RESEARCH PLAN

aE Studio

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Msc3 Spring 2023/24
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ADAPTIVE REUSE OF CAMPUS BUILDINGS TOWARDS A LIVING CAMPUS

ADAPTIVE REUSE OF POST WW2 CAMPUS BUILDINGS INTO STUDENT HOUSING, CREATING SUSTAINABLE AND ADAPTABLE CAMPUS AREA

Keywords

Adaptive reuse, adaptability, flexibility, transformation, campus buildings, student housing, dwellings

Choise of studio

The studio of architectural engineering covers a wide scope of topics where the inclusion of sustainable, ecological, societal and technical challenges become a playing field for your fascination. Its is then from this fascination where the link between the design and research is created, leading to an integrated design track which I value. The studio offers me to explore topics, such as sustainability through the scales, by the track's make, flow and stock groundworks. It is from this groundwork that my fascination on the technical challenges can be combined into the architectural design.

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General Problem Statement and Relevance

In the Netherlands more students are studying at universities than ever, growing form 353.500 in the year 2022-’23 to 396.300 students in 2028-’29 (Ministerie van Onderwijs, Cultuur en Wetenschap, 2022). This increase in students directly links to the severe lack of student housing present, with a shortage of 27.000 in 2022 and expecting to grow to 44.800 in 2030 (Kences, Kenniscentrum Studentenhuisvesting, 2022). But it’s not only the inability to find housing that causes problems for the students’ wellbeing, young people in general indicate more often than older people that they feel “emotionally lonely” (NOS, 2022). This means, among other things, that they lack a close bond with others or feel abandoned. The risk is becoming isolated. Students are having a hard time in many areas, and it has long been clear that the corona crisis and associated measures of isolation have had a negative impact on the mental health of young people in particular, when the universities and the sports and social association were closed (NOS, 2022)(Martirosova, 2020).

On the other hand, the older campus buildings within the portfolio of the universities are in dire need of an investment to stay up-to-date, or they will become obsolete and face abandonment (TU Delft Strategic Framework 2018-2024 [TU Delft], 2018). It is the stricter regulations, higher requirements for energy performance because of sustainability reasons, new forms of education and higher (comfort) requirements of users, that example trends that strongly influence the functional requirements of the buildings within the university’s portfolio’s (Heijer et al., 2016). The creation of a home base with its own identity also appears to be important in an ever- growing university community (Heijer et al., 2016). It is this uncertainty in the campus context, that asks for flexibility and adaptability in order to quickly encounter the changing demands. But the current strategy is partly to get rid of these expensive and energy inefficient older building within the university’s portfolio (Van der Veldt, 2020). Therefore not only excluding their cultural heritage within the build environment and campus area, but also giving away opportunities for these buildings to become part of a sustainable and future proof university.

There is also the campus area itself, these often lack a ‘beating heart’ and are deserted in the evening hours and at night (TU Delft Strategic Framework 2018-2024 [TU Delft], 2018). Hereby creating a difference between the city the university is based in and the campus area. The fourteen universities in the Netherlands confirm that student satisfaction and study success rates both benefit from more physical encounters and collaboration on campus (Heijer et al., 2016). This search for a vibrant heart: a central hub that connects the primary process of education with a range of social activities, calls for a ’living campus’, benefiting not only the university community but also the residents of local neighborhoods (TU Delft Strategic Framework 2018-2024 [TU Delft], 2018).

Project Objective

The heritage of the university buildings contribute to the historical richness and spatial identity of the campus. The added value of cultural history requires careful consideration of transformations, with the aim of taking the cultural-historical quality as the starting point for developments where possible (SteenhuisMeurs, 2018). By facing these challenges such as sustainability, the campus needs to stay up-to-date and continue to respond flexibly and adapt to upcoming changes, in other words: innovate and still remain recognizable (SteenhuisMeurs, 2018).
Therefore establishing a campus strategy, where the incorporation of adaptive reuse of campus buildings can create opportunities for the university to respond flexibly to current (and future) problems on the campus area. Student housing is a current problem, but this problem can change in the (far) future (Kences, Kenniscentrum Studentenhuisvesting, 2022). It is this uncertainty that asks for flexibility and adaptability over time, and in the context of the university campuses, yearly changes (e.g. amount of students per year) can create obstacles that need addressing. The technique of adaptive reuse therefore is not a one-time intervention. Adaptive reuse is different from renovation: the former includes a change of use, and therefore presupposes a more drastic intervention than the latter (Clarke, 2021). **And it is the intervention of the technique (adaptive reuse) that the future campus must be able to respond quickly, on a yearly basis and on building scale, to be able to address the uncertainty of the campus area as a whole.**

The adaptability of buildings is tightly connected to the concept of the 'shearing' layers. This concept by Steward Brand (1994) envisions the building as a set of layers that change at different rates. These layers include site as the eternal entity, structure (columns, floor slabs), services (ductwork, piping), space plan (interior partitions, ceiling tiles) and stuff (furniture, fixtures) as seen in figure 1 (Schmidt & Austin, 2016). The more the layers are connected, the greater the difficulty and cost of adaptation. It is thus the interaction which defines in some way a buildings resistance to be adapted (Brand, 1994). And the qualities and characteristics of the slow layers dominate the possibilities for change of the faster

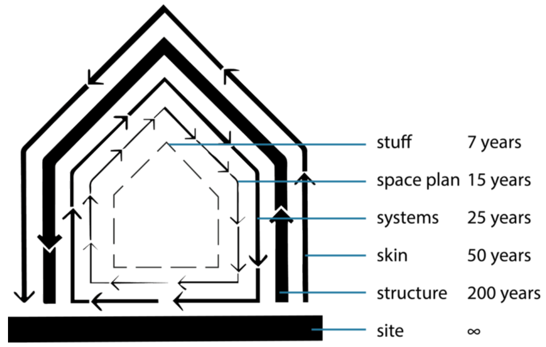


Figure 1: 'Shearing' layers concept. Openbuilding.co. (2021). Shearing Layers of Change (1994) Stewart Brand. https://www.openbuilding.co/manifesto

ones. So, for instance, the structure will dictate the capacity for change of services, space plan and stuff. (Clarke, 2021).

It is with these faster layers, that the flexibility of campus buildings comes into play. For instance, when changing the function of a building from educational purposes to dwellings, these faster layers (mainly services, space plan and stuff) are relevant. But because the qualities and characteristics of the slower layers (site, structure and skin) dominate the possibilities of changes, these are the deciding factors if the building is even fit for the adaptive reuse in the first place.

Because each campus building is unique, the appropriate number of layers, and their relation to each other, must be decided for each project, according to its complexity, uncertainty and expected changes in use (Blakstad, 2001). Adaptive reuse thus incorporates these 'shearing' layers in order to grasp the adaptability of campus buildings.

And the incorporation of student housing, with the adaptive reuse, on the campus area can create this 'living campus' which universities are exploring to develop (TU Delft Strategic Framework 2018-2024 [TU Delft], 2018) (Heijer et al., 2016). Creating more liveliness on the campus area, not only in daytime but also in the evening and nighttime. And the sustainability of adaptive reuse can create less impact on climate by using and transforming what is already there, reducing material and energy use when comparing to building new.

Overall Design Question

Instead of destroying, it is with adaptive reuse that the campus buildings can be sustained. Thus conserving the heritage and giving new functions to these buildings, according to their location, size, and potentials to help to future generations (Mısırlısoy & Günçe, 2016). The design question specifies on how a (educational) campus building can be adapted to the ever changing demand of the university campus area as a whole. The design question is how adaptive reuse, as a technique, can be applied to change the building's characteristics (e.g. function) on a quick (yearly, or few years' time) basis. The role of the building is therefore to reinvent itself constantly to future-proof itself in order to become sustainable.

The scope of the project now will therefore focus on a (yet to be determined) current educational campus building (on the TU Delft campus) from the post world war 2 period. It is with the technique of adaptive reuse, that the current problem of the student housing shortage can be addressed, by transforming the buildings function form educational to dwelling. But this shouldn't be a permanent change, as said before, the building should be able to reinvent itself constantly, in order for it to become future-proof. It is the characteristics of the building itself, that determents amount of student housing possible, but the amount should be considered to be in the hundreds.

The implementation of student housing in a collective manner becomes an important factor in the elaboration of the design. Because collective housing promotes social, economic and environmental sustainability. And thereby contributes to a better quality of life of students (Verhetsel et al., 2017). The sharing of communal functions, like kitchens, bathrooms or living areas, becomes therefore part of the design question. This project is not set to aim for the creation of as many individual studios per square meter, the basis is creating communities, groups of students connected by sharing functions and living together. When establishing this on a building scale, it should manifest itself upon the campus area as a whole. In order for the complete campus to become part of the cityscape and create the future living campus area. The design project is based upon one building, but the design and the process should be seen as a example for similar future cases.

On the building scale, the question of sustainability (i.e. energy neutrality) becomes also part of the scope of the project. And the connection between the cultural heritage of the aesthetics of the buildings and the implementation of up-to-date building methods and materials can give an interesting look and feel combination, as seen in figure 3. How can therefore a building be brought up-to-date, without losing its current values.

Design question: How can a campus building, with adaptive reuse, be made flexible, sustainable and future proof?

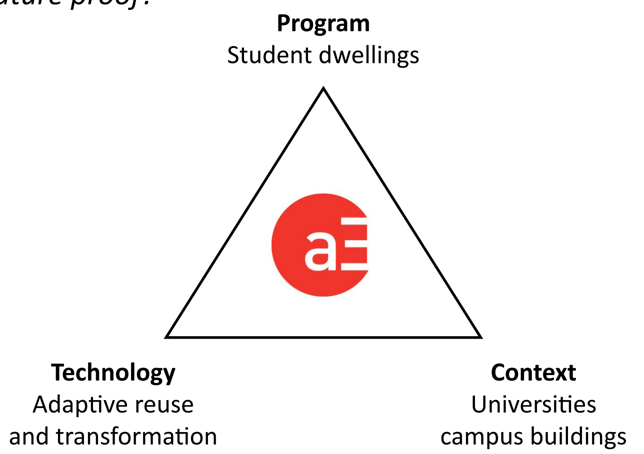


Figure 2: Infill of the triangle approach of the aE studio. Own creation

Context: The focus of the design question will be based upon the Dutch universities' campus buildings

Technique: Adaptive reuse and transformation

Program: Creating dwellings in the form of collective student housing

Figure 3: Collage of adaptive reuse strategy applied to the TU Delft campus . Own creation

Thematic Research Question

The thematic research is dedicated to adaptive reuse of the campus buildings. In order to get a broad view of the campus buildings and the technology of adaptability.

Research Question:
How adaptable are campus buildings from different construction period when transforming them to student housing?

The existing campus buildings have to be analyzed on their adaptability potentials. This gives insight in the characteristics of the buildings, and their possibilities towards the contemporary campus problems. The first part of the reasreach is dedicated on how the adaptability of a building can be analyzed or measured (see Sub Question 1). The research is then focused on the difference in spatial and technical requirements between the (current) campus buildings and their educational typology, and the typology of student housing (see Sub Questions 2 and 3). This research is based upon case studies where the difference in requirements comes forth from the design, further established by literature studies to investigate the legal requirements behind this transformation. This part of the research compares the functions and their requirements in order to get a view upon the difference or similarities.
Because most campus buildings in the Netherlands are from the post world war 2 period development phase (TU Delft Strategic Framework 2018-2024 [TU Delft], 2018). And these buildings are already listed for a 'midlife renovation', means they are in dire need of investment to stay up-to-date and become sustainable (Van den Dobbelsteen, 2022). On the campus of the TU Delft, 4 major campus buildings from this construction period are present, built between 1955 (3ME; Building 34) and 1975 (Civil Engineering; Building 23), with buildings form 1963 (Applied Sciences; Building 22) and 1972 (EEMCS; Building 36) in between (Basisregistratie Adressen en Gebouwen (BAG), 2018). These buildings are to be taken as a case to be represented for universities in the Netherlands, or even abroad, and area then compared to their adaptability when transforming them to student dwellings. This research will be executed with the findings or the other sub questions, and further elaborated upon.

Figure 4: TU Delft campus buildings listed for adaptation. Van den Dobbelsteen, A. (2022). Climate Design & Sustainability [Slide show; Research Lecture]. Brightspace. https://brightspace.tudelft.nl/d2l/le/content/503093/viewContent/3089449/View

The last part of the research is dedicated towards creating an overview of adaptability as a whole, filtering out the design characteristics of the case studies to conclude what makes a campus building adaptable or not. These characteristics are then to be taken as examples to be applied in new design projects, as part of the sustainability, or can be used in similar adaptive reuse projects for post-world war 2 campus buildings.

Sub Questions:
SQ1: How can the adaptability of a building be analyzed?
SQ2: What are the spatial requirements for the student housing and how does this differ from the educational requirements of campus buildings?
SQ3: What are the technical requirements for the student housing and how does this differ from the educational requirements of campus buildings?
SQ4: How do campus buildings from the TU Delft between from different construction periods compare to adaptability when transforming them to student housing?
SQ5: What design characteristics of the TU Delft buildings make them adaptable or not?

Hypothesis
This research broadens the scope of adaptive reuse analysis for post-world war 2 campus buildings, by establishing an analysis methodology for the specific context and program. The outcome will make the design characteristics clear that makes a campus building adaptive. It is by using this information in order to comply with the sustainability goals of the universities and create opportunities for the 'living' campus of the future.

Thematic Research Methodologies

In the table below, the methodologies for answering the sub questions are given.

Sub research questions	What data do you need?	How can this data be collected?	What will be the expected result?
1. *How can the adaptability of a building be analyzed?*	Qualitative data about adaptive reuse method and cases on campus buildings	Literature study	Explanation of ways of implementing it on the chosen context
2. *What are the spatial requirements for the student housing and how does this differ from the educational requirements of campus buildings?*	Legal requirements and building characteristics of educational buildings and student dwellings based upon the spatial qualities of the building	Case study, further aided by literature study	Explanation of the different spatial characteristics and requirements of the different typologies
3. *What are the technical requirements for the student housing and how does this differ from the educational requirements of campus buildings?*	Legal requirements and building characteristics of educational buildings and student dwellings based upon the technical qualities of the building	Case study, further aided by literature study	Explanation of the different technical characteristics and requirements of the different typologies
4. *How do campus buildings from the TU Delft between from different construction periods compare to adaptability when transforming them to student housing?*	Case study on 3/4 buildings on the TU Delft campus, and the analysis method of SQ1	Building documents (i.e. plans, sections, ext.), site visits, photo analysis, literature research	Listing the strong and weak points of adaptability of the case study buildings
5. *What design characteristics of the TU Delft buildings make them adaptable or not?*	SQ4 answers, the strong and weak points of adaptability of the case study buildings, conclusions form this data	Building documents (i.e. plans, sections, ext.), site visits, photo analysis	Concluding design characteristics from the case study buildings, to be applied for later design or research

Table 1: Methodologies for the sub questions. Own creation

Preliminary Investigation And Findings

In order to get a grasp on the adaptive reuse and the field of adaptability and transformability, preliminary investigation is used to scout the existing sources. Via literature research (until now) three main ways of analyzing a building on its adaptability are depicted below in figures 5, 6 and 7.

Table 13.1 CARS mapped against case stu

	Design Characteristics	
1	REVERSIBLE	
2	MOVABLE STUFF	
3	COMPONENT ACCESSIBILITY	
4	FUNCTIONAL SEPARATION	
5	SERVICE ZONES	
6	CONFIGURABLE STUFF	
7	MULTIFUNCTIONAL COMP	
8	NOT PRECIOUS	
9	'EXTRA' COMPONENTS	
10	DURABILITY	
11	MATURE COMPONENT	
12	EFFICIENT SERVICES	
13	GOOD CRAFTMENSHIP	
14	OVERDESIGN CAPACITY	
15	READILY AVAILABLE MATERIAL	
16	STANDARDISED COMPONENT	PHYSICAL
17	STANDARD COMP LOCATIONS	PHYSICAL
18	OFF-SITE CONSTRUCTION	PHYSICAL
19	SIMPLE CONSTRUCTION METI	PHYSICAL
20	OPEN SPACE	
21	SUPPORT SPACE	
22	OVERSIZE SPACE	
23	TYPOLOGY PATTERN	
24	JOINABLE/ DIVISIBLE SPACE	
25	MODULAR COORDINATION	
26	CONNECT BUILDINGS	
27	STANDARD ROOM SIZE(S)	SPATIAL
28	SPATIAL VARIETY	SPATIAL
29	SPATIAL AMBIGUITY	SPATIAL
30	SPATIAL ZONES	
31	SPATIAL PROXIMITY	
32	SIMPLE PLAN	
33	STANDARD GRID	
34	SIMPLE FORM	
35	MULTIPLE VENTILATION STRATEGIES	
36	SHALLOW PLAN DEPTH	
37	PASSIVE CLIMATE CONTROL	
38	BUILDING ORIENTATION	
39	GOOD DAYLIGHTING	
40	SPACE TO GROW INTO	
41	PHASED	
42	USER CUSTOMISATION	
43	MULTIFUNCTIONAL SPACES	
44	USE DIFFERENTIATION	
45	MIXED DEMOGRAPHICS	
46	MULTIPLE/ MIXED TENURE	
47	SHARED OWNERSHIP	
48	ISOLATABLE	
49	MULTIPLE ACCESS POINTS	
50	PHYSICAL LINKAGE	
51	VISUAL LINKAGE (views)	
52	ATTITUDE & CHARACTER	CHARACTER
53	SPATIAL QUALITY	CHARACTER
54	BUILDING IMAGE	CHARACTER
55	QUIRKINESS	CHARACTER
56	TIME INTERWOVEN	CHARACTER
57	GOOD LOCATION	CONTEXT
58	CONTEXTUAL	CONTEXT
59	CIRCULATION (neighbourhood)	CONTEXT
60	A COMMUNAL PLACE	CONTEXT

Figure 5: Method 1; (Schmidt, R., & Austin, S. A. (2016b). Adaptable Architecture: Theory and Practice. Routledge.)

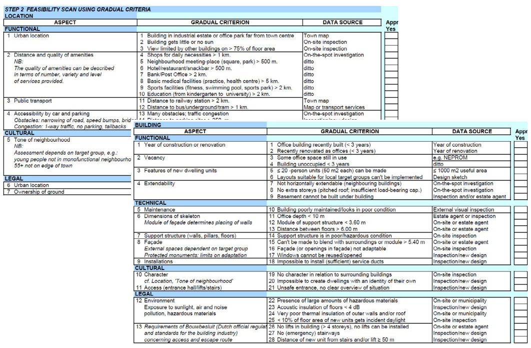


Figure 6: Method 2; (Geraedts, RP., & van der Voordt, DJM. (2007). The New Transformation Meter: A new evaluationinstrument for matching the market supply of vacant office buildings and the market demand for new homes.In W. Bakens, N. J. Habraken, K. Kamimura, & Y. Utida (Eds.), Building stock activation 2007 (pp. 33-40).THEI Printing Co.)

In order for the first sub question (SQ1) to be answers, these three methods as shown will all three be applied on the same buildings. This way a broader view of how adaptable a building is, is established. Where method 1 is executed mainly by photo and site analysis of the building, creating a more tangible connection of the adaptability of the building toward the transformation. Methods 2 and 3 focus more

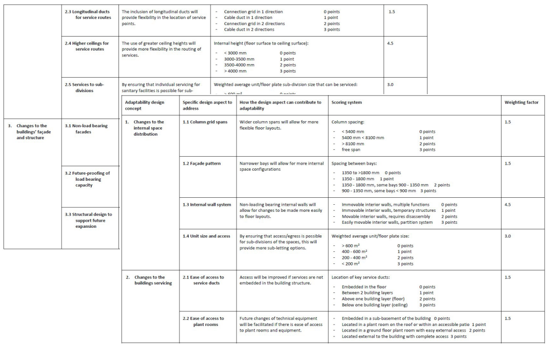


Figure 7: Method 3; (Dodd,N., Donatello,S., & Cordella.M. 2020. Level(s) indicator 2.3: Design for adaptability and renovation, User manual: overview, instructions and guidance (publication version 1.0))

on exact characteristics of the building, creating a factual basis for the analysis. For the research, these three are taken as a basis to work upon, but this doesn't exclude other finding that later can intervene during the research. If more or other extensive analysis methods are to be discovered, these can be taken into account.

After having established this basis of the analyzing methods, the next step in the process is to find a useful and applicable project (or rather projects) for the case study analysis for sub questions 2 and 3.

Why?

Problemstatement

Growing number of students and shortage in student housing

(Inter)National scale

The search for a'living campus'

Urban scale

(older) campus buildings need to stay up-to-date and become sustainable

Building scale

Universities campus buildings

Context

Student dwellings

Program

Adaptive reuse and transformation

Technology

Who?

Plan

Dwellings on campus
Using the program, the student dwellings in order to connect back to the Adaptive architecture, a technique to create

Collective housing
With the implementation of collective housing, by sharing, cooperative living and creating communities. The overall social impact of the dwellings can sustain the 'living' campus

People scale

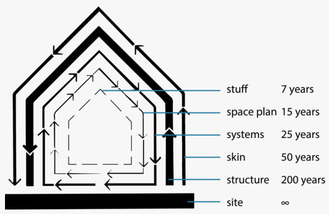
+

How?

Technique

Sustainability;
The campus needs to stay up-to-date, with a lot of buildings from different construction periods in need of change and made future proof to continue to respond flexibly and adapt to upcoming changes

Living Campus;
Making the campus area more than educational purposes, creating a vibrant heart within the city and create a place of coming together



Building scale

+

Where?

Location

Sustainability;
The campus needs to stay up-to-date, with a lot of buildings from different construction periods in need of change and made future proof to continue to respond flexibly and adapt to upcoming changes

Living Campus;
Making the campus area more than educational purposes, creating a vibrant heart within the city and create a place of coming together

Campus scale

Setup

Research

Research Question:
How adaptable are campus buildings from different construction period when transforming them to student housing?

Sub Questions:
SQ1: How can the adaptability of a building be analyzed?
SQ2: What are the spatial requirements for the student housing and how does this differ from the educational requirements of campus buildings?
SQ3: What are the technical requirements for the student housing and how does this differ from the educational requirements of campus buildings?
SQ4: How do campus buildings from the TU Delft between from different construction periods compare to adaptability when transforming them to student housing?
SQ5: What design characteristics of the TU Delft buildings make them adaptable or not?

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Outcome

Answers

Adaptive reuse analysis method
for post-world war 2 campus buildings in the specific context and program.

Design characteristics
What makes a campus building adaptive and thereby helping at the sustainability goals

Opportunities for 'Living' Campus
create ways for the development of the 'living' campus of the future by implementing adaptive reuse

RESEARCH

APRIL

- WEEK 1.9 — 11-4
- WEEK 1.10 — 18-4

Setup Research

Design vision

P1 PRESENTATION APR. 24 2023

- WEEK 2.1 — 25-4

MEI

- WEEK 2.2 — 2-5
- WEEK 2.3 — 9-5
- WEEK 2.4 — 16-5
- WEEK 2.5 — 23-5
- WEEK 2.6 — 30-5

JUNI

- WEEK 2.7 — 6-6

Research Paper

SQ1, SQ2 & SQ3 — Answering the subquestions in order to establish a theoretical literature groundwork, and being creating the analysis of Adaptive Reuse method

SQ4 — With the analysis method the cases, the buildings of the TU Delft area analised. Doing so with site visits and analyzing documents

SQ5 and conclusion — Concluding from research done in SQ4, and forming the whole of the research paper

P2 PRESENTATION JUN. 15 2023

- WEEK 2.8 — 13-6
- WEEK 2.9 — 20-6
- WEEK 2.10 — 27-6

JULI

- WEEK 2.11 — 4-7

From Research to Design

Design characteristics — Turning the conclusions form the Research Paper back into Design vision and characteristics

Location analysis and Design Brief — Determenting the location of the design question, and creating the design brief to further narrow down the design vision into facts and figures

SUMMER BREAK

DESIGN

SEPTEMBER

- WEEK 3.1 — 6-9
- WEEK 3.2 — 13-9
- WEEK 3.3 — 20-9
- WEEK 3.4 — 27-9

Design Brief — Finetuning the design brief to establish a clear vision of what the design is to be

Building analysis — Getting a clear overview of the chosen adaptive reuse building, and understanding the building from every aspect

Design variants — Variant study on the use of adaptive reuse and the eventuality of additional building(s)

OCTOBER

- WEEK 3.5 — 4-10
- WEEK 3.6 — 11-10
- WEEK 3.7 — 18-10
- WEEK 3.8 — 25-10

Working out Design — Working out a Design based upon the variants for before. Creating drawings, plans, sections, ext. for the upcomming P3 presentation

NOVEMBER

P3 PRESENTATION NOV. 13 2023

- WEEK 3.9 — 1-11
- WEEK 3.10 — 8-11
- WEEK 4.1 — 15-11
- WEEK 4.2 — 22-11
- WEEK 4.3 — 29-11

Technology — Zooming in to the certain technologies where futher detail is needed. Such as Building construction or details

Zooming out — Seeing the design not only as a individual project on its own. But zooming out on location, technique and program to reflect

Working out Design — Working out a Design based upon the P3 presentation and the futher development. Creating drawings, plans, sections, ext. for the upcomming P4 presentation

DECEMBER

- WEEK 4.4 — 6-12
- WEEK 4.5 — 13-12

P4 PRESENTATION DEC. 15 2023

- WEEK 4.6 — 22-11
- WEEK 4.7 — 29-11
- WEEK 4.8 — 13-12
- WEEK 4.9 — 20-12

Technology — Zooming in to the certain technologies where futher detail is needed. Such as Building construction or details

Wrapping up Design — Creating renders, visuals, sections, ext. for the upcomming P5 presentation

2024 JANUARI

- WEEK 4.10 — 10-01

P5 PRESENTATION JAN. 19 2024

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