Research Plan

Graduation Studio Architectural Engineering
2020-2021

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Argumentations of choice of the studio

I have always been interested in the relationship between technical innovation and design. Coming up with new solutions, or contributing to the existing state of knowledge in a technical discipline, in order to solve social issues as a goal I find a valuable purpose to aspire to. I am looking forward to extend my knowledge on the topic; design for disassembly in office buildings and contribute to the current status of a technical discipline.

Glossary

Adaptability:

The capacity of a building to accommodate effectively the evolving (spatial) demands of its context, thus maximising its value through life. (Robert Schimidt III, 2016)

Demountability (losmaakbaarheid):

"Demountability is the degree to which objects can be disassembled all levels of scale within works and buildings, so that the object can retain its function and high-quality reuse can be realized. " (Pianoo, 2019)

Disassembling:

The process of dismantling a building in order to salvage its materials for recycle or reuse.

DFD:

''DFD (Design For Disassembly) is the design of buildings to facilitate future change and the eventual dismantlement (in part or whole) for recovery of systems, components and materials.'' (Guy & Ciarimboli, 2005)

Structure:

Parts of a building which support the primary transfer of vertical loads and horizontal bracing. (Guy & Ciarimboli, 2005)

Graduation Project

Title

Demountability in existing buildings – Design for an unknown future

Problem Statement

Buildings are complex products. They can be viewed as a unique merge of resources and requirements that involve design, building methods and operational complexities. Architect Stewart Brand visualized a building as a range of 'shearing' layers that change at different durations (Figure 1). More connections that take place between the different layers, generate a increase in difficulty of adaptation and cost. (Robert Schimidt III, 2016)

Figure 1: Shearing layer concept by Stewart Brand.

Today's rooms and spaces in buildings are still classified with specific functions, using prescribed space dimensions from building regulations, that as a result accommodate the layout of the furniture, subsequently defines today's buildings by their function. (Till, 2009) Although the building industry's fixation on the static object, (Tsukamoto and Kaijima, 2010) suggests a building should be perceived as a dynamic commodity, that can be changed through the transient agency of elements in time. The future of a building may not be fit for purpose anymore, resulting ultimately in falling out of use or have to be demolished when they cannot be adapted in a cost effective way. Maximizing the life span of a building, provides a place for the developing needs of the community (Robert Schimidt III, 2016) It is in my personal interest to analyse how existing office building structures can be transformed into residential buildings, and evaluate to what extend adaptability can be incorporated.

Relevance (link to architectural and societal matters)

The reason to develop more buildings that are adaptable is based on the premise that adaptable buildings are simpler to make changes to during their existence, which additionally may have benefits, being; reducing disruptions to users of the building, lessening the cost of adaptation and finally making it easier to sell or rent out the building. (Robert Schimidt III, 2016)
The type of connections and assembly processes can make it very challenging to disassemble an object and separate the materials for reuse purposes (Shetty, 2015).
Adaptability can consequently be seen as a instrument to increase the lifespan of our built environment. The increasing understanding of the embodied energy in buildings when being constructed, is an argument for the understanding that the most sustainable building, is the one that already exists. (Robert Schimidt III, 2016)
Additionally there is a housing shortage in the Netherlands. Estimations are that between 2020 and 2030 a total of 845.000 dwellings are needed to be build to accommodate the housing demand. (Rijksoverheid, 2020) It is therefore of relevance to investigate how this research can contribute to the further development of buildings in order to increase the housing stock.

Objective & Research Focus

The design objective for the graduation is targeted at the transformation of the tax authorities office in Sloterdijk (Kingsfordweg 1, Amsterdam) into a residential building. This is in line with the municipal ambition to transform the current office district of Sloterdijk to a residential/mix-use live and work environment. To transform the tax office into a residential building can be an interesting study case that represents a solution for an existing building that will implement an adaptable design solution to accommodate to the evolving demands of its context.

Accommodating the evolving demands in a context through an adaptable design can still be interpreted in different ways. In this paragraph will be explained what the focus in the brought spectrum of adaptability in this research will be and subsequently its relevance.
According to the research of R. Schmidt III & S. Austin, the term 'adaptability' in architecture can be distinguished in six different typologies (Figure 2). Each typologies can assist and clarify the goal setting of the design outcome. (Robert Schimidt III, 2016)

Adjustable	Versatile	Refitable	Scalable	*Convertible*	Movable
Change of Task	Change of Space	Change of Performance	Change of Size	Change of Use	Change of Location

Figure 2: Typologies of adaptability

Convertibility indicates to a change in use, that is caused by changes on the demand side; in the market, ownership, occupancy or social demand for example. Although these changes were not envisioned in the original designs, allot of buildings are converted to accommodate new functions. (Robert Schimidt III, 2016) Convertibility therefore focuses on the maximisation of the longevity of a building in a brought sense and is accordingly chosen as a focus in the research. Feasibility for numerous conversions is depended on the positioning and capacity of different physical elements (e.g. floor loading, acoustics, services, fire design and circulation).

In order to ensure that materials will be reused, Chong et all. stated that it is the task of the designers, to be at the front-line of this endeavour and stresses the importance for design for disassembly. They address the lack of quantitative methods in order to measure the benefits of demounting and recycling of buildings and materials. This results in an oversimplifications of the ways to address the reuse of materials and measuring cost and benefits cannot be done efficiently. (W.K. Chong, 2010)

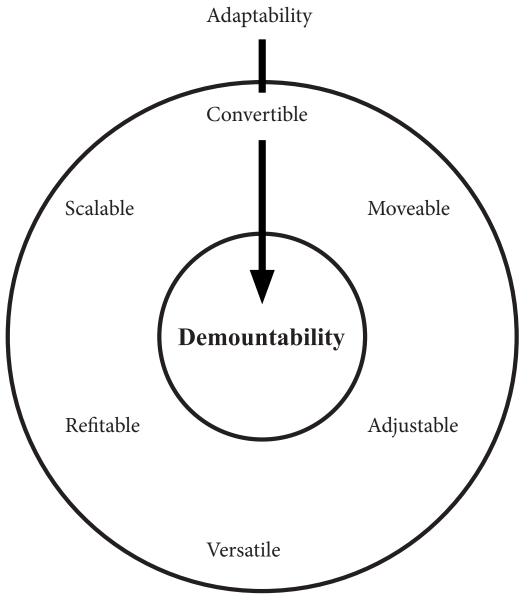


Figure 3: Adaptability through Demountability

Overall design question

How to transform the building De Knip in Amsterdam Sloterdijk in a residential, adaptable live environment/(vertical village)?

Thematic Research Question

How to improve the demountability of existing office buildings by using designed for disassembly components?

Sub research questions:

- 1. How do the current demountability measuring tools measure demountability?
- 2. To what extend are the currently used demountability measuring tools applicable on existing office buildings? (De Knip)
- 3. How useful are the results from using the demountability tools on the Knip, to transform the building from an office to a residential function? (for architects)

Methods & Methodological positioning

In order to improve the demountability of existing building buildings, it is necessary use measure instruments that are able to quantify the extend of the current demountability level of a building. The tools that will be used to investigate the current demountability level of the building 'De Knip' are the following:

Measuring tool 1	***Measuring tool 2***	***Measuring tool 3***
Alba Concepts	DFD - Rating factors	Measuring circularity
Developer: Alba Concepts, Dutch Green Building Council, Rijksdienst voor Onderne-mend Nederland, W/E Ad, Transitieagenda Circulaire Bouweconomie	*Developer*: Devdas Shetty & Ahad Ali.	*Developer*: Platform CB'23

Figure 4: Demountability Measuring tools

A building is a composition of complex materials and products that can be measured at various levels. The different levels indicate the complexity of a building component. By making the different levels specific, allows to properly evaluate the desired level of demountability (Alba Concepts, 2019). In the building sector there are several methods available to define these buildings levels. In the Dutch building Industry the NL/SfB & STABU2 methods are used. The NL/SfB classifies and categorises building products to determain building levels. The STABU2 also classifies and categorises building products but on a more specific bases (Vliet, 2018) (Figure 5).
In this research the goal of measuring demountability as specific as possible and is therefore set to level 5. The level of measurement is determined on the availability of archival documentation and technical drawings.

Measuring Tool 1 - Alba Concepts
Objects in buildings are often connected to one or several other objects. To ensure that the determination of the demountability will not result in a unnecessarily complex calculation of connections between objects, the decisive connection in this tool is demarcated as the connection between the object and mother object that has a supporting function. This connection results in a demountability-index. The demountable measuring method by Alba Concepts consists of three aspects regarding demountability; the process- , technical- and financial aspects. The assurance that objects are physically demountable is the central focus point in this research. Therefore the financial- and process aspect of the tool will be left out.

Measuring Tool 2 - DFD - Rating factors
The DFD tool based on rating factors is developed for engineer designers for productively analysing the demountability of assemblies or products in an automated way. The analysis of disassembling parameters are focused on the practical side of the disassembly. The rating factors which are used contain; the accessibility of a component, the tools that are required, component damage, reuseability,

Research methods - Elaboration

Sub research Question	*What data do you need?*	*How can this data be collected?*	*How will this data be analysed?*	*What will be the expected results?*
Theory (state of the art) 1. How do the current demountability measuring tools quantify demountability?	-Existing demountability measuring tools -Explanation of the execution of tools -Calculation examples	-Literature (online)	-A summary of the working of the tool and a comparison between the differences and similarities of parameters that the tools use.	-Outline of three demountability measuring tools. -State of the art overview of current execution and implemented techniques regarding demountability.
Analytical (case studies) 2. To what extend are the currently used demountability measuring tools applicable on the existing office building (De Knip)?	-Most recent reviews on demountability -Most recent discussions on the demountability topic -Technical drawings and building specifications of De Knip	-Archival research -Literature study -Establish a clear framework for using demountability measuring tools.	-Applying demoutability measuring tools on detail connections (case studies) -Recognizing the reachable application of the tools.	-Comparison matrix between the case studies(connection details) using predefined parameters. -Generating 3D models of the most extensively used connections (details) of De Knip.
Methodological (reviewing methods) 3. How useful are the results from using the demountability tools on De Knip, to change the building from an office to a residential function?(for architects)	-Quantitative data on the demountability level of De Knip (retrieved from sub-question 2) -Requirements for a function change from office to residential	-Using the existing demountability measuring tools -Technical building code regulations -Literature of transformation projects	-Documenting the changes that occur De Knip. (delimited to the building skin & structure)	-List of improvements regarding demountability of De Knip -Relation between demountability and transformation from office- to residential projects.

Level	*Source*	*Adopted Definition*	*Example Description*
0.	Layers of Brand	Building layers	Space plan
1.	NL/SfB (2 digit coding)	System level	Interior wall
2.	NL/SfB (3 digit coding)	Element group level	Non-structural
3.	NL/SfB (4 digit coding)	Element level	Fixed partition wall
4.	NL/SfB (6 digit coding)	Product level	Metal stud wall, plasterboard
5.	STABU2 (specification group)	Component level	Plasterboard
6.	STABU2 (specification group)	Material level	Plasterboard
7.		Raw material	Gypsum

Figure 5: Different Building levels. (Vliet,2018) Adapted by Alba Concepts.

removeability, recyclability and the time required to disassemble the component. The tool includes Design for disassembly (DFD) and Design for assembly methods (DFA). The latter will be left out of this research.

Measuring Tool 3 - Measuring circularity
The measuring tool by Platform CB'23 concentrates on the generic contribution to preserve and efficiently usage of materials in the building built environment. The tool aims to accomplish a supporting method for circular use of materials. The input and output of the tool regarding the quantification of the demountability of a building are based on the initial weight (Kg) of a building component and the reusable weight (Kg) respectively.

Link Thematic Research & Design objective

The investigation on how to turn offices into apartments on an adaptable basis presents a multitude of challenges. The building De Knip has currently a low connection to its context. The high rise typology of the building (20 stories) makes it a challenge to change the function from an office to a residential function while strengthening a meaningful relation of the building to its surroundings. Additionally, the materialisation of the building; a facade made of reflective glass facade on the ground floor, aluminium- and natural stone facade panels contribute to the weak connection to the surroundings. Secondly, the ambition of the municipality to transform the area of Sloterdijk into a residential/mixed use living environment requires functions that enable a residential lifestyle. This standalone entity should therefore function as a vertical village, with the inclusion of public spaces and additional functions where people can live, work and spend their time on leisure activities. The demand for required functions and space is not fixed and will change over time, as argued in the problem statement. Adaptability must therefore be incorporate to facilitate future adaptations.
The level of adaptability that can be reached in the building De Knip will explored for the structure and the building skin. The results of the research should provide a understanding of the generic quantification of the demountability of a building and how this can benefit the future change of use.

Preliminary conclusions

The goal of this research is to investigate how to transform a building from an office to a residential function on the basis of demountability. The selected demountability measuring tools made it possible to quantify the demountability for the various components of the building. The higher the specification of the connections between components results in a exponential increase in time investment to make the calculation. The amount of calculations from the element level (e.g. Fixed partition wall) to the product level (e.g. Metal- stud wall, plasterboard etc.) results in an exponential growth of calculations since the element consist of multiple products. To rule out a very large time investment for the demountability calculation, it is essential to determine the goal of the demountability upfront.

The low rise part of the building De Knip scores lower than the high rise part on the subject of demountability. The main cause is due to the structural difference and materialisation of the façades, as well as the analized parameters; connection type and element enclosure. Since the primary load bearing elements in the low rise part of the building have a more prominent function than the high rise part, will effect the access routing and outdoor spaces to enable the residential function. The possibilities to increase the demountability of the building will now be further explored to comply to the design ambition.

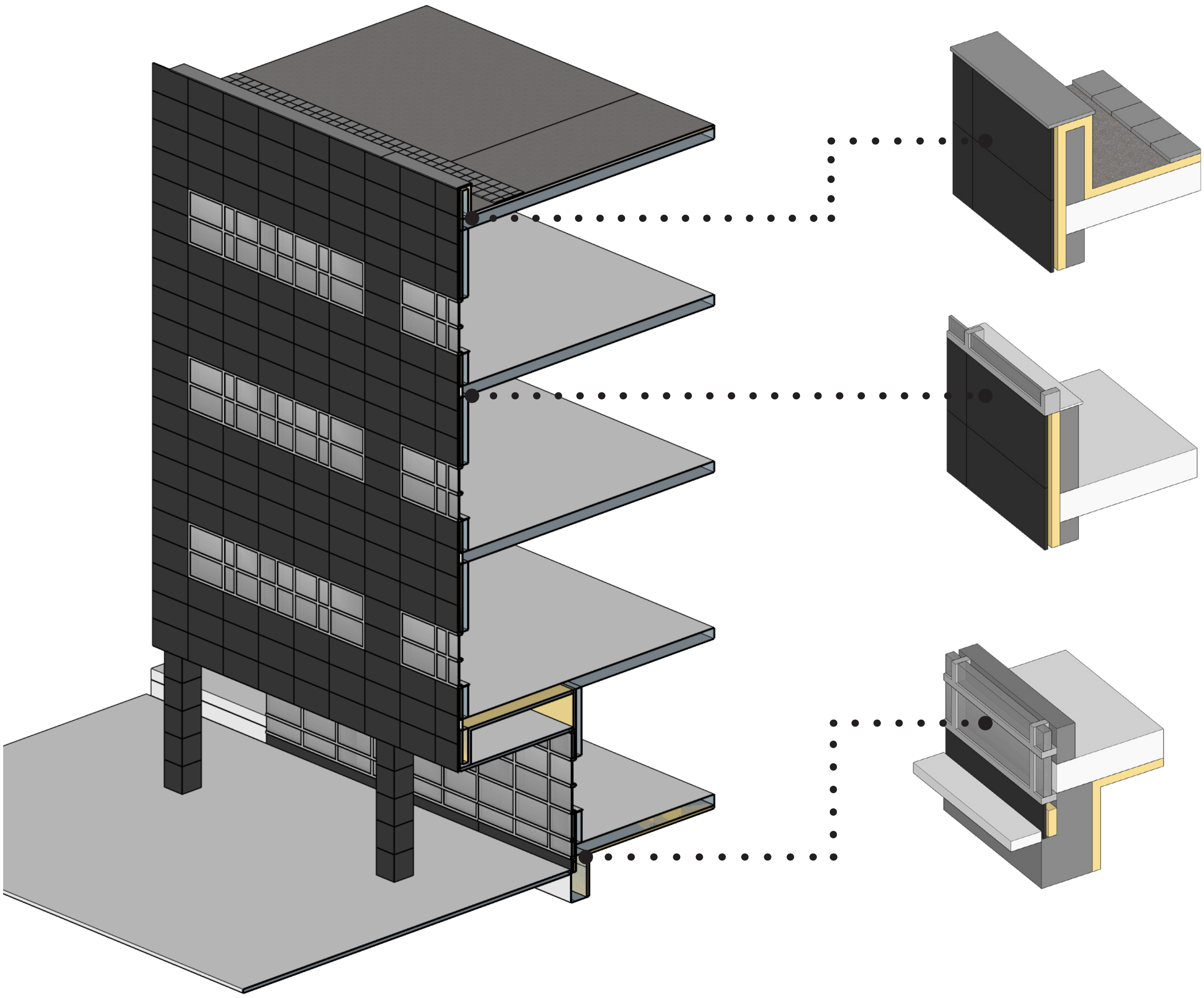
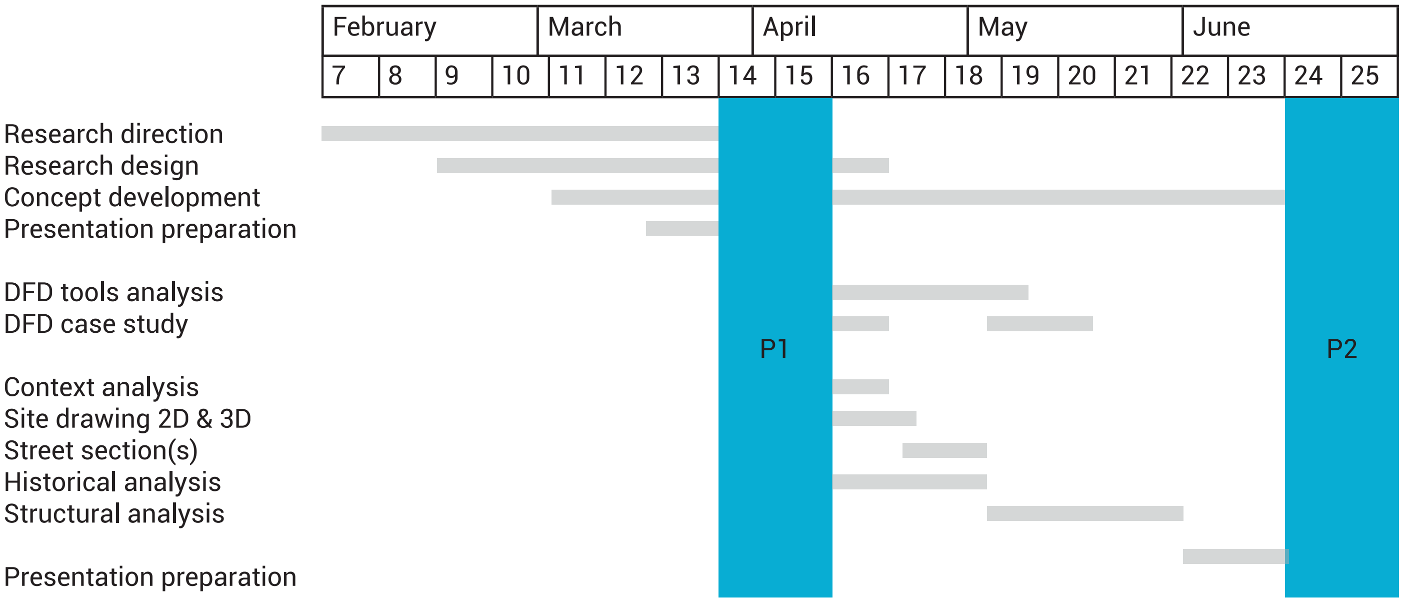


Figure 6: 3D Section of the low rise part of the office building De Knip.

Planning – Towards P2



References

Alba Concepts. (2019, November) Circular Buildings - Meetmethodiek Losmaakbaarheid. Alba Concepts.

CB’23, P. (2019). Kernmethode voor het meten van circulariteit in de bouw. Platform CB’23.

Diederen, A. (2010). Global Resource Depletion, Managed Austerity and the Elements of Hope.

Guy, B. Ciarimboli, N. (2005). Design for disassembly in the buildenvironment: a guide to closed-loop design and building. Seattle.

Habraken, J. (1961). De dragers en de mensen : het einde van de massawoningbouw. Eindhoven: Stichting Architecten Research.

Pianoo. (2019). Handreiking Losmaakbaarheid. Pianoo Expertise Centrum Aanbesteden.

Rijksoverheid. (2020, Juni 15). Staat van de woningmarkt 2020. Opgeroepen op Maart 10, 2021, van Rijksoverheid: https://www.rijksoverheid.nl/actueel/nieuws/2020/06/15/staat-van-de-woningmarkt-2020

Robert Schimidt III, S. A. (2016). Adaptable Architecture Theory and Practice. London: Routledge - Taylor & Francis Group.

Shetty, D. and Ali, A. (2015). A new design tool for DFA/DFD based on. Emeral Group Publishing Limited.

Till, J. (2009). Architecture Depends. Cambridge, MA: MIT Press.

Tsukamoto, Y. and Kaijima. M. (2010) Behaviorology. New York: Rizzoli.

Vliet, M (2018). Disassembling the steps towards building circularity. Eindhoven University of Technology.

W.K. Chong, I. S. (2010). Sustainable Recycling Approach: An Understanding of Designers’ and Contractor’s Recycling Responsibilities. University of Kansas.

Research Diagram

Design Research Question

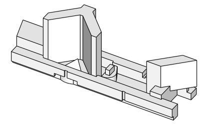
How to transform the building De Knip in Amsterdam Sloterdijk in a residential, adaptable live environment/ (vertical village)?

OBJECTIVE & RESEARCH FOCUS

Adaptability → Moveable, Adjustable, Versatile, **Convertible**, Refitable, Scalable → **Demountability** →

DESIGN

De Knip



Office → Residential

Skin

Structure

RESEARCH QUESTION

Thematic Research Question

How to improve the demountability of existing office buildings by using designed for disassembly components?

SUB RESEARCH QUESTIONS

How do the current demountability measuring tools quantify demountability?

To what extend are the currently used demountability measuring tools applicable on the existing office building (De Knip)?

How useful are the results from using the demountability tools on De Knip, to change the building from an office to a residential function? (for architects)

METHODS

Theory (state of the art)

Measuring tool 1
Alba Concepts

Measuring tool 2
DFD - Rating factors

Measuring tool 3
Measuring circularity

Generical nature

Analytical (case study)

Demountability case study on technical detailing of De Knip.

Comparison parameters:

Connection Type
Connection Acces
Element Intersection
Element Enclosure
Acces
Tooling
Task
Reuse
Removal
Recyclability

Generical nature

Methodological (reviewing methods)

Relating demountability to a transformation project; from an office to a residential function.

Skin & Structure

1. De Knip 1994 (existing)

2. 'De Knip' 2021+ (objective)

Technical - Functional -Aestetical

3. Current demountability (office) & Desired demountability (residential)

4. Demountable solutions for transformation

Specific nature