CASE STUDIES

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June 2025

Cover picture: P-Olympos (personal communication with UU)

Case 1	**P-Olympos**	Utrecht	Parking garage
Case 2	**Techbank**	Enschede	Office/education
Case 2*	**Temporary Court**	Amsterdam	Court
Case 3	**Flux**	Delft	Education

Case study booklet

Dear reader, presented here is an extra product of my master thesis at TU Delft called Build to Be Back. In this research I investigated how Dutch universities can integrate remountability in the construction of their campus real estate.
To get practical insights into remountable campus buildings, I chose three cases. Two of them are to be remounted and one is already disassembled and is now being reassembled.
This booklet with information on these cases is an assembly of information from literature studies, notes and interviews with the universities in question and stakeholders of the supply side during the construction process.

This booklet serves as a case overview with a special focus on materials and circular strategies. It furthermore serves the purpose of portfolio with enough pictures to give you a feeling of the buildings and their construction processes.

Let this booklet be a reminder that it **is** possible to embrace circular construction strategies for real estate with varying functions. One can always come up with a critical note, but I urge you to look at circular opportunities that also the people from these universities and from the construction sector saw. In addition, these examples show how different types of universities – with a wide range of real estate units – looked at circularity in their real estate and how this has been expressed. As one of the project developers said:

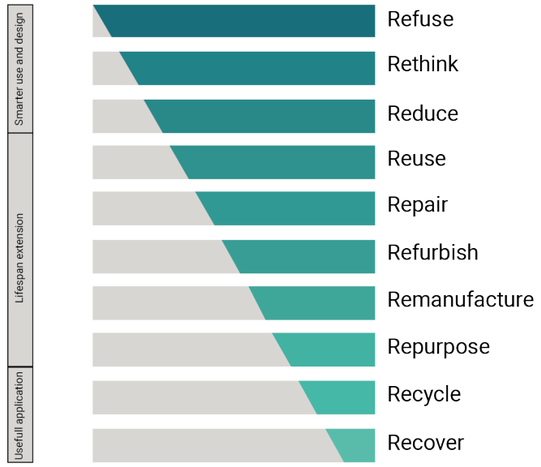
"We have proven that it is possible"

After reading this, I hope you too look differently at your own university or office building!

Kind regards,

Lynn Kamphuis

Circular card game (Galle, 2020)



R-ladder (own illustration)

Reading guide

Every case chapter contains the following elements:

- ***Background information***
- ***R-ladder:*** the two or three most outstanding R-strategies per case are highlighted. The choice of R-strategies is based on the interviews.
- ***Lets design out waste!-cards:*** the Vrije Universiteit Brussel has established a card game with circular design approaches, concepts and qualities. The cards are defined with the help of designers, researchers and organisations related to construction. The game's purpose is to get more insight in a building and what motivated the designers to make them (Galle, 2020). This game is also played for the cases of this research. The cards are chosen based on the gathered knowledge during this thesis.
- ***Six layers of Brand:*** per case, the materials and their expected lifespan is discussed. The materials are identified through the use of technical detail drawings and floorplans (which are not shared due to them being private documents). The expected lifespan is based on general information (Brand, 1994).

Important to note is that the buildings are documented in this booklet on basis of interviews, observations and public information. The information is as detailed as possible but there is a margin of error. Keep in mind that the projects can be altered since the moment of writing (June 2025).

Personal communication UU

P-Olympos

Building function:	Parking garage
Client:	University of Utrecht
Location:	Utrecht
Year:	2021

Relevance for this research
Applied remountability principle:
Design for disassembly

Continental Car Parks

Personal communication UU

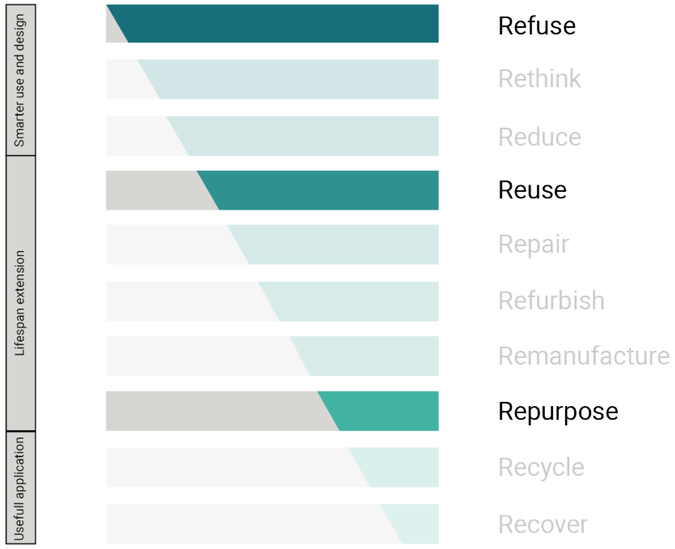
Information P-Olympos

Utrecht Science Park (USP) has 16 car parks of which P-Olympos is one. This above-ground parking garage of University of Utrecht (UU) has room for 320 vehicles, divided over four floors. Both regular and electrical parking spots form parallel rows alongside the walls of the building. The parking garage has a one-way traffic system for vehicles, designated walking paths for pedestrians and spacious, transparent stairwells. A broad lay-out is emphasized through the use of slim columns and by placing the ramps on the outer edge. The façade consists of gabions plinth and wooden slats requiring minimal maintenance. The gabions are filled with greenery which is part of a university course where students choose the plant and experiment with biodiversity.

The objective of the university was to build P-Olympos in a circular and modular way. Almost the entire building is demountable and remountable in its current form after 15 years (Utrecht University, n.d.). Regarding the RE strategy of UU, the ambitions are threefold: future-proof buildings, future-proof Utrecht Science Park and having a CO2-neutral energy supply (University of Utrecht, n.d.). P-Olympos being energy positive and remountable as one entity contributes to these ambitions. However, the remountability of P-Olympos is yet to be practically proved.

Being visible from the A28, P-Olympos is part of the sport complex Olympos of University of Utrecht. Olympos is mainly focussed on students and employees of the university but does not exclude external sportsmen and women. Sports enthusiasts can choose from 70 different sports, 65 group lessons or become member of one of the 31 sport associations (Olympos, n.d.). With this wide range causes the continuity of traffic flows beyond working days, only directed at sports. It is therefore not a random choice to place P-Olympos at the edge of USP. It is also a broader goal of the University of Utrecht to situate most of the parking needs around the borders of the USP to align with the ambition to make a car-free campus, stimulating cyclists and pedestrians (Utrecht University, n.d.).

R-ladder



R1 - Refuse
Refusal of permanence: opted for a temporary, demountable structure over permanent construction.

R4 - Reuse
Dom Tower parts were reused directly in the construction of the garage. Structural and façade components are designed for reuse after the temporary lifespan. The steel skeleton, concrete hollow floor slabs and wood slats can be remounted elsewhere.

R8 - Repurpose
Some façade materials, like the gabions also serve an educational function, repurposing an architectural element for biodiversity experiments.

Let's design out waste!

This building is designed with the intention of...

Approaches

To shift the built environment and construction sector towards a circular practice, designers and clients can take some basic approaches. Do you design for longevity, disassembly and reuse?

02
DESIGN FOR DISASSEMBLY AND DECONSTRUCTION

03
DESIGN FOR REUSE

Concepts

In past and present design practices, a variety of design concepts combine circular design qualities, tailored to a specific project context. Make yourself familiar with the most typical ones.

03
BUILDINGS AS MATERIAL BANKS

Qualities

Circular design qualities enable more effective reuse, recycling or renewal of buildings and building components. Walk through them and set your ambitions from the start of the project.

03
RENEWED
Use materials that are replenished continuously by responsible agriculture and forestry.

06
PURE
Prefer components that consist of a single material instead of a blend.

07
DURABLE
Use components that resist the wear and tear of use and reuse.

08
SIMPLE
Go for low-tech, legible solutions rather than complicated ones.

10
ACCESSIBLE
Integrate components so they can be reached and recovered without much effort or damage.

11
REVERSIBLE
Make it possible to undo connections without damage to the components they join.

12
INDEPENDENT
Assemble components so they are structurally, functionally and geometrically separated.

13
COMPATIBLE
Use building components that can be interchanged and (re)combined.

16
LOCATION AND SITE
Recognise and develop the qualities of a place responsibly.

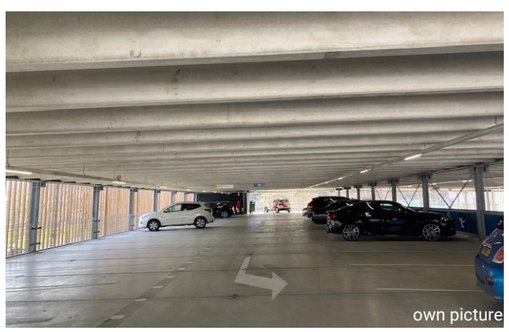
Personal communication UU


Continental Car Parks

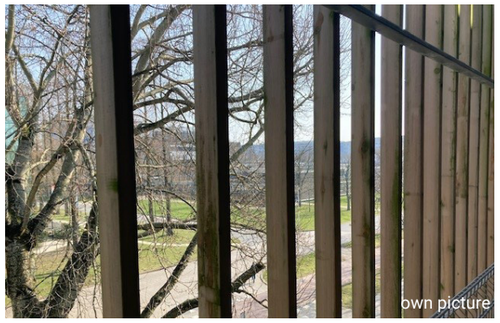
Site
50-100 years

Structure
50-100+ years

Space plan
30-100 years

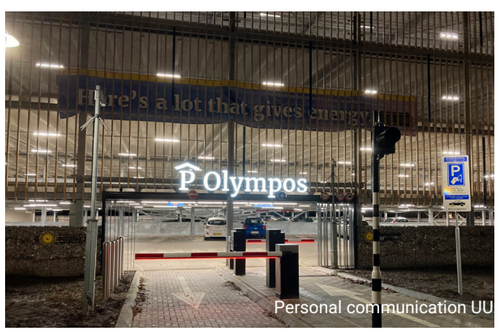


Skin
20-50 years



Services
7-15 years

Stuff
8-10 years



Brand layers

Site: concrete pavers, soil and asphalt
The site used to be a parking lot as well, but on open ground level. On ground level, around the north and west side of P-Olympos is a small green strip of 1 meter (expected lifespan: eternal). Around this strip lies an asphalt cycling path for public use, leading to the bicycle parking spaces of sports complex Olympos (expected lifespan: 20-30 years). On the east and south side of the parking garage is a car road of concrete pavers with the entrance – of the same materials – to P-Olympos at the centre of the east side (lifespan: 50-100 years).

Skin: gabion plinth and wooden slats
The gabion plinth composes of steel fencing, filled with concrete waste chunks. The expected lifespan of a steel fence is 30 years.

From the top of the garage down to the first floor, the façade is clad with pinewood slats measuring 44 by 93 millimetres, spaced openly with no material in between. Pine wood, exposed to outside weather conditions has a life expectancy of 25 years. The wooden slats themselves are thermally preserved. They do not receive maintenance.

For visual effects, a few slats are placed in an aluminium construction of which further information is unknown for this research. Aluminium has a life expectancy of 20-50 years, depending on the environmental conditions and the finishing.
To resist different weather conditions, the material in the façade is required to have structural durability to be reusable on a new location.

Structure: steel
The garage's structure is made of steel. According to different sources, steel constructions are able to last 100 years with proper maintenance (Dev2021, 2022). Although newly fabricated steel is not considered a sustainable material, the reuse of the P-Olympos structure demonstrates durability, provided the university performs regular maintenance. However, given that P-Olympos is exposed to external weather conditions such as moisture, wind, and sub-zero temperatures, additional care is required throughout its 15-year use on this site.

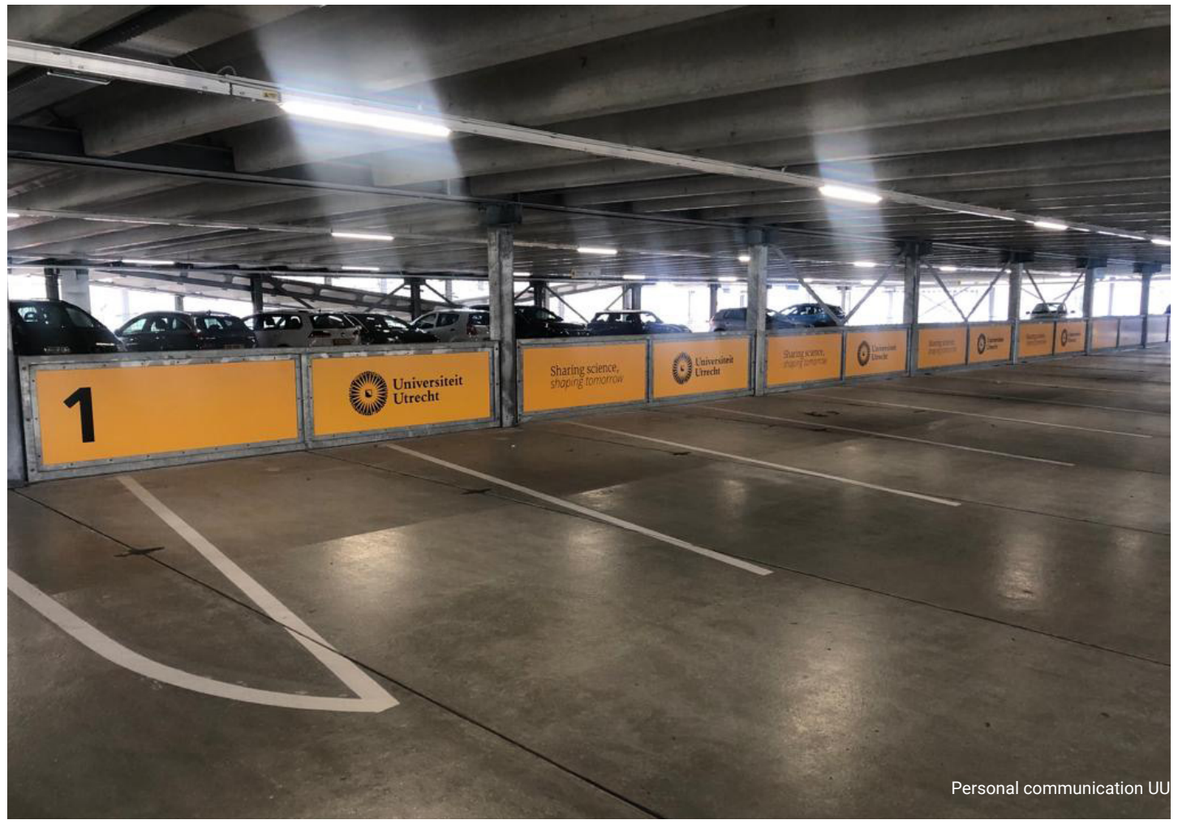
Services: LED lighting and elevator
As a parking garage with an open façade, the building requires relatively few installations. LED lighting has been incorporated, along with a single elevator powered by energy generated from the solar panels on the roof (expected lifespan: 7-15 years).

Space plan: prefabricated concrete TT floors and steel fences
In P-Olympos, concrete, prefab TT floor composes of the floors. The average lifespan of concrete can be 100 years with proper maintenance. However, since this concerns an open parking garage, road salt, freeze and moist will reduce the expected lifespan to 40 to 60 years (Haitsma Beton, n.d.).
The segregation of the one-way route are steel fences, like the gabion plinth (life expectancy: 30 years). These fences are easy to reassembly and change the space plan due to dry joints. However, in its current form and for current function, it is unlikely that the spatial lay-out needs severe alterations.

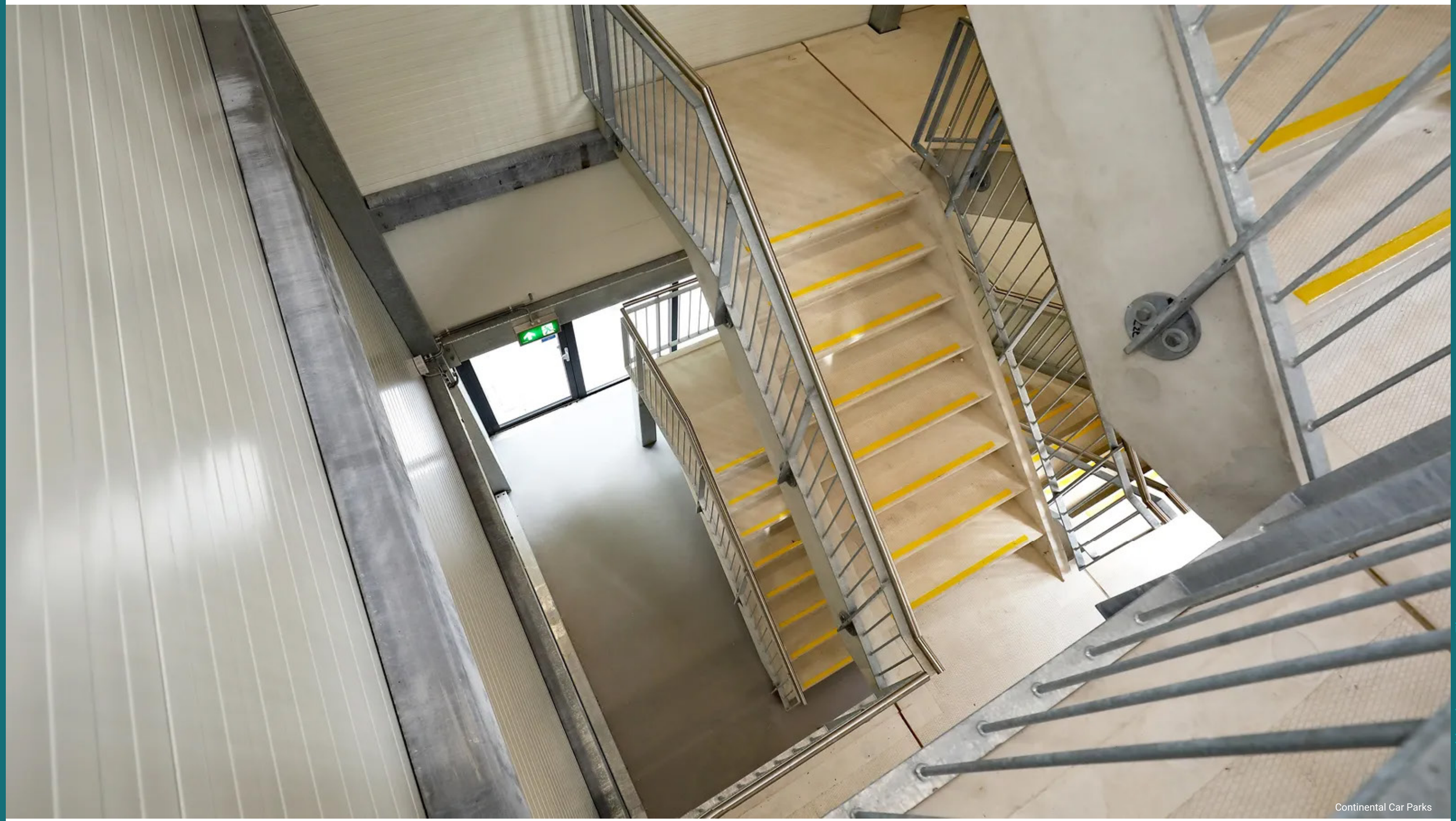
Stuff: parking machines and barriers
The only equipment installed within P-Olympos consists of parking meters and barrier systems located on the ground floor. These technological elements typically have an expected lifespan of 8 to 10 years, primarily due to wear and the rapid pace of technological advancements (Kredietaanvraag vervanging parkeerautomaten, 2023).

Personal communication UU

Personal communication UU



Personal communication UU



Continental Car Parks

own picture

Techbank

Building function:	Office and education
Client:	Kennispark
Location:	Enschede
Year:	2025

Relevance for this research
Applied remountability principles:
Design for disassembly, disassembly, reassembly

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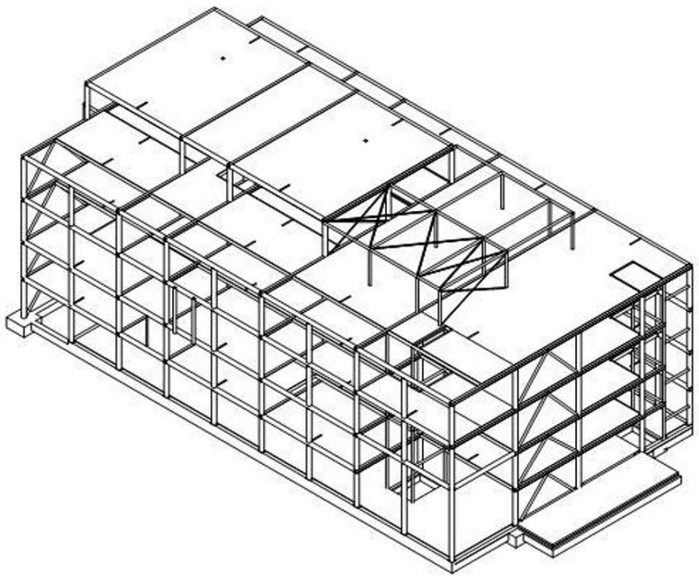
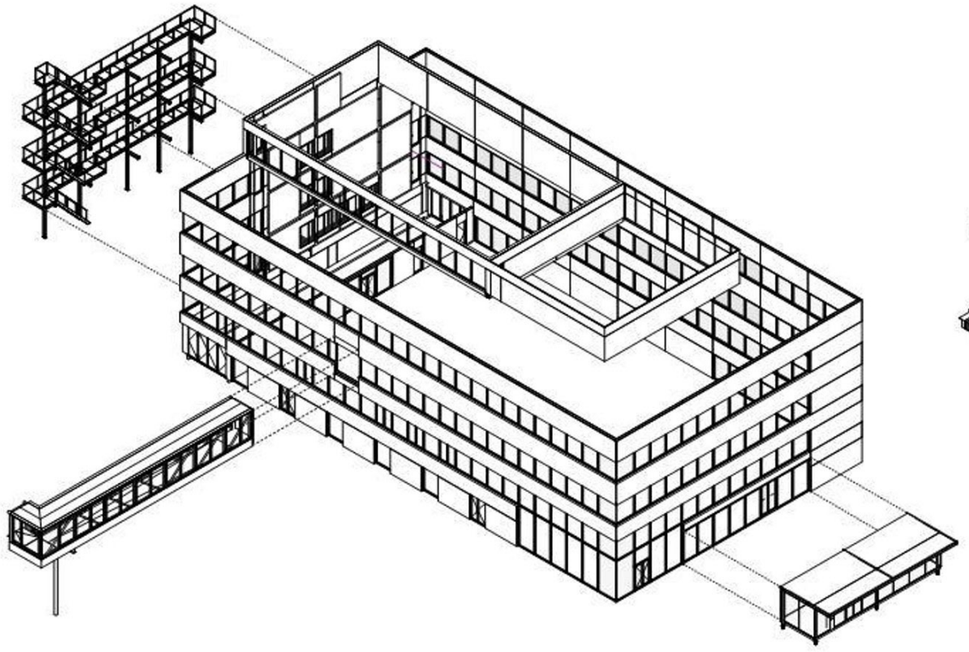
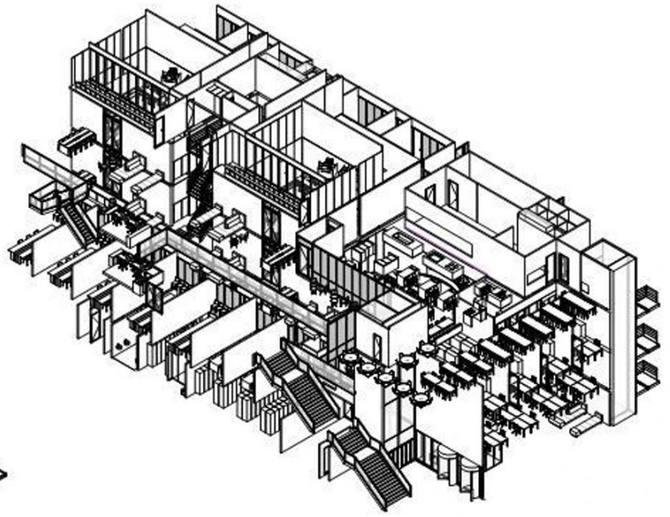
Flux
Techbank
P-Olympos







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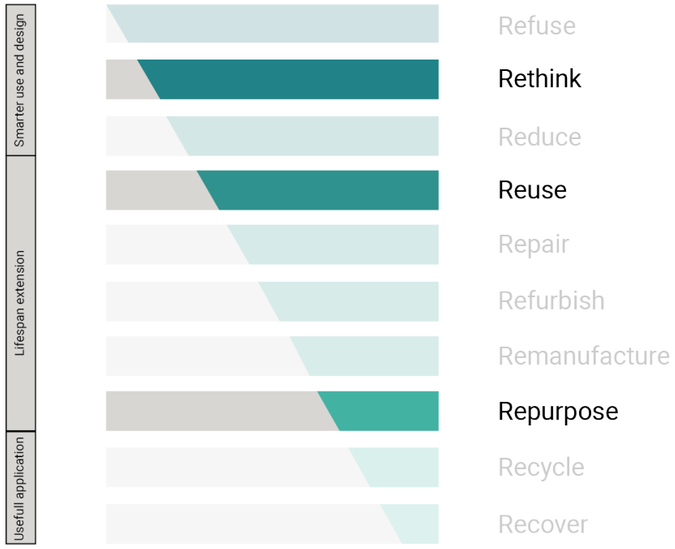
Information Techbank

The Techbank is a currently reassembled building on Kennispark in Enschede, originally constructed as the Temporary Courthouse of Amsterdam. This modular and remountable structure was designed to serve as a sustainable alternative during the renovation of the permanent court and has now found a second life as an office building focused on innovation and entrepreneurship. Situated in between train station Kennispark and University of Twente campus, Techbank offers workspace for start-ups, mature and research companies. The building retains its clean, industrial character with a visible steel frame and a light and open interior. The Techbank has a flexible layout and significant ceiling heights to ensure adaptability to different users.

The relocation of the Temporary Court to Enschede was driven by a desire to prove the feasibility of circular construction at building scale. The project emphasized how demountable buildings can be transported and reassembled without reducing architectural aesthetics or functional quality. Techbank thus directly contributes to circular building ambitions, aligning with broader sustainability goals of both the municipality and the University of Twente. While the original design was aimed a temporary legal function, its successful reuse will now support economic development within a regional innovation ecosystem. It is unclear for how long the Techbank will remain in Enschede, but another relocation, disassembly and reassembly are not ruled out (HMO, n.d.).

With its high visibility along the station area and proximity to both academic and entrepreneurial actors, Techbank plays a strategic role in Kennispark's ambition to become a dynamic innovation district. The building shows a shift toward more awareness of materials and construction and stands as a clear example of how reuse can contribute to sustainable area development.

R-ladder



R2 - Rethink
The design was reviewed on the ease of assembly for the components. On the urgent advice from the contractor, components (e.g. the staircase) were prefabricated and transported as a whole, instead of multiple individual parts.

R4 - Reuse
Entire structure (steel frame, floors, stairs, façades) was reused almost 1:1 in a new location.

R8 - Repurpose
The building's function changed from judicial (court) to educational (innovation hub), extending its useful life in a new way.

Let's design out waste!

This building is designed with the intention of...

Approaches

To shift the built environment and construction sector towards a circular practice, designers and clients can take some basic approaches. Do you design for longevity, disassembly and reuse?

02 **DESIGN FOR DISASSEMBLY AND DECONSTRUCTION**

03 **DESIGN FOR REUSE**

Concepts

In past and present design practices, a variety of design concepts combine circular design qualities, tailored to a specific project context. Make yourself familiar with the most typical ones.

02 **KIT-OF-PARTS**

Qualities

Circular design qualities enable more effective reuse, recycling or renewal of buildings and building components. Walk through them and set your ambitions from the start of the project.

01 **REUSED**
Use building parts and components already present on site or reclaimed elsewhere.

06 **PURE**
Prefer components that consist of a single material instead of a blend.

07 **DURABLE**
Use components that resist the wear and tear of use and reuse.

08 **SIMPLE**
Go for low-tech, legible solutions rather than complicated ones.

09 **MANAGABLE**
Design building components that can be grabbed, moved and handled easily.

10 **ACCESSIBLE**
Integrate components so they can be reached and recovered without much effort or damage.

11 **REVERSIBLE**
Make it possible to undo connections without damage to the components they join.

12 **INDEPENDENT**
Assemble components so they are structurally, functionally and geometrically separated.

13 **COMPATIBLE**
Use building components that can be interchanged and (re)combined.

14 **MULTI-PURPOSE**
Design buildings and spaces that support changing needs and requirements without alterations.

own picture

own picture

Site
50 -100 years

Skin
10-100 years

Structure
50-100 years

Services
15-25 years

Space plan
5-20 years

Stuff
8-10 years

Brand layers

Site: soil
The location of the Techbank used to be a grass lane in Enschede, repurposed as part of the university's tech campus.

Skin: sun blocking fabrics, prefab laminated veneer lumber and glass wool
The façade is mainly composed of specialized durable and recyclable solar blocking fabrics. The fabric by comes with a 10-year warranty, indicating its expected durability under normal conditions. This fabric is designed for outdoor weather as it is a woven polyester base cloth with a PVC coating and double-sided acrylic lacquer, which ensures dimensional stability and mechanical strength, contributing to its longevity.
While the warranty period is 10 years, actual lifespan can vary based on factors such as environmental conditions, installation quality, and maintenance practices. Regular cleaning and proper care can help maximize the fabric's service life. For detailed maintenance guidelines and to ensure optimal performance, it's advisable to consult the manufacturer's care instructions.
The glass wool has an expected lifespan of 55 years whereas the laminated veneer lumber is expected to last for 50-100 years, depending on its maintenance and protection.
All façade elements are easily demounted and reassembled.

Structure: steel with dry joints and prefab concrete hollow-core slabs
Composed of steel columns and beams (H-sections), all connected with mechanical bolts — no welding was used, to allow for disassembly (expected lifespan: 50-100 years with proper maintenance and protection e.g. against corrosion).
The floors were made from prefab concrete hollow-core slabs that were dry-mounted on the steel beams (i.e., no cast-in-place concrete). These slabs are reused in Enschede with some alterations to a few slabs for safe placement. The expected lifespan is 75-100 years, they need to be carefully disassembled, transported and reassembled for reuse.

Services: HVAC and lighting
Includes HVAC, basic lighting, and ventilation systems – typical for educational and office buildings. New systems are installed during remounting (expected lifespan: 15-25 years).

Space plan: lightweight wall system
Interior layout consists of modular partition walls, movable lightweight wall systems, and flexible floor plans. These are often adapted to suit the building's new tech/educational function and can be reconfigured as use changes (expected lifespan: 5-20 years)

Stuff: fixtures and furniture
The solid furniture is not reused, whereas the moveable furniture is also transported to Enschede.

cepezed

Neptunus

Flux

Building function: Education

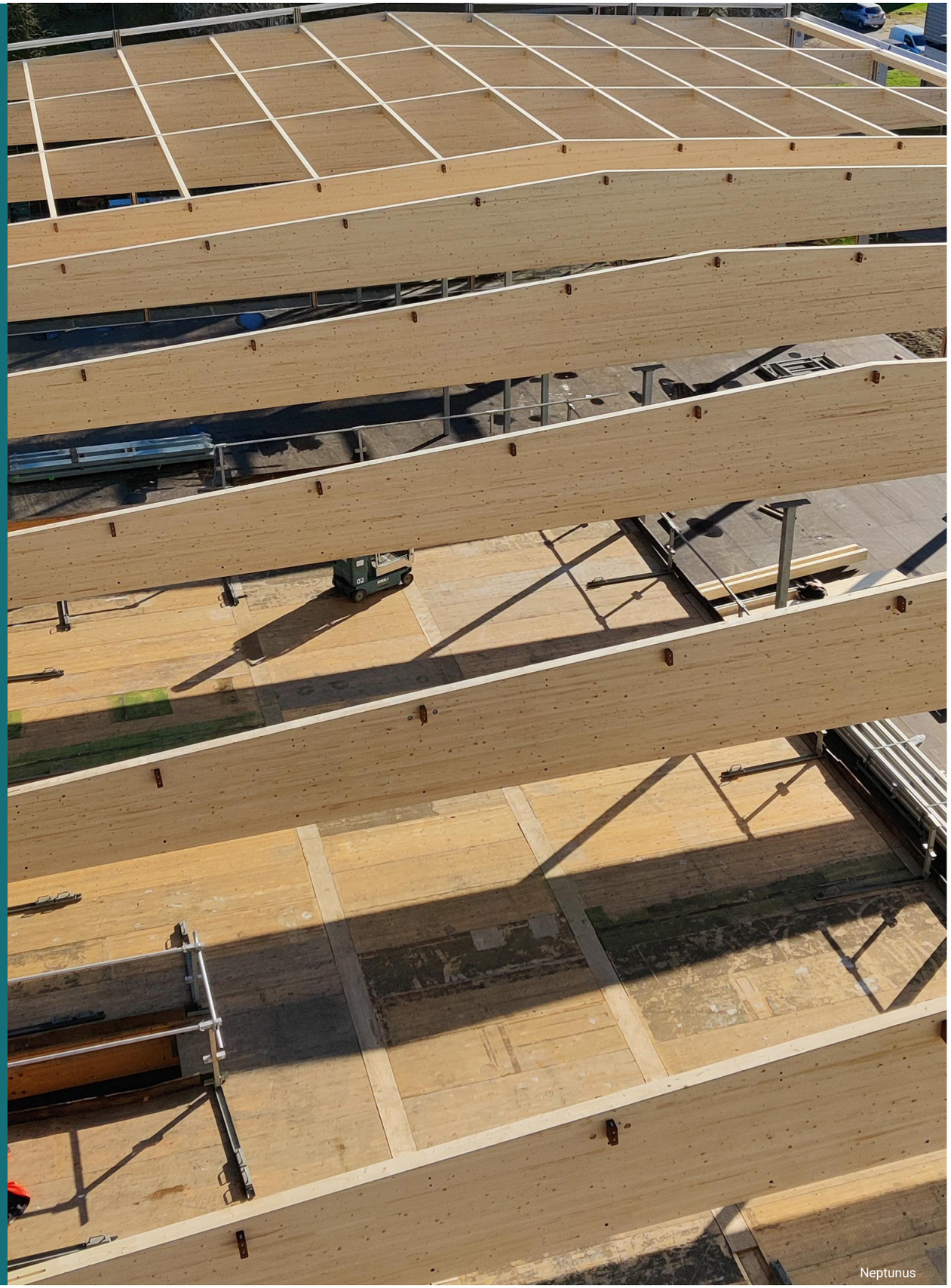
Client: Technical University of Delft

Location: Delft

Year: 2023

Relevance for this research
Applied remountability principle:
Design for disassembly

BroekBakema



Neptunus

Information Flux

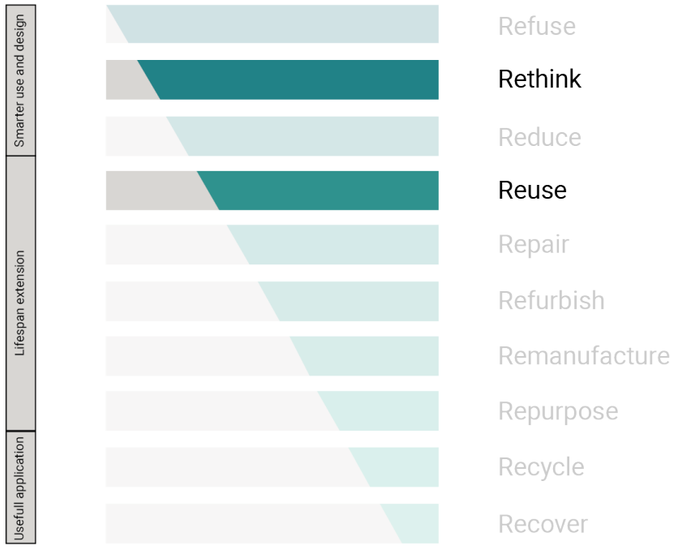
TU Delft Campus is home to various innovative educational and research facilities, one of which is the Flux building. Flux is developed as a temporary and fully remountable structure in response to an urgent need for educational spaces due to growing student numbers and an on-campus mentality. With this building, the university wanted to maintain flexibility for future campus development, which they embodied through for example leasing the building rather than the usual full ownership. Flux will remain at its current place for approximately 10 years. The second-life plan is not yet set.

On the site of a former parking lot, Flux comprises of four large lecture halls, each accommodating between 158 and 192 students. The design supports mixed didactics, allowing for both traditional lectures, exams and group work. The building's modular construction enables rapid assembly and future relocation, aligning with TU Delft's sustainability goals.
Sustainability is integral to Flux's design. The building features solar panels on the roof, a heat pump for climate control, and refurbished furniture. Notably, the floor panels were previously used during the 2012 London Olympics, exemplifying circular use of materials.

The building aligns with TU Delft's sustainability and circularity ambitions. As part of its Campus Vision for 2024, TU Delft aims for a future-proof and adaptive campus (Dorst, 2023). Flux is located centrally on campus, with its placement between key faculties and student hotspots ensures high accessibility. However, placed behind the EWI building does not accelerate its visibility.

Flux demonstrates how beneficial temporary buildings are for universities and how they can be (re)used and given a second life while complying with functional needs. When the promise of reusing this entire building is filled in, TU Delft not only reduces construction waste but also showcases a practical example of remountable architecture on campus environments.

R-ladder



R2 - Rethink
By opting to rent the building rather than own it, TU Delft has adopted a more flexible approach to real estate management.

R4 - Reuse
The design avoids use of permanent materials and cast-in-place components. The steel structure, façade panels, and modular units are all designed for reuse in another location after the current use period ends. Also, floors from the London Olympic games are reused in Flux. Finally, some furniture from other faculties of TU Delft are reused.

Let's design out waste!

This building is designed with the intention of...

Site
50-100 years

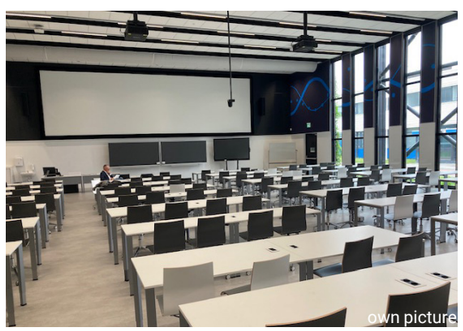
Skin
30-50 years

Structure
50-100+ years

Services
15-25 years

Space plan
5-20 years

Stuff
8-10 years



Brand layers

Site: concrete pavers and soil
The site on which Flux stands is a former parking garage and part of the ground is still covered with concrete pavers (explected lifespan 50-100 years). The building on site is intended for temporary use. As the building was constructed entirely above ground, without permanent foundations, the site remains fully reusable after removal. This reflects a conscious strategy of spatial flexibility, in which the land can easily return to its original function or be redeveloped in the future. Lifespan is permanent.

Skin: modular panels, glass, panels, aluminium frame
The skin of the building is made up of prefabricated modular façade elements, incorporating glass panels, aluminium frames and insulation. These elements were specifically chosen for their ease of installation and removability, aligning with the temporary and circular design of Flux. Some panels were newly produced, while others were reused from earlier projects. The materials used in the façade are expected to last 30 to 50 years, depending on maintenance and exposure to weather conditions.

Structure: steel with dry joints
The structure of Flux consists of a lightweight steel skeleton with wooden beams, assembled using dry connections such as bolts and mechanical joints. This system was chosen to ensure the entire structural frame could be fully demounted and reused. Notably, part of the internal floor structure was reused from the temporary McDonald's pavilion at the London 2012 Olympics, highlighting a practical application of high-value reuse. The expected lifespan of the structural components, if properly maintained and protected against corrosion, ranges between 50 to 100 years.

Services: HVAC, solar panels, heat pump
The services within Flux are deliberately kept minimal, reflecting the building's temporary character. The HVAC system and lighting installations were newly added and tailored to the building's office and educational functions. These installations are not modular in themselves but were installed in such a way that they can be easily removed or replaced (expected lifespan: 15-25 years).
A large share of the electricity comes from solar panels on the roof (expected lifespan: 25 years with after 10 years reducing performances). The building is provided with heat from a heat pump. The type is not known in this research, but an average heat pump has an expected lifespan of 15-20 years. These sustainable service choices align with the TU Delft circular ambitions, but both need regular maintenance to upkeep the performance.

Space plan: modular interior
The space plan is open and flexible, designed to support various short- to medium-term uses. Interior partitions are non-load-bearing and modular, allowing rooms to be reconfigured or cleared out entirely depending on the changing needs of TU Delft. This adaptable layout supports both office use and educational activities, with an anticipated lifespan of 5 to 20 years.

Stuff: reused furniture and new audiovisual equipment
The lifespan of the stuff is varying. All furniture comes from other TUD buildings or external locations. The technical equipment in lecture halls as the audiovisual equipment need maintenance over time to keep it updated and durable. Overall, the expected lifespan is 8-10 years.

Neptunus