. However, the requirement not to dig into the sand limits the adaptability of the site for other buildings.

SKIN: The wooden Douglas cladding with drywood woodstain has an expected lifespan of around 20-30 years with proper maintenance. This material enhances the demountablility and lightweightness of the building but may require periodic replacement or refinishing, which can a maintenance challenge.

STRUCTURE: Cross-laminated timber (CLT) used in the structure is a durable and sustainable choice with a lifespan of 50-100 years or more. Its mix of strength and lightness is advantageous for a movable building, providing structural integrity and portability.

SERVICE: The air heating system on the roof has a typical lifespan of 15-25 years. Placing it on the roof allows for easy disassembly and relocation. This choice supports the shearing layer’s adaptability but may require replacement during the building’s lifespan.

SPACE PLAN: The flexible space plan with folding walls enhances adaptability and future-proofing. These walls can last for many years, but their exact lifespan depends on factors like usage and maintenance.

STUFF: Lightweight and movable interior furniture made of materials like multiplex with HPL and steel are versatile and adaptable. They can last for decades with proper care and maintenance, contributing to the building’s flexibility. However, the robust materials used may make them less comfortable but more durable.

In summary, the application of the Shearing Layers Theory by Frank Duffy to this building reveals a delicate balance between stability, adaptability, and durability across the various layers. Each layer contributes to the overall success of the project, highlighting the importance of strategic material choices and maintenance considerations to ensure the long-term functionality of the movable building.

Site
Eternal

© Google 2023

Skin
20-30 years

© Abodo Wood Ltd 2023

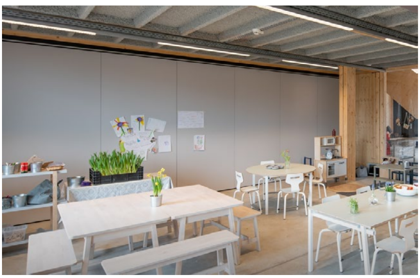
Structure
50-100 years

© Woodteq 2021

Services
15-25 years

© Ned Air bv 2023

Space plan
3-30 years



© Egbert de Boer, SeARCH

Stuff
Various

© Studio Rogier Martens

Carbon Footprint of Materials

Layering for the roof construction:
single-ply PVC roof covering
PS sheathing insulation
sheet metal
Structural beams

PVC coated galvanised steel under-cap
with a plastisol coated covering cap

Layering for prefab wall:
douglas vertical sections 220x24mm hout
colour red cf. finishing state
preservation cf. supplier
HSB (Houtskeletbouw), EPS insulation rc>3.5m²K/W
3s board finishing cf. finishing state

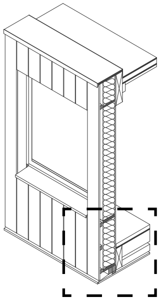
Layering for the floor structure:
screed floated and polished concrete
sheet metal
insulation rc>3,5m²K/W
structural beam cf. structural engineer

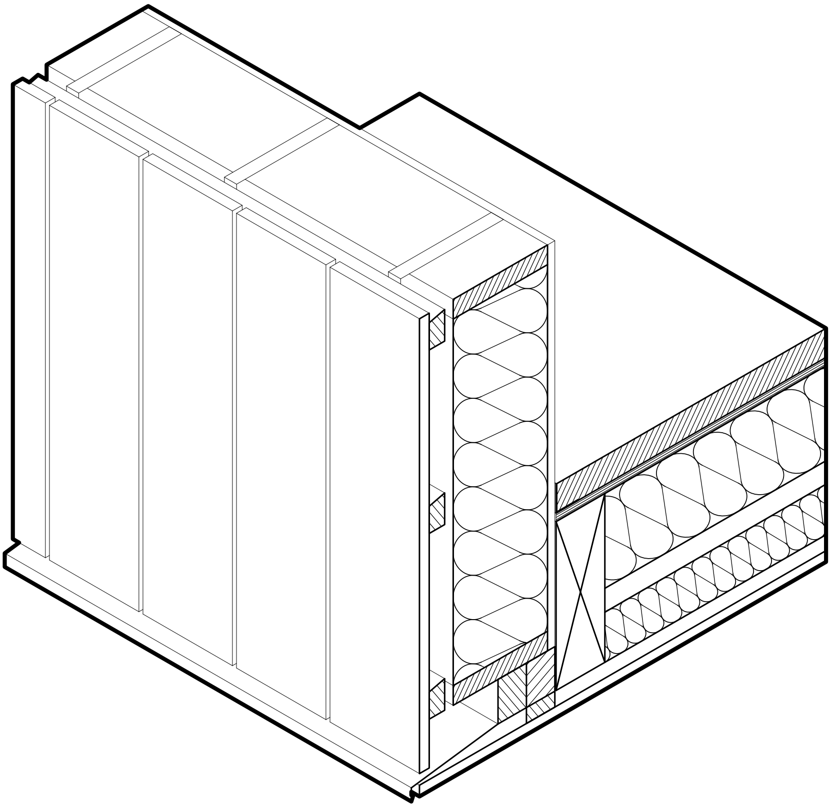
Material:Spruce
Group: Tree
Volume: 0,02 m3
Area: 1 m2
Thickness: 24 mm
Result: -18.7 kg CO 2 eq

Material: EPS Insulation Graphite 80
Group: Plastic
Volume: 0,23 m3
Area: 1 m2
Thickness: 232 mm
Result: 10.1 kg CO 2 eq

Material: Plywood
Group: Tree
Volume: 0,02 m3
Area: 1 m2
Thickness: 18 mm
Result: -11.7 kg CO 2 eq

Total result: -20.3 kg CO 2 eq





Credits | Design: SeARCH | Drawing: Ezgi Üzümcü

Building Material Origin

The Klein Amsterdam school is built out of wood: wooden modules form the construction of this building. As shown in the previous chapters, the materials used are mostly prefab materials, such as the roof isolation and covering.

This chapter is about whether the materials are technical, biological or critical. In the map on the right the locations of origin of the materials are shown.

Structure
This report divides the building into different categories, starting with the construction of this building. It mainly consists of wood. Three manufacturers are responsible for delivering wood for construction: Mayr Melnhof, Oude Hengel and Züblin. Interesting enough Melhof and Züblin are quite clear about where their wood does come from and where it's processed. However Oude Hengel only refers to their certificate: FSC and PEFC. For the PEFC certificate it means that the wood can come from The Netherlands, but also South-America. It's not specified. According to Milieucentraal PEFC is a certificate that grants good conditions to the woods. The same is applicable to FSC. These materials are biological, because those can be taken up by nature if discarded.

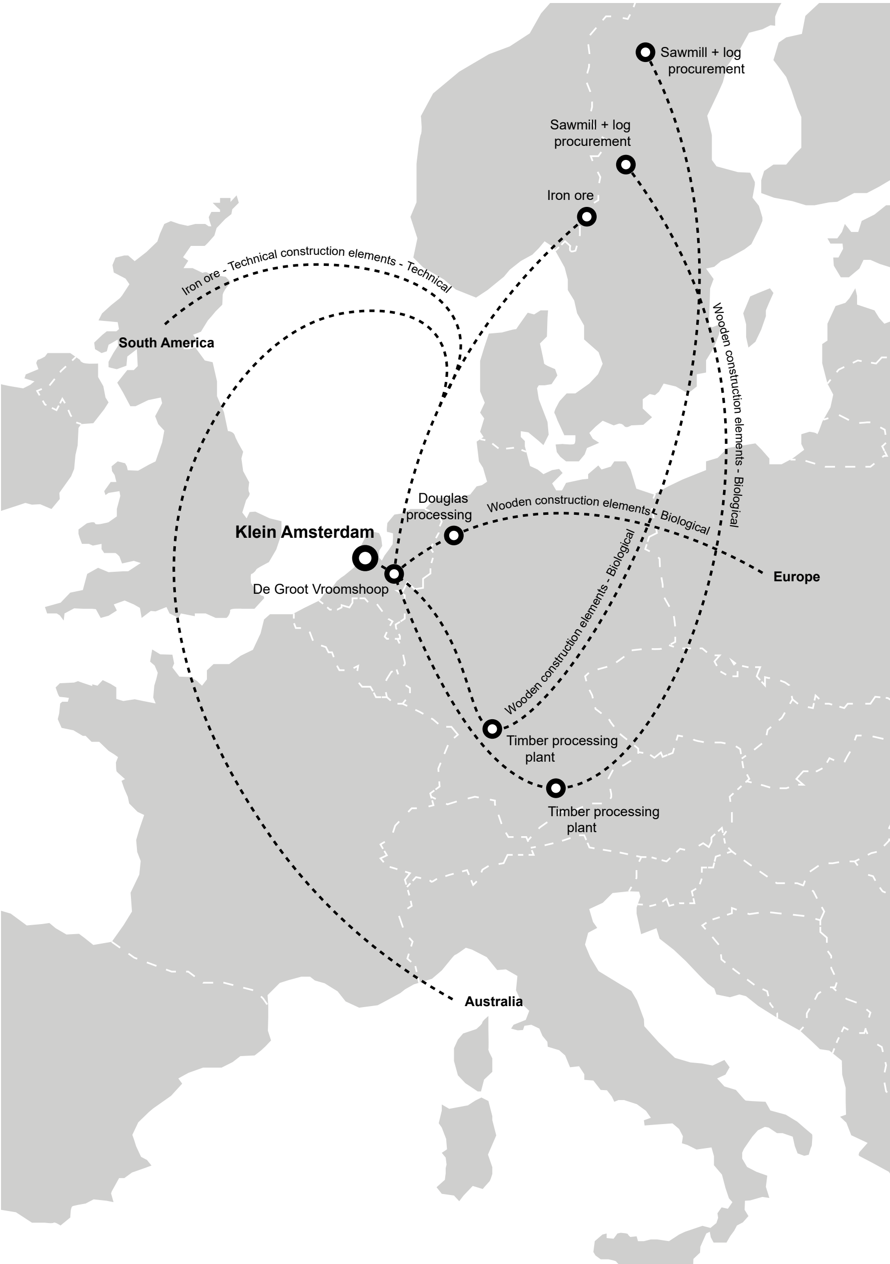
Construction firms:
Oude Hengel, Züblin, Mayr Melnhof.

For the foundation, concrete and steel have been used. The contractors are not published, but we assume Tata Steel to be the supplier of the steel construction on top of the foundation, to hold the modules. Their information about the resources is quite vague: iron ore could come from relatively nearby (Norway, Sweden), but also from South America or Australia.

Skin and services
Under this category finishings and coverings are put. The roof consists of EPS and PVC. Not the most sustainable building materials. Those are technical materials and can be produced and assembled anywhere. Also Olster, responsible for the roof coverings, doesn't share any information about material origins apart from claiming using recycled materials.

Also a lot of installations have been placed by for example Huijsman, VentKlima Interduct and NedAir. Those parties don't share anything about the materials origins either.

Roofing: Olster
Installations: Huijsman, VentiKlima Interduct
Ventilation systems: NedAir



Credits | Map of material origins | Photo: © own work

R-Strategies

Alongside the R-strategies it can be considered if one building can be called circular. For that reason Klein Amsterdam is being analyzed on those R-strategies, which are divided into smarter use, extending lifespan and end of life scenario.

SMARTER USE & MANUFACTURING:
Refuse
This building is not only sustainable or circular because of the reusable modules, but material use has also being reduced: the module's walls and ceilings haven't been finished with paint or plaster.

Rethink
The fragment chosen is part of the modules. The facade of those modules can be replaced, the facade is not load bearing. However there are construction elements in the facade. The space betweens the columns can be filled in to one's liking.

Reduce
Most of the materials used are of biological sources. There are two elements that could be reduced, because of their technical resource. The floors are finished with concrete. These could be replaced by other floors. However, to reduce contact noise, you should take action. On the other hand you could reduce the use of steel and concrete in the foundation. However they used this construction because its temporary stay.

EXTENDING LIFESPAN OF PRODUCT AND ITS PARTS:
Reuse
As this building consists of modules, those can be easily reused, which is going to actually happen. They can be used multi-disciplinary, because of their open plans, column structure. The material use has been reduced, so finishing doesn't have to be redone after replacing the modules. If the use of the module is changed. The modules can be easily strapped down and adapted fast because of its structure.

Repair
Because of the modular way of building and the fact this building will be moved soon, all elements/installations are easily accessible: finishings haven't been used, so those are in sight. And also, finishings don't have to be redone in case of a repair of installations, so that reduces materials as well.

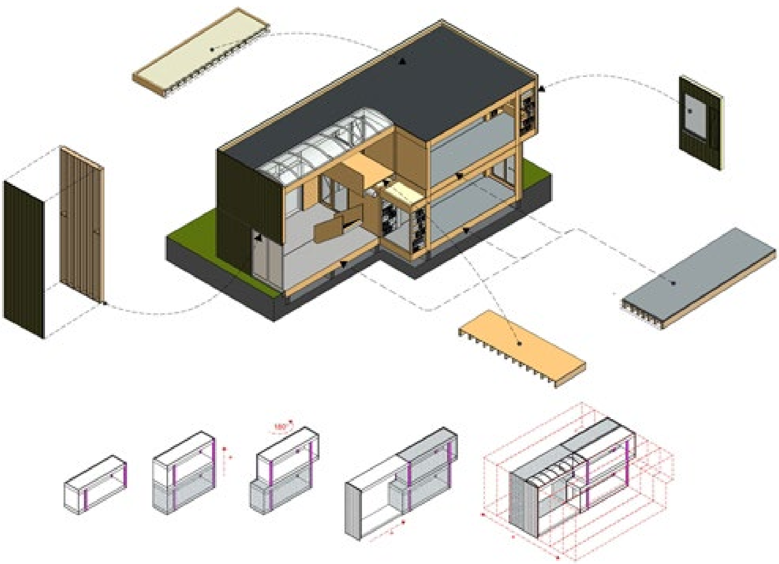
Refurbish
The materials used are of high standard and it is claimed that all parts can last at least 30 years. However when it comes to insulation, they used the bare minimum of insulation. Because it is a temporary building the requirements are lower. However it can be argued that these standards are too soft: in the future

the Rc of the facade and roof really need to increase.
Because of the modular way of building, elements are easily demountable and can be refurbished.

Remanufacture
This fragment can be remanufactured as a whole. The fragment is a whole and all elements do have a function in this detail. Taking it out and remanufacturing would do damage to the fragment as a whole. The whole element, the module, can be remanufactured. By changing floors and dividing walls, this element can be brought up to date.

Repurpose
As the building will be moved, repurposing the building will be a fact. The building can be rebuild in different set ups for different uses. Also the facade elements can be reassembled.

END OF LIFE SCENARIO:
Recycle
Most of the elements used are of biological nature. This means they can be taken up by nature. However the wooden parts can be recycled to different materials, for example floor elements, walls. Upcycling is not really possible, as those materials are already at their peak performance.



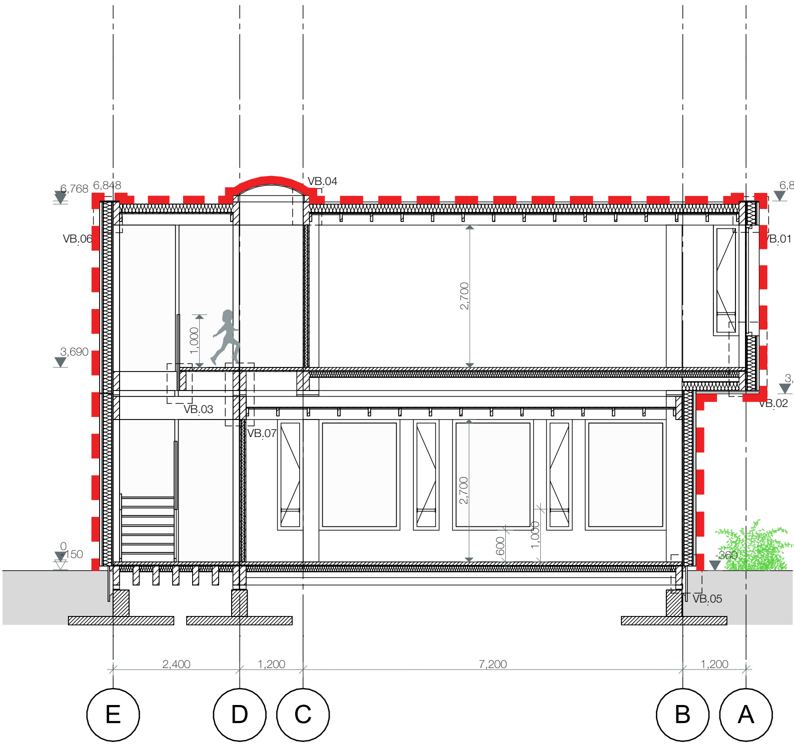
Credits | Klein Amsterdam: SeARCH | Drawing: © SeARCH

The NEW Nexus

The central sustainability goal of this project was firmly rooted in the principles of modularity and demountability, with little regard for other critical environmental factors. In the case of Klein Amsterdam, a structure designed for mobility, the very nature of its purpose precludes the establishment of a lasting relationship with its surroundings. As such, a comprehensive analysis of the building's impact on the nutrient-energy-water nexus reveals a conspicuous absence of significant outcomes or effects. In essence, the sustainability approach predominantly focused on the structural aspect of modularity, inadvertently overlooking the broader ecological considerations that often play a crucial role in the sustainable development and operation of architectural projects.

Within the surrounding environment and ecological context, one could perceive this structure as an isolated island

© Google 2023



doorsnede B-B

border of NEW nexus impact

Design Approaches

What types of circular design approaches are there?

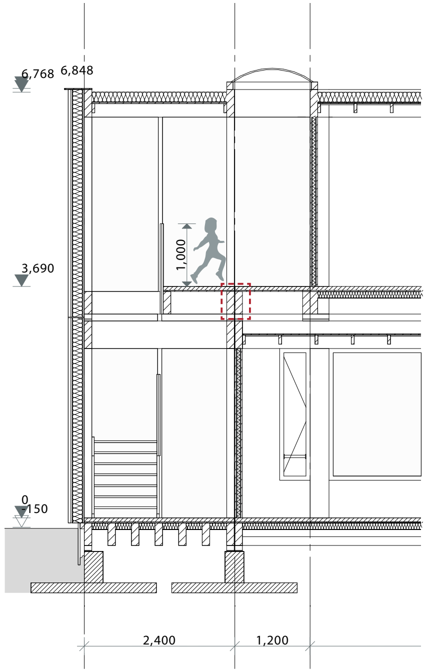
Klein Amsterdam has contain the design approaches of adaptability, disassembly, modular design and longevity. These set of drawings are from the extension of the Klein Amsterdam.

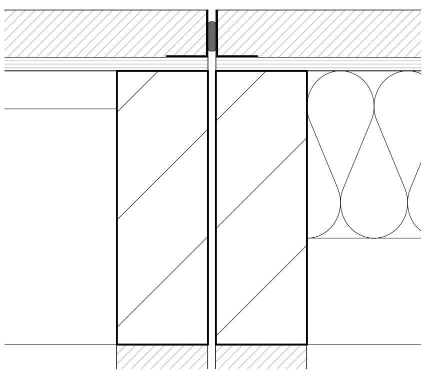
This project based on ready-to-use modules made entirely of timber wood and can be easily dismantled, moved, enlargad and extended. In that sense it has a adaptable spatial layout is allowing different reconfigurations and extensions.

It is composed of 34 prefabricated timber modules (8,4 m to 2,40 m), which module is perfectly fit on a standard truck. The design of disassembly of the modules is connecting each modules in a reversible way and it allows dismantling each modules without reducing their remaining value.

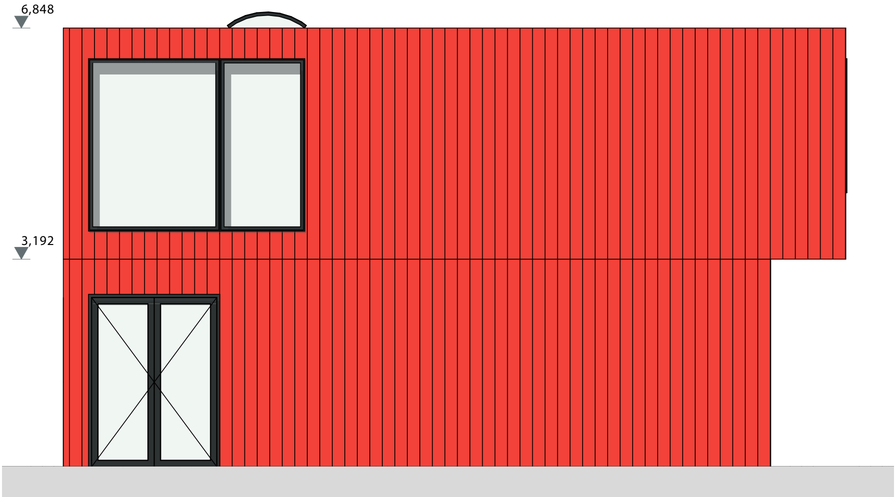
This approach of modular design also allows easy transport, quick assemble and potential future relocation for different uses. This can increase the longevity of the project.

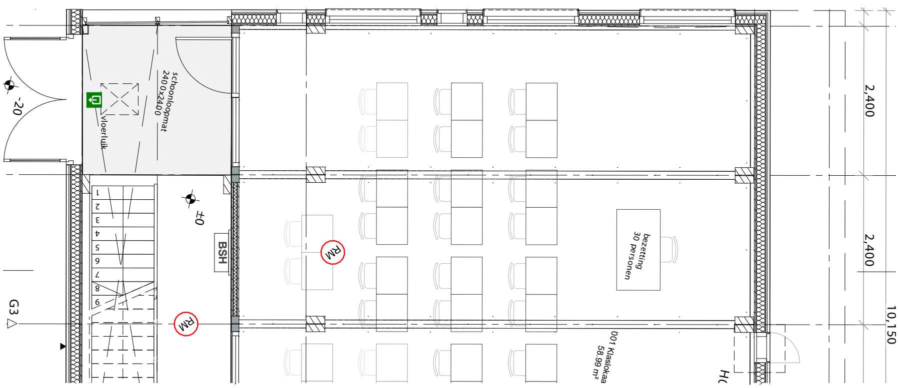
In 2024, Klein Amsterdam will move to NDSM area for it is permanent location and it will be using in different purpose of uses.





Credits | Drawings: SeARCH





Credits | Drawings: SeARCH

Stakeholders & Value Chain

The role of the architect is promising in the issue of sustainability and circular construction. There are not only opportunities, but also dangers.

To start with the dangers. The architect’s role is the greatest at the beginning of a building’s life cycle. It is the architect’s turn to initiate sustainable materials or to make sustainability a design point at all. But at the end of the building’s life, the architect has no influence on what happens to all the materials.

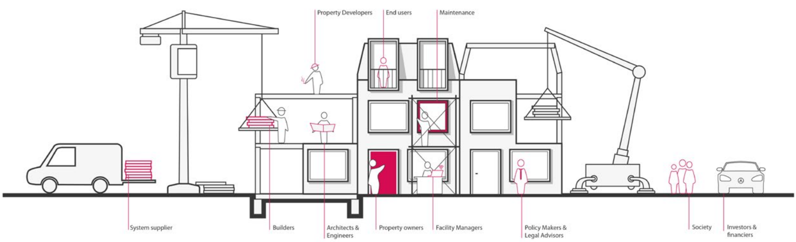
However, the architect can influence how materials are handled at the end of a building’s life. This can be done in different ways, namely through architectural style. How do I assemble the building?

If the Klein Amsterdam of SeARCH is taken as an example, the integration of the end of the life of the Little Amsterdam is very clear. When the school becomes redundant, it can be taken apart, relocated and only small elements in the interior need to be replaced or added to give it a new life.

The architectural style, modular construction in this case, is efficient and future-oriented. It can subsequently serve as a new space in completely different disciplines.

There are also opportunities outside of module construction. Demountable construction, for example, where connections can be taken apart without damaging the material. This way, parts can be reused.

That about the beginning and end of a building. But there is also plenty of room for the architect to contribute to the sustainable and circular use of a building. Namely in construction and during use, savings can be used.



Based on a diagram by the CBE Hub, BK TU Delft

The footprint of a building is not only determined by materials, but also by construction. In the present case study, for example, the construction footprint was reduced to a minimum by collecting all materials in one factory and then transporting them with trucks where the modules could be stacked on top of each other. The construction took only 4 months.

Even when the building is put into use, the architect has influence on its use. Are walls being finished? Are installations hidden behind lowered ceilings? Due to the chosen architectural style, finishing is not necessary. But also in the case of malfunctions of installations for example, when repair is needed, it means minimal adjustments and interventions, since the construction elements are both construction elements and finishings.

This project shows how the architect can influence the different life phases of the building. Not only at the drawing board, but also during construction, when put into use and when the building becomes redundant.

Lessons Learned

Klein Amsterdam is, in itself, a very intriguing design. Modular construction with architectural and aesthetic value is not often seen. The concept is promising: modular, multidisciplinary units that can be used for extended periods and easily repurposed. Organic materials, mainly sourced from Scandinavia, have been utilized, and the facade finishing is crafted from FSC wood. Despite the certification, the origin of the materials remains unknown. The same holds true for the 'sustainable steel' used in the foundation. It's quite peculiar that there's no transparency, considering the claim that this firm actively contributes to sustainable and innovative solutions.

The sustainability of this building lies in its gas-free installations, but more so in the potential for reuse and material conservation. In this design, the construction is the finishing, which means fewer (finishing) materials and easily replaceable elements since they are readily accessible.

The architect, working closely with the builder, has effectively focused on exerting influence before, during, and after the life of the design. Particularly, the end of a building's life, constructed from modules, is clearly evident, as it was indeed the designers' intent.

Unfortunately, due to a strong emphasis on modularity and demountability, other aspects of sustainability have been largely overlooked.

Klein Amsterdam is an innovative project featuring adaptable, disassemblable, and modular timber modules that can be easily moved, expanded, and reconfigured. It consists of 34 prefabricated modules designed for quick assembly and disassembly, allowing for potential relocation and extended use, thus ensuring its longevity. In 2024, it will find a permanent home in the NDSM area, serving various purposes. For the carbon material footprint part, total result is -20.3 kg CO 2 eq. The timber employed in the project sequestered a minimum of 222,964 kilograms of CO_2, excluding the meranti window frames from this assessment. According to the StorageCO2inhout.nl tool on the Centrum Hout website, this amount is equivalent to the distance a mid-sized car would need to travel 1,873,647 kilometers to produce the same emissions. It's also comparable to the annual emissions of 247 households. Additionally, CO_2 was conserved in the project by reusing concrete piles for the foundation.

Colophon

Student(s):
Ted van Duin
Steven van Haaften
Ezgi Üzümcü

Studio:
Complex Projects

Tutor(s):
Rico Heykant

Image credits:
https://architectenweb.nl/nieuws/artikel.aspx?ID=47354 // Photo: © SeARCH
https://architectenweb.nl/nieuws/artikel.aspx?ID=47354 // Photo: © Egbert de Boer
https://www.woodteq.nl/product/clt-cross-laminated-timber/// Photo: © Woodteq 2021
https://www.abodo.com.au/resources/articles/managing-risk-black-stain-vs-charred-hardwoods // Photo: © Abodo Wood Ltd 2023
https://www.nedair.nl/producten/ // Photo: © Ned Air bv 2023
https://www.rogiermartens.nl/school-interior-design-/-klein-amsterdam // Photo: © Studio Rogier Martens
https://www.search.nl/modulinn/ // Photo: © SeARCH

References:
https://keurmerkenwijzer.nl/keurmerken/fsc-100-hout/
https://www.olster.nl/diensten/duurzaamheid/
https://www.dakweb.nl/roofs-2019-08-26-de-prefab-dakspecialist/l9889c20
https://www.oude-hengel.nl/duurzaamheid-en-certificering/
https://www.zueblin-nederland.com/databases/internet/_public/content.nsf/web/NL-ZUEBLIN.NLN-brochures.html#?men1=8&sid=800
https://www.mm-holz.com/en/about-us/locations
Houtblad Mei 2019 Vereniging van Houtconstructeurs

Disclaimer

The Circular Design Atlas is an online open-source database intended for educational purposes on a non-profit basis. It accommodates a series of case studies researched and analyzed by students across the material, component, building, as well as the neighborhood, city and regional scale. We have tried to be careful with third-party rights, such as intellectual property rights, on visual material we have cited in order to make these case studies possible. In the unexpected event of incorrect source citation or indication of credits or any other complaint, please contact CircularBE-bk@tudelft.nl.