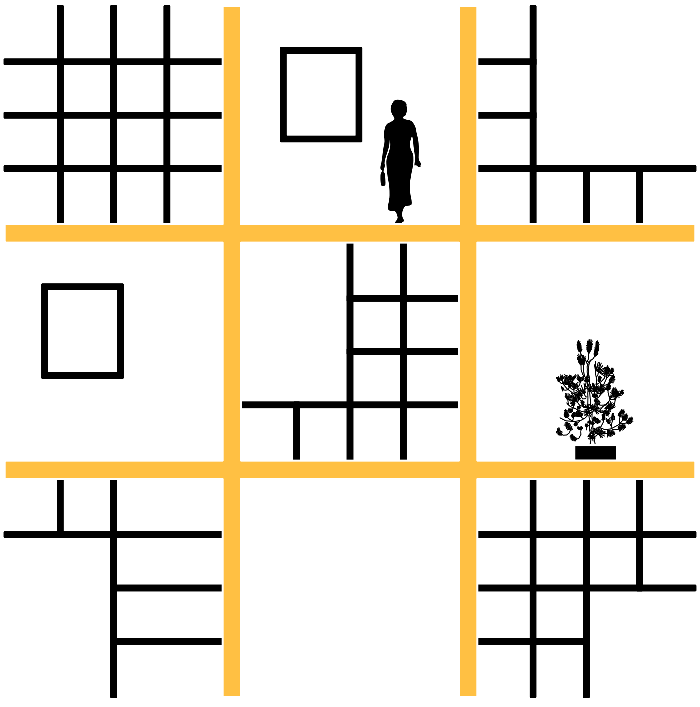

A NEW TRANSFORMER

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Group 22
ARCH04
AAU

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A NEW TRANSFORMER

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ABSTRACT

This master thesis is engaged in the transformation of a 1950's transformer station in Copenhagen, renewed to accommodate living quarters for temporary settlements, and a public communal space.
The transformation incorporates theoretical discourses on both the topics of altering architecture, and structuralist tectonic ideals trying to encapsulate a framework of working towards adaptability and durability. The project investigates the reprogramming of the original building, with the implementation of two new structural components- each with their own temporal and adaptable character. These components facilitate and initiate the renewed life implemented in the building, while working towards enabling future alterations of a less irreversible character. This is fused with structural analysis using FEM software and with detail studies investigating assembly and functionality. The general building is upgraded towards meeting building regulation standards using the IDP methodology.

READER'S GUIDE

This Master Thesis is captioned into seven chapters. The first is the introductory chapter containing the introduction, project theme and methodologies. The second is the theoretical chapter, developing the theoretical framework of the project. The third chapter will elaborate on the site specifics and building analysis and registrations. The fourth chapter describes the programmatic framework of the project. The fifth chapter will take the reader through the design process, ending in the sixth chapter, presenting the project proposal. Lastly the seventh chapter concludes the project in the form of an epilogue, followed by the appendix, and reference and illustration lists. All referencing has been done according to the Harvard Method.

ill. 7.01: Main Structure

INTRODUCTION

Since the earliest settlements, the landscape surrounding humans has been in a constant state of change. This man-made landscape is not only an endless resource of our historical heritage, but the framework in which many architects are working today. Many countries have experienced a seemingly constant migration towards the larger cities since the industrialization, further pressurizing city development.

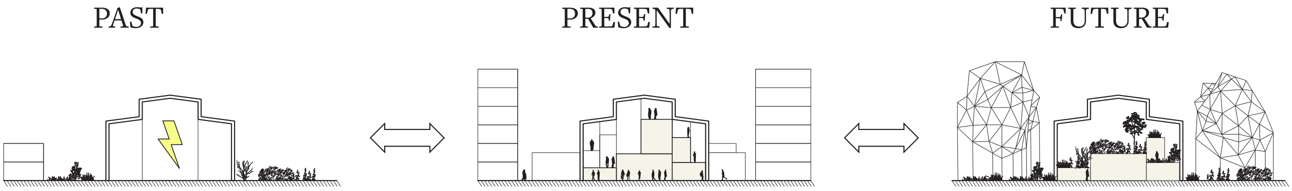
The agent engaged in this development is often faced with obstacles from these cities primarily being made of already existing built fabric, some of which are containing cultural and historical values, and thus should be met with an increased awareness of why, when, and how to preserve, transform, and demolish.

When engaging in preserving cultural heritage one not only allows the coming generations to experience and enjoy works of our common ancestry and to feel a historical coherence and connection. Preserving our build history is an endeavor in which knowledge and skills are encapsulated, where future generations might gain valuable insight both within the accumulated knowledge of our civilization. When destroying cultural heritage one robs future generations from its potential relevance and value. Eugene Viollet-Le-Duc argues that through historical knowledge and understanding, one can enter the polemics of contemporary society with potentially newly found relevance.

“And if these archaeologists occasionally leave the dust of the past to throw themselves into polemics, is not time lost ; for polemics engender ideas, and induce a more attentive examination of doubtful problems ; contradiction helps to solve them.”

(*Viollet-Le-Duc, 1875, p. 17*)

Thus presenting a somewhat Hegelian view on the dialectical process of history, and its relevant value in “showing the way forth”. (Thyssen, 2012)

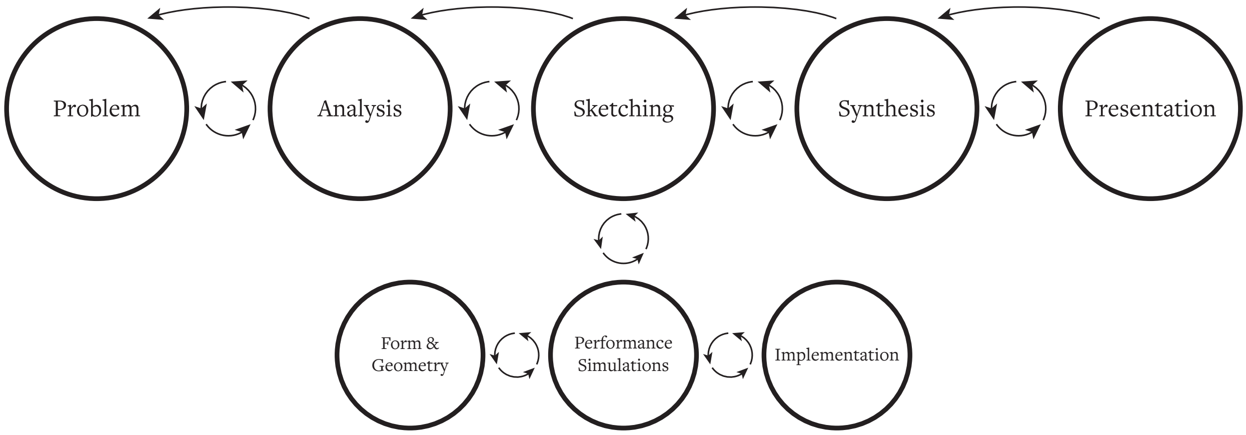


ill. 11.01: *Project Theme*

PROJECT THEME

This project will investigate the art of transforming an industrial 1950's transformer station. By introducing a new program, the design seeks to revitalize and maintain the buildings relevancy in a new and constantly changing context. The design will seek to answer questions on how one goes about translating a building from past to present and prepare it for an unknowable future.

How does one extend a buildings life-cycle, and enhance its livability in a contemporary zeitgeist? By introducing different theoretical viewpoints which all have the common investigative framework; *Time and Change*, the project seeks to illuminate the question of how to approach alterations in architecture. This will be mixed with theoretical studies on program specific necessities and theories regarding general livability.



ill. 12.01: *Methodology*

METHODOLOGY

To devise and ensure a holistic methodological approach for the project the methodology of the Integrated Design Process (IDP), by Mary-Ann Knudstrup, is combined with the framework of Performance-Aided Design (PAD), by Dario Parigi.

The IDP is a problem-oriented methodology which demands an iterative process of analysis, sketching, and synthesis. The method is developed for the creation of sustainable architecture and emphasizes early technical ambitions and a collaborative multidisciplinary design processes. (Knudstrup, 2004)

The PAD methodology seeks, similar to the IDP, to create holistic designs, however it does so in a computation - oriented framework.
It utilizes performance simulations to generate feedback loops for informed decision-making in the process to seamlessly integrate feasible solutions that synthesize influential parameters. The simulations make way for added parametric complexity and is a viable tool for streamlining decision-making on the basis of informative feedback. (Parigi, 2014)

The basis for performance investigations with continous finite element investigations, the project has an informed design loop seeking to verify and optimize the structure. This methodology will be utilized for technical designs and solutions whereas the overall methodology will be the IDP seeking to unify the entirety of the project.

TRANSFORMATION METHODOLOGIES

In the article *Arkitekturens transformation- fem metoder* five different methods of analyzing and handling a building that is to undergo either conservation or transformation is described. (Andersen, 2015)

These methods range from a general evaluation of the building within what is referred to its historical, technical and the phenomenological context, its different scales of interest, its architectural tectonic and spatial character and two methods describing how one can systematically conceive of different design approaches and concrete acts of intervening.

METHOD 1

The Technical - Historical - Phenomenological (THP) -method serves as a tool for analyzing, valuating and understanding the existing building and its context within the historical, technical and phenomenological perspective.

" The THP(red.) method specifies how one should seek to understand the building intellectually and emotionally throughout all the building phases. The building can be understood both as material and technique; it can be analyzed as part of a longer historical continuum, and acknowledged as an immediate sensual experience."

(Andersen, 2015, p. 72, (trans.))

The technical perspective serves as a way of understanding the building within its structural, material and technological framework. What building technologies and techniques were used during its construction, and how can they be altered, preserved or utilized when transforming the building? What is the structural and material shape of the building?

The historical perspective aims to understand the buildings historical and contextual relevance and presence, the buildings cultural value and its originality. This can be in dialog with the technical perspective, where building technologies and techniques can be viewed through the historical lens, as being of special interest and value. The historical perspective is not only meant as a way of understanding the building, but its connection to its local and cultural context.

The phenomenological framework is a way of studying the building on an emotional and sensory level, in order to aim for an understanding of the buildings and its contexts subtle atmospheric and spatial qualities.

These three different categories should be viewed as having reciprocal valuation, making these dependent of all levels to be understood simultaneously, when trying to understand a project.

METHOD 2

This method describes three different scales in which the building and its surroundings are to be investigated and understood. The method title Landscape – Still life – Portrait is derived from three archetypical genres within the art of painting, and is a systematic and yet abstract way of analyzing and recording the character and quality of a project.

"The landscape image relates to the large scale: the spatial extension, the slightly curved fence, which combines the far-reaching grass field with the sky, the relation between the close and the distant. The Still-life image is engaged with the middle scale: It is not so much the objects in themselves, but rather the entire configuration, the spacing and the relation between the parts, which is interesting. The Portrait painting pictures the portraited posture, characteristic details and possibly a mental state."

(Andersen, 2015, p. 77 (*trans.*))

These three lenses in three different scales are meant as an approach, where one approximates an understanding of the building and context on all levels; from contextual relations and qualities to the material usage and patina e.g, using the supplemented methods as themes of investigation.

METHOD 3

With the "Skin – Meat – Bone" method the building is deconstructed into its different reciprocally dependent constituent parts; the façade (Skin) the volume and spatial configuration (Meat) and the structure (Bone), extending the framework of Gottfried Sempers four basic architectural elements. (Andersen, 2015, p. 78) This is both as a means of analyzing the different relations and qualities between these basic architectural components, but refers additionally to the different drawing formats- the elevation (Skin), the plan (Meat) and the section, in which these elements should be visualized and investigated. (Bone) The building components is finally evaluated on the estimated lifespan for each part; the façade (Skin) with an average lifespan of

20 years, the spatial configuration and interiors (Meat) with an average of 7-15 years, and finally the structure (Bone) estimated to last on an average between 30-300 years, making it the longest lasting component. This information is used when the building is valuated, and should be kept in mind when making new alterations, in order for future transformations to be possible. (Andersen, 2015)

METHOD 4

The View – Throw – Project method describes a way to separate the design process into three different methodological phases. The initial phase (View) contains the valuation, registration and analysis of the building and its context by using the preceding three methods. The objective of this phase is to obtain a holistic understanding of the building and its context, to a degree in which one can determine what is worth preserving, and the intentions and limitations of the transformation. (Andersen, 2015)
In the second phase (Throw) one is encouraged to momentarily forget the preceding phase and to engage in a more open minded process of synthesizing different proposals, incorporating some of the obtained knowledge from the first phase, examining different transformation possibilities.

In the last phase (Project) the intentions regarding the transformation approach are clearly elaborated and the project is developed with increased precision and detail within all scales and components. (Andersen, 2015)

METHOD 5

The last method describes different architectural interventions and actions that can be used during a transformation project. The different approaches is removing existing material (Subtraction), reconstructing missing material and elements (Reconstruction), repairing existing material and elements (Reparation), transforming existing material and elements (Transformation) and adding new material and elements (Addition). The different strategies for architectural intervention, when transforming a building and context, should be approached within the framework of the preceding methods. (Andersen, 2015)

Chapter 2 *theory*

This chapter contains the investigated theory and emphasizes on two topics in particular; the transformation of buildings as well as what makes humans thrive in their living conditions.

It is therefore an investigation of architectural discourse in regards to both of these topics, and is the groundwork for the applied theory of the project.

The chapter contains:

TRANSFORMING ARCHITECTURE

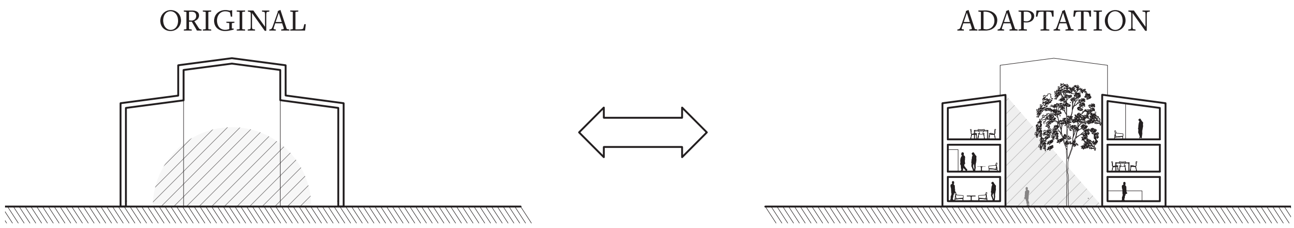
The discourse of how one approaches and intervenes in architectural heritage has been characterized by a longstanding and continuous controversy. Most notably are the dialectical discourses propagated between John Ruskin and Eugene Viollet-le-Duc. Ruskin represents a kind of romanticism of the ruination and authenticity of buildings, perceived as having an intrinsic right to decay without being altered from their original state .(Scott, 2008) Eugene Viollet-le-Duc proclaims of a more pragmatically oriented approach, where the buildings authenticity and history is secondary to a building that lives up to contemporary technical standards and programmatic needs.

"While the architect entrusted with the restoration of an edifice ought to be acquainted with the forms and styles belonging to that edifice, and the school to which it owed its origin, he should, if possible, be still better acquainted with its structure, its anatomy, its temperament ; for it is essential above all things that he should make it live."

(Viollet-Le-Duc, 1875, p. 49)

Whereas one could mistakenly seek to preserve an idealized and romanticized view of a certain building (and/or element(s)) in an arbitrarily conceived point in time, Viollet-Le-Duc would argue that one should first and foremost make the building "better" both in its technique and materials as well as make it in such a way in which future restorations are less likely, through an intrinsic and thorough understanding of a buildings construction, anatomy and temperament, and secondly make it truthful to a specific moment in history or stylistic context, including how and what techniques and materials where present and used during its time. The idea of a buildings intrinsic authenticity and stylistic integrity is questioned even further in the discourse presented by Fred Scott, where with reference to efforts in restoring Le Corbusier's *Les Quartiers Modernes Fruges* in Pessac, he asks of how one goes about determining its *"ideal or authentic"* state. In the case of Pessac, is it right after finished construction or years later as its inhabitants takes over making their own "vernacular alterations" as described by Philippe Boudon, Fred Scott argues against the simplistic perception of valuing surface and structure with their patina and decay, over functionality, atmosphere, and contemporary and historical relevance. Fred Scott believes that one cannot arbitrarily determine the "correct" state of a building, without making the mistake of excluding its organic and temporal character within a contemporary and historical context. Similar to Viollet-Le-Duc he wants to avoid making romanticized anachronisms, and seeks a more nuanced perspective on how to translate a building from the past and prepare it for the future. (Scott, 2008)

Scott argues that conservation, restoration and alteration is essentially the same endeavor. The job of the "intervening" architect is to engage in altering the building through stripping back the building, which means understanding the building intrinsically. Through interpretation and "informed



ill. 19.01: *Adaptation*

imagination", the task is to determine its ideal state and bring forth qualities in the building, some of which might be exposed throughout and as a consequence of the alteration.

"No work of restoration should be attempted without knowing all that there is to know of the host building, materially, spatially.[...] *Even then any such restorative work will be arbitrary, that is needing judgement and imagination as well as learning to be carried through. All investigative and analytical work will only take you this threshold where decisions are needed. It is work for the informed imagination."*

(Scott, 2008, p. 123)

When doing an architectural intervention one has the potential to make what Fred Scott calls *the privileged view and behaviour* where one through the alteration is allowed a new mode of behaviour or point of view within the building. Through cutting, reprogramming and reorganizations of the existing built fabric one is shown, or allowed, what was previously excluded from the user, thus altering ones qualitative experience of the building.

"One now moves as in a ruin, in a way previously accessible only to the intruder or the thief, seeing the building from new and privileged points of view."

(Scott, 2008, p. 99)

Fred Scott proclaims that architectural alterations are essentially a way to translate a building through the ages, and a method of addressing its temporal context, while embracing change. An intervening architect is thus responsible for its temporal presence and relevance.

"The relationship between interventional design and architecture is as the relationship between temporality and timelessness, while one takes note in passing that temporal is different from temporary. The interventional designer is an agent of temporality, of change and of altering styles of inhabitation. [...] *If a building is to be altered, chances are it will be altered again. The designer therefore has responsibility for a building's past, its present and indirectly its future. The interventionist makes a contribution to a continuum, which is the life of the host building."*

(Scott, 2008, p. 152 - 153)

SUMMARY:

- Make the *building better* and bring it back to '*life*'
- Work with *interpretation* and the '*informed imagination*'
- Take on responsibility for the *temporal character* of the building
- Bring forth *intrinsic qualities* in the building
- Incorporate *privileged behavior and view*

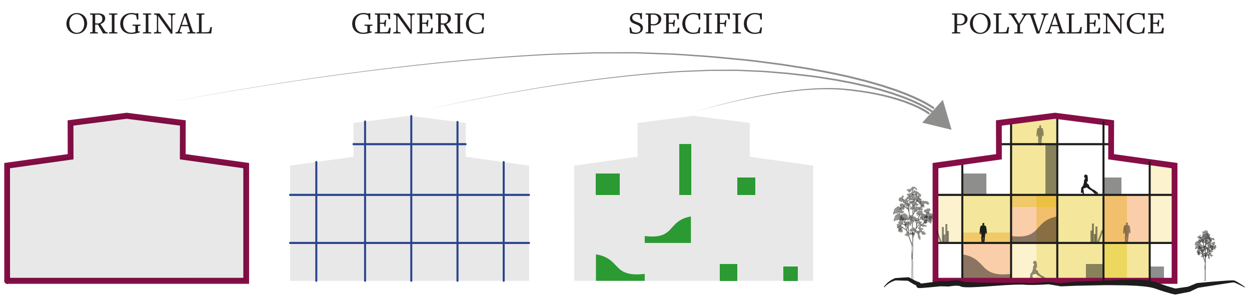
ARCHITECTURE AND CHANGE

If the task of an intervening designer is of responsibility towards the temporal continuum of the architectural project, one is faced with the obstacle of how to prepare it for an unknown and interchangeable future. How can one revitalize and renew a building in the contemporary zeitgeist, while also maintaining its relevancy and prolonging its lifespan?

This can be addressed with structuralist ideas as expressed by Herman Hertzberger. In his theoretical writing *Architecture and Structuralism* the idea of architecture made for and allowing change and alterations are developed. He proclaims for an architecture conceived of as a *work in progress* and not as an idealized and finished object, created and concluded in the mind of the responsible architect.

Architecture should be conceived of as a process rather than objects in space, and should be understood and evaluated by how it interacts and adapts to its environment and temporal context. Rather than making obstacles for future usages by limiting its scope of programmatic and experiential capacity, the architect should engage in encouraging modes of usage and reuse, through innate qualities in the spatial and tectonic character of the building. Rather than making a *made to measure* building specialized towards meeting a prescribed design brief as effective and exact as possible, one should design as to leave room for a potential future. One should aim for a structure that is both restrictive and interpretable, allowing the unknowable to emerge and blossom. This means in practice, that the architects should oversize the spaces, and exaggerate the structures strength and stability, as to allow for a margin of uncertainty. Hertzberger sees this capacity for embracing the emergent, as a preceding truism for a sustainable architecture. (Hertzberger, 2015)

The architect should think of designing as “defining the rules of the game”, in which narratives are played out in time. One should design an architecture that encourages, makes gestures and is itself interpretable for alternate interactions, rather than enforcing a certain set of behavior.



ill. 21.01: *The Work In Progress*

"The end-result on offer must be open to being identified and identified with, and must also be mentally appropriated as if 'the idea' of something the users have made manifest themselves. [...] *It is possible to add to it or subtract from it. In other words, it is programmed less like an apparatus than like a musical instrument, which in itself is a possibility (or rather a potentiality) and only comes into its own when played"*
(Hertzberger, 2015, p. 118)

Aiming for openness and interpretability in architecture would give associations towards neutrality and indifference. This is not meant as meaning lack of identity. Contrary it should be conceived as the constituent of three reciprocal layers. Hertzberger introduces the three notions of the *generic*, the *specific* and *polyvalence*. The generic should be understood as the overall framework stripped from predefinitions and allowing it to be defined progressively, while acting as a general linkage, keeping the design together in a conceptual sense. The specific is the infill allowing for fluidity, while giving the design its temporal identity. Polyvalence is a forms capacity for interpretation, understood as an intrinsic quality that induces an opportunity or idea in the user. (Hertzberger, 2015)

In short the generic can then be thought of as the undefined and unifying framework, interpreted by specific infill giving it definition and identity, enabled through qualities of polyvalence.

This notion of generic and specific (frame and infill) can then be translated into more specific tectonic qualities, perceived through the progression of time and change. The building should be perceived though an explicit tectonic order characterized by permanence and long time-cycles, and its interplay with short time-cycled adaptive usages and inputs. Hertzberger insists on the importance of the permanence of the structure (as in the overall traits and frameworks of the building) and our ability to determine what is to be preserved and changed, making a hierarchy of temporal endurance. (Hertzberger, 2015)

"What in music is called a cadence, a unifying element in time, can in the context of space be conceived of as the means of holding that space together. In structural terms, we call

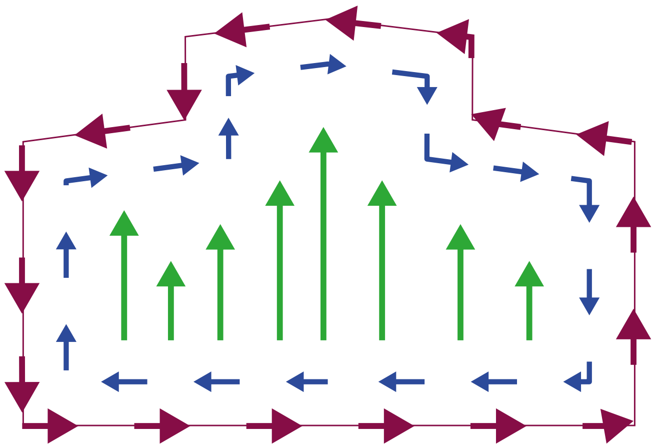
it tectonics and in general it refers to relatively weighty components, structural walls, columns, arches and the like. As a repetition of units with identical qualities, these form the overall frame- structurally in the literal sense but also figuratively as shapers of space. Their fundamental space-defining impact gives them a more permanent character within which, as with the infill of a concrete frame, more time-bound additions can do justice to needs with a shorter time-span"
(Hertzberger, 2015, p. 168)

This tectonic duality should not only allow for future interpretations and alterations, but encourage and make gesture as a catalyst for stimulating the imagination of the usage. Hertzberger uses the example of the university building for the Faculty of Architecture in Delft, which relocated after burning down in 2008 into a vacant brick building having more of an industrial presence than that of an educational building. The ad hoc and impermanent appearance between the building and its new usage instilled a sense of temporality and incompleteness, encouraging the students to imagine how they could go about making further alterations, and how it could have been different. (Hertzberger, 2015)

"[...]*These 'stimuli' must be so designed as to evoke images in everyone's mind; images which, through being projected into his experiential world, will result in associations that encourage individual use, that is to say, the very use that is most appropriate for his situation at that particular time.*
(Hertzberger, 2015, pp. 103-104)

Architecture and tectonics should act as an offer and a spark for the imagination, allowing for a variety of experience by having just enough associative stimuli for it to emerge, while not narrowing and limiting its scope of diversity. Hertzberger would argue that this should not only be in relation towards the individual user, but act as an engine for social engagement and collectivism. (Hertzberger, 2015)

"On the one hand, the structure stands for collectivism but, in the way it allows itself to be interpreted; it represents the parameters for any separate individual, and so manages to reconcile collectivism and individuality. Besides the bastions of sectional interest, what is particularly important is ensuring shared interest. Architecture is to



ill. 23.01: *Rates of Change*

create space for shared concerns; in other words, what brings and keeps people together."
(Hertzberger, 2015, p. 96)

In his polemical writing *How Buildings Learn* Steward Brand advocates for a similar architectural discourse; Buildings that are built for change, in which maintenance, functionality and longevity of building components are primary design engines. He describes how a building should be understood in its different 'rates of change' expressed in six different *shearing layers*. These are Site, Structure, Skin, Services, Space plan and Stuff. Structure (ca. 30-300 years) is the essential component in building conservation as it is the one which outlasts the others, and according to Steward Brand, can be conceived of as being 'the building'. Services get changed every 7-15 years, as technologies change, and if too embedded into the building to be repaired easily, a typical reason for it to be demolished. The Skin is the exterior façade and last typically 20 years. The space plan change depending to usage and program and stuff (furniture etc.) change weekly-monthly. It is essential to allow for intervention in correspondence to the different rates of change without disturbing or destroying elements that change at different rates.

"An adaptive building has to allow for slippage between the differently-paced systems of Site, Structure, Skin, Services, Space plan, and Stuff. Otherwise the slow systems block the flow of the quick ones, and the quick ones tear up the slow ones with their constant change. Embedding systems together may look efficient at first, but over time it is the opposite and destructive as well."
(Brand, 1995, p. 20)

Architecture should learn from previous experiences in buildings techniques with vernacular styled buildings as the primary source of collective experience and knowledge. One should investigate into how buildings have adapted through times to pragmatically solve the necessities and amenities of its occupants, and not as much due to the fashions and styles of its zeitgeist. With inspiration derived from Darwinian natural selection, Steward Brand proclaims for an architecture that gains its fitness by hindsight rather than foresight, stressing on the impossible task of predicting the future. Rather than working towards an over specified program- one should design towards a variety of scenarios, all deducted in collaboration with the user. The design that solves most scenarios, in the best way would then be considered more robust for future uncertainties, than if designed specifically in regards of the present amenities and needs. One should design a building with areas that are “raw and uncooked” (a term that bears resemblance the Herman Herzberger’s notion of the generic), with its structural and spatial capacity in surplus, in order to make way for *future hindsight*. The more specific a design is made to a present amenity or technology, the more likely it is to become maladaptive towards the future. (Brand, 1995)

SUMMARY:

- Design with the *Generic, Specific, and Polyvalent*
- Make room for *uncertainty*: Leave spaces uncooked and with surplus capacity
- Create a *tectonic order* as an explicit visual link
- Make the design as a *Work in Progress*
- Implement *‘stimuli’* for the imagination
- Create a *playground for the collective*, driven by their shared interests
- Work with the different ‘*Rates of change*’

ill. 25.01: *Generic, Specific, & Polyvalent*
Photo: Michael Müller

LIVING ENVIRONMENTS

To redefine and program housing for contemporary living one must define what are the needs for the users. The architectural qualities and the functions should be in a reciprocal relationship where they together create added value and uniqueness. In the book "Bo-miljø" by Ingrid Gehl, the living-environment is defined as everything the user experiences e.g. textures, surfaces, space, volumes and the space between them. Additionally comes all the related social processes. (Gehl, 1971). The living-needs are categorized by three general categories; the physiological needs, security needs, and the psychological needs. The two first groups are broadly considered to be covered by the regulations and building laws in Denmark. However, the psychological needs are not as easy to translate into law, and these are relevant when experimenting with new typologies. What do people need to feel at home?

Gehl describes eight basic psychological categories that should all be considered when designing well-functioning living-environments; *Contact, isolation, experience, activity, play, structuring, identification,* and *aesthetics.* (Gehl, 1971)

Gehl puts the perceived physical environment into four main categories and through these investigates the different psychological needs to find ways of implementing the considerations into design. The four categories are:

- Dimension of environment
  Height, length, width
- Arrangement of the environment
  Objects/facilities in the space
- Location of environment
  The environments relation to objects
- Sensory stimuli from the environment
  All elements related to sensory perception

(Gehl, 1971)

CONTACT

Dimension of the environment:
You can observe people from 100 meters away, but not their faces. This requires around 10 meters. As well as designing niches for people to feel safer, as opposed by large open spaces or long flat walls. It can also be very difficult to establish vertical contact over 3 stories or more.

Arrangement of the environment:
Here the main drivers are the functions placed in the spaces. People are likely to establish contact over functional activities such as washing rooms and kitchens. Things like sports activities, clubs and bars that are more recreational create a slightly different type of contact.

Location of the environment:
The location of the environment can create contact through the fact that people are moving through or past the space, as well as if people are able to be observed from the space. Gehl emphasizes the need for a building to have one façade facing a busy road as well as visible common functions.

Sensory stimuli of the environment:
The environment can help to create an experience of movement for people. Here things like traces of writing, or sounds of steps and voices can create a feeling of passive contact. (Gehl, 1971)

ISOLATION
Dimension of the environment:
This can be used to emphasize the feeling of isolation; vast spaces can make a person seem small or alone. Small rooms can strengthen feelings of safety and security.

Arrangement of the environment:
Inside, this need can be satisfied through creating small units or niches where people can isolate themselves. Outside, it can be achieved through juxtapositions of walls, terrain, or by plants.

Location of the environment:
Isolation is increased when fewer people are present. This can be achieved by avoiding disruptions by circulation and visual connection.

Sensory stimuli of the environment:
The fewer sensory inputs from the outside one receive, the higher the degree of isolation. blocking sounds, views, smells, and movement caused by other people are increasing factors. (Gehl, 1971)

EXPERIENCE
Dimension of the environment:
Movement through a space, shifting room sequences, contrasting scales are all increasing factors. The pace of which one moves through a space can influence the experience. The perceived activity level of the room can also be influenced by the size of the room. The smaller the room the higher the activity level feels.

Arrangement of the environment:
This can be used in a vast variety of combinations to create different experiences in the different parts of the room. Plants, sitting spaces, and the enabling of varied human activities and combination of these have a large impact in this category.

Location of the environment:
The presence of other humans play a significant role. Varied

physical environment and closed spaces with a diverse set of physical experiences have a large impact in this category.
Sensory stimuli of the environment:
Here all the senses can be activated through a variety of elements in the space. Colours, textures, varied sound sensations through surfaces and materials all play a part. Smell, touch and taste can also be activated trough certain activities. (Gehl, 1971)

ACTIVITY
Dimension of the environment:
Most activities require some sort of designated space to reduce conflicts with other functions. By changing the balance between private area and common area one can give the possibility to boost activity on a physical and social level.

Arrangement of the environment:
This can be a limiting or a boosting factor. Limitations occur when two functions are sharing a space. Social interaction will usually leave one of the activities more dominant. It can also be a boosting factor if the environment its pleasantly and functionally optimized for its function. It is found that a non-structured layout with possibility for interpretation and alteration are usually the most well-functioning. Old playgrounds that only allow for certain types of play quickly become uninteresting as they allow for no variation.

Location of the environment:
Activity in this sense is most often done in company with others. Therefore, places that are visible or where people passes through are usually boosting factors. The distance to a certain activity is important for how likely people are to attend it. A high prioritized activity must have a good location. An estimate of 50 meters are given as a maximum distance from activity space to a certain facility for them to be used in combination.

Sensory stimuli of environment:
This describes what people can see and hear. For a place to encourage a certain activity it must be visible and acoustically usable.

PLAY
This is in largely covered by the same aspects as contact, experience, and activity.

STRUCTURING
Dimension of the environment:
The dimensions of the spaces have a large impact on one's ability to navigate and general orientation.

Arrangement of the environment:
Elements of the space can be used to better differentiate between similar spaces. Plants, furniture,

lights can be used to give the environment different markers.
Location of the environment:
Here the context is the most important factor. This can be in the form of build or naturally occurring landmarks.

Sensory stimuli of the environment:
Colours, lights and textures can here be used to help one navigate in and structure a space.

IDENTIFICATION
This is generally achieved in a well-functioning combination of the other aspects in both the physical and social. It can be desirable to leave the possibility for users of the building to have some influence on the physical or the social aspects of the environment. (Gehl, 1971)

AESTHETICS
Gehl points out that aesthetics is an important aspect of the psychological living needs but offers no specific tools for designing for it, as the term itself can be up for interpretation and the result will be subjective.

CONCLUSION
These eight aspects can be used as a way of investigating the different spaces and environments one wants to create. However, it does not offer any specific answers to what to do in all scenarios. It is important to note that this can be used as a tool but not a definitive answer.

SUMMARY:

- The dimensions, arrangements, locations and sensory inputs of a space has a significant effect on the human behaviour.
- One can ensure a good living environment by facilitating the eight psychological needs.
- The eight psychological needs are not necessarily present in each individual unit but can be achieved and boosted by accessible and flexible common spaces.
- Some aspects of the psychological needs, e.g. aesthetics, are mainly subjective and specific to each project.

INTERIORITY

What makes a building feel homely? And how can an architect design to incorporate homeliness in architecture?

This relation between building and home is within the architecture according to Marie Frier. It is the connection between object and subject in space, a relation of our human bodily scale and proportions sensuously to the objects surrounding us. This is Interiority according to Frier, and is a relation predominantly elaborated in furniture in their physical manifestation and semiotic interpretation.

Frier quotes Mario Praz pointing out furniture being moulds for the human body, coming to life in the interaction with their counterpart, as well as a mirror being a mask for the human to take on, allowing interaction between the object and subject. Praz further compares an apartment to a shell of a snail with the human and the appartments symbiotic relationship. (Frier, 2011)

Marie Frier's PhD thesis, *Interiority*, seeks to find design values which add a human connection to domestic architecture. The general state of architecture, she argues, is one with a need for effective and economical constructions to such a degree that it leads to dwellings being experienced as uninviting rather than intimate and engaging. The general notion of domestic architecture in the contemporary context is predominantly "*uninviting boxes making us feel rootless*", with a lack of common human function and emotional needs. (Frier, 2011) These functions and needs are, or rather are a lack of, the relation of the human body to, and in interaction with, the scale of the architecture as furniture.

This relation of object and subject is interpreted as gestures of the object to the subject. Frier derives at a selection of principles from furnishing and which gestures these principles can envoke. The principles range from *function*, *emotion*, *realm, construct,* and *principle* and to which the gestures of interiority are accordingly *guiding, revealing, covering, caressing,* and *embracing*.

She further elaborates that design can, through a utilization of simple principles, help achieving gestures in terms of f*olding, stretching, marking, cutting,* and *elevating* elements in the envelope creating spaces of interiority within the envelope.

Constructural elements such as the *plate, the shear wall, the beam, column, bolt,* and *screw* can be understood as physically and emotionally furnishing elements gesturing in relation to the human body and mind. This can be utilized to encourage interaction between object and subject through detailing, thereby giving a sense of connectivity between the user and the interior. (Frier, 2011)

It is the goal to incorporate gestures of interiority into the project which emphasizes both time and temporality, the subject and interaction with ones habitat through the means of detailing. The methodological approach will be similar to Frier's, analysis of design propositions in terms of gesture and principle supporting the theory of Ingrid Gehl and seeking a holistic approach for creating *homeliness* in the building.

Designed interiority will seek to emphasize the 8 psychological living needs with gestures, enhance sought atmospheres, and the ability of the elements to interact with the subject.

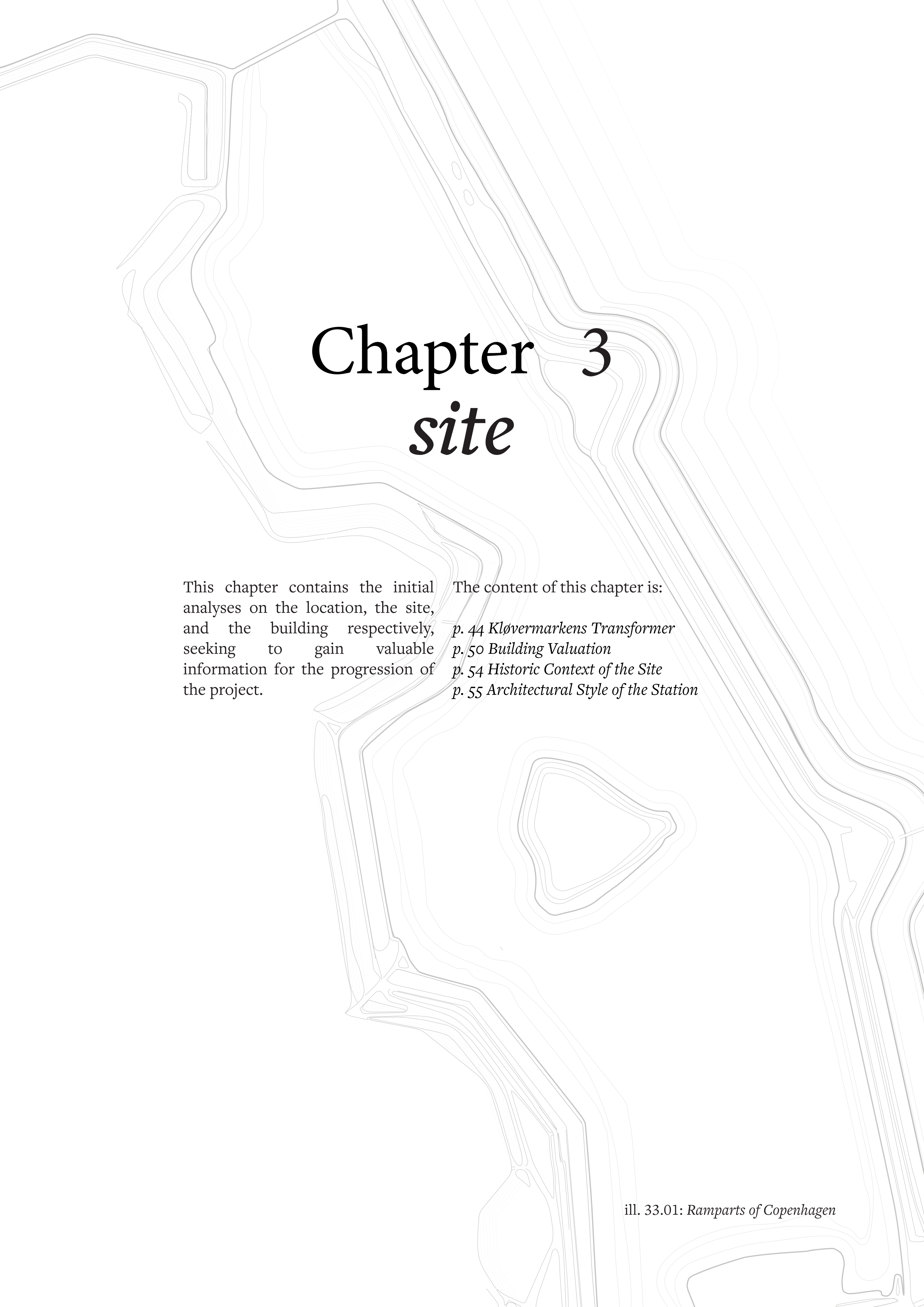
SUMMARY:

- Enhance *homeliness* with a sensual human scale
- Use *principles* to accomodate gestures
- Use gestures to emphasize living needs
- Allow for *interaction* between object and subject

Chapter 3 *site*

This chapter contains the initial analyses on the location, the site, and the building respectively, seeking to gain valuable information for the progression of the project.

The content of this chapter is:



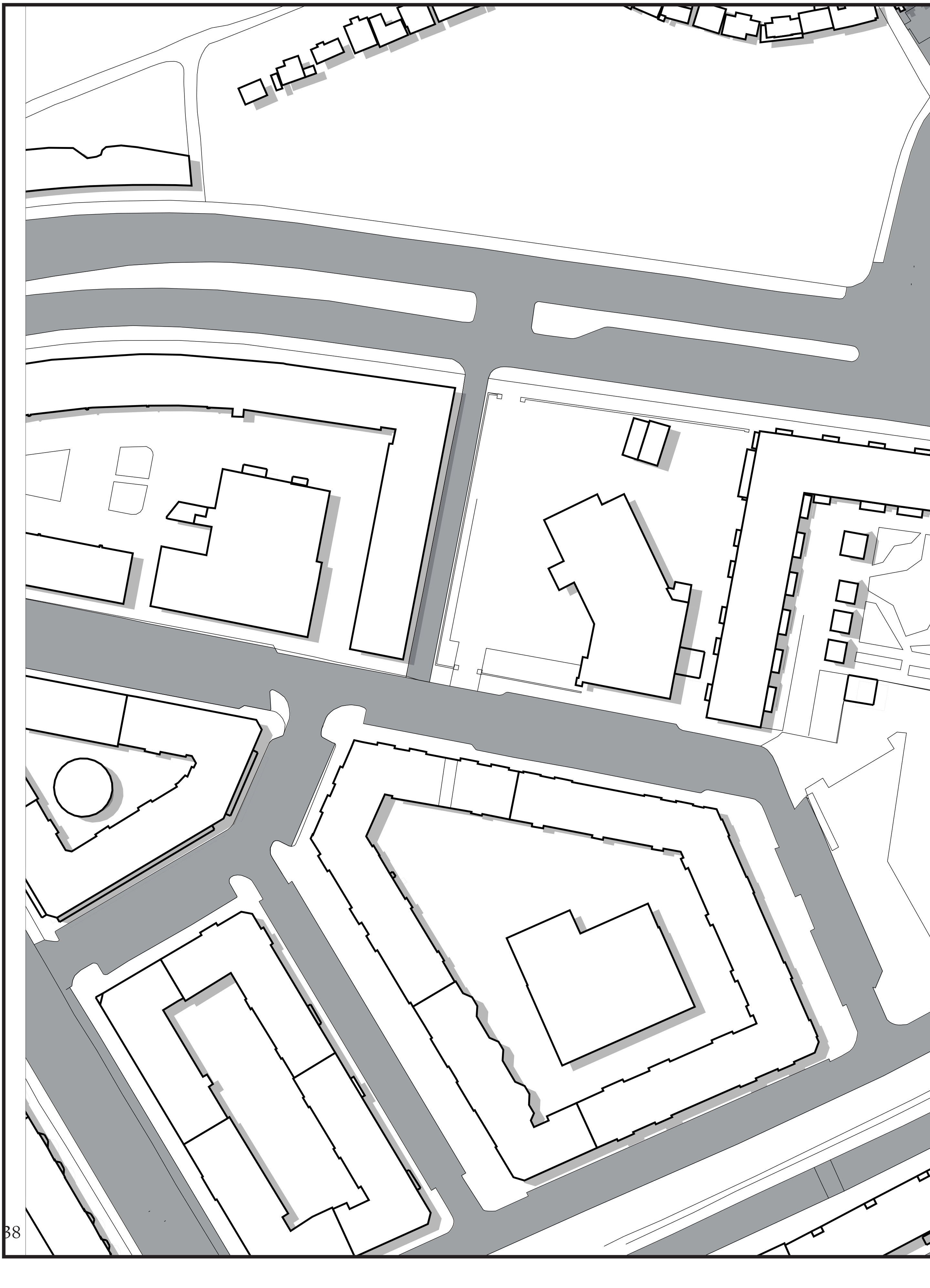
ill. 33.01: *Ramparts of Copenhagen*

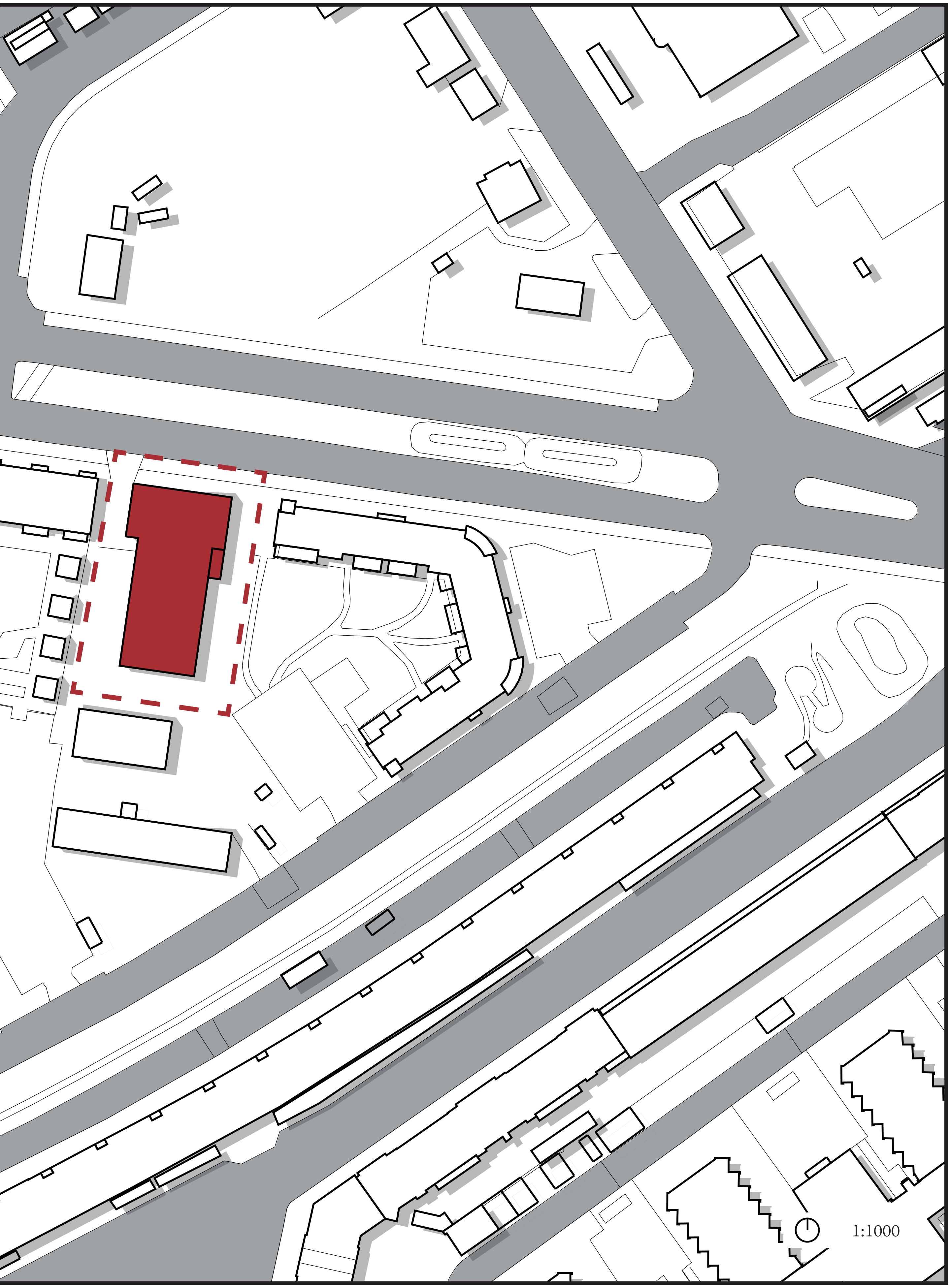
ill. 34.01: *Map of Denmark*

ill. 35.01: *Map of Copenhagen*


Christiansborg
Den Sorte Diamant
Langebro
Chris

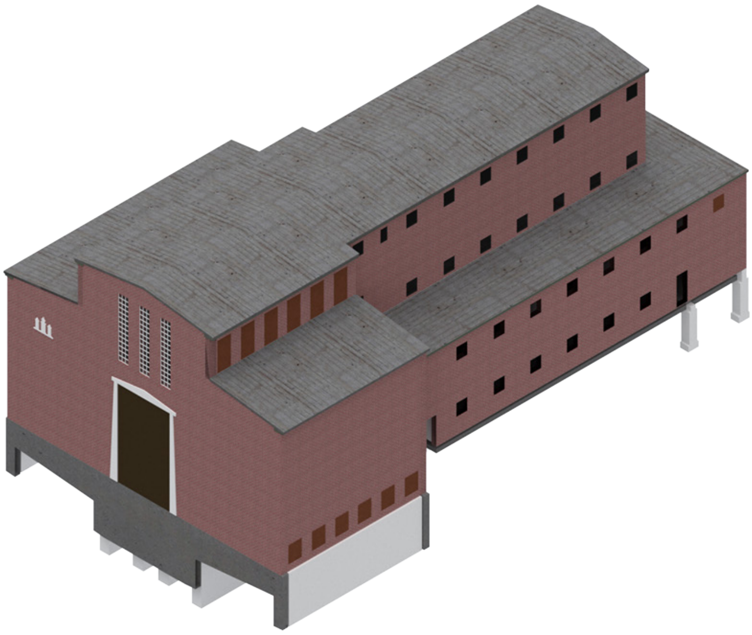
ill. 37.01: *Map of Context*





ill. 39.01: *Map of Site*

ill. 41.01: *North Facade*



ill. 42.01: *Kløvermarkens Transformerstation*

KLØVERMARKENS TRANSFORMER

Kløvermarken Transformer Station is an electrical facility built in the early 1950's and is currently operated by the company Radius. The station is still functioning as the electric distributor to the surrounding area.

The building is located on Vermlandsgade at the border between Christianshavn and Amager, with its northern facade facing Christiania and Christianshavn (ill. 43.01).

The surrounding area is built in a functionalist brick style, and consists mainly of six story residential blocks and a kindergarten just south of the building.

The transformer is made of a red brick envelope and concrete decks, columns, beams, and slabs. Having a bombastic frontal presence towards the road, its volume jumps in heights and narrows inwards towards the south.

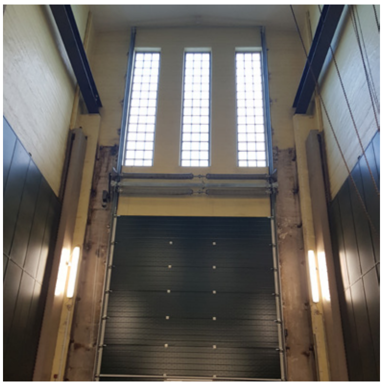
The interior consists of several highly diverse rooms, which differs both in materiality, scale and ceiling height.

When entering from the northern facade, one is met with a space of full building height, aprroximately 13 meters, (ill. 43.04) surrounded by four lower rooms of full building height. Moving further southward, the building gets segmented into smaller rooms, distributed over several floors, with colors ranging from yellow (ill. 47.03), grey and white (ill. 43.08), with black painted doors and blue frames. Each space has a variety of elements related to its functionality. These elements and details range from strips of copper and metals (ill. 47.09) attached to the walls as a safety mechanism, cranes (ill. 43.06), electrical wires, trapdoors connecting the floors, small internal openings (ill. 43.09), exposed steel I-beams and mechanical equipment.

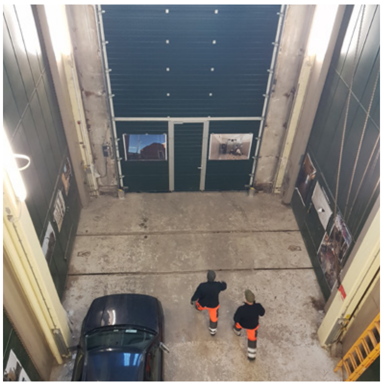
ill. 43.01: *North Facade*

ill. 43.02: *Brickwork*

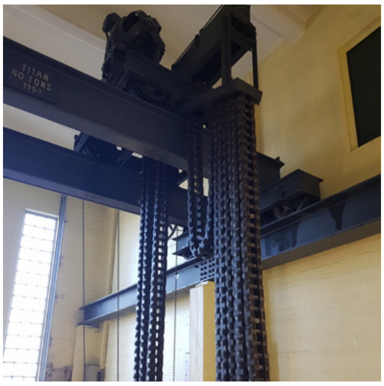
ill. 43.03: *Window Detail*



ill. 43.04: *Montagehallen*



ill. 43.05: *Montagehallen*



ill. 43.06: *Crane*

ill. 43.07: *Window frames*

ill. 43.08: *Relay Room*

ill. 43.09: *Air Vents*

ill. 45.01: *Volume Shifts*

ill. 46.01: *View from Vermelandsgade*

ill. 46.02: *View towards Vermelandsgade*

ill. 46.03: *On the facades*

ill. 46.04: *Frontal View*

ill. 46.05: *Undergoing alteration*

ill. 46.06: *Cut Wall*

ill. 46.07: *Extention Mark*

ill. 46.08: *Volumeshift*

ill. 46.09: *Recess*

ill. 47.01: *North Windows*

ill. 47.02: *Spatial Relation*

ill. 47.03: *Operator Room*

ill. 47.04: *Window / Stair*

ill. 47.05: *Room height*

ill. 47.06: *Roof Structure*

ill. 47.07 : *Window Height*

ill. 47.08: *Tactility*

ill. 47.09: *Copper Grounding*

BUILDING VALUATION

In order to make an informed evaluation of the building, a thorough analysis of its constituent elements has been made in the form of a valuation matrix. The valuation matrix describes and rates significant building components within their historical, technological and phenomenological qualities, going from its overall exterior composition, to small interior details. In this text only the central elements will be described, although many elements have been rated of special character, but not of significant preservable character.

When looking at the building exterior the essential preservable building elements is the symmetrical and stylistic appearance of the northern façade (ill. 46.04), the shifts in the buildings geometrical volumes (ill. 46.02), the window composition and the general façade brickwork (ill. 46.09). It is in the exterior façade that one finds the primary historical and stylistic character of the building, while the façade also being its main structure and thus of high technical preservability.

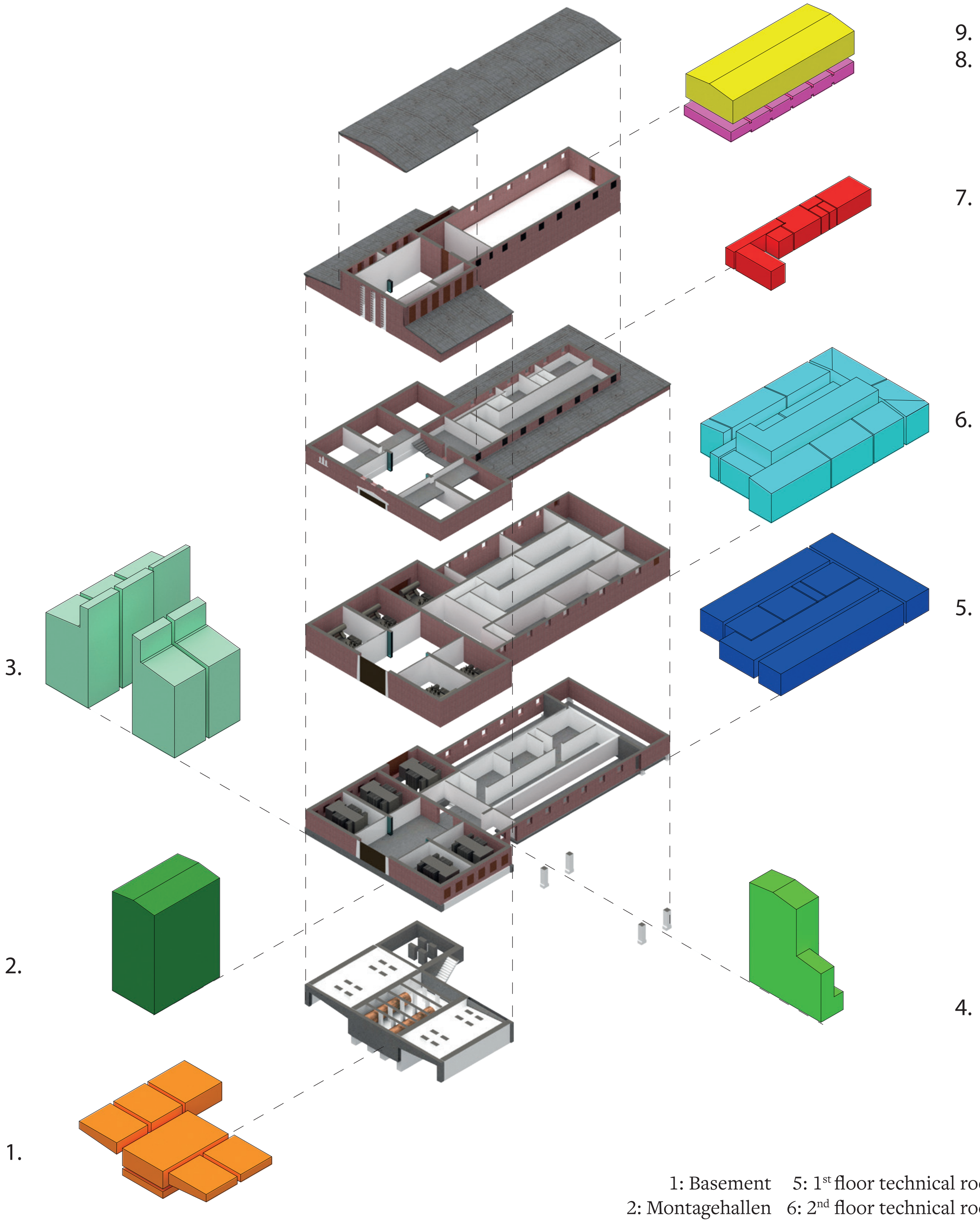
The primary interior areas of significant and preservable character are the rooms directly related to the buildings functionality and usage as a transformer station. This means the *transformer rooms* and *Montagehallen* (ill. 47.02) connecting them all. These characteristic spaces express the history and usage of the building as a transformer station, while being of great atmospheric quality and sensory stimuli, both in its surface materials, spatiality and how one circulates within them. A high amount of charismatic details expressing the narrative of the life in the building as a transformer station can be found in the Montagehallen adding to the phenomenological and historical experience of the building.

Below these spaces is the cellar which is of lesser historical significance, but is one of the most atmospheric and spatially expressive areas of the building. The upper floor containing the operator room has a charismatic aesthetical presence with its yellow painted surfaces and explicit structural roof.

The most challenging obstacles in the building are in the sparse lighting of several spaces, some of which have no exterior exposure. In the central core of the building the issue of daylight can be one that could require drastic alterations.

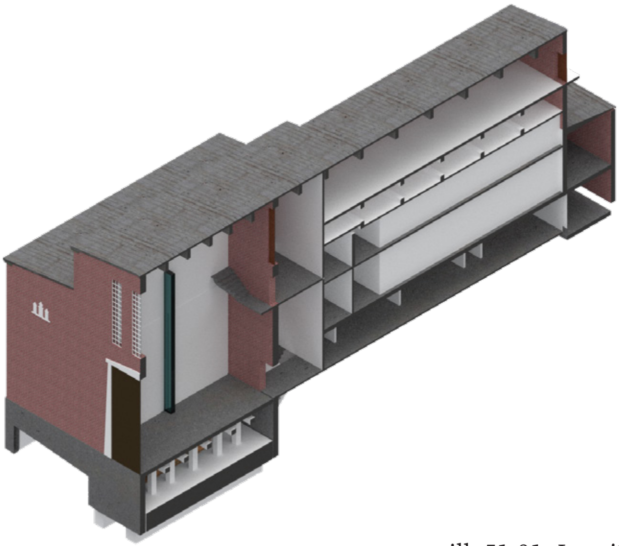
The same issue needs to be addressed in the transformer spaces, although solutions in this area require less radical interventions. In parts of the building the surfaces are deteriorating and destructive ad hoc reparations can be found throughout the interior and exterior. The building needs additional general improvements in order to live up to modern standards, these include:

- *Insulation of walls, ceiling and foundation.*
- *Noise reduction through insulation.*
- *Ensuring satisfactory daylight.*
- *Fire Requirements*
- *Ventilation*

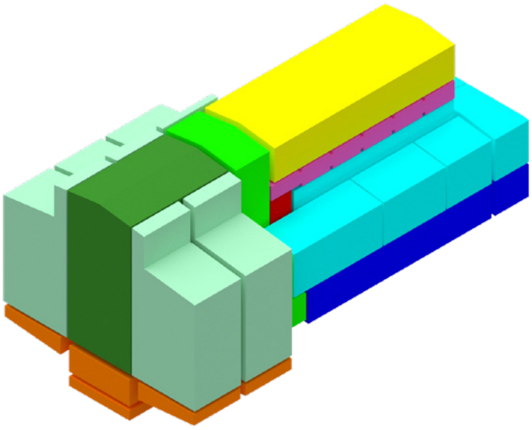


1: Basement
2: Montagehallen
3: Transformer rooms 1-5
4: Access
5: 1st floor technical rooms
6: 2nd floor technical rooms
7: Kitchen, toilets and baths
8: Cable floor
9: The Yellow Hall

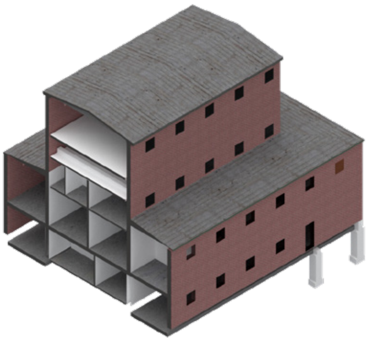
ill. 50.01: *Exploded Diagrammatic Deconstruction of the Station*



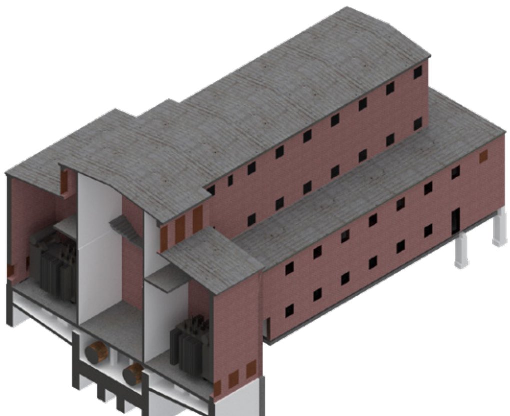
ill. 51.01: *Longitudinal Section of the Station*



ill. 51.02: *Program of the Station*



ill. 51.03: *Cross Section through Southern Part*



ill. 51.04: *Cross Section through Montagehallen*

ill. 52.01: *Aerial Photo Amager, 1930*
Photo: Dansk Luftfoto

ill. 52.02: *Aerial Photo, 1989*
Photo: Dansk Luftfoto

ill. 52.03: *Aerial Photo Amager, 1992*
Photo: Dansk Luftfoto

HISTORIC CONTEXT OF THE SITE

1950, the year in which Kløvermakens Transformer Station was erected, was a peak in the building of public housing across the country (Frost, 2015) and in these years five identical stations were built in different areas of Copenhagen.

The extensive lack of housing after WWII gave way for an ambitious plan to create equal access to welfare in inclusive modern cities. The state tried to solve the lack of housing by issuing new laws, and enabling people to borrow money from the state to build houses.

1940's and 1950's brick housing was influenced by Kay Fisker at The Royal Danish Academy of Fine Arts. Kay Fisker described his architecture as "a functional tradition". It involved combining functionality and local building tradition in terms of materials, constructions, shapes, rhythms and proportions (Frost, 2015).

This meant that the Danish architects of the period embraced the new, but without abandoning traditions. The Nordic Functionalism was hence characterized more by the shapes, materials and placements of the buildings rather than a certain style. The international building trends was interpreted through Danish building traditions and Danish materials, most often by using bricks and devoid of historic references. The use of precise geometric shapes and simple materials was defining features of the Functionalism (Frost, 2015).

By 1947 24.000 housing units were built pr. year (Frost, 2015). The Danish Engineering Union established a committee of rationalization, to simplify the execution and organisation of the building of housing units.
This rapid growth and advances in technology and welfare (TV's etc.) naturally put an increase in the demand for electrical facilities.

At the time of completion, Kløvermarkens Transformer Station was placed in an industrial area, however during the next 40 years the area would see drastic changes and the context is now primarily housing.

ARCHITECTURAL STYLE OF THE STATION

The main architectural style of the period was functionalism but looking at the symmetrical plan layout of the transformer station, and the symmetrical northern façade, it seems that the station resembles more of a hybrid between functionalism and neoclassicism. The frame of the main gate takes an almost ornamental shape, arguably a resemblance to a classical column and pediment entrance.

From 1915 – 1930 there was a rise in neoclassicism in Denmark. Carl Petersen, one of the prominent figures of early 20th century neoclassicism in Denmark, expressed some of its principles at the time.

" Things shouldn't happen at every point on a building. It is a lack of intention to place differently acting ornamentations everywhere. The buildings surfaces and rhythmical segmentations should quietly prepare for contradiction in the essential areas, where everything is put in, where the ornament or the meaningful relief outlines, that here is an essential point, I relation to which the large mass should be calm before the storm."
(Carl Petersen, 1951, p. 286 (*trans.*))

Here Carl Petersen describes how the overuse of ornaments makes them redundant and hence should be preserved for the few key places of the building.

When looking at the Transformer Station the usage of ornamentation could arguably align with these principles though mixed with an industrial tone. (Carl Petersen)

Chapter 4
program

This chapter investigates the user and the circumstances under which the user is defined. Furthermore in this chapter, the intial necessary studies with regards to the implementation of derived program are are conducted.

This chapter contains:

GIG ECONOMY

The global economy has faced radical changes as technological innovations alter and challenge our social structures and ways of living. Lately digital services as Uber, Airtasker and Deliveroo etc. have introduced new services for the layman, allowing him/her to engage, as a self-employed unit within different marked areas. This economic model is what is broadly referred to as "The Gig Economy" (Healy, Nicholson & Pekarek, 2017) Although highly associated with digital platform services as mentioned above and freelance work, it is also a more common trend in the general global marked economy.

"*Among the many consequences of this shift is that today over 40% of Americans work on a 'contingent' basis – in part-time, on-call, and contract roles – without the security of permanent employment*"

(Healy et. al, 2017, p. 234)

This leaves the question; How will people work and live in the future economy? What new opportunities emerge as digital technologies and marked trends allows for alternative and different lifestyles. A lifestyle where one not necessarily needs to live in the same place as where one works, and or where one can jump between work opportunities in different places. One such emerging lifestyle can be classified with the notion of "the Digital Nomad" In the article Digital nomads – a quest for holistic freedom in work and leisure by Ina Reichenberger this term is defined as:

"*Digital nomads are individuals who achieve location independence by conducting their work in an online environment*"
(Reichenberger, 2017, p. 8)

This type of nomadic way of living can be considered within different levels of location independency, where some will have a permanent home base, only travelling/working occasionally in changing locations, others will live and work permanently moving between different places. (Reichenberger, 2017) Where some people in the future economy will be forced into gig structured labor, becoming freelance, self-employed etc. by way of changes in the marked (Healy, Nicholson & Pekarek, 2017) others will embrace this coming opportunity as a means to be liberated from some of the limitations in the traditional labor structure, and live a life where leisure and work merges, and one is independent to move and live as one wants. (Reichenberger, 2017)

THE SOJOURNER

This project will be relevant for a general type of person defined as an archetype temporarily living in a place; *the sojourner*. The building is to be programmed to alter the contemporary metropolitan experience giving its habitants an shared experience of time and location. Reasons for temporal settlement vary, but in order to specify a program a few types are selected.

THE WORKER
Freelance- and posted workers

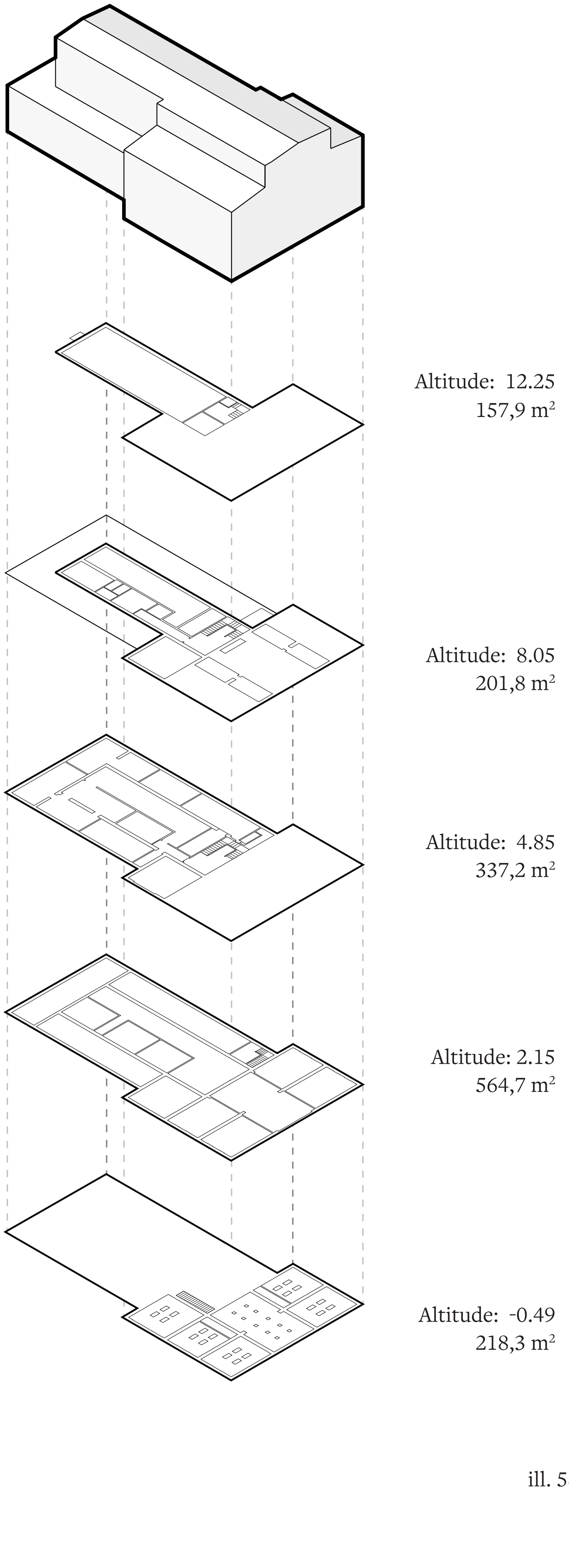
This person might only seek temporary accommodation during this period, or he might be looking for a place, where a predictable work routine and informal social encounter can happen simultaneously. The sojourned worker might desire to find a social gateway to maximize their experiences throughout the stay.

SOJOURNING LIFESTYLE
Digital Nomads

The Digital Nomad is very similar to the freelance worker, but where the freelance worker can be thought of as having moved for a job, the Digital Nomad has a job that allows them to move. This lifestyle is driven by the desire for location independency, and strives to travel and live in different places, thus the motivation factor is essentially having new experiences and obtaining new social relations. The need for a steady work routine can be present but depends greatly on the specifics of the individuals circumstances.

TEMPORARY SETTLER
Transitioning or looking for permanent residency

Cities such as Copenhagen can be hard to find permanent settlement in and thus this user-type becomes a viable user. This user seeks to find temporary settlement before finding permanent solutions.



ill. 58.01: *Exploded Isometry*

FUNCTION	NUMBER	AREA	TOTAL AREA
Unit	15-25	10 - 20m²	225 - 750 m²
Kitchen	---	---	70 m²
Laundry	1	20 m²	20 m²
Supplies	---	---	15 m²
Circulation	---	15 %	265 m²
Shared toilets	---	---	50 m²
Bicycle parking	1	50 m²	50 m²
SUM			1220 m²
Thematic Spaces			500-1000 m²

PRELIMINARY ROOM PROGRAM

The building has a net area of 1250 m² excluding the basement area.

Current estimation allows for 15-25 units with each unit housing one person. This gives each person 50-70 m² of total to be used for common facilities, circulation, and private quarters.

The private quarters are estimated to be minimal and to be comprised of sleeping areas, wardrobe, and areas for secluded work for occasional use. This seeks to add sentiment for active usage of common facilities rather than retreating to the private facilities.

Common areas are the keystone of the project to enhance social interaction. The goal is to create a social setting with highly appealing areas offering a variety of atmospheres and functions which would have otherwise been inaccessible to individual renters, thereby creating additional value in the social setting. These consists of both the thematic spaces, and the kitchen facilities trying to accomodate the living needs derived from Ingrid Gehl. Additionally inhouse laundry, cleaning supplies, and miscellaneous technical rooms including rooms for mechanical ventilation.

PRELIMINARY DAYLIGHT STUDIES

These priliminary studies are conducted in order to gain further knowledge on the consequences and complications on the implementation of program into the existing building, along with how the concept could seek to aid in these issues.

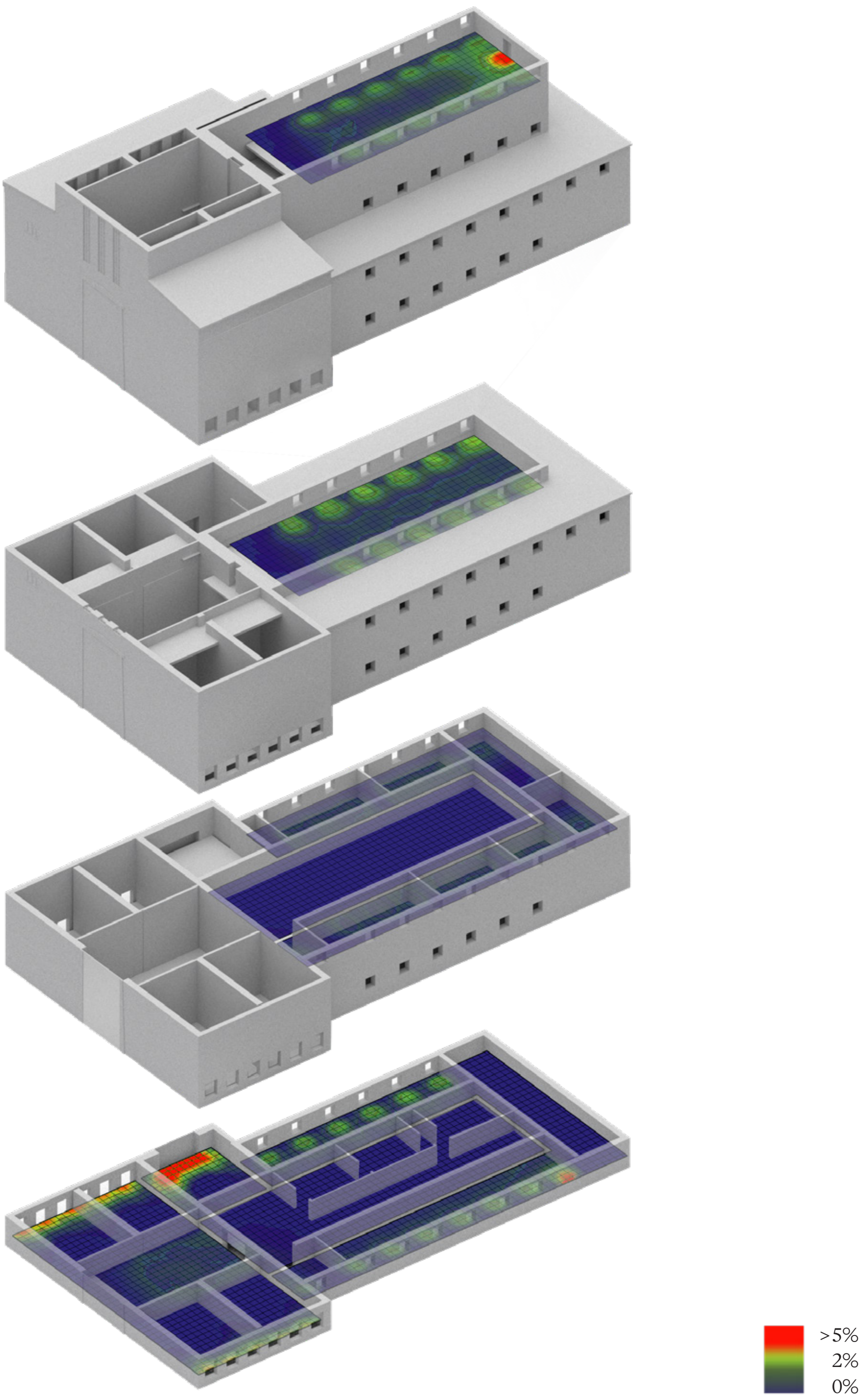
The goal is to comply with the Danish Building Regulation (DKBR), which requires dining, kitchen, and living space, are *well-lit*. This is elaborated on further by DKBR with the estimation of 2% daylight factor average in half of the room. (Bygningsreglementet.dk, 2018)

The analysis is conducted using DIVA for Grasshopper and is with the building *as-is*, except for a small intervention removing ventilation grills and utilizing these openings as potential windows.

The outcome of the simulations clearly shows that one of the main issues is scarcity of light, especially in the core of the building. Here the average DF is 0,02 - 0,04, which is a reaction to the core having no link to exterior exposure.

It becomes obvious that any transformative concept must allow for the integration of natural daylight to the core, or at least close to.

With the assumption that near all programmatic alterations of the building would require link to the exterior from these spaces this will be a fundemental condution for the evaluation of concepts in the design process. Furthermore, the original window openings provide too little daylight to satisfy the Danish Building Regulations.



ill. 61.01: *Preliminary Daylight Studies*

VISION

The project aims to make a design proposal, that revitalizes and enhance the usability and adaptability of the original transformer station in correspondence to the discourses depicted in the former theoretical chapter. There will be implementation of a new programmatic case derived from emerging structures within society, acting as a relevant example for a contemporary programmatic scenario. This should end in the synthesis of a tectonic architectural intervention that accommodates the needs arisen from such a program, while aiming towards longevity in regards of its future adaptability, while preserving and enhancing the qualities of the original building.

Chapter 5
design process

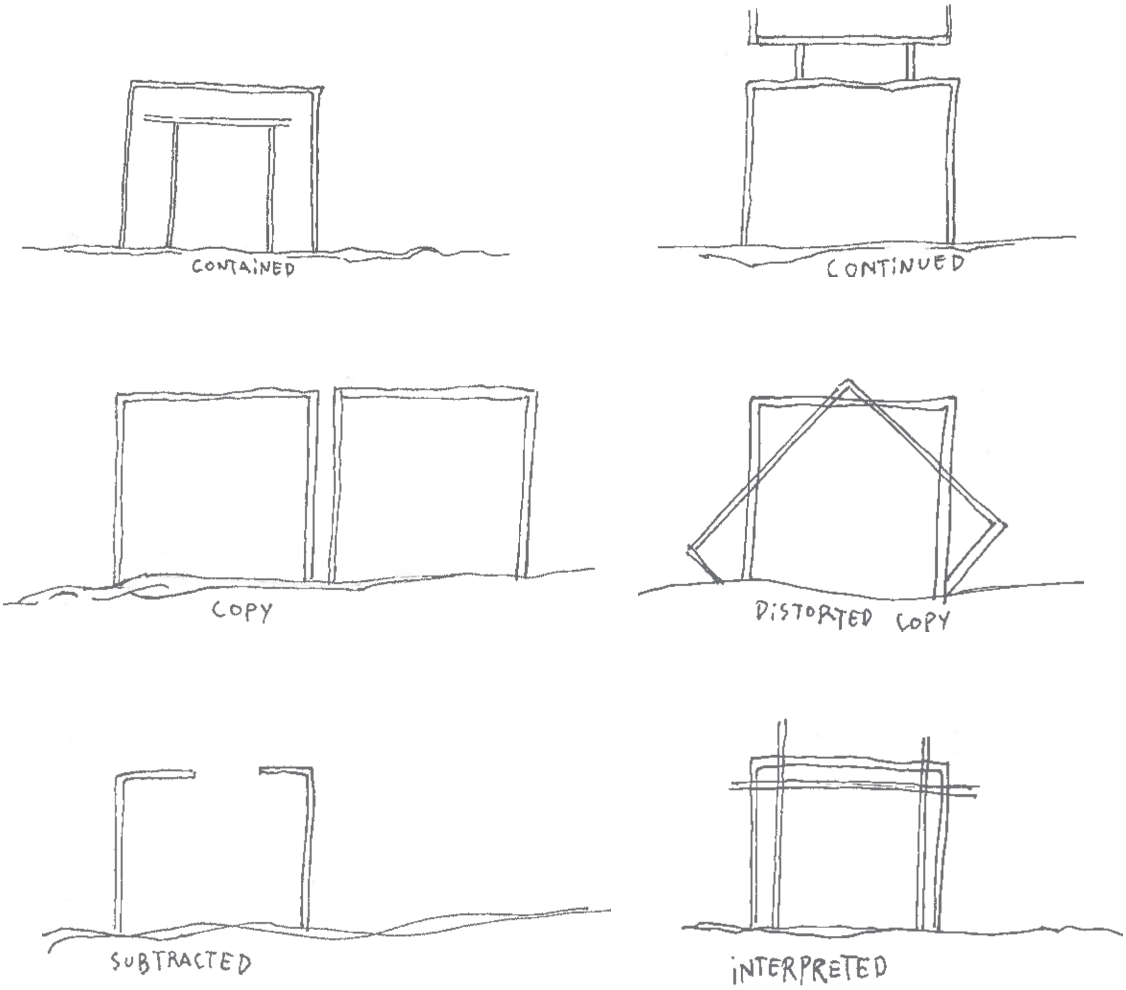
Phase 1: **Preliminary Studies**	Phase 2: **Concept Defined**	Phase 3: **Refinement**
- Transformation Principles - Programmatic adaptation - Sketching - Conceptual modelling	- Sketching - Physical models - Conceptual development - Structural concept	- Fine tuning - Detailing - Calculations and simulations

This chapter seeks to depict the design process in separate phases to create an overview of the iterative design process. It has a relative chronological order to show how the project evolved, however, several of the themes, which might appear separated, have occurred simultaneously and might be further emphasized or simplified for the sake of overview for the reader.

The initial stages of the design process, referred to as the *Preliminary Studies*, seeks to investigate how the applied theory, building analysis, and the program can be translated into form and concept.
This includes investigating transformation principles, adaptation possibilities, and consequences of the implementation of a new program and internal programmatic connections.
It is in this phase that the conceptual framework for the project is constructed, which is then further used in the later stages for creating a meaningful concept, and has the highest amount of trial-and-error in the process.

Having found an overall framework in the *Preliminary Studies*, the second phase seeks to give a *Defining Concept*. This is done by looking at different aspects and areas of the building in a much more concrete way than the previous phase. It investigates how a plan might look, and how a concept can be derived from these. It defines a structure, and seek to apply theory from the program such as Herman Herzberger's theory on the generic, the specific, the infill, and the polyvalent.

The third and final phase seeks to be the *Refinement*. This chapter will concretize the project in terms of the detailing and ensuring its feasibility. It further investigates homes and scales in on both rooms, structures, and joints of the structures.

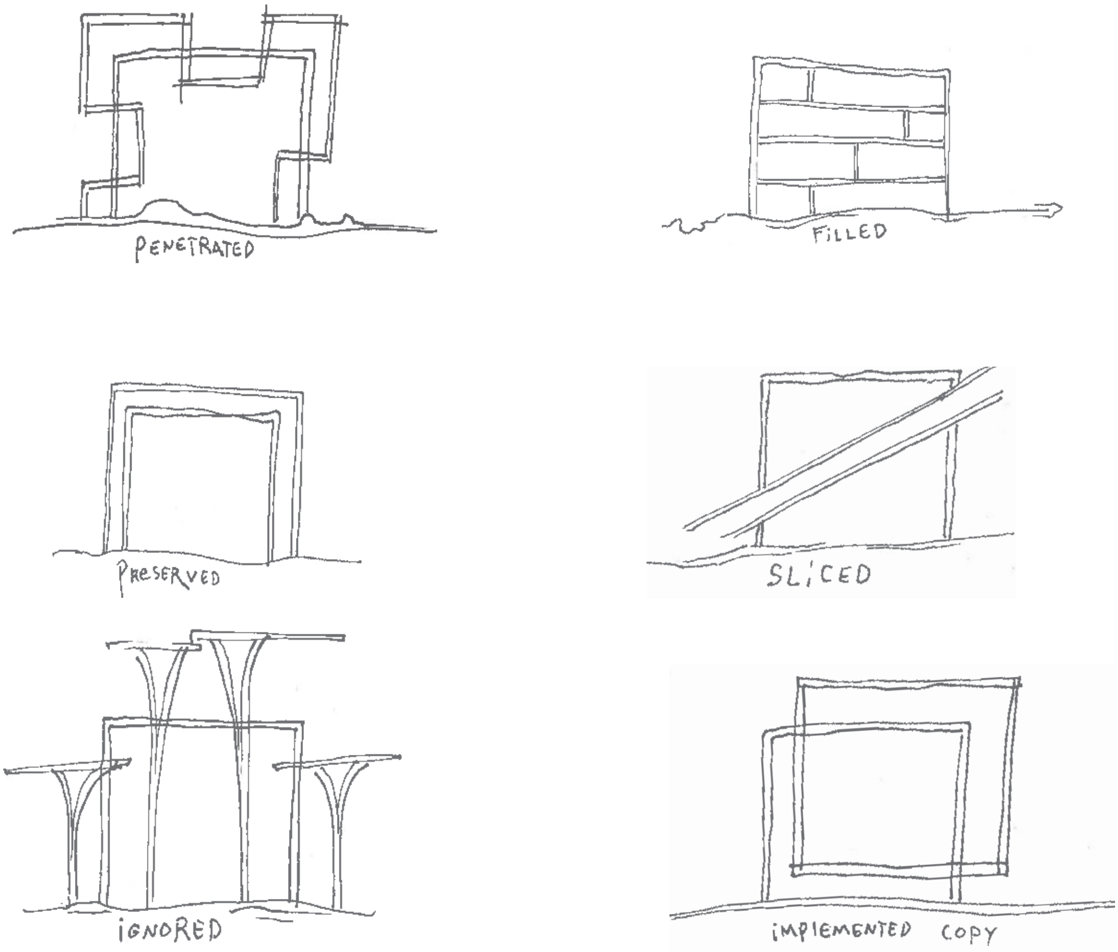


ill. 66.01: *Transformation Principles 1/2*

TRANSFORMATION PRINCIPLES

With the project inherently being a transformation project the initial stages of the design process seek to investigate overall principles for altering existing buildings.

The design process is initiated by creating abstract, but suggestive conceptual interventions, where arbitrary relations between the existing building mass and intervening elements are examined. The purpose of these are to generate ideas for a diverse set of concepts and create fundamental grounds for the evaluation of how a concept could have consequences for the implementation of a new program to the building. Keeping this study to this level of abstraction allows these principles to manifest themselves in a wide range as well as for potential combination. While some are in principle more sympathetic to the building, the level of sympathy is not defined at this stage.
These initial investigations therefore tries to disregard the previously derived program, being the building, context, and room program, trying not to force conceptual solutions prematurely, and rather list different principles for transformation.



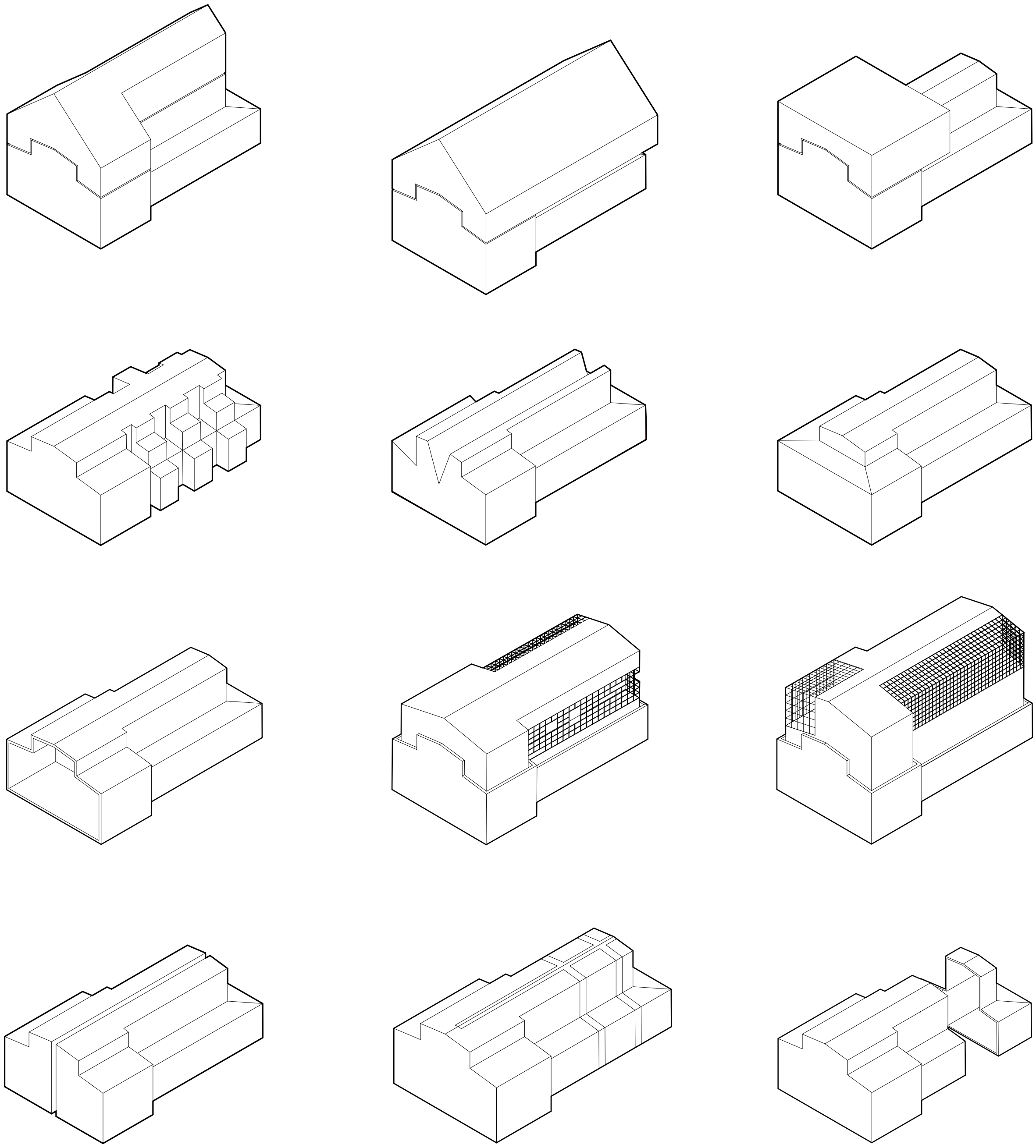
ill. 67.01: *Transformation Principles 2/2*

The deduced 12 principles are each given a princple sketch and a name, being:

Contained, Continued, Copy, Distorted Copy, Subtracted, Penetrated, Filled, Preserved, Sliced, Ignored, and *Implemented Copy*

These principles are further subcatagorized for the sake of simplicty. Some principles, such as *ignored, copy, distorted copy, continued* or *penetrated*, speak to conceptual interventions by perhaps juxtaposition and contrast and imply an addition to the volume. Others, such as *subtraction* and *sliced*, are easily interpreted as relatable to adaptation of the building in order to facilitate lit rooms in the center of the building, or to emphasize the anatomy of the old building and thereby suggest a reduction of volume.

At this stage of the conceptual development it was uncertain if the program could be implemented within the existing volume or extentions and additions would be needed and therefore these studies are conceptual.



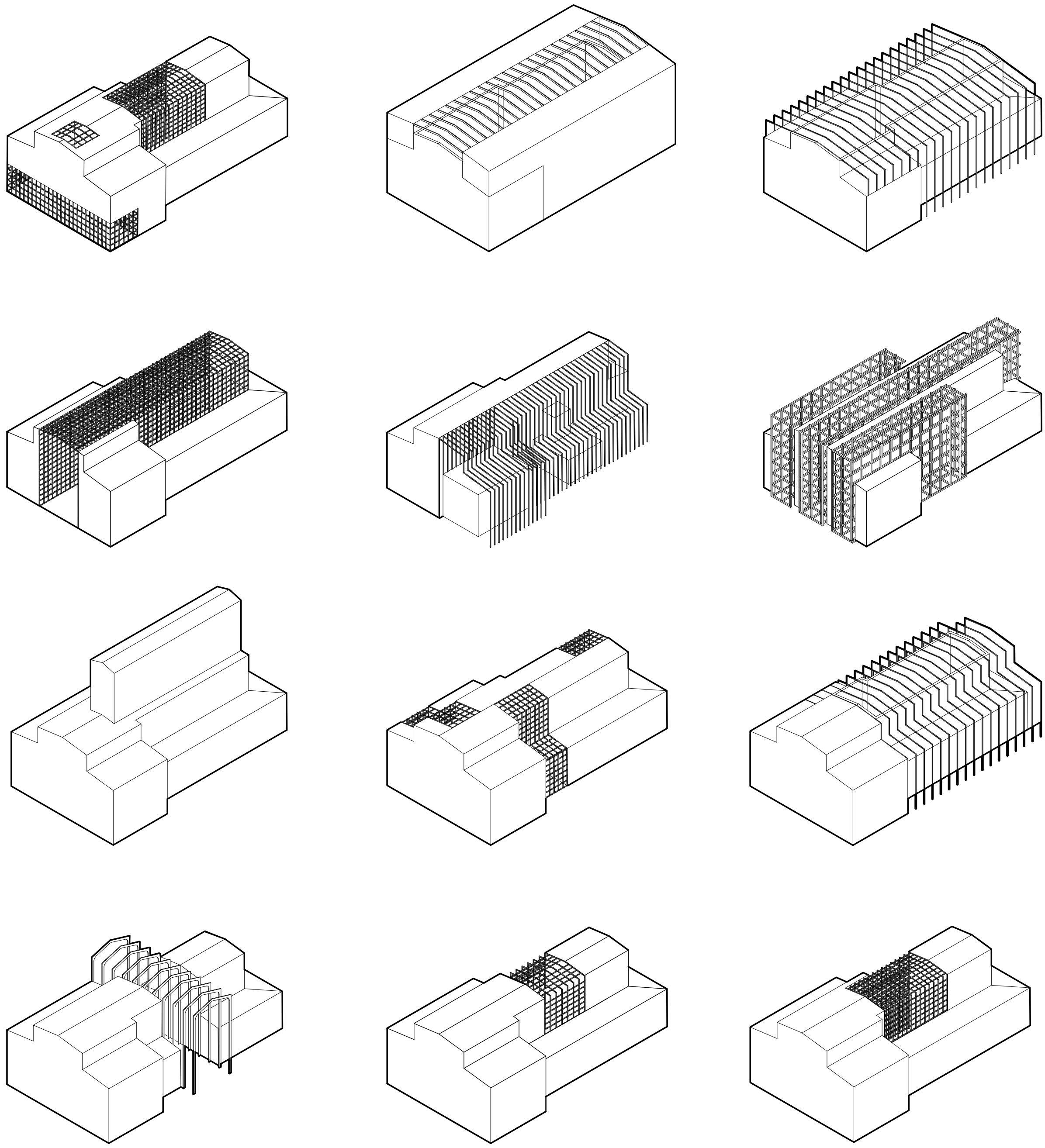
ill. 68.01: *Intervention Investigations 1/2*

INTERVENTION INVESTIGATION

The previous study initiates an investigation into possibilities in building transformations. Whereas the principle study was kept at an abstract level, these investigates were kept in relation to the building volume, as well as the context although this part is hidden on these illustrations.

These investigations try to clarify the consequences of utilizing some of the principles, by adding or subtracting volume, how imitation versus juxtapositions compliments the volume, alignment versus contrast and investigate.

Since no coherent programatic implementation had been

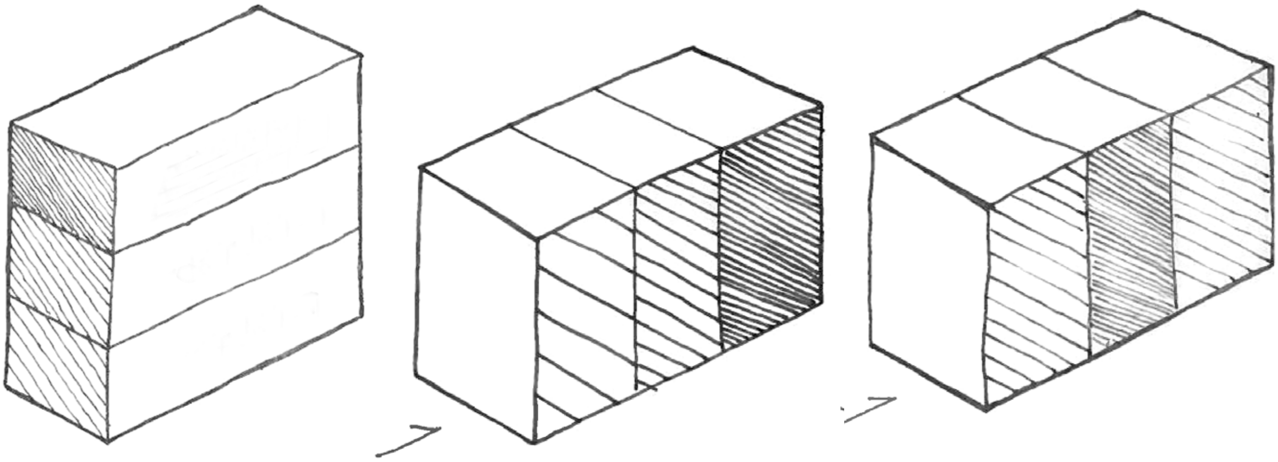


ill. 69.01: *Intervention Investigations 2/2*

developed at this point, these interventions are mostly evaluated on the premise of which problems could further arise, but are regarded as a database for further iterations to be derived from, when more information is gathered.

The concepts catching most interest emphasises both the original building and the intervention as points in time, narrating the history of the building.

This study made it obvious that investigations on implementation of the program were necessary in order to evaluate a concept.

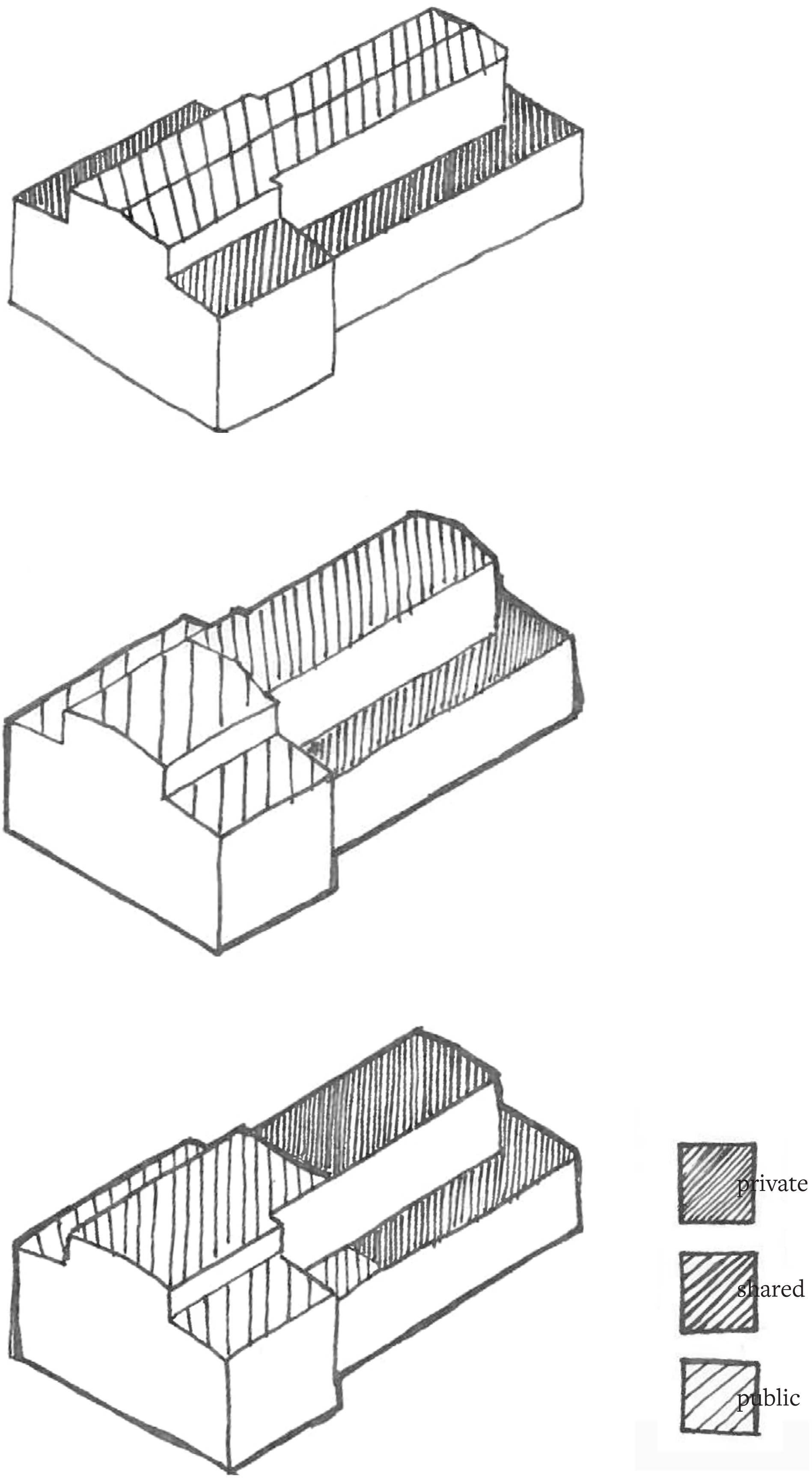


ill. 70.01: *Preliminary Program Investigation*

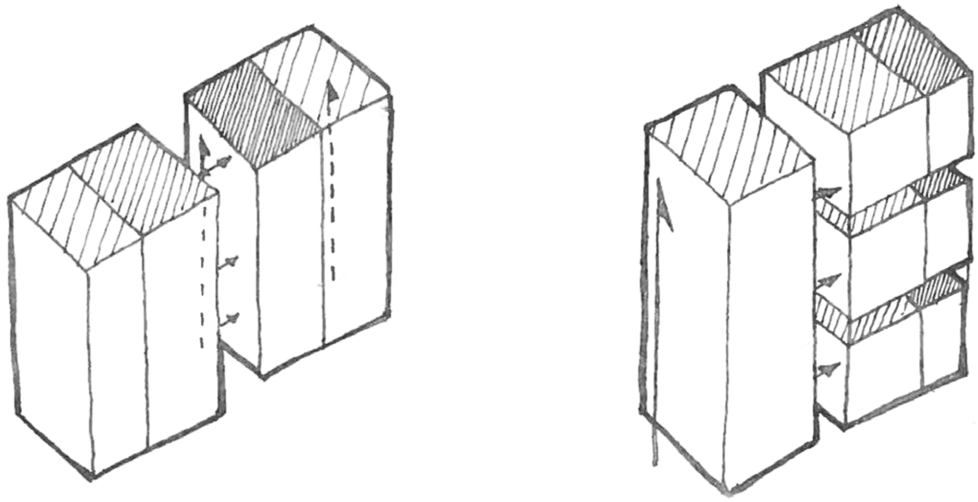
PROGRAM DEVELOPMENT (1 / 3)

At this point in the progress, the need to evaluate the transformative interventions give a need to develop a coherent program. Therefore a few studies are initated, investigating from an overall programatic division to a link between individual rooms.

The first investigation of this study (ill. 70.01 - ill. 70.03) categorizes into areas of shared and private as well as a potential public area. Whether the division is done horizontally, vertically, or mixed, and how to connect the different zones. It further investigates what occurs if shared areas are seperated by private areas.
The second study (ill. 70.01 - ill. 70.03) investigates the overall building shape in relation to the programatic seperation.
The different volumes create clear suggestions on where to seperate the volume, both in relation to given space and in admittance of possible daylight for the units.
With the combination of the first study to the volume of the building the orientation of the building naturally aligns with gradients from the northern facade, facing Vermelandsgade, towards the sourthern. Thereby it seems most natural to implement the shared, or even public, areas in either the north area, on the ground level of the building, or in the central part of the building.



ill. 71.01: *Preliminary Building Division*

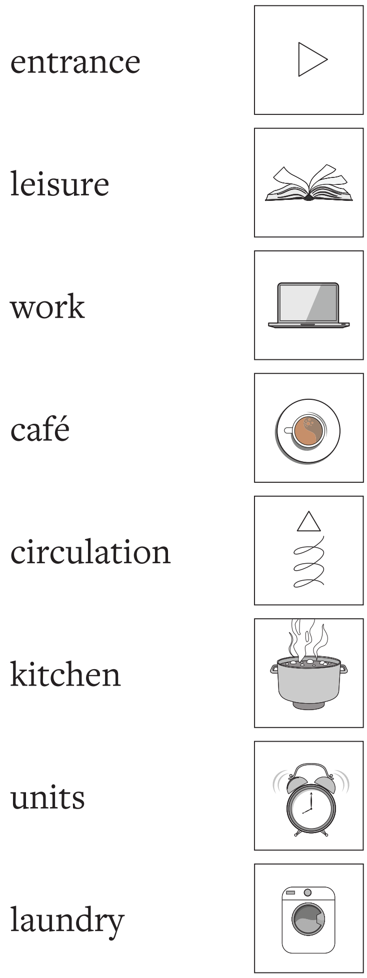


ill. 72.01: *Programmatic Sketches*

PROGRAM DEVELOPMENT (2 / 3)

The next step is a further seperation in two programmatic diagrams. Different functions are introduced and linked in relation to each others. These include the main *entrance* giving orientation to the program, *leisure* for contemplation, *work* areas, *café*, vertical *circulation*, *kitchen* and dining, *units*, and *laundry* also including the miscellaneous programming.

The lens is especially focused on the consequences of having a floor seperation of units granting each floor individual kitchen and dining areas. Whether these kitchens are linked and thereby function on a multi-storey scale or seperately is further investigated, and the premise of having them linked is establised. The idea is that a multicultural set of habitants share cultural experiences through the kitchen. At this point in the discussion it is still undecided if there ought to be multiple kitchens or a single main one. Another development from the previous study is utilizing the natural seperation of floors for the sake of having the top ones for isolated usage reducing disturbances from transitioning and being the destination in themselves. Gradients of isolation occur on two levels at this point. From shared to private and from leisure to work



ill. 72.01: *Program Ledger*

ill. 73.01: *Program Discussion*

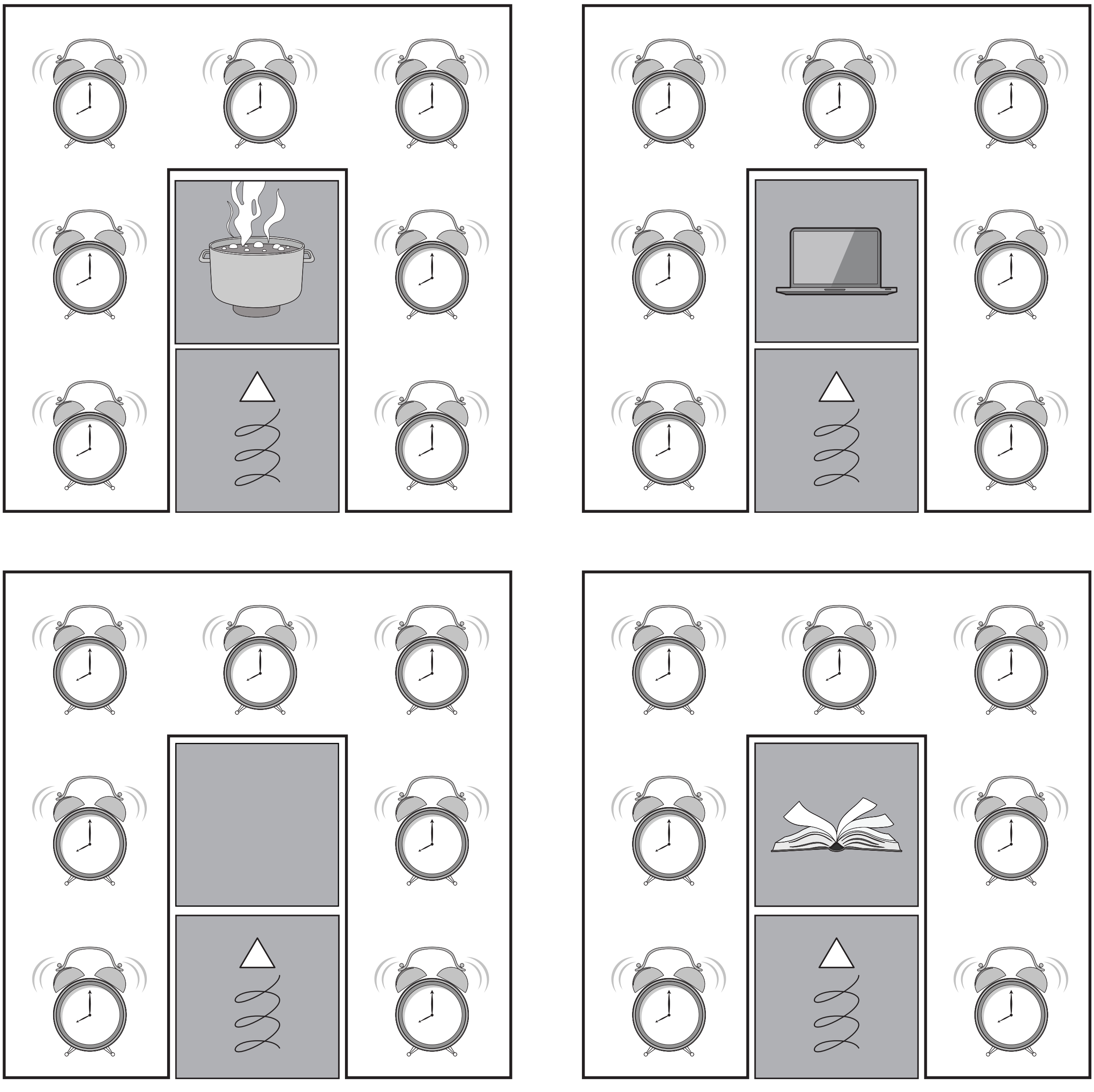
PROGRAM DEVELOPMENT (3 / 3)

The study seeks to investigate how private areas are linked to the shared areas and enhance the social encounters.

While the private areas are to be withdrawn from the shared, the transition and link between these would seem to be a potential social catalyst. The goal is to create casual and engaging meetings in the transition itself, allowing familiarity between the users to arise faster and naturally. Leaving your room immediately gives you direct contact to the habitants around you thus encouraging interaction.

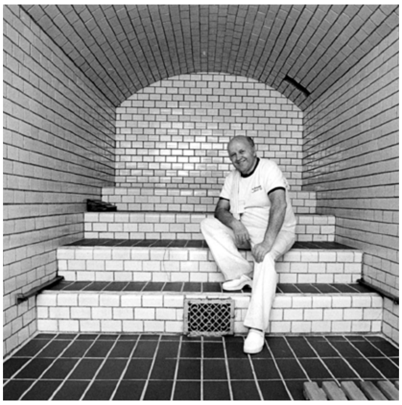
While one can easily imagine scenarios where one seeks to leave ones room without confrontation, it is investigated if implementation of dining, work, or leisure could enhance the social qualities of being new in a city.

In conclusion to these studies, there are overall principles to bring along from this point onwards. The orientation of the building is at this point given, and the configuration allows for natural gradients throughout the volume. While these investigations do not give conclusive strategies for any specific implementation, which they were not meant to do, they allow for rapid adaptation of developments. The purpose is to have a fluid iterative program developement in combination with the further conceptual development, utilizing these investigations for navigating in the further development of the project. However, there is still an issue in not having concrete squaremeters available for individual functions, it is assumed at this point in time that the amount of squaremeters having to be added is at a minimal compared to initial thoughts of a large additions to the volume.



ill. 75.01: *Room Connections*
note: illustrations are depicted in plan

ill. 76.01: *La Fabrica*
Photo: Ricardo Bofill



ill. 76.02: *Silkeborg Badeanstalt*
Photo: Jens Anker Tvedebrink

ill. 76.03: A Thousand Yards Pavillion
Photo: Penda Architects

THEMATIC SPACES

With the reduction of personal space and an increase in shared and social space allowing for engaging interactions between the temporary habitants. Therefore early stages of the development of these social spaces were a combination of atmospheric case studies.

PLANTERUMMET

Contemplation through contrast. Nature conquering the built. It is the dialectical confrontation between inside-outside, a harmonic symbiosis of chaos and order.

PEJSESTUEN

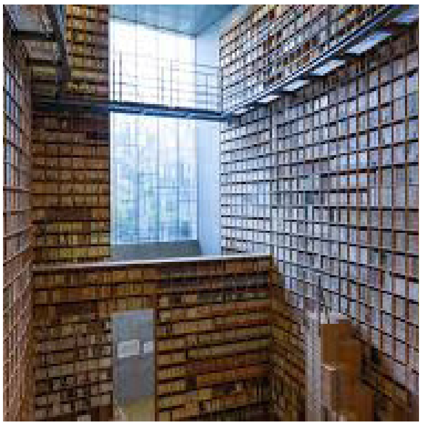
The hearth of the home. Inspired by Danish modernist architects own living rooms, mixing an informal social environment with an eye for modest details and tactility.

BADEANSTALTEN

Part of the home, yet far enough from it to be contenuously exciting. Inspired by traditional bath houses, this area becomes recreational and a place of exposure, intimacy and tactile stimulation. It is a space of refreshing relaxation, meditative contemplation and alternative and potentially challenging social encounters.

MONTERINGSTÅRNET

Disrupting ones familiar sense of scale and allowing for vertical expression. It is a place for creative activities, changing environments and dynamic movement. It's a place where social encounters can be brief and without any commitment.



ill. 77.01: *Shiba Ryotaro Memorial Museum*
Photo: Jonas Aarre Sommarset

ill. 77.02: *Børge Mogensen's Cottage*
Photo: Erik Theil

ill. 77.03: *La Fabrica*
Photo: Ricardo Bofill

ill. 77.04: *Sofiebadet*
Photo: Sofiebadet

ill. 77.05: *En Model*
Photo: Tyra Dokkedahl

ill. 77.06: *Sofiebadet*
Photo: Sofiebadet

ill. 77.07: *Børge Mogensen's Cottage*
Photo: Erik Theil

ill. 77.08: *The Orangery*
Photo: Lenschow og Pihlmann

ill. 77.09: *Øjne i Natten*
Photo: Claus Bonderup

Phase 1: **Preliminary Studies**
- Transformation Principles
- Programmatic adaptation
- Sketching
- Conceptual modelling

Phase 2: **Concept Defined**
- Sketching
- Physical models
- Conceptual development
- Structural concept

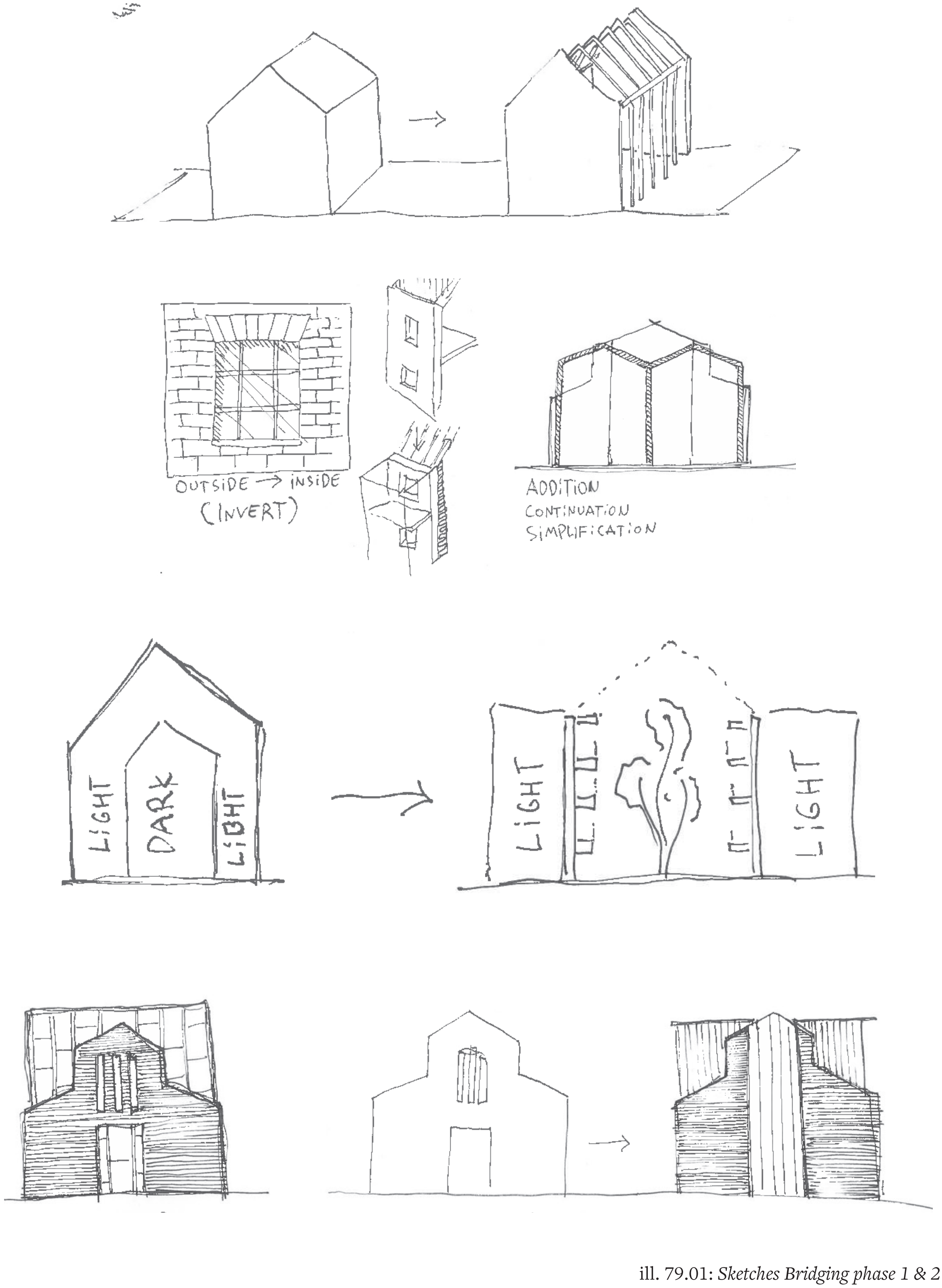
Phase 3: **Refinement**
- Fine tuning
- Detailing
- Calculations and simulations

CONCLUSION ON PHASE 1
PRELIMINARY STUDIES

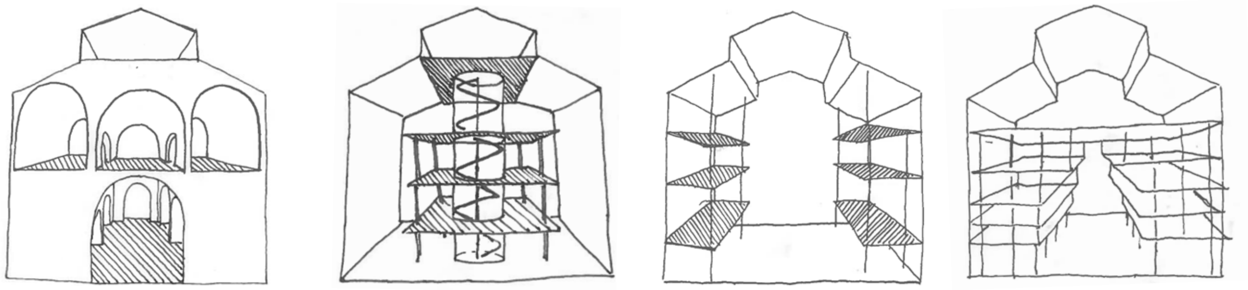
Phase 1 of the Design Process has examined principle studies, conceptual transformations, adaptations to the program and connectivity between functions through sketching and computer modelling.

The transformation needs to allow daylight into the core in order to have an adequate amount of daylight and flexibility in the established and implemented program. It has investigated deconstruction of the *skin* and *meat*, leaving the *bone* behind for readaptation. It has further investigated on how inverting the building gives the old facade a new context to be appreciated in.

The starting point for phase 2 is finding and defining the concept these preliminary investigations have initiated.



ill. 79.01: *Sketches Bridging phase 1 & 2*



ill. 80.01: *Sketches of Montagehallen*

MONTAGEHALLEN

Montagehallen is a characteristic space having the full building height, only cut by the sloped roof. In order for this text to be accuratly percived, it will start off by redescribing the room(s). This is the area facing Vermelandsgade along the north facade, thereby being the initial point of entry to the building. It has four transformer rooms seperated by gates. The room itself is oriented towards the Southern part of the building.

Having derived at utilizing this space for either a shared or a public function, this is used to create a few ideas to see how the room responds.

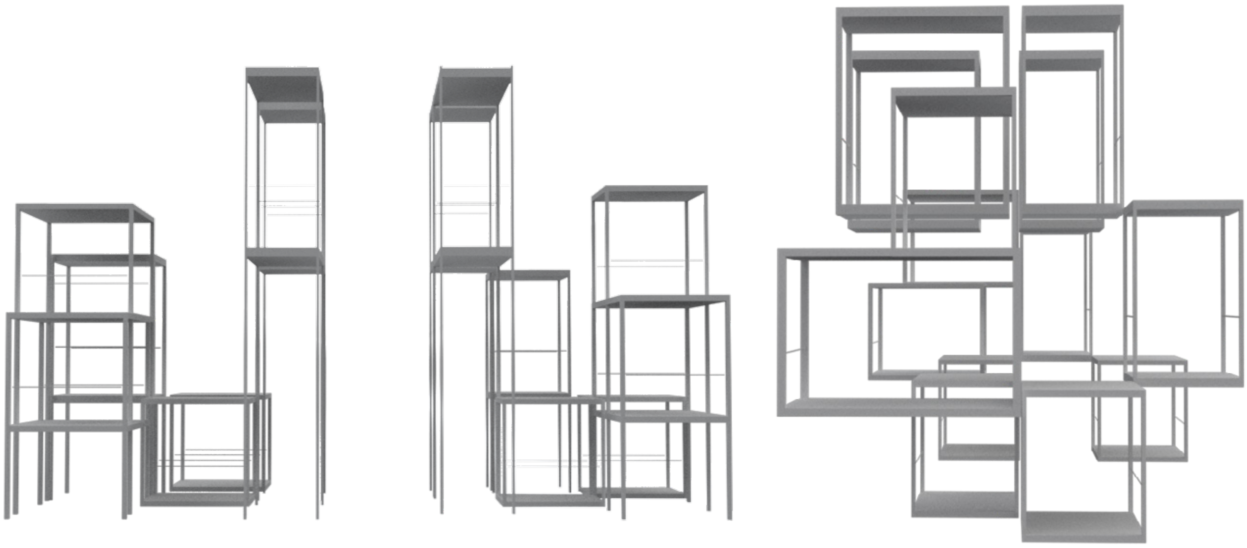
The room is surrounded by large brick walls and concrete decks, having the entire volume feel monolithic.
The initial suggestions elaborate on this monolithic nature, but the iterations quickly move towards lighter plans, seperate structures that juxtapose the heavy brick walls. These can be categorized into two; a centered multi-storey island and multi-storey areas where the old transformer rooms are.

These are percieved from two angles, as experienced on a point of entry, and as the space they emphasize.

It is decided to work with the second solution, allowing Montagehallen to enhance the quality of the original space.

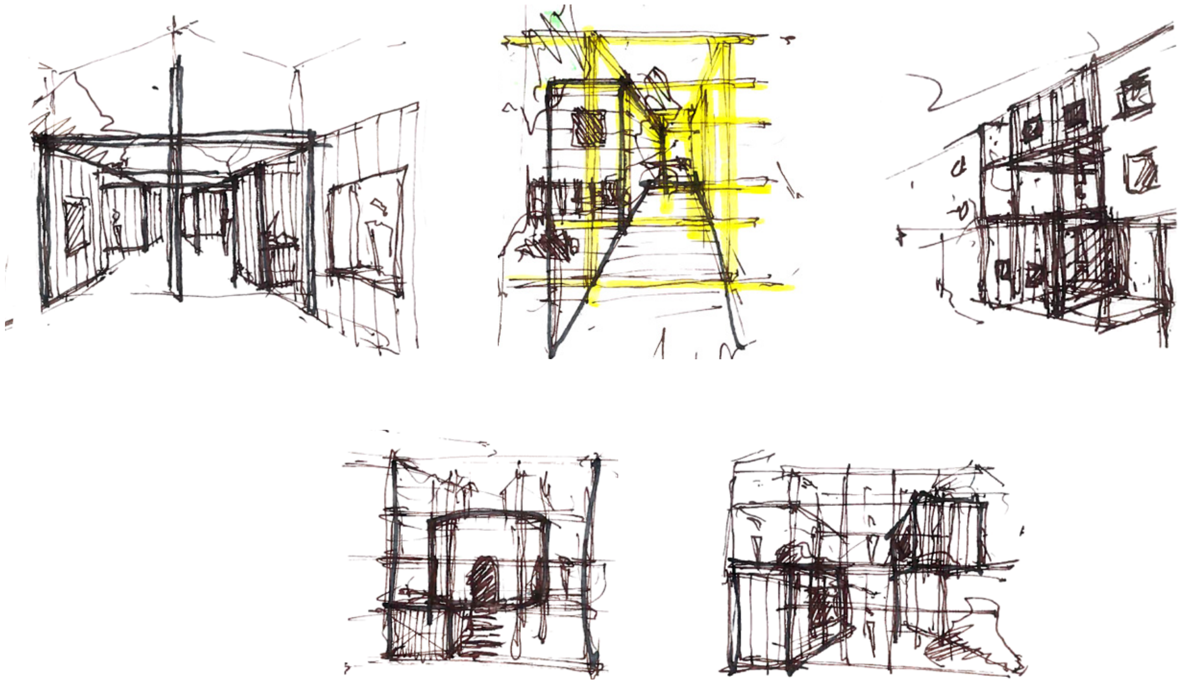
At this point it is further suggested to implement flexible structures into this space, where assembly and disassembly can occur within the space itself non-destructively. This is further enhanced by adding a lighter material, enhancing the contrast between the heavy bricks and the new implemented structure.

The initial investigations into this space therefore defines this room as shared or public, and to be infilled with a light and easy to assemble structure that can non-destructively be erected within the borders created by the Station.



ill. 81.01: *Conceptual 3D modelling for Montagehallen*

ill. 81.02: *Conceptual Sketch, Montagehallen*



ill. 82.01: *Atrium Sketches*

THE ATRIUM

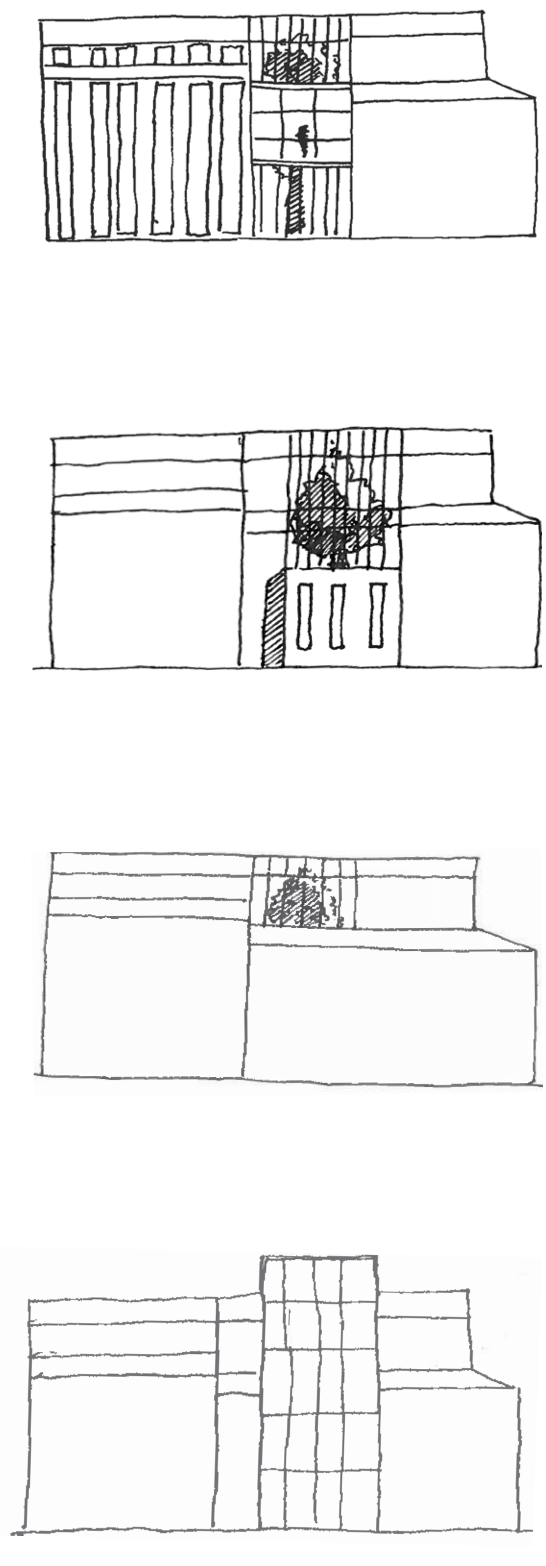
At this point it is clear that it is crucial to provide adequate natural daylight to the core of the building in order to make it work. The previous investigation on interventions suggests substractive trans-formations, and a few of these suggest an atrium-like solution.

Therefore in order to investigate how such an atrium solution would be implemented, and how the building responds to it, these are further investigated.
Questions arose, such as what could be placed in the atrium, whether it ought to be kept on the outside, where it should be placed and its extent.

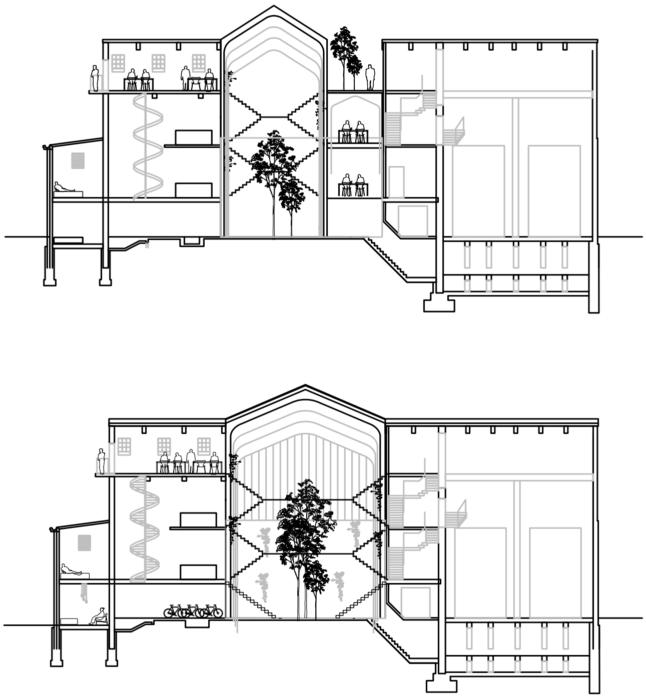
These questions sparked discussions on whether to make a complimentary or constrasting appearance between the building volume and the scale of the atrium.

Soon the work was focused on a juxtaposition to the building, not only in the material, but also in form and direction.

While the atrium overall subtracted squaremeters from the Station, it seemed to be able to provide daylight, add contrast, provide social areas or circulation on its peripheral areas. And while the atrium might subtract original volume, it offered possibilities to further add onto it.



ill. 83.01: *Comparative Atrium Sketches*



ill. 84.01: *Atrium Section Sketches*

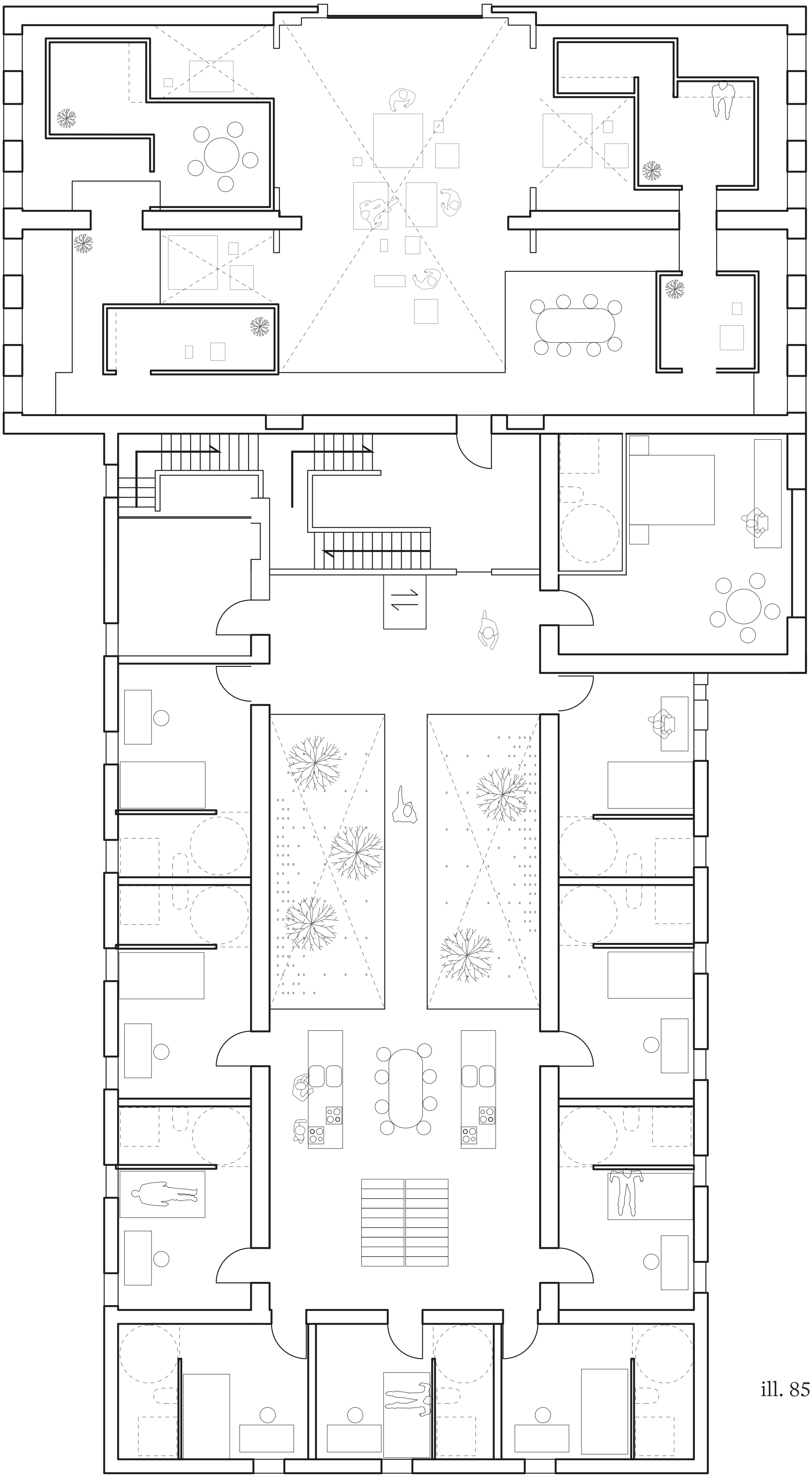
PLAN: THE ATRIUM

The area considered to be least characteristic in the valuation in the program is the one to be transformed into an atrium, also creating the possibility to sustain natural lighting conditions. This creates a surrounding area of the atrium that becomes open and shared to not further block the natural light, to which the units are placed peripherally, and therefore linked to these shared spaces that the atrium helps to create.

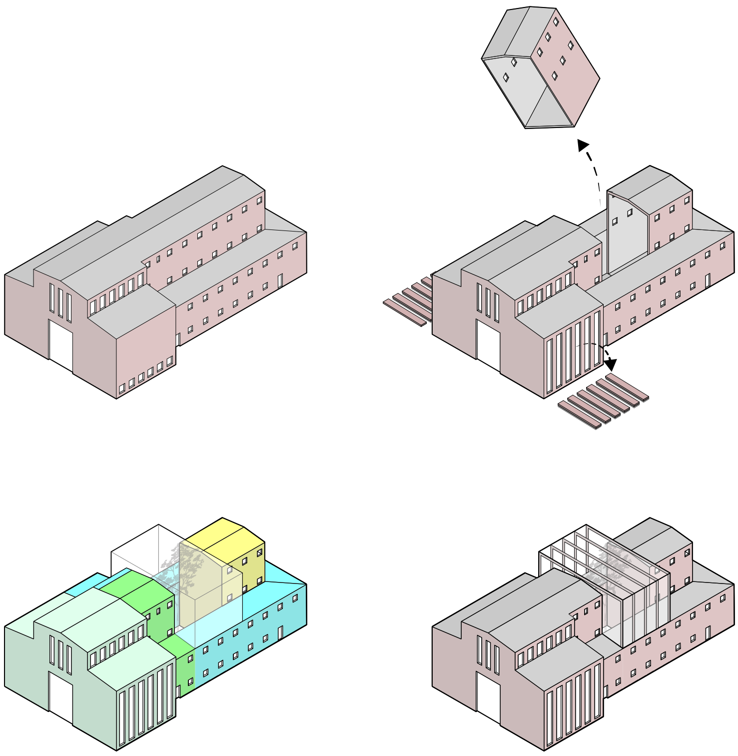
The kitchens are in this configuration placed on seperate floors and borders to the atrium recieving natural lighting. On the top floor, where no units are directly linked to the kitchen area, a shared kitchen is established.
Having kitchens on individual levels allow the neighbours of a specific floor to have a common identity while still mingling with others in both Montagehallen and in the shared kitchen on top. It further allows habitants to utilize some privacy, not having to be in the same space as others preparing their meals every time.

With this plan solution it seems to establish area for 20-22 units, all having an individual bathroom that is within handicap standards. While this for most people is slightly overdimensioned, it allows complete accessibility, and these are placed to be sharing piping and water supplies. The plan solution utilizes original stair, incorporates an elevator close to it, and allows for a fire escape route in the dining area in the Southern bit.

The units vary in size, which is a natural consequence of the programmatic adaptation to the old station. It is not considered an issue, with the largest having space to accomodate couples or the like.



ill. 85.01: *Plan Investigation*

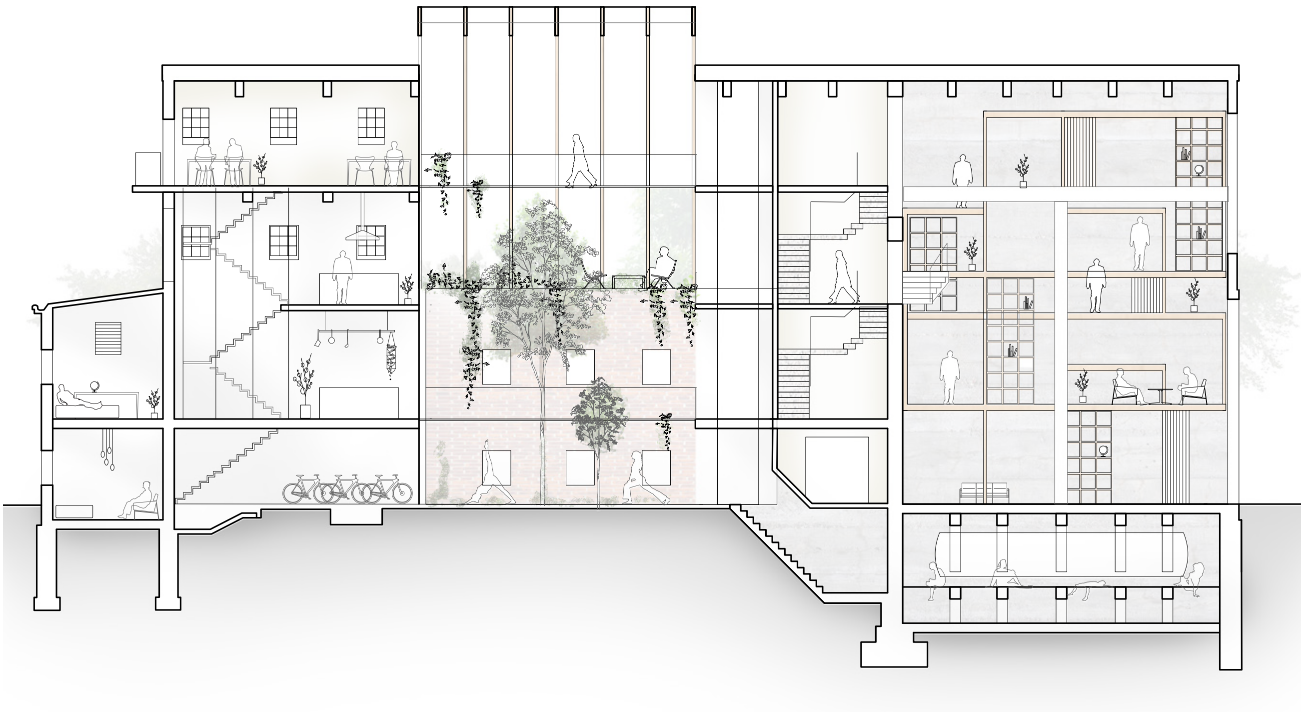


ill. 86.01: *Concept Diagrams for Midterm*

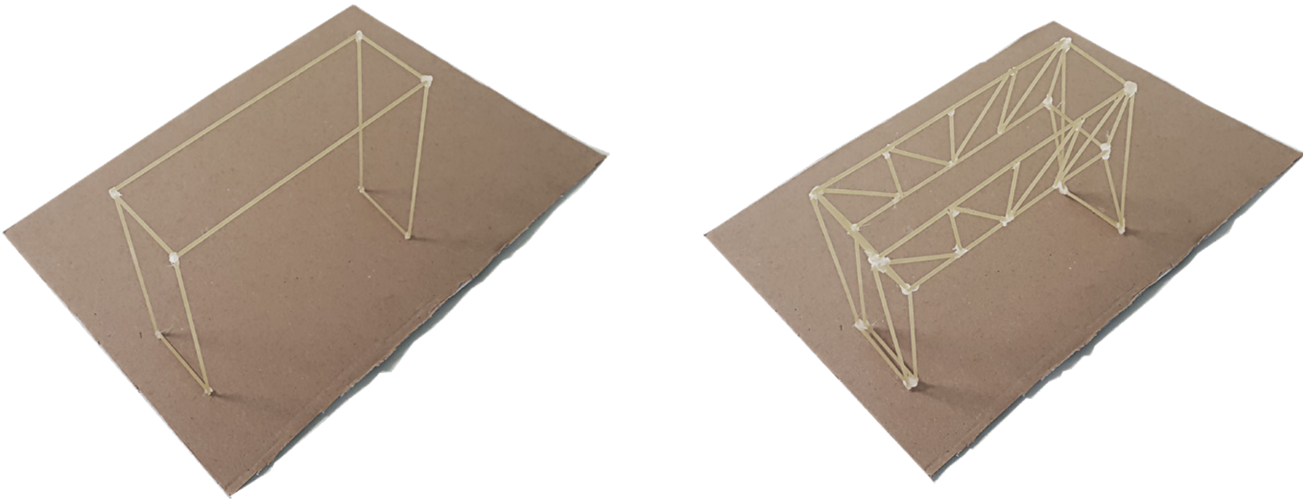
MIDTERM SEMINAR

During the Midterm seminar, a design iteration was presented, showcasing the transformative intervention through the atrium, with a new structural iteration in the shape of a undefined geometrical element adding a formal contrast towards the existing building. This allowed for the implementation a structure disrupting the directionality of the original building, while enabling different spatial configurations within. In this iteration the units where placed on the ground floor and second story, allowing for indoor common spaces on top. This led to discussions of what usages these could contain, accompanied with the obvious problem of sunlight exposure at this scale, which could potentially have led to unwanted thermal atmospheric qualities within the atrium. The general response towards the formal presence of the intervention raised questions regarding its seemingly arbitrary relation to the existing building, resulting in a post mid-term discussion on how to relate the old and the new and with what intention. During the seminar, the conceptual framework of Montage hallen were presented, resembling a freestanding structure within the former spaces. The section showcases the somewhat intended life within this area, as a highly diverse and playful atmosphere.

ill. 87.01: *Atrium Render for Midterm*



ill. 87.02: *Section for Midterm*



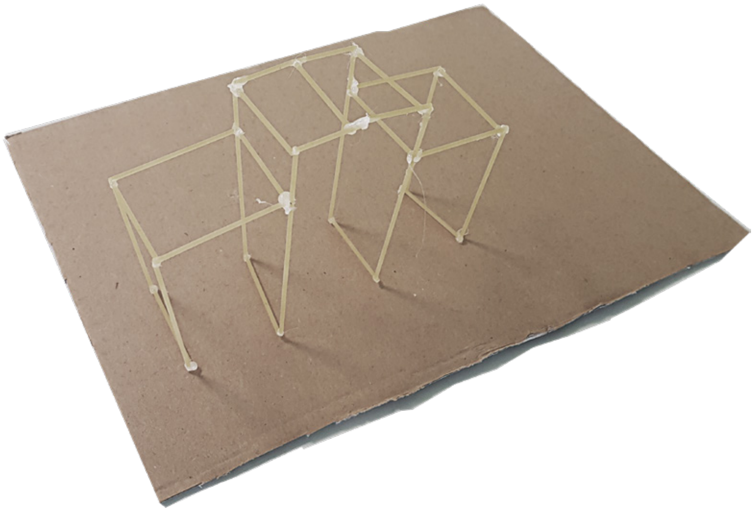
ill. 88.01: *Structural Models*

STRUCTURAL MODELS

With feedback from the midterm the project takes a few turns. The feedback focused on the formative language of the atrium, and of the wish to utilize long-span glulam elements, which was felt chosen arbitrarily and not aligning well with the industrial aesthethic.

Both arguments had valid points and therefor revisions had to be made. The decision was first and foremost to investigate how a new structure in an atrium could be designed. These were investigated with some physical models, starting of with revisions of the atrium from the midterm and a truss extension. The frame felt rather undefined, and seemed to have possible struggles in the long span it would have to sustain along the roof.

Whereas the truss would accomodate these long spans it arose a discussions on the base of the project, having these function as generics with interchangeable alterations, it soon became a suspicion that these were too restraining for this purpose, and still rather alien from the overall building shape.



ill. 89.01: *Structural Model - Extension*

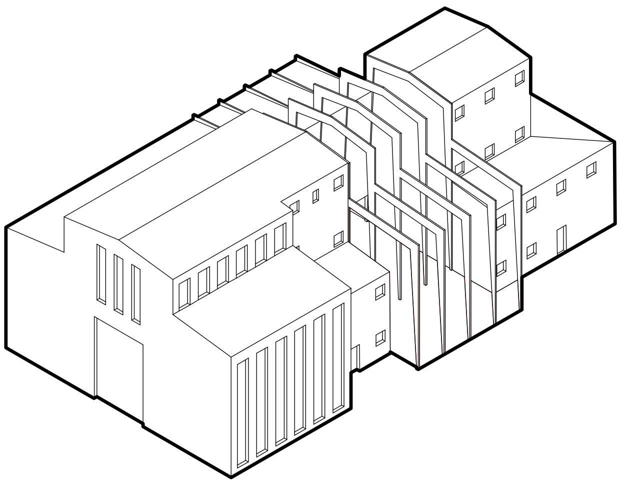
EXTENDING THE STATION

The solution to this dipute on form and type of structure became to imitate the outline of the northern facade, and extending it to the atrium.

Maintaining the original shape of the Station allowed for a more sympathetic interpretation and interplay in the formative language.

It was further discussed that one could make a juxtaposition between new and old by reinterpretion of the materials from site and context.

These frames are designed to create the generic substance of the intervention, allowing for future adaptations to utilize these in a variety of ways, and seem capable to do so with some justifications. They extend the cut volume along to both east and west facade and replace this section entirely.



ill. 90.01: *Frame Structure*

DEFINING THE EXTENSION

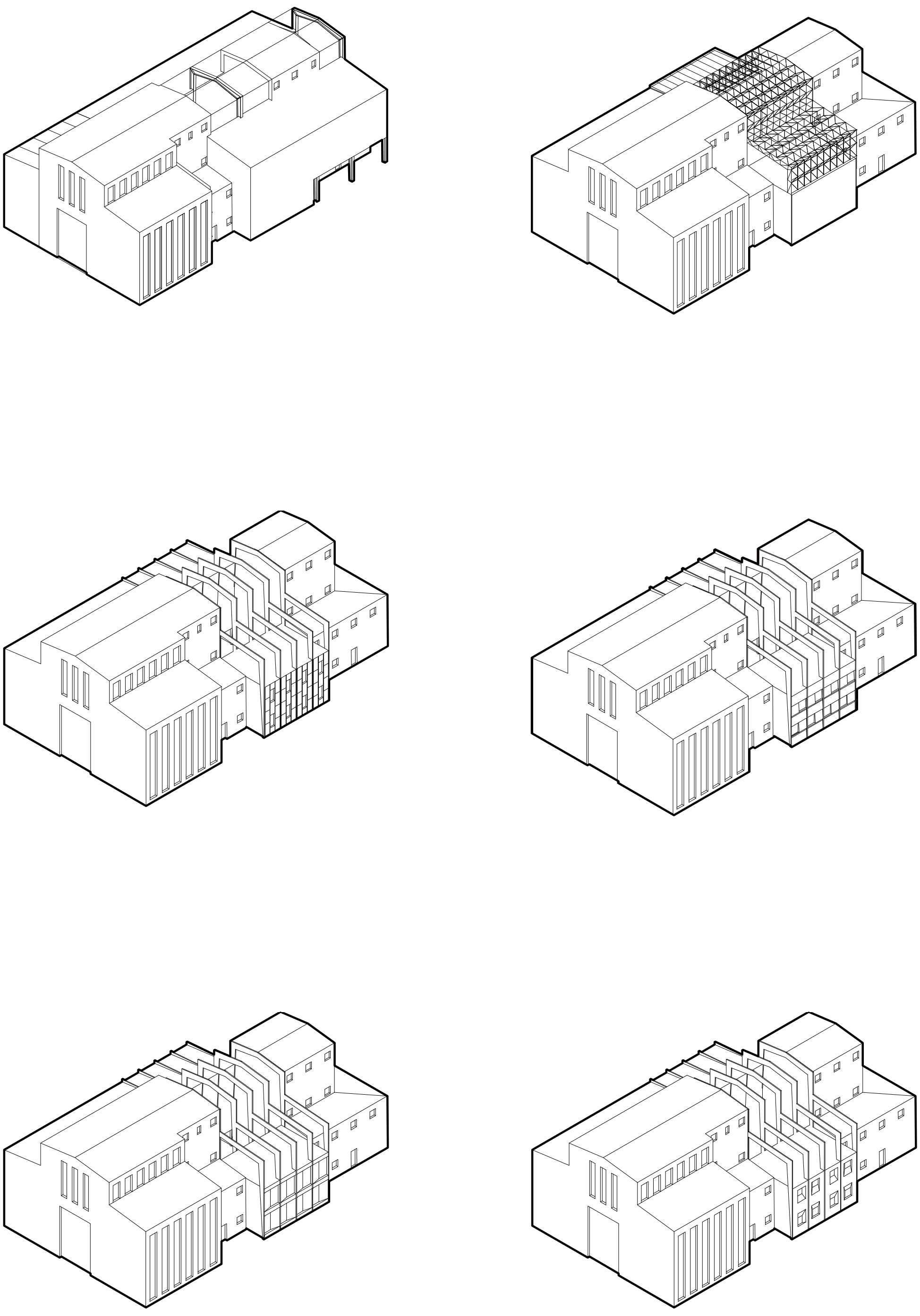
Having found an outline for the atrium extension it still needs to be defined. It has already adapted the spot where the initial atrium is, and has an ambition of aligning with the original building in volume and composition. But many decisions are still left undefined, such as materiality, direction, and how this aligns with the ambition of creating a generic structure allowing for future adaptations.

This is the point where the discussion on material of the frame reemerges. Up till this point the discussion always had a tone of utilizing glulam for the main structure.

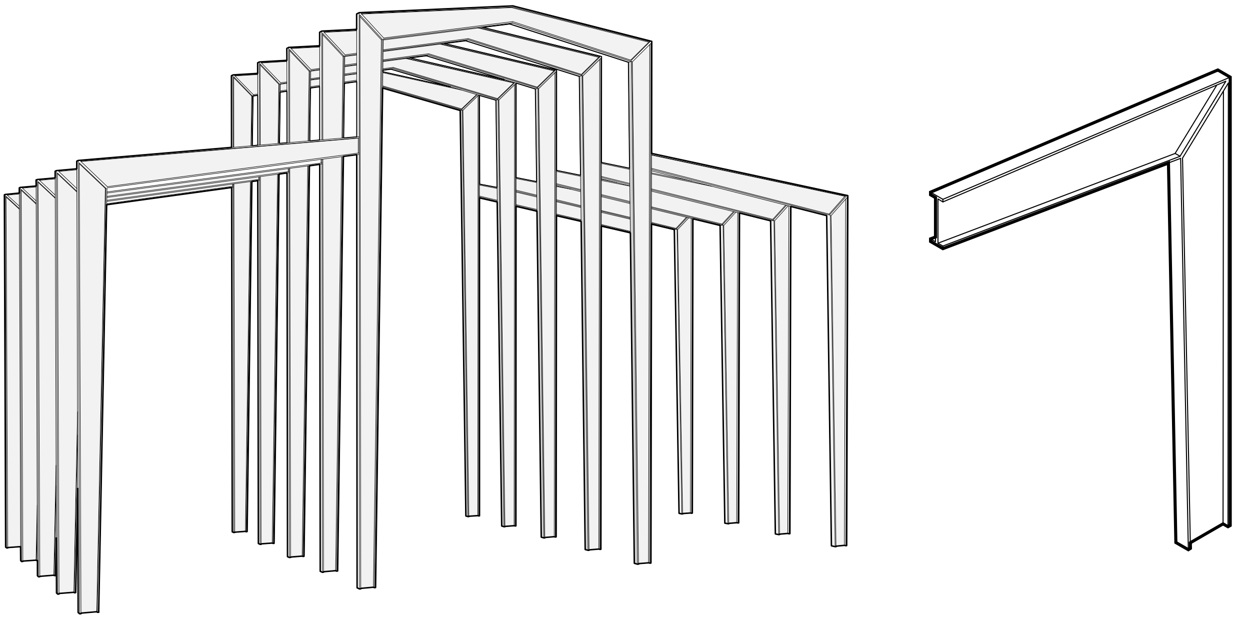
Steels capacity for adaptability and the ability to have rather long slender spans. Therefore the group decides to investigate steel structures for the atrium from this point onwards.

Seeking a unifying framework both linking the building from north to south, that in symbiosis with the old building links new and old and allows for a new identity.

The frame seeks to be interpretive while suggesting for a variety of options, and thereby allows unknowable adaptations to bloom.



ill. 91.01: *Extension Concepts*



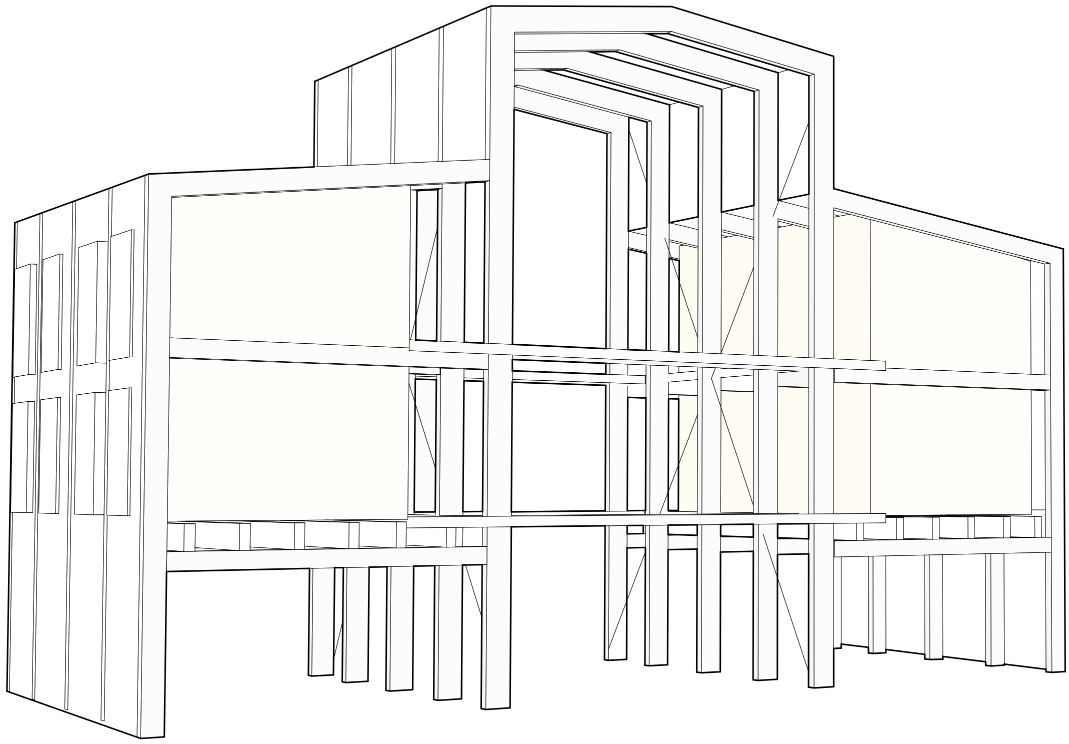
ill. 92.01: *The Frame*

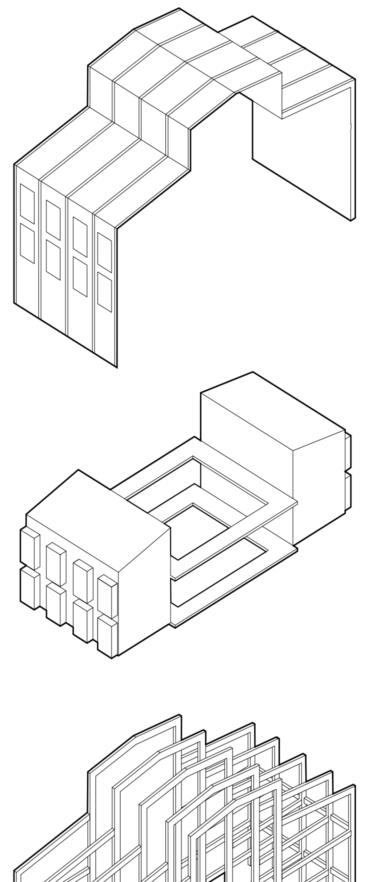
THE FRAME

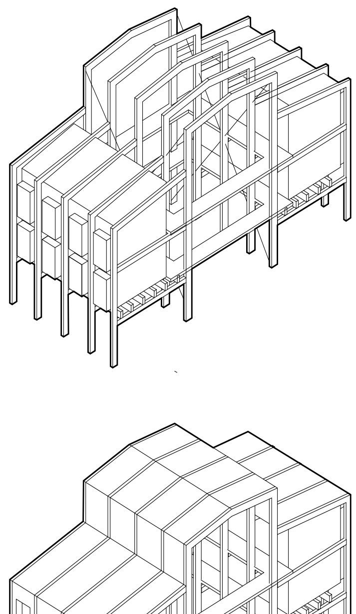
Having decided on a steel structure in an East-West orientation of the building, the next steps become to define how this can be interpreted within the notion of generic.

With inspiration from large industrial sheds with h-profiles expanding their crosssection towards critical joints, it is assumed that this is a precaution to transfer moment forces created by the spans, and could allow minimizing the diagonal supports, thereby granting more design freedom.

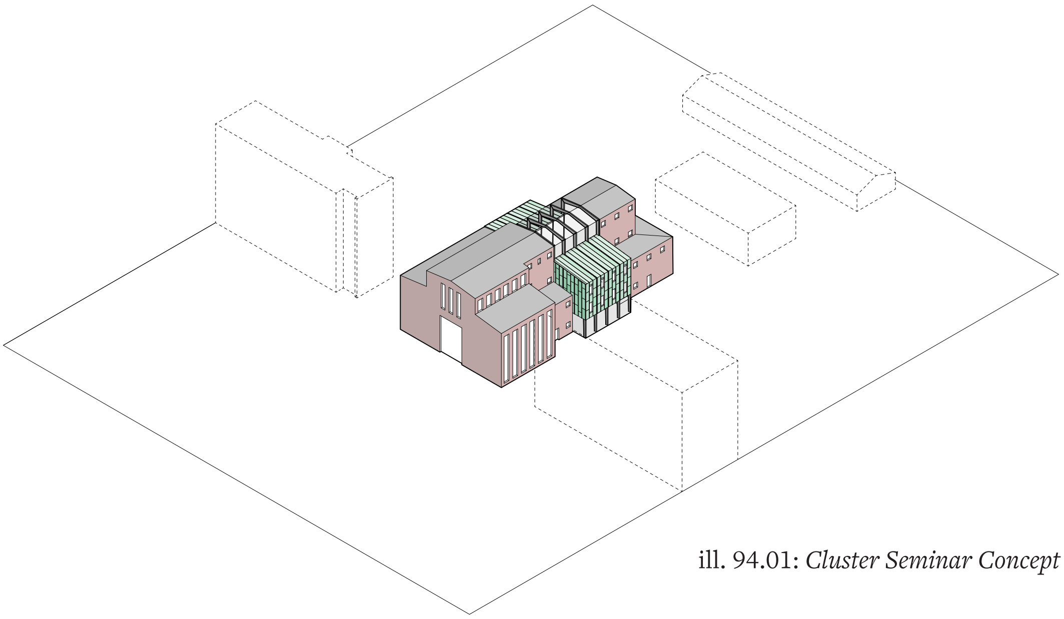
After which the rates of change in the structure are investigated. Layering the structure, and seperation of outer facade and inner rooms seem to allow for further adaptiveness. Questions such as to the degree of how adaptive a structure should be arose, since this is a grayscale between entirely rigid and entirely modular, each with faults of its own in this context. One could perhaps investigate joints allowing for changable deck heights with adjustable beams connecting the pillars.







ill. 93.01: *The Frame vs Generic, Specific, & Infill*



ill. 94.01: *Cluster Seminar Concept*

CLUSTER SEMINAR

The isometric illustration (ill. 96.01)shows how the frame structure is at this point, and has a feature that has not been introduced so far. This being the boxes cladded in patinated copper.

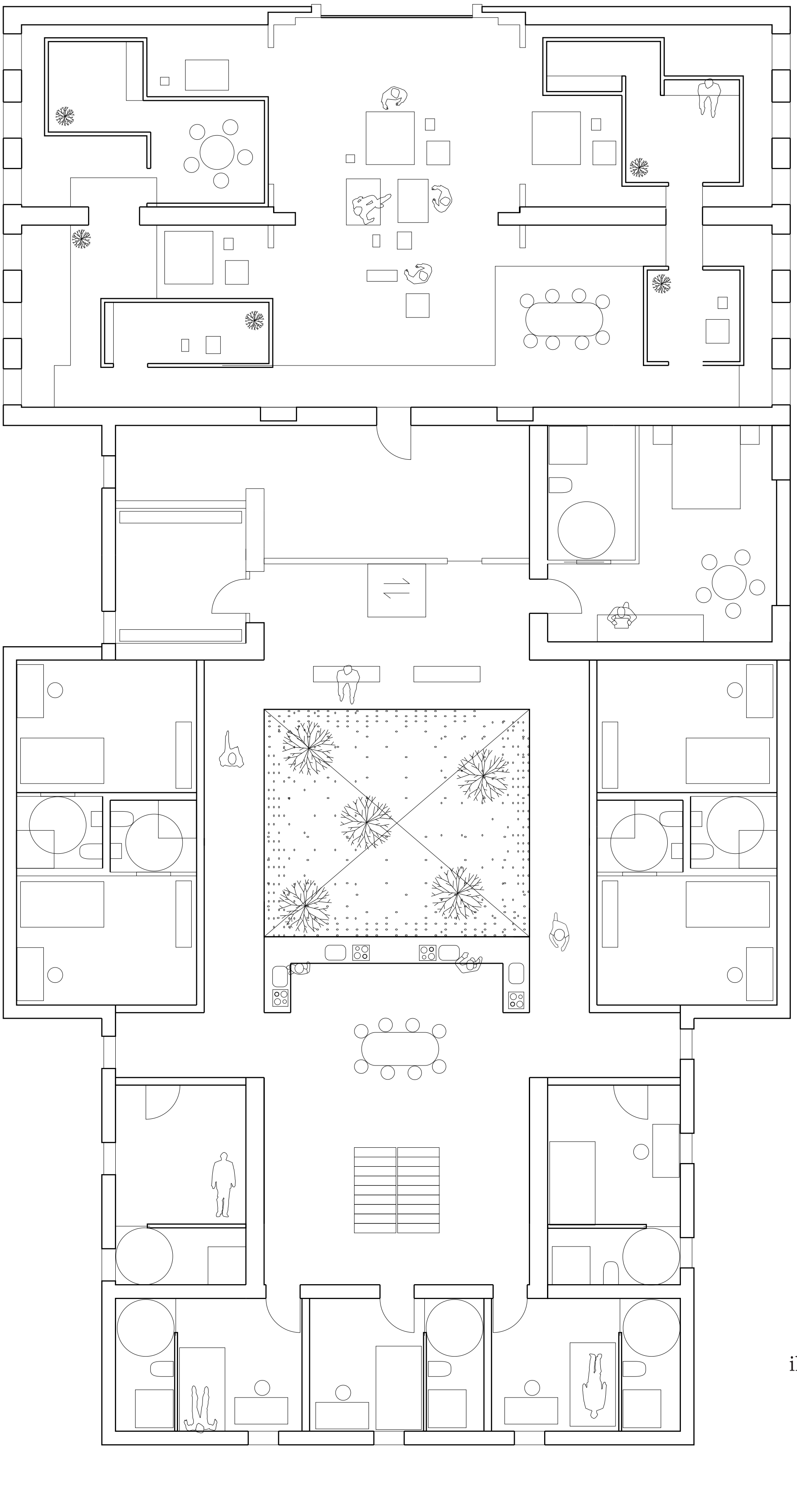
The development is perhaps most comparable to the midterm, where these were the original building allowing for a greenhouse or roof garden to be placed on top of it. The change here allows for a direct view through the building on the ground floor, and allows for the entire cut to be juxtaposing the Station.
The cladding itself both speaks to the history of the transformer station with the copper bands for grounding, but also signifies that as this part establishes it patinates, emphasizing the point in time where these are implemented, untill it is a part of the concieved history.

Further changes are primarily in found in the plan, where the atrium becomes an open and unifying space, which is to be kept uninterrupted by elements and transition is kept peripherally.

Kitchen have been moved and is now bordering to the atrium, having life and movement span over multiple storeys.

Reduction of Southern units allow for lighting hallways accomodating that both kitchens and dining area has a view.

Boxes are inserted in the atrium and are elevated, allowing the ground floor additional lighting, view through the building and connectivity to the neighbouring backyards. Within these boxes additional units are placed. The boxes are cladded in copper to draw parallels to the history of the building with copper being the chosen grounding material, as well as the relation to other usage of copper cladding in Denmark.
Montagehallen itself seem to be a little without purpose in this iteration, and therefore revisions are made to its function in the context.



ill. 95.01: *Cluster Plan*

Phase 1: **Preliminary Studies**	Phase 2: **Concept Defined**	Phase 3: **Refinement**
- Transformation Principles - Programmatic adaptation - Sketching - Conceptual modelling	- Sketching - Physical models - Conceptual development - Structural concept	- Fine tuning - Detailing - Calculations and simulations

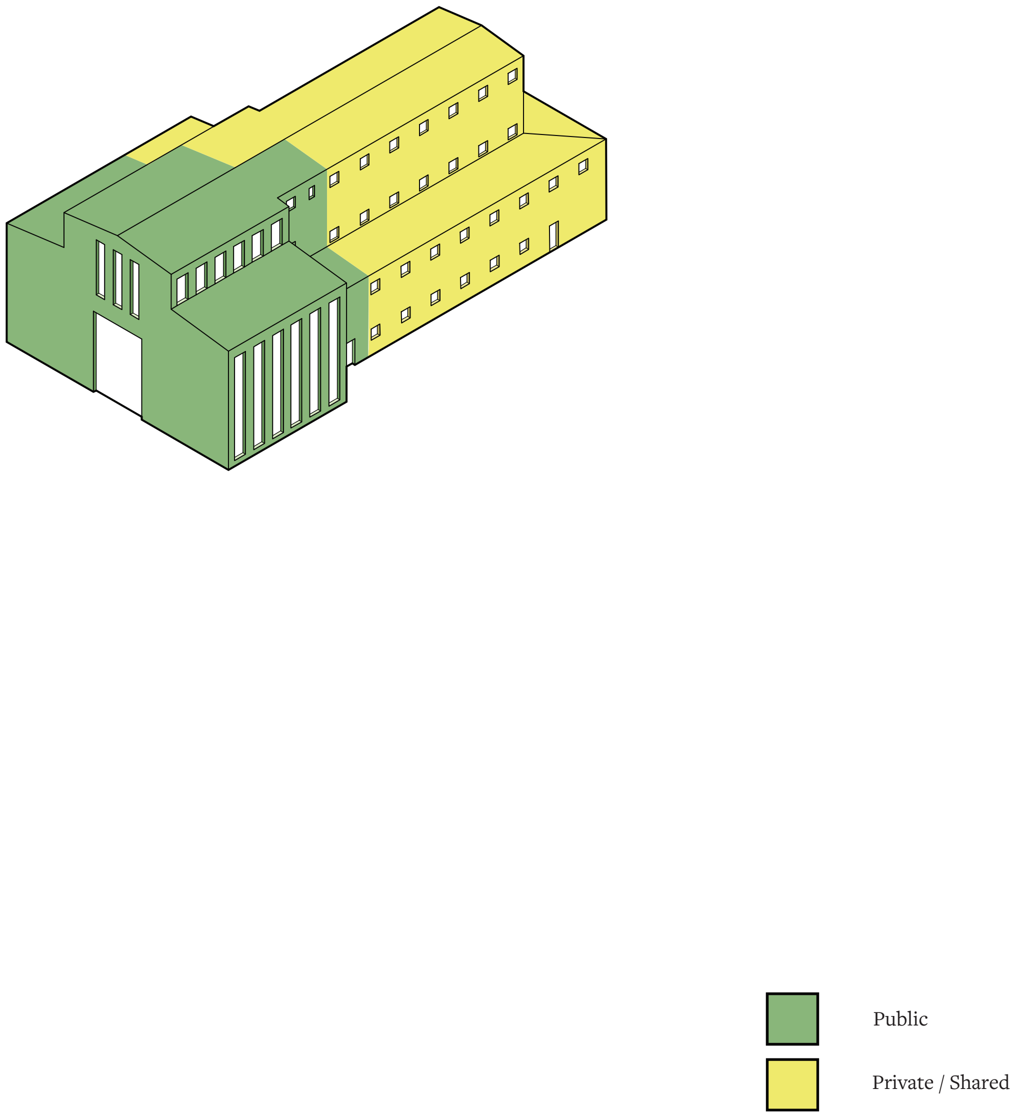
CONCLUSION ON PHASE 2
CONCEPT DEFINED

Phase 2 of the Design Process had a much more qualtative in direct relation to volume than the previous phase.

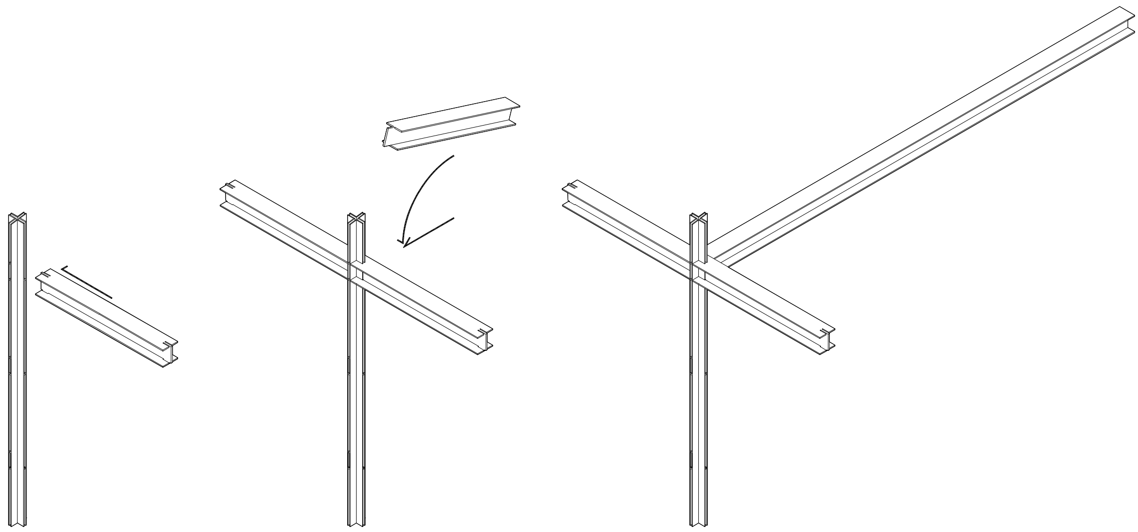
Developing a plan has allowed for a revision of public and private, and established the relation to having Montagehallen as a public area in the building.

The project has a concept with a implemented functioning program, although rough around the edges.

Within it a concept with two distinct tectonic challenges have risen to create both a generic structure and a specific one, both giving identity to a part of the building and seperated by volume, function, material, and assembly technique.



ill. 97.01: *Public / Private diagram*



ill. 98.01: *Steel Frame Assembly*

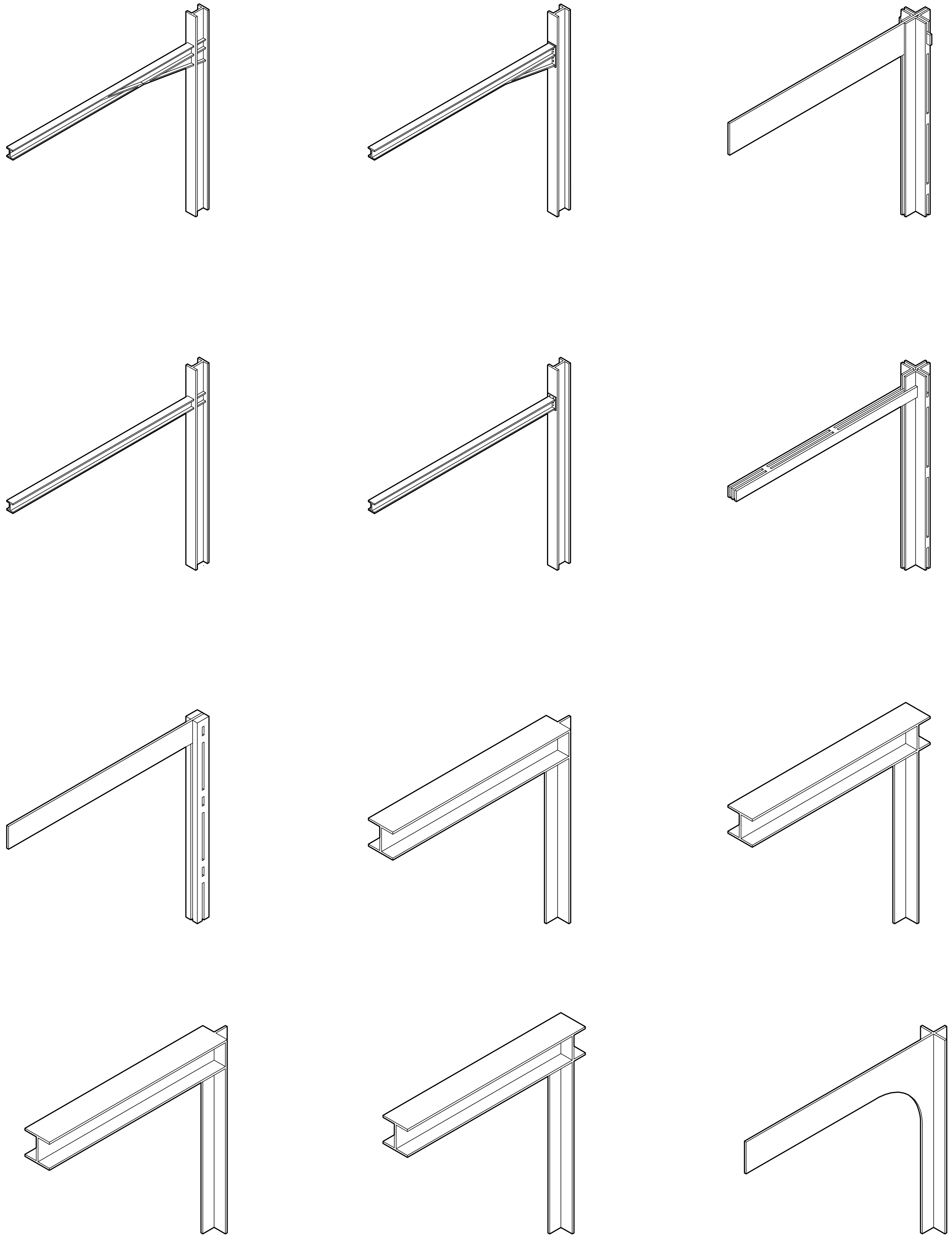
STEEL JOINTS

This study is conducted with precise 3D modelling, and suggestions of interest are investigated globally in Robot Analysis guiding decisions, and further investigate on how a structure is to be assembled.

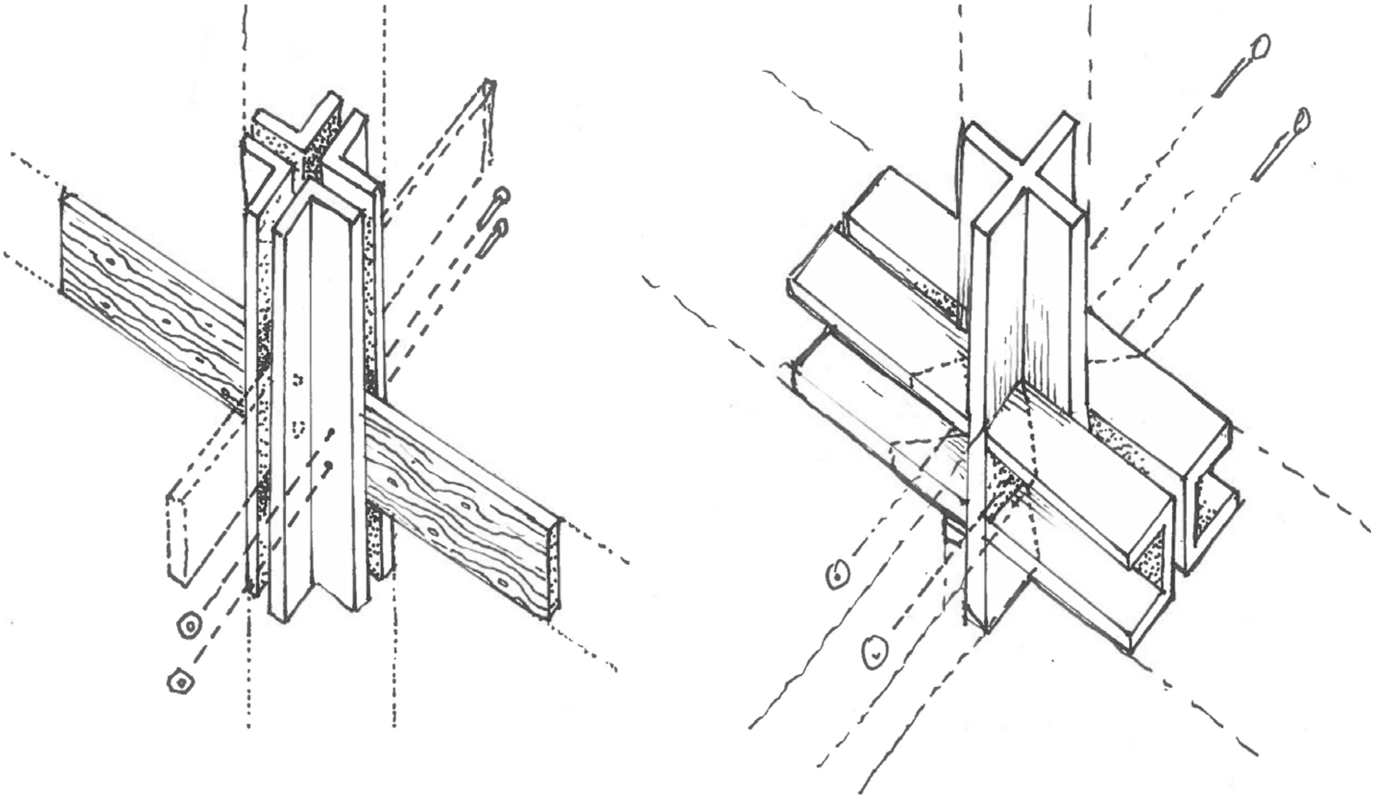
Assuming assembly on site, the pillars are to be erected first, after which the beams are to be connected to these. This creates a focus on the feasibility of a joint; can it be standardized? Is it possible to be bolted, welded, or does it provide options of both? It also investigates what the consequences of this might be, and if it allows for alterations independently.

Initially the frame is constructed of H-profile elements; beams and pillars alike. This does intially seem to make sense, where an element most often meets orthogonally and have a surface to attach to. This allows for both bolt and welding, but does provide some issues where there are multiple elements intersecting. The H-profile pillars fail in robot, unless dimensioned to a degree where the utilized ratio is low. This seemed due to loads in the from multiple directions, and the h-profile not being able to handle them very well.

After which x-profile pillars, similar to Mies Van Der Rohe's. This type of pillar excels in having angular loads in bi-axial directions and allowed for a more slender profile with higher utilization ratio. These, however, are harder for h-profile beams to intersect with. This lead to the decision of changing profile to double sided elements of which two iterations were investigated.



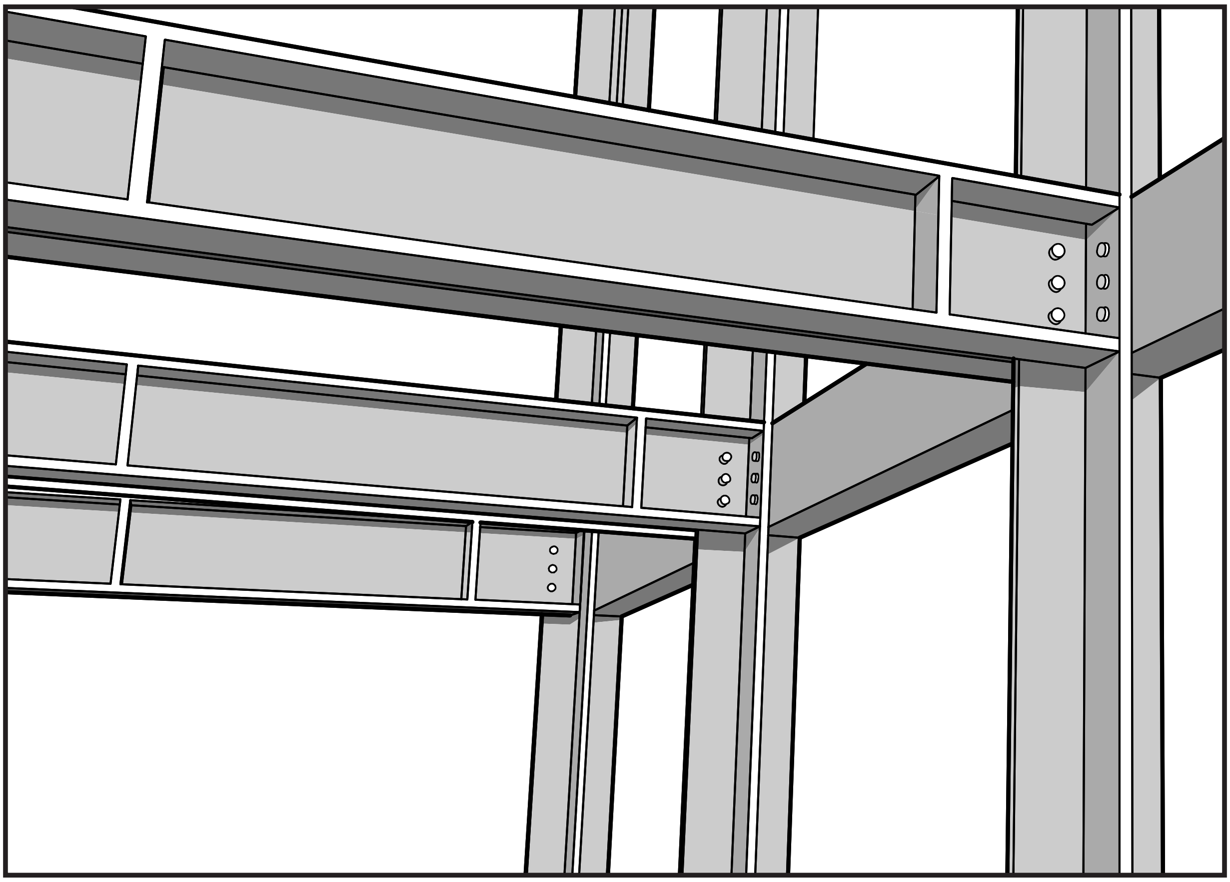
ill. 99.01: *Steel Joint Iterations*



ill. 100.01: Assembly Concept

DOUBLE JOINTS

Throughout the cross joint investigations, it was decided to make a joint system with a more simplified assembly process. This resulted in iterations containing segmented beam and column elements that would allow for intersections, while not relying on welding. The first iteration consisted of deconstructing the cross beam into four L-profile elements (ill 100.01a), with a beam element intersecting into it's the central axis. This led to a thin plane on top of the beam, making it harder to solve how to implement the decks. This resulted in the reverse solution, deconstructing what formerly were an H-profile into pairs of U-profiles bolted onto each side of the column element (ill 100.01b), cut into a 45-degree angle in the corners. This solution preserved qualities from the h-profile, while allowing for easy assemblage.



ill. 101.01: Structure Diagrammatic Sketch

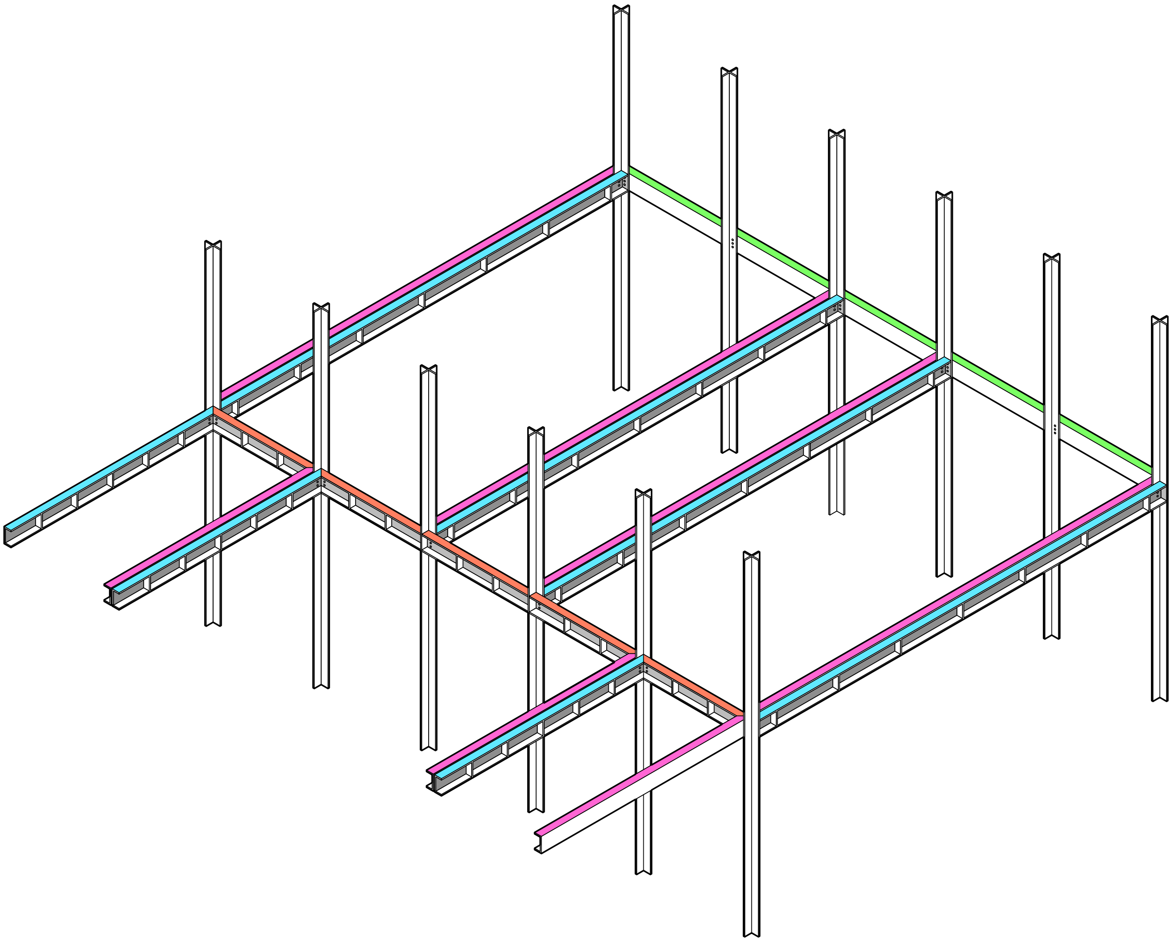
STRUCTURAL SYSTEM

The implementation of this type of structure allows for the usage of a single U-profile beam or a double.

This allows for a seperation between which beams carry the facades and which are to lift the decks emphasizing the direct function of an element.

It further enables the implementation of timber rafters into the decks, decreasing the span of these elements while allowing for adaptability in the future. When implementing a deck onto these, one does not have to have the decks go all the way across but can simply utilize the system to adapt to ones needs.

Further this solution reduces angular meetings between elements in intersections. The central beams does, however, create such an intersection meeting with beams of the other direction. It is solved by cutting the intersecting bit by 45 degrees of both intersecting elements.



ill. 103.01: Structural System Diagram

** this diagram seeks to show how the different U-profile beams are placed in the system. The notion of color is merely to emphasize orientation of a beam.*

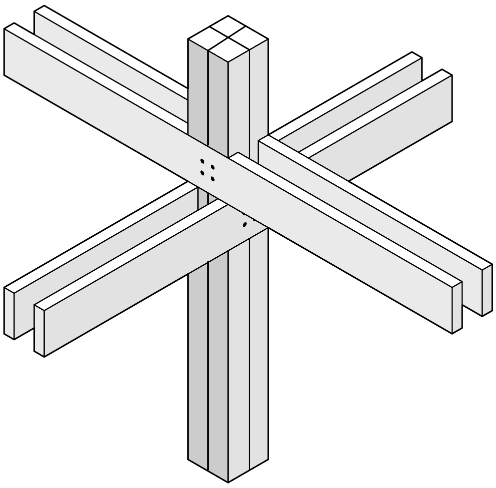
RENDERING STUDIES OF THE ATRIUM

These pictures emphasize how the atrium evolved through visualisations. They were used as a tool to evaluate solutions of joints and the aesthethic quality of the structure. These depicture different iterations of structure, but soon evolved into redefining the units within the atrium, minimizing them and emphasizing the conceptual link between generics, specifics and infills.

This allowed for both more intake of daylight, but also gave these small niches, leading a user to a place of contemplation with a book. A bookshelving system was designed to allow the users to inhabit the space collectively and give it their own identity through infill, and adapt it further if needed.

Also responding to some of the identity parameters derived in both the theoretical chapter on Living Environments and Interiority.

ill. 105.01: Atrium Render Progression



ill. 106.01: Montagehallen Structure Assembly

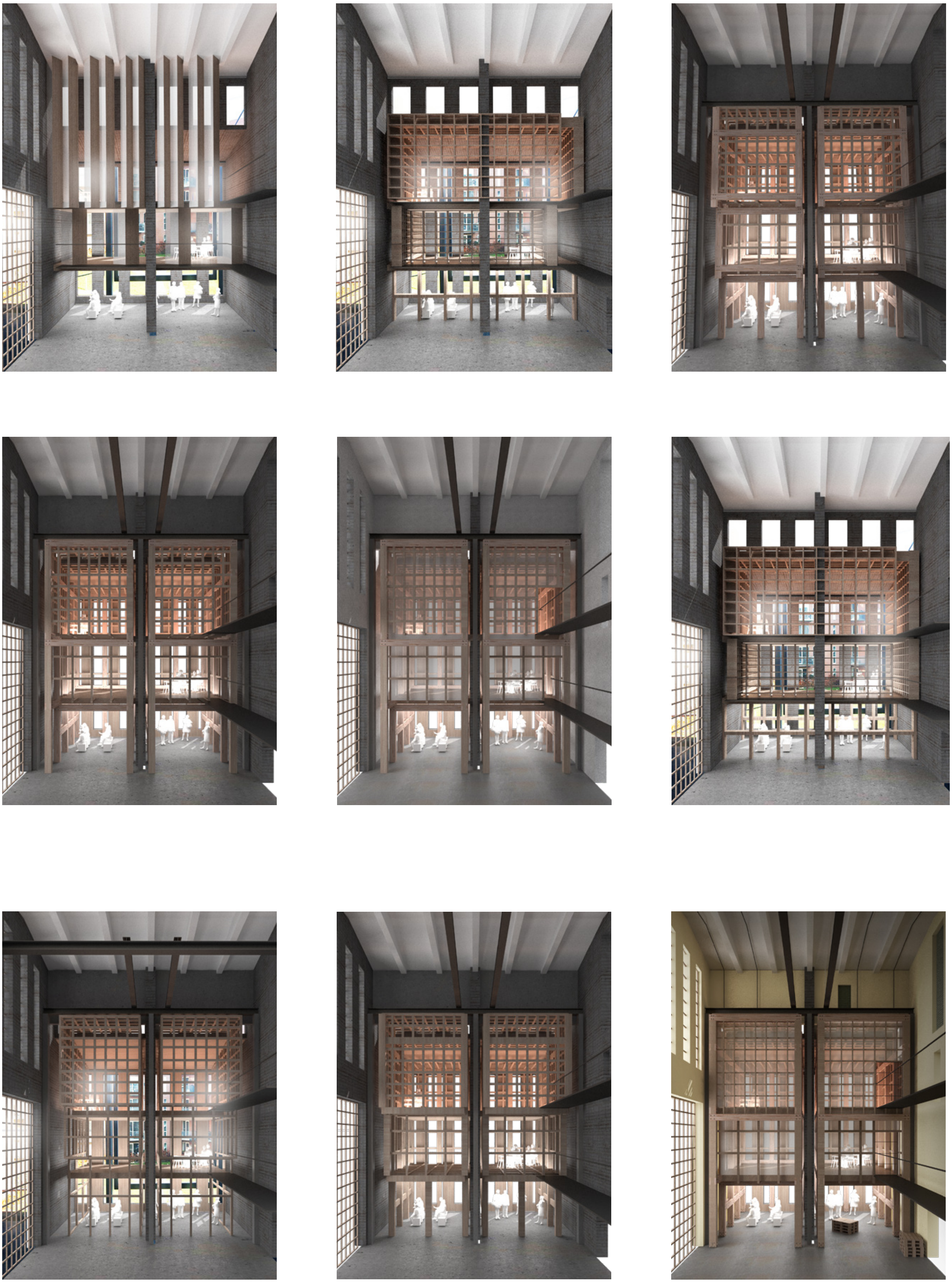
ill. 106.02: Montagehallen Render

RENDERING STUDIES OF MONTAGEHALLEN

These renderings, similarly to the previous ones, show the development of this specific area; Montagehallen.

The implemented structures are constructed of glulam timber and assembled with bolts, cut into the pillars allowing for the load to be directly distributed downwards.

The concept utilizes the vertical seperation for splitting of functions going from public and in a workshop-like area towards less disturbed areas utilized for work and leisure.



ill. 107.01: Montagehallen Render Progression

Phase 1: **Preliminary Studies**
- Transformation Principles
- Programmatic adaptation
- Sketching
- Conceptual modelling

Phase 2: **Concept Defined**
- Sketching
- Physical models
- Conceptual development
- Structural concept

Phase 3: **Refinement**
- Fine tuning
- Detailing
- Calculations and simulations

CONCLUSION *REFINEMENT*

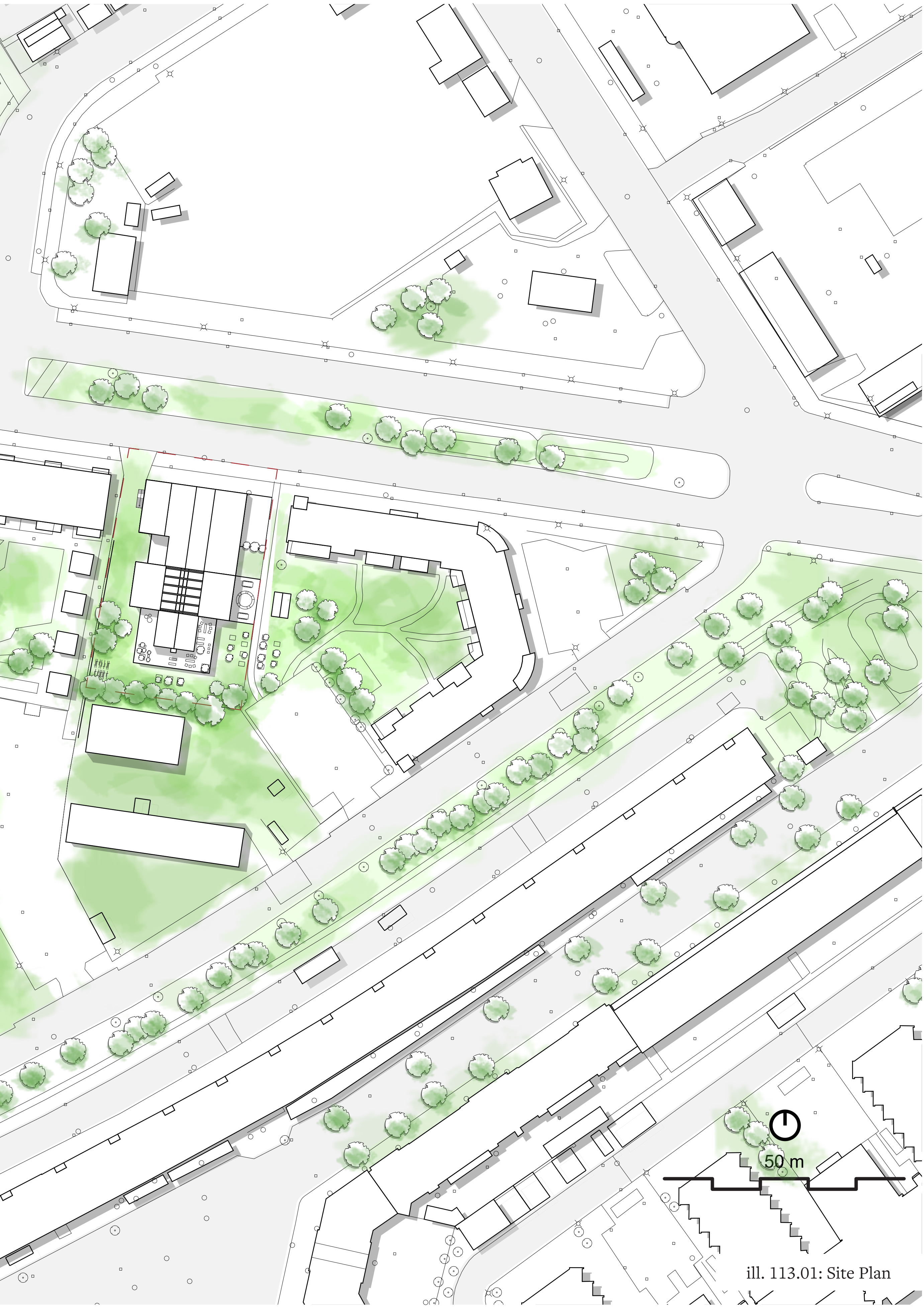
Phase 3 of the Design Process elaborates with further detailing, mostly emphasizing on the tectonics, the assembly and the overall joineries of the steel structure, and investigates how a timber structure could be implemented in Montagehallen.

Chapter 6
presentation

This chapter contains the presentation of the current design proposal.

The design will be presented through spatial visualizations, plans, sections, elevations, detail drawings and diagrams. Additional drawings can be found within the drawing folder.

The chapter contains:



ill. 113.01: Site Plan

ill. 114.01: Visualization, Exterior

PRESENTATION

Having spent its life serving as a knot in the electricity grid, brightening the homes of its neighboring residents and allowing them to indulge in their domestic errands, Kløvermarkens Transformer Station is relieved from service aspiring to be revitalized with a new communal and contemporary spirit.

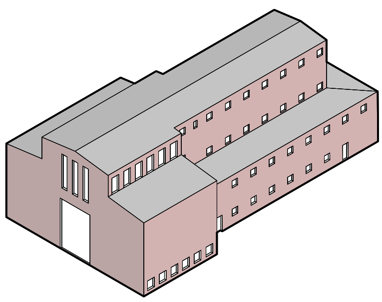
Following the steps of its prior function as an electrical distributor, the station will continue to allow for its users to live out their needs, though in a much different manner.

COMMUNAL SPACE
What used to be the central core for maintaining and operating the transformers, will now serve as a communal space for whomever wants to engage thereby promoting participation, social interaction, and user initiative. This communal facility will serve as the face of the building towards the city, and spite having most of the northern façade preserved in the original state, its appearance will now glow with the life contained within its renewed function. This communal space will serve as the connection between the local lives in the city and its new residents located within the remaining parts of the building.

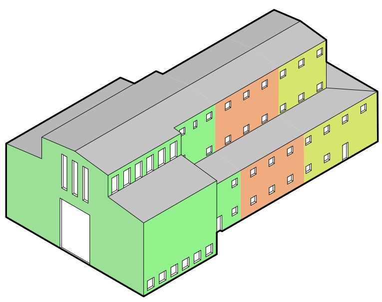
COLLECTIVE HOUSING
These residents will be engaging in an emerging and modern lifestyle, enrolled as temporary settlers in a collective housing unit, with private spaces distributed along the façade in what used to be the relay rooms, the users will have a full unit pr. resident apart from a small portion of couples' units.

Units are minimized for living as a sojourner, allowing for maximizing the quality of the shared facilities, which amongst practical facilities are containing a shared kitchen and dining room, work spaces, areas for leisure and relaxation, a bathhouse and a large outdoor roof terrace.
This collective housing unit will not only serve towards fulfilling the domestic needs of its residents, but seeks to increase social connectivity and engagement, aiming to create a unique architectural and social experiences and atmospheres, enhancing the quality of their experience living in Copenhagen.
The revitalization has mainly been enabled through an intervening architectural reconfiguration of the existing building mass. Though the aim has been to preserve much of the original building, a cut in the central part of the longitudinal axis allows for an atrium, distributing light into the building core. This serves as the central circulatory knot for the inhabitants, and simultaneously adding to an altered building appearance through elements of contrast, while imitating the formal language of the original building.

This intervention not only allows for the total reprogramming of the original spatial plan distribution, but is developed in a way in which future reprogramming are encouraged and aimed to avoid alterations of an irreversible character. This is supplemented by a general upgrade in window openings, insulation and general building performance, enhancing the general usability and durability of the transformer station.



The Original Building

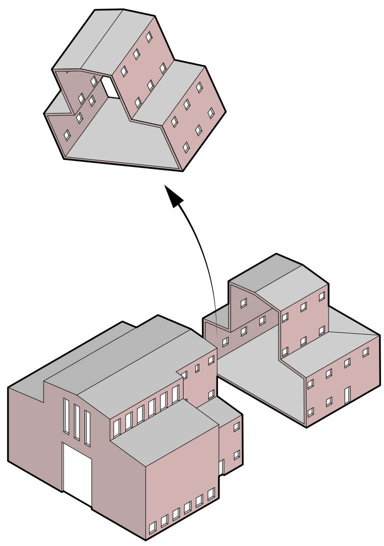


Valuation of the Building.

Green: High amounts of valuable elements.

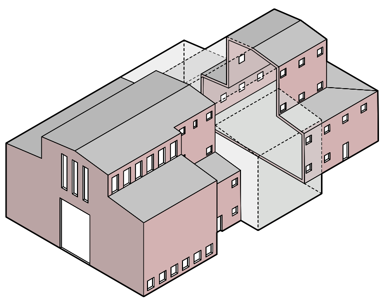
Yellow: Some valuable elements.

Red: Less valuable area



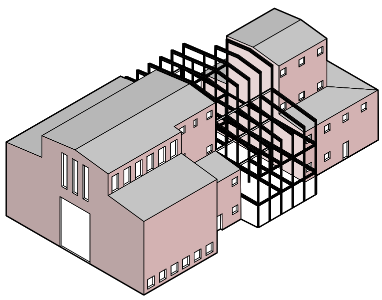
The Intervening Cut

Removing the less valuable area, allowing for a light intake into the central core



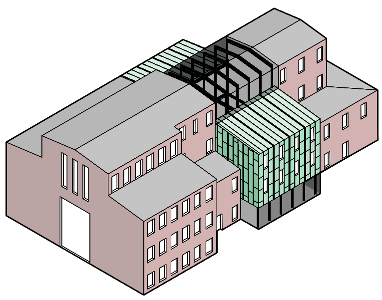
Addition Implemented

Imitating the formal language of the building.



Steel Frames

A steel structure is implemented into this addition



Constructed Envelope

creating openings towards the garden and an atrium. The original building is optimized through subtraction, creating openings and enhancing the daylight intake

ill. 117.01: Concept Diagrams

ill. 118.01: Montagehallen

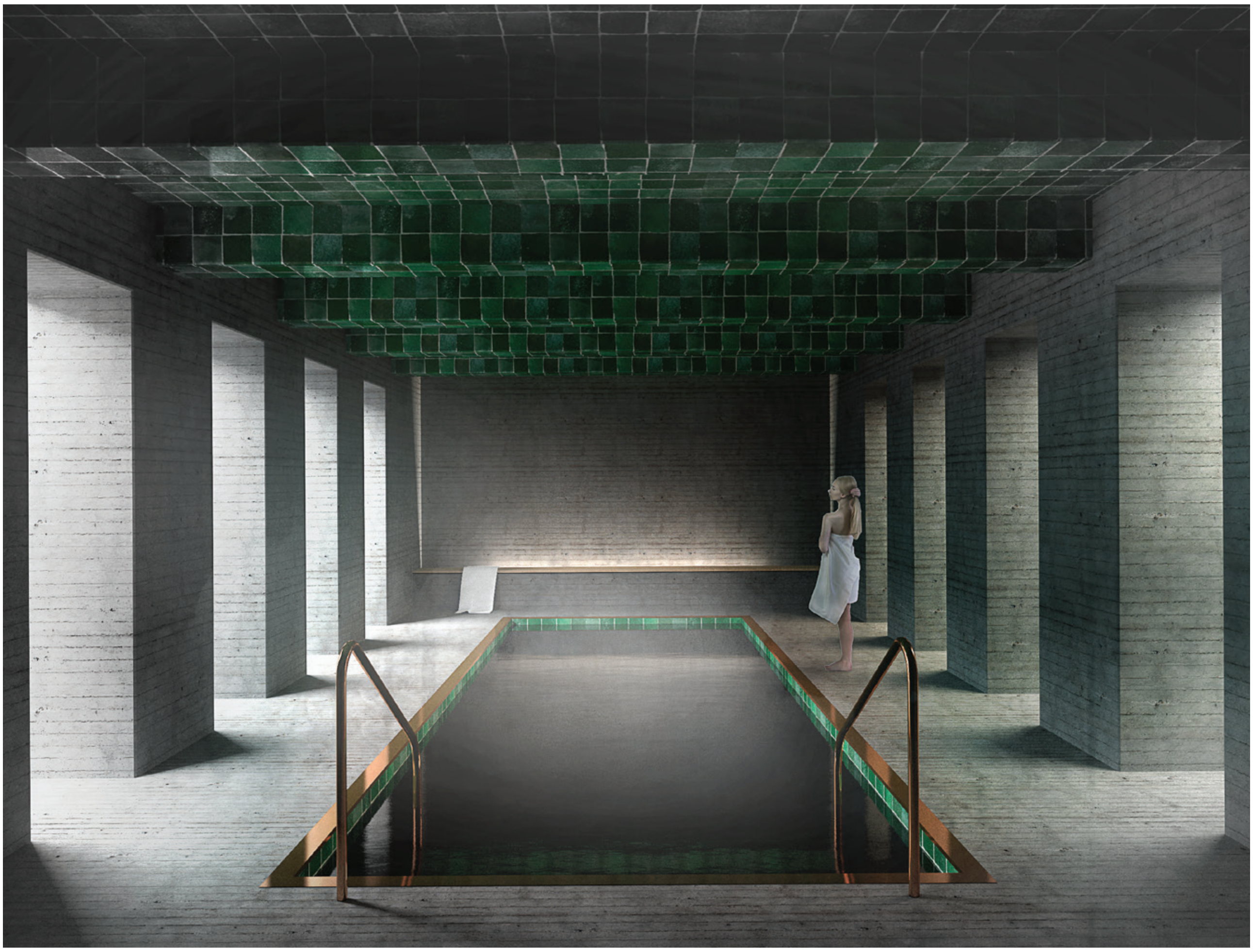
THE COMMUNAL SPACE

The communal space is designed as an independent freestanding wooden structure filling the former transformer spaces. The design allows for a segmentation of the large space created through merging the installation hall with its surrounding transformer rooms enabling a diverse usage of the space.
The vertical seperation allows to create a gradient from a more secluded and serene as one travels up the floors. This is intended to offer possibilities of facilitating a variety of activities, thus offering the framework for allowing the users to engage creatively in the space.
While the overall spatial quality and atmosphere has been preserved from the original building, the juxtaposed wooden structure generates a tension between the existing and the new, through its shift in materiality, structural configuration and formal presence. The design is intended to be of a temporary character, and should be built and possibly dismantled without further changes to the existing building mass.

ill. 120.01: The Atrium

THE UNITS

While aiming towards offering high quality private spaces for the building residents, the units have all been minimized to allow for larger social facilities while still meeting the needs of the occupants. They are designed to fill the occasional need for secluding oneself from the collective, though through their minimal scale simultaneously encouraging the usage of the social facilities. The design aims towards enhancing the level of activity and consequently the success of the social atmosphere within the collective. Through a stable degree of social activity within the collective, the users are more likely to develop a sense of familiarity towards the neighboring occupants, thus maximizing the incentive towards social engagement.



ill. 122.01: The Oilswamp

THE COMMON FACILITIES

The social facilities are designed to complete the needs of the residents in practical regards, while acting as catalysts for the social engagement within the facility. The residents will dine together in the kitchen and dining facilities on the ground floor, and in the garden terrace during the summer, thus always gaining an amount of social exposure. Here the residents can cook using vegetables grown within their own urban kitchen garden, located next to the garden terrace.

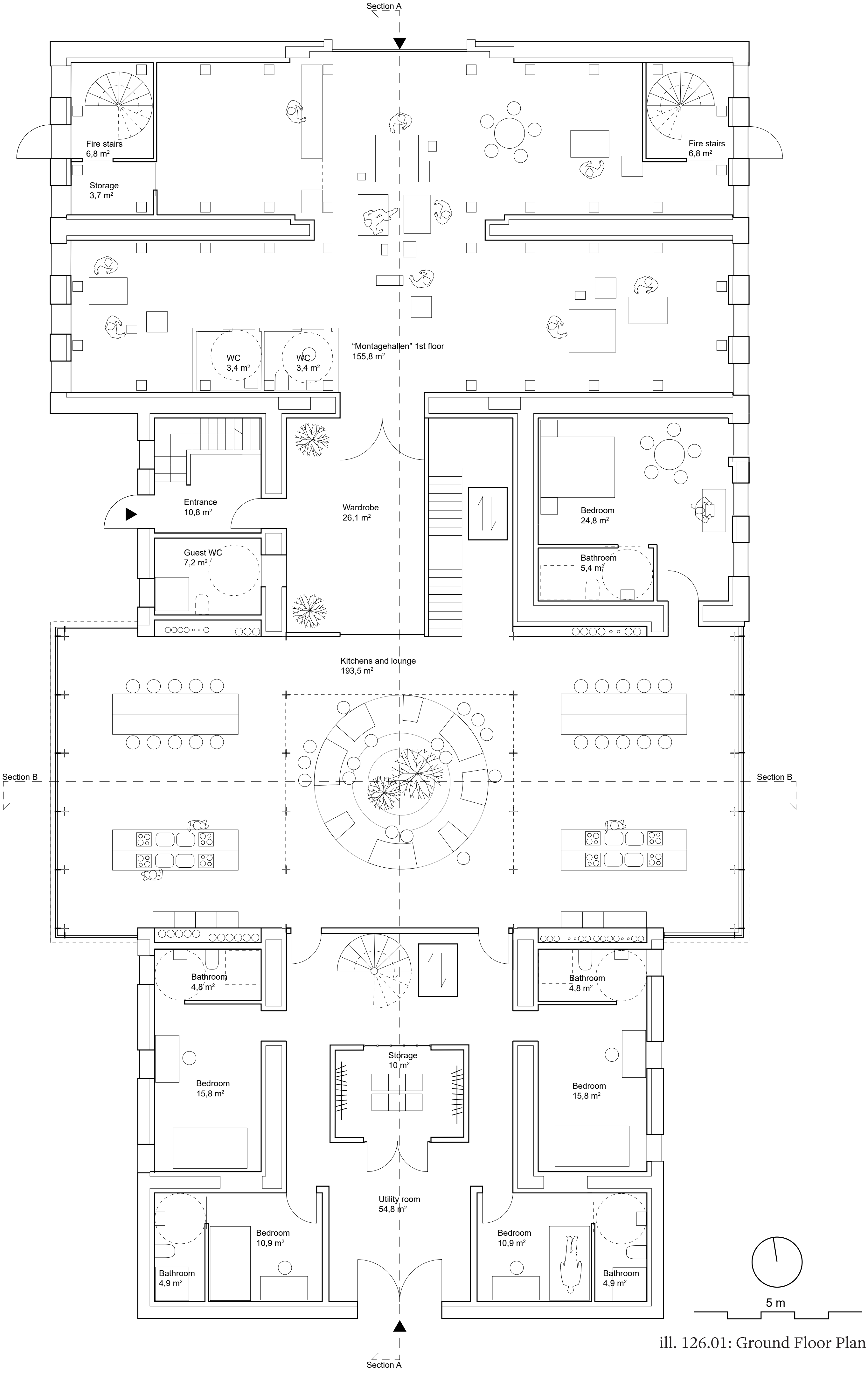
When a resident wants to work on ones project, they can use one of the designated workstations within the more secluded zones of the upper floor. Here the resident will find lounge spaces for relaxation directly connected to a large rooftop terrace with sun exposure throughout the day.

Going down into the basement the residents are offered a bathhouse facility in what used to be a container for the oil spill from the transformers. This refurbishment is inspired by a traditional public bathhouse facility, allowing for a relaxed and intense architectural atmosphere, unique to living within the collective.

ill. 124.01: Exterior Twilight Render

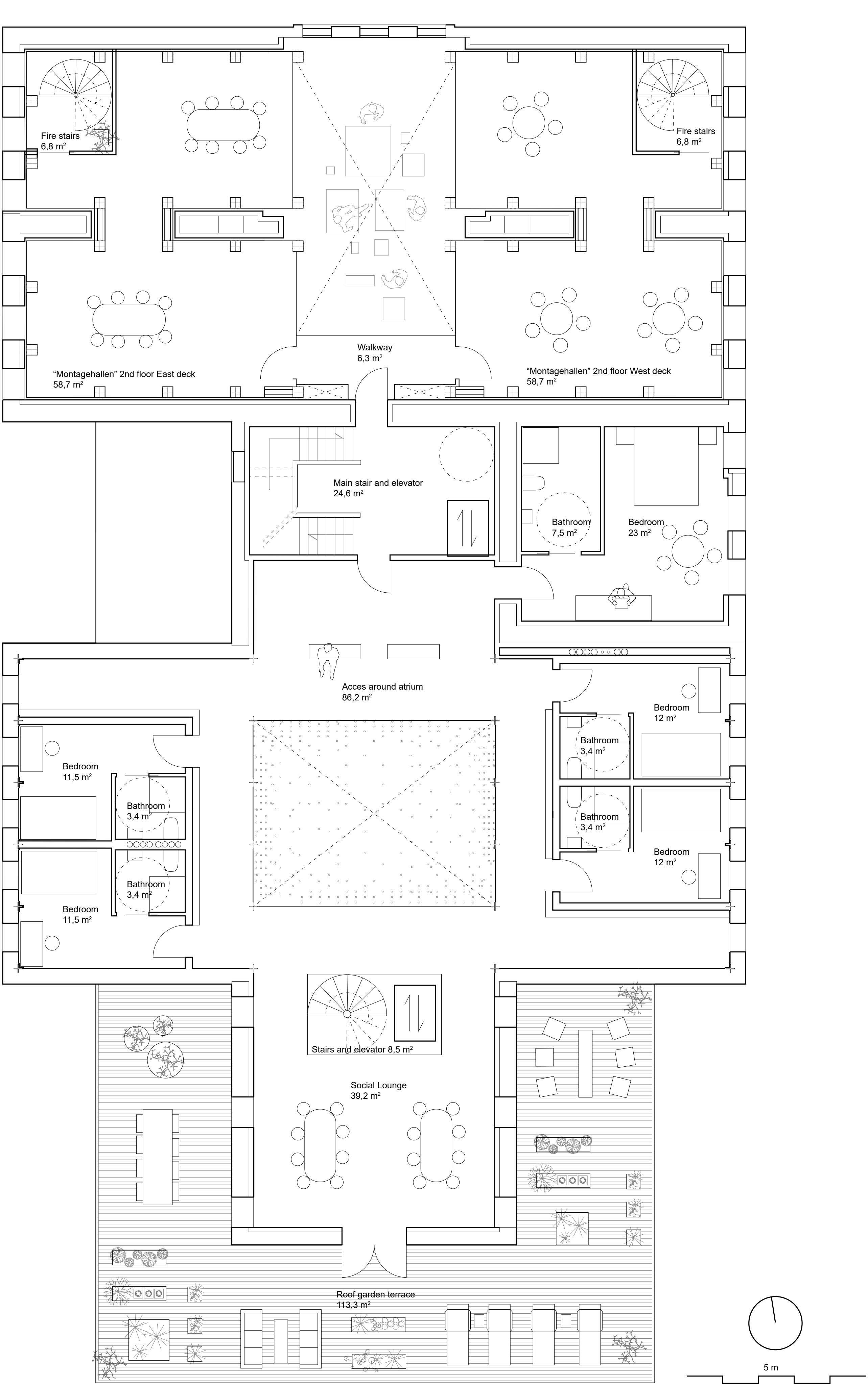
THE ARCHITECTURAL TRANSFORMATION

The architectural transformation is both sensitive and disruptive of the original appearance of the building. It imitates the geometrical shape of the frontal area, enhancing the dynamic shifts in the overall building form, while making a contrasting gesture though a shift from a heavy stereotomic to a light tectonic order and material usage. The new addition draws on the existing industrial character of the transformer station and through the copper cladding acts as a homage to the cobber roofs found in many parts of architectural heritage around Copenhagen. The brick is intersecting the new implemented addition through a draw back in the form of a recess in the original brick walls, articulating where the old clashes with the new. The original building is transformed by subtracting from the brick wall, to create or enlarge the existing openings. The existing windows so far as possible have been preserved, by subtracting downwards to preserve the original brickwork on top. The wall in the transformer spaces are punctured to allow for daylight in Montagehallen, while continuing the rhythm of the overall window configuration.

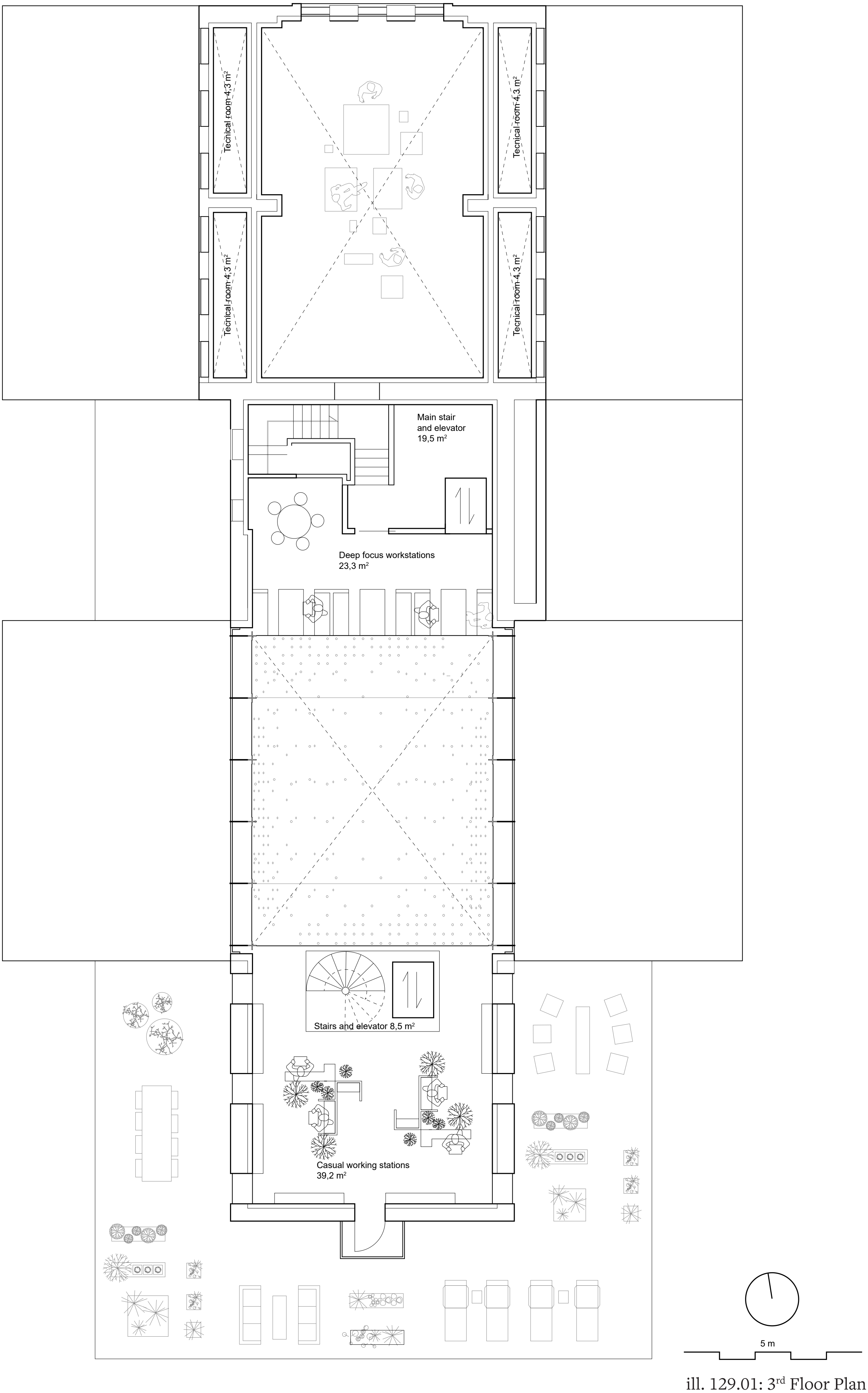


ill. 126.01: Ground Floor Plan

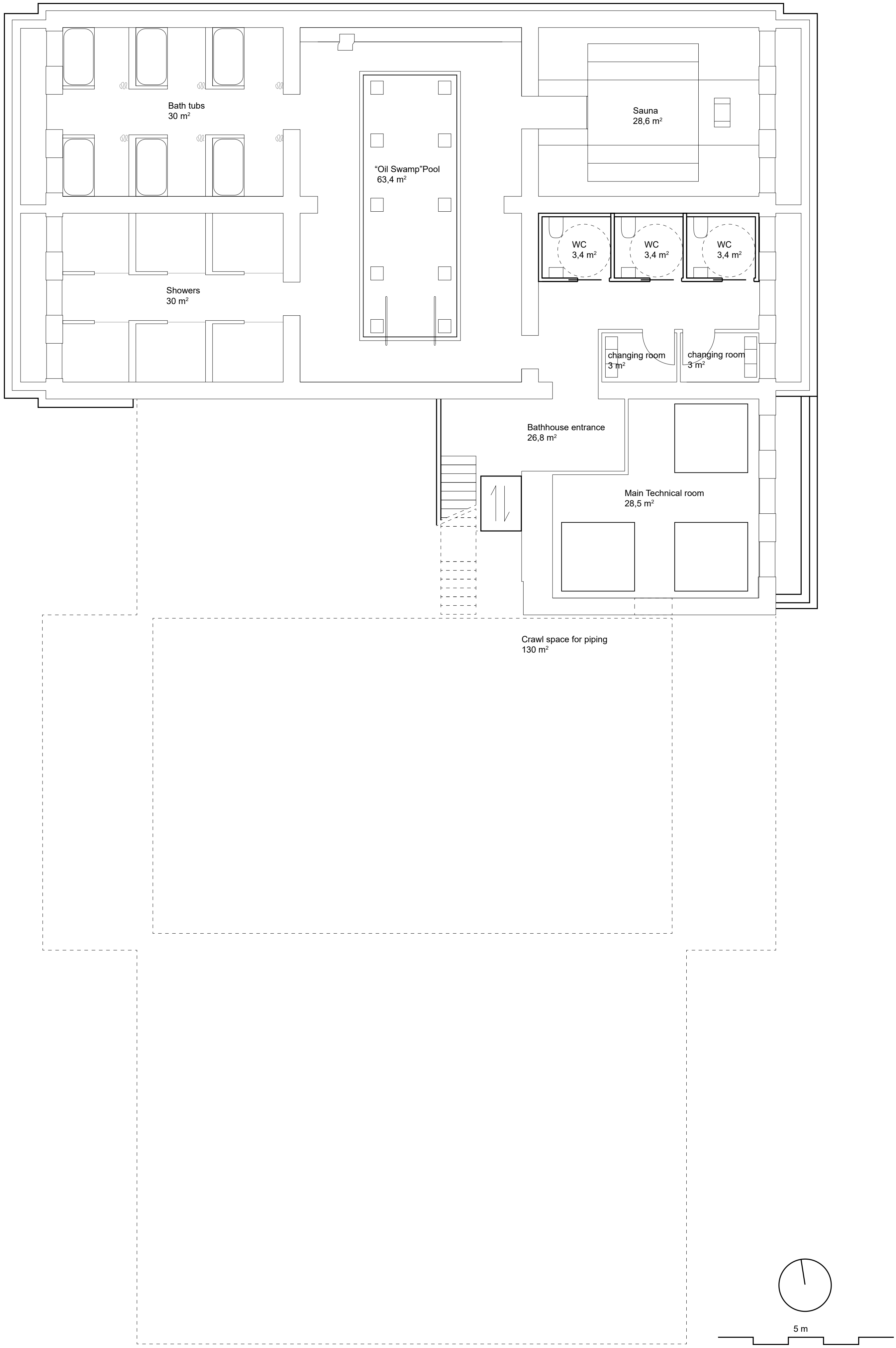
ill. 127.01: 1st Floor Plan



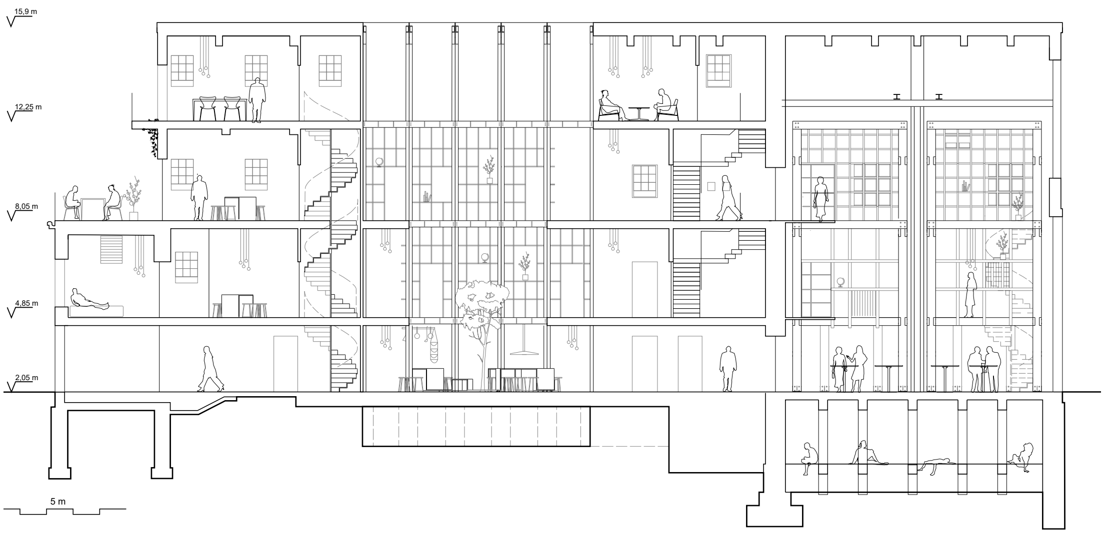
ill. 128.01: 2nd Floor Plan



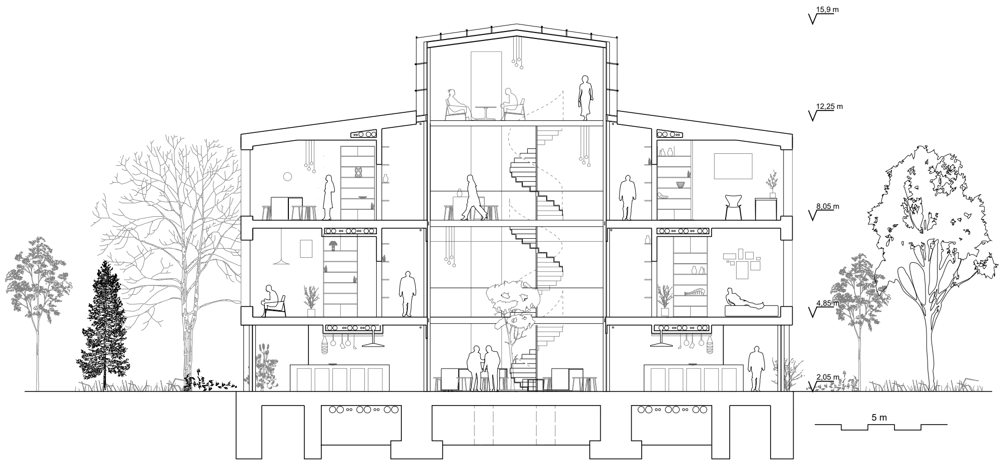
ill. 129.01: 3rd Floor Plan



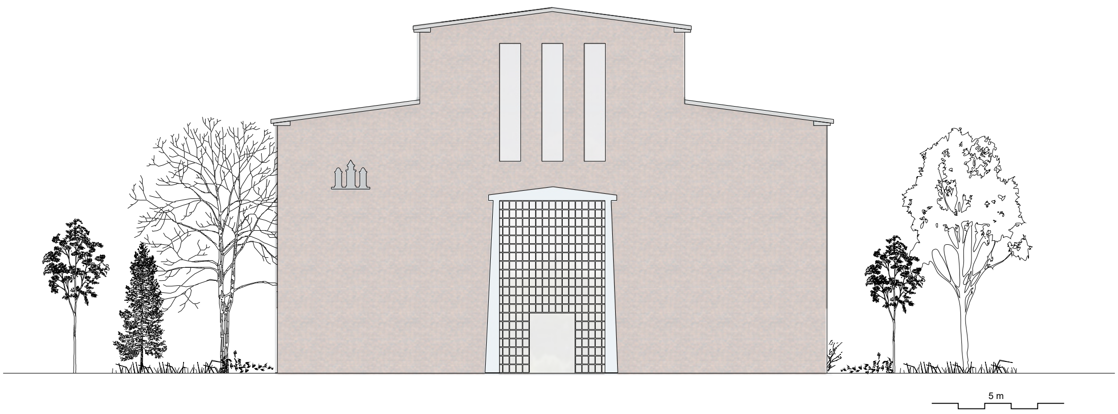
ill. 130.01: Basement Plan



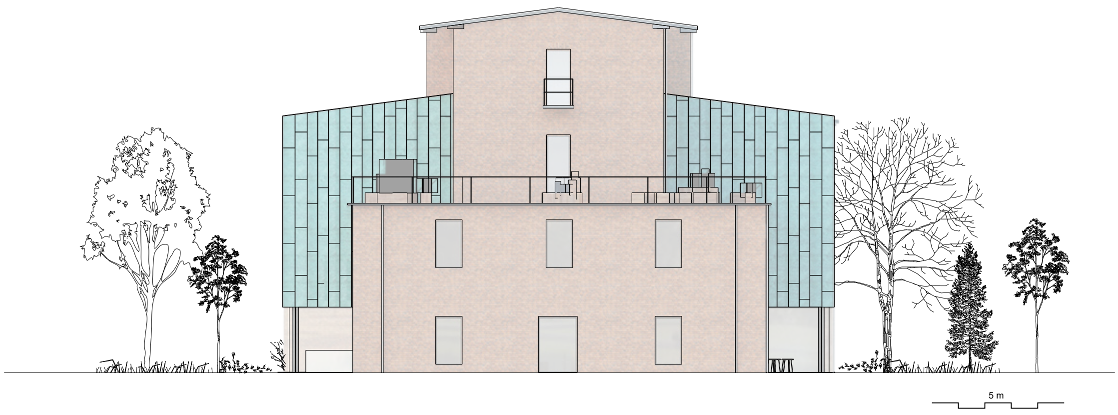
ill. 132.01: Section A
Longitudinal Section



ill. 133.01: Section B
Cross Section

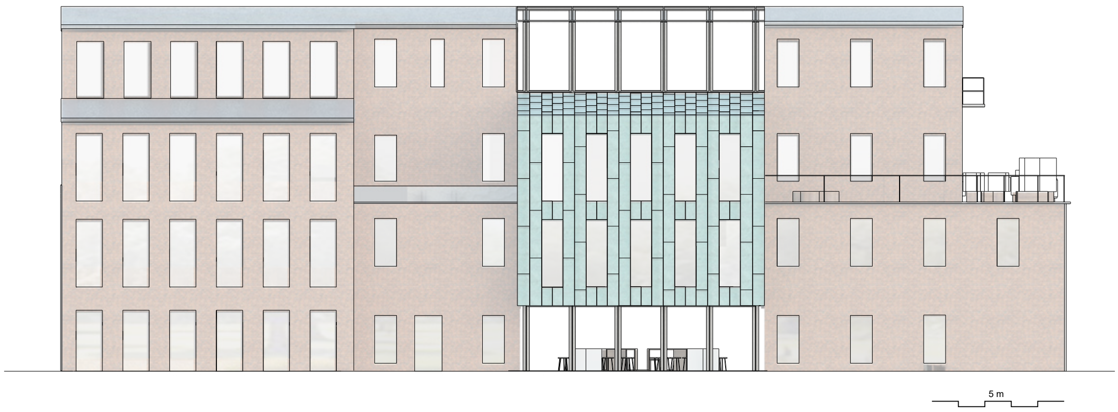


ill. 134.01: North Elevation



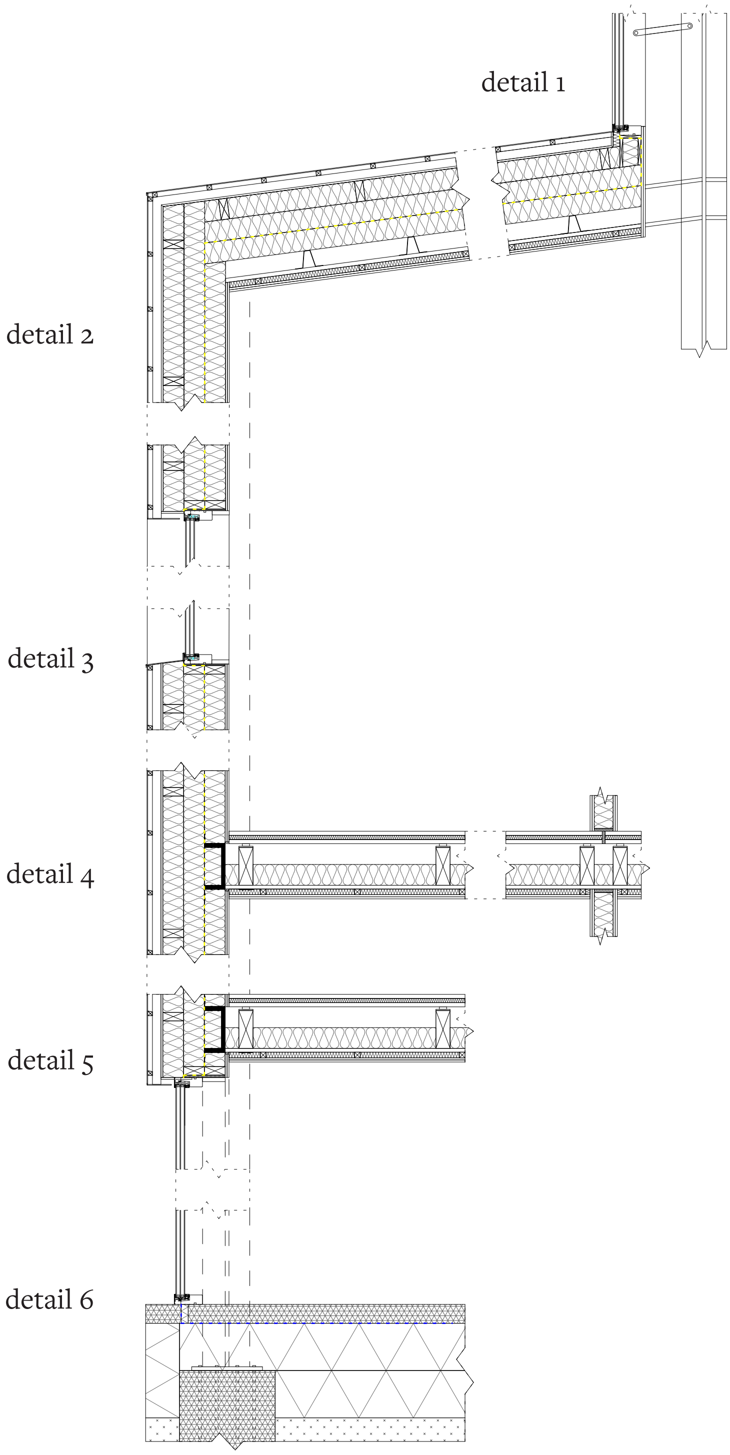
ill. 135.01: South Elevation

ill. 136.01: East Elevation

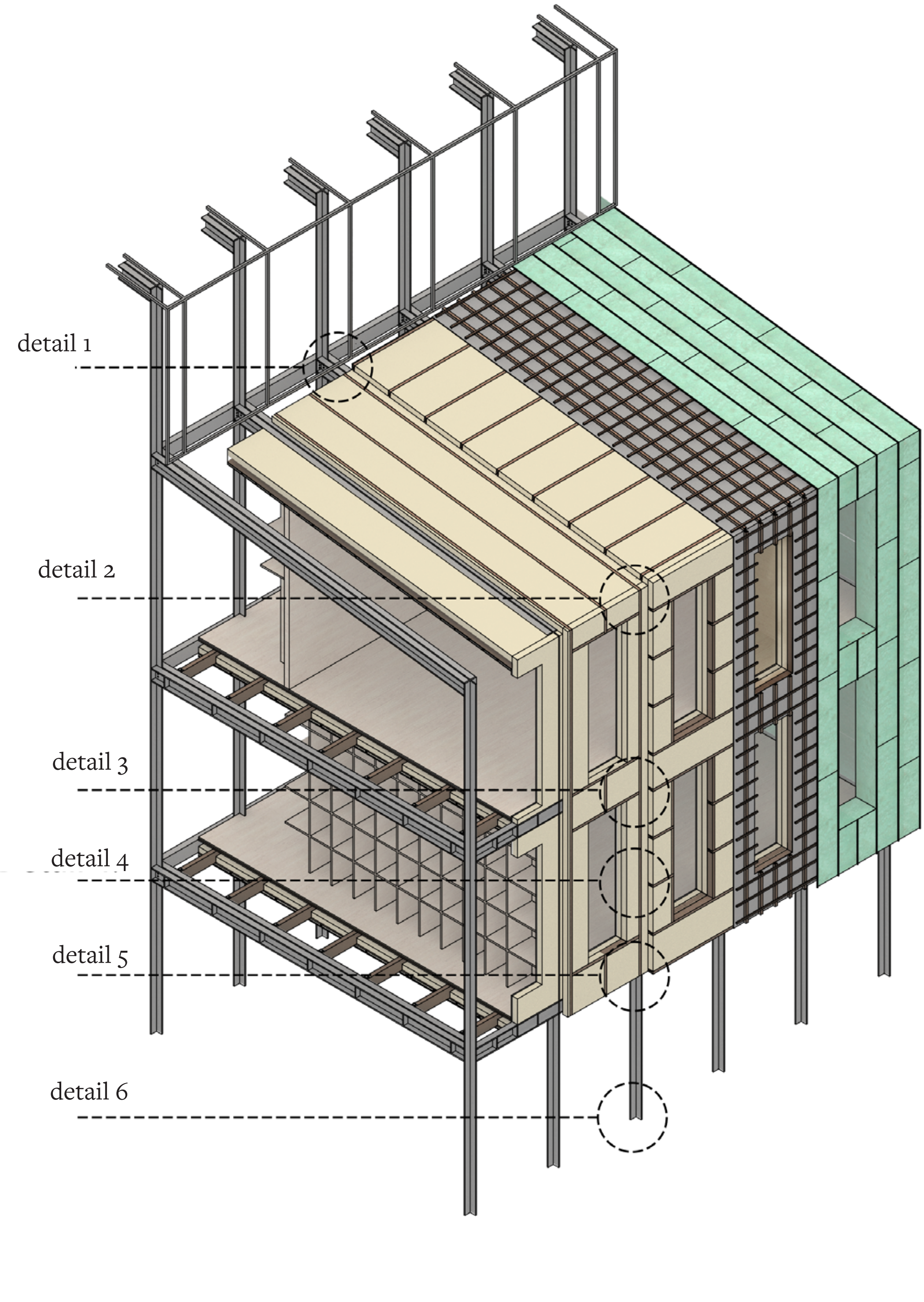


ill. 137.01: West Elevation

DETAILS

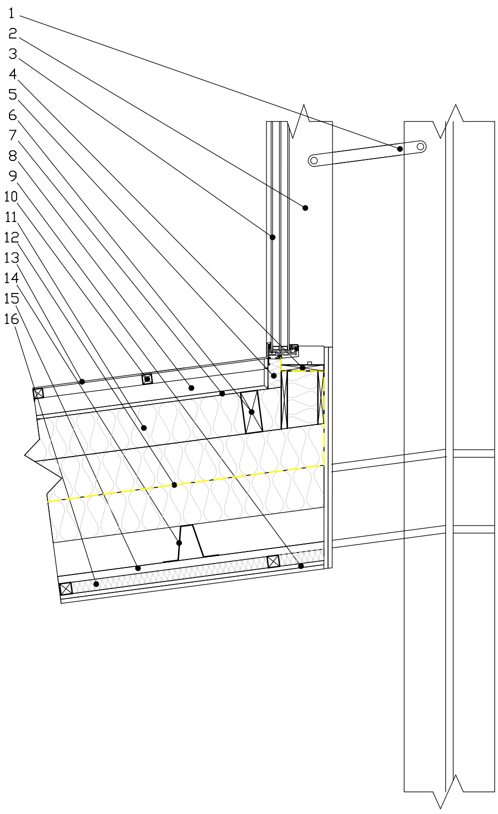


ill. 138.01: Section Detail



ill. 139.01: Layer Diagram

DETAIL 1

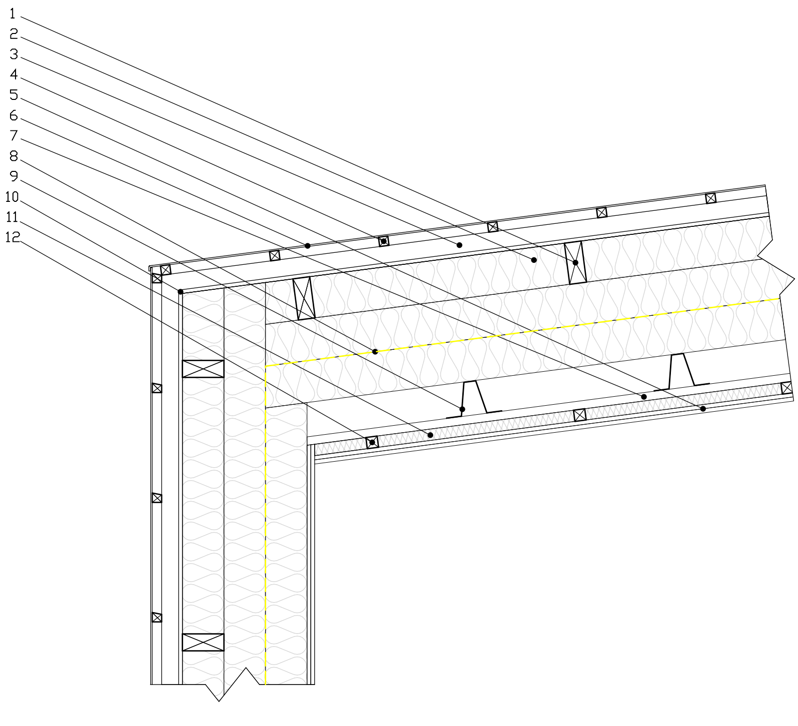


1 Steel bracket
2 Window Frame
3 Velfac 200
4 Wooden Board
5 Rigid Rockwool Insulation
6 Wooden Joist 45x110mm
7 Windboard
8 Wooden Joist 45x45mm (Ventilated Gap)
9 2x Fermacell Gypsumboard
10 Wooden Studs 25x25mm
11 Rockwool Insulation 110mm
12 Vapor Barrier
13 Cobber Cladding 4mm
14 Steel bracket
15 Chipboard 22mm
16 Soundinsulation

ill. 140.01: Facade / roof detail 1:20

DETAIL 2

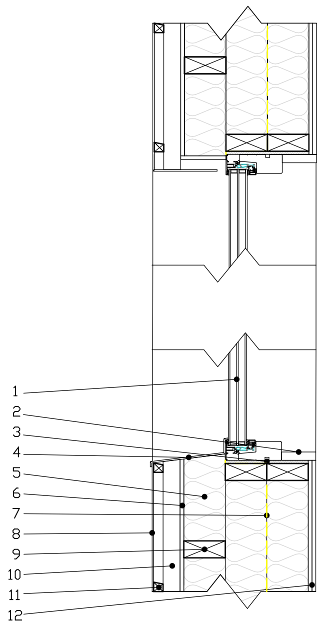
1 Wooden Joist 45x110mm
2 Rockwool Insulation 110mm
3 Wooden Joist 45x45mm (Ventilated Gap)
4 Wooden Studs 25x25mm
5 2x Fermacell Gypsumboard
6 Cobber Cladding 4mm
7 Chipboard 20mm
8 Vapor Barrier
9 Steel Rail
10 Windboard
11 Soundinsulation
12 Wooden Stud 25x25mm



ill. 141.01: Facade / roof detail 1:20

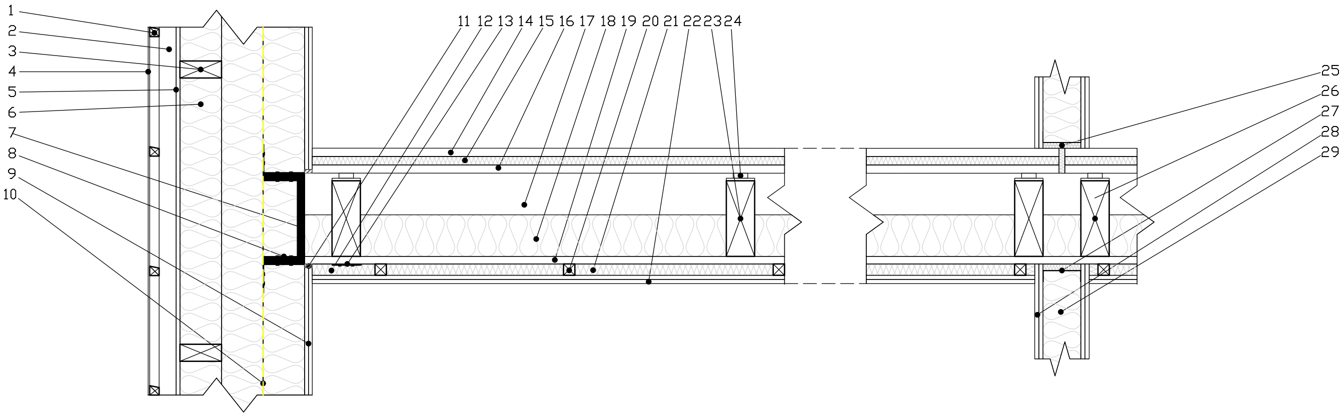
DETAIL 3

1 Velfac 200
2 Wooden Frame
3 Rigid Rockwool Insulation
4 Cobber Drip Edge
5 Rockwool Insulation 110mm
6 Windboard
7 Vapor Barrier
8 Cobber Cladding 4mm
9 Wooden Joist 45X110mm
10 Wooden Joist 45x45mm (Ventilated Gap)
11 Wooden Studs 25x25mm
12 2x Fermacell Gypsumboard



ill. 142.01: Facade / window detail 1:20

DETAIL 4

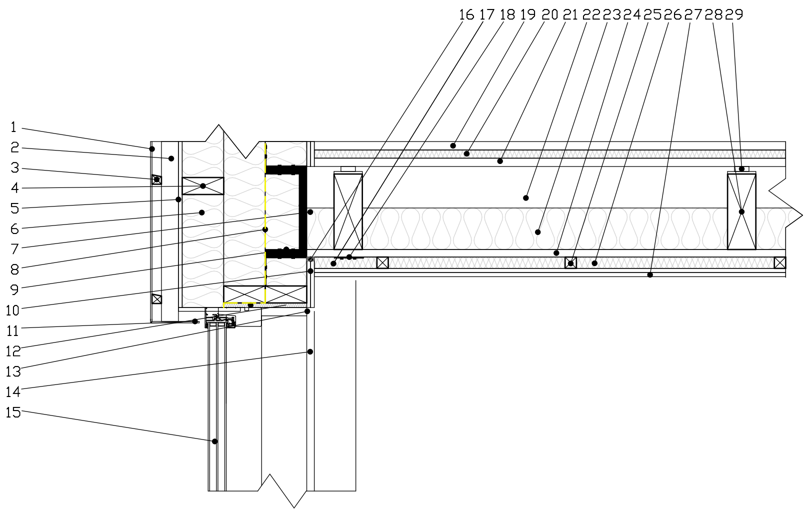


1 Wooden Studs 25x25mm
2 Wooden Joist 45x45mm (Ventilated Gap)
3 Wooden Joist 45X110mm
4 Cobber Cladding 4mm
5 Windboard
6 Rockwool Insulation 110mm
7 2x U- Steel Profile 240x110mm
8 Steel Brackets Joist Connection
9 2x Fermacell Gypsumboard
10 Vapor Barrier
11 Acoustic Sealant
12 Rigid Rockwool Insulation
13 Steel Brackets
14 Wooden Flooring
15 Sound Insulation
16 Chipboard 22mm
17 Air Gap
18 Rockwool Insulation 110mm
19 Chipboard 22mm
20 Wooden Studs 25x25mm
21 Rockwoll Insulationboard 25mm
22 2x Fermacell Gypsumboard
23 Wooden Joist 200x45mm 1000mm Spacing
24 Joist Isolator
25 Sound Insulation Foam
26 Wooden Joist 200x45mm 1000mm Spacing
27 Gyproc Steel Rail
28 2x Fermacell Gypsumboard
29 Rockwool Insulation 100mm

ill. 143.01: Facade / deck / internal wall detail 1:20

DETAIL 5

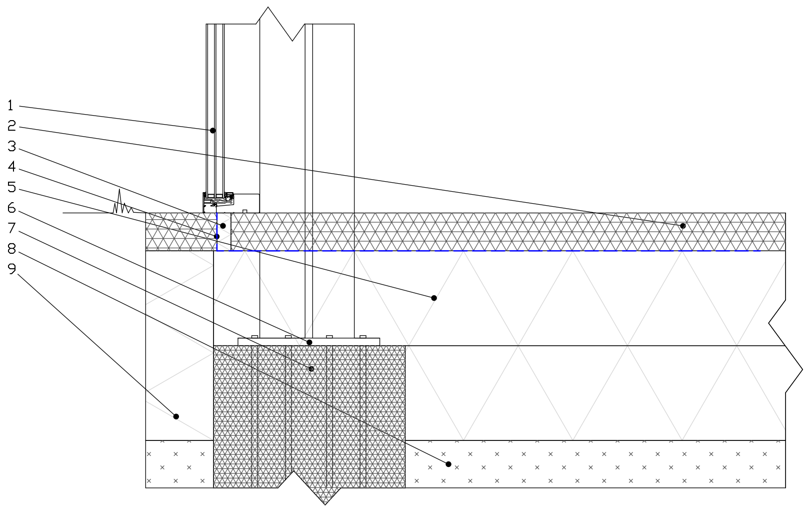
1 Cobber Cladding 4mm
2 Wooden Joist 45x45mm (Ventilated Gap)
3 Wooden Studs 25x25mm
4 Wooden Joist 45X110mm
5 Windboard
6 Rockwool Insulation 110mm
7 2x U- Steel Profile 240x110mm
8 Vapor Barrier
9 Steel Brackets Joist Connection
10 2x Fermacell Gypsumboard
11 Cobber Cladding 4mm
12 Rigid Rockwool Insulation
13 Wooden Frame
14 Steel Column
15 Velfac 200
16 Acoustic Sealant
17 Rigid Rockwool Insulation
18 Steel Brackets
19 Wooden Flooring
20 Sound Insulation
21 Chipboard 22mm
22 Air Gap
23 Rockwool Insulation 110mm
24 Chipboard 22mm
25 Wooden Studs 25x25mm
26 Rockwoll Insulationboard 25mm
27 2x Fermacell Gypsumboard
28 Wooden Joist 200x45mm 1000mm Spacing
29 Joist Isolator



ill. 144.01: Window / facade / deck detail 1:20

DETAIL 6

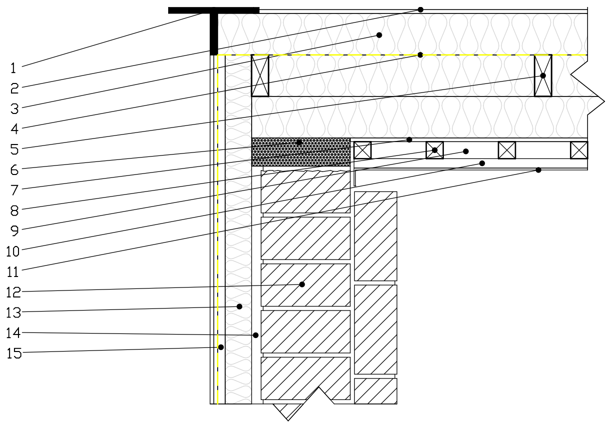
1 Velfac 200
2 Concrete Flooring
3 Polystyrene Insulation Foam
4 Radon Barrier
5 Polystyrene Insulation Foam 250mm
6 Steel Connection
7 Steel Connection
8 Reinforced Concrete Foundation
9 Polystyrene Foam



ill. 145.01: Facade / Foundation detail 1:20

Plan
Intersection between new units and existing brick structure

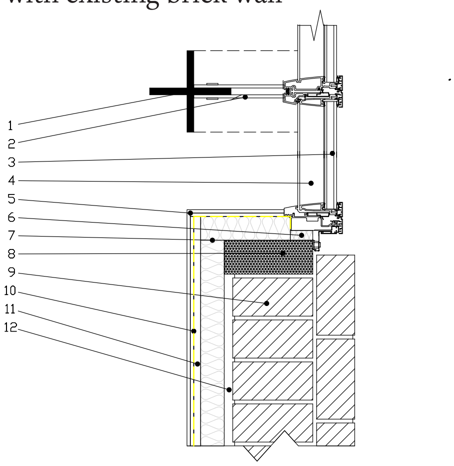
1 Steel Column 240x240mm
2 2x Fermacell Gypsumboard
3 Rockwool Insulation 110mm
4 Vapor Barrier
5 Wooden Joist 45x110mm
6 Yutong Multipor Insulation Block
7 Windboard
8 Wooden Joist 45x45mm
9 Ventilated Gap
10 Wooden Studs 25x25mm
11 Cobber Cladding 4mm
12 3-Layer Brick
13 Isover Insulation Lamdba 30 70mm
14 Ventilated and Dehumidified Gap
15 Chipboard



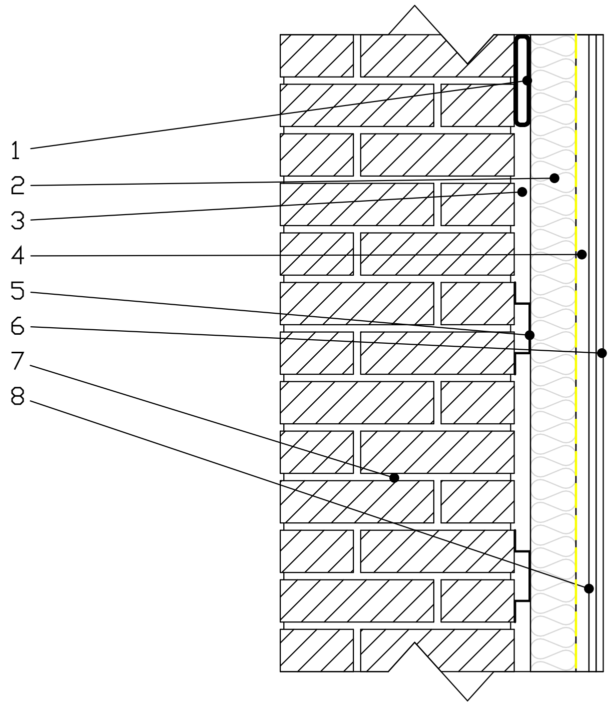
ill. 146.01: New / Existing Detail 1:20

Plan
Atrium Window meeting with existing brick wall

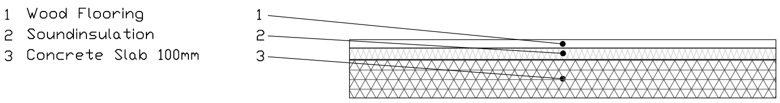
1 Steel Column 240x240mm
2 Steel Brackets
3 VELUX Nordlys
4 Window Steel Frame
5 2x Fermacell Gypsumboard
6 Rigid Rockwool Insulation
7 Isover Insulation Lamdba 30 70mm
8 Yutong Multipor Insulation Block
9 3-Layer Brick
10 Vapor Barrier
11 Chipboard
12 Ventilated and Dehumidified Gap



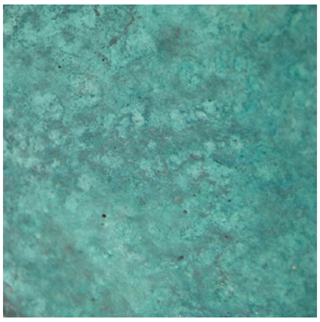
ill. 147.01: Atrium / Existing Detail 1:20



ill. 148.01: Insulation of Existing Wall Detail
using the Isover Retrowall System 1:20



ill. 149.01: Insulation of Existing Deck Detail 1:20



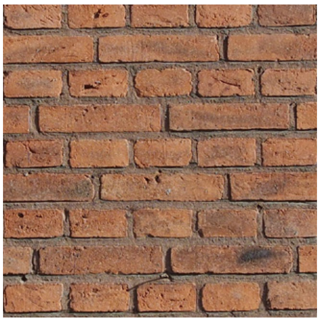
ill. 150.01: Copper, patinated

ill. 150.02: Steel, coated

ill. 150.03: Concrete

ill. 150.04: Wood

ill. 150.05: Glulam



ill. 150.06: Bricks

ill. 150.07: Green tiles

MATERIALS

The project uses a wide range of materials. These are ranging from wood in the form of a glulam structure in Montagehallen, wooden flooring and surfaces within the units and atrium, gypsum walls and ceilings throughout the entire building. Concrete walls and slabs can be found in the original parts of the Bathhouse. The exterior consists of cobber cladding juxtaposed to the original bricks.

STRUCTURAL SYSTEM

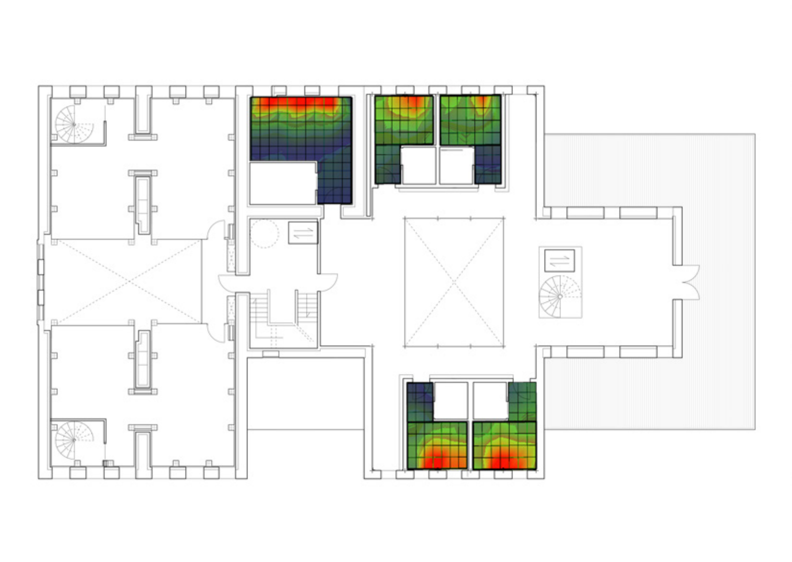
The structural system designed to fill the void from the transformation cut are made up from a simple steel framing system through the connection of cross columns and u-profiles bolted onto the columns. The rather simplistic configuration is designed to enhance the adaptability for future reconfigurations on decks and partition walls implemented within the structure. This aims to exemplify the notion of the generic, specific and polyvalence, as described in the theoretical chapter; the steel structure serving as a generic tectonic order, allowing itself to be filled and refilled with specifics in the space it creates, through qualities of polyvalence. The simple and functional grid like frame structure is optimized to allow for insertion of floor decks and have a partition wall implemented along the frames. The structure is intended to give a simple gesture of reconfigurability, yet with a clear and enduring presence throughout these adaptations, linking contrasting elements together to be perceived as part of a unity. The materiality of the structure is generally associated with riditidy and durability, enhancing its potential adaptability throughout many future alterations. The joints are designed in a way to simplify the assembling process, and could themselves be replaced or removed, if future scenarios would see a need to it.

The envelope buildup has been made to allow for the structure to be exposed in the interior. The envelope is thus offset from the central axis on the impacted u-profiles, as to allow for the vapor barrier placement within 1/3 of the insulation, yet outside the main structure.

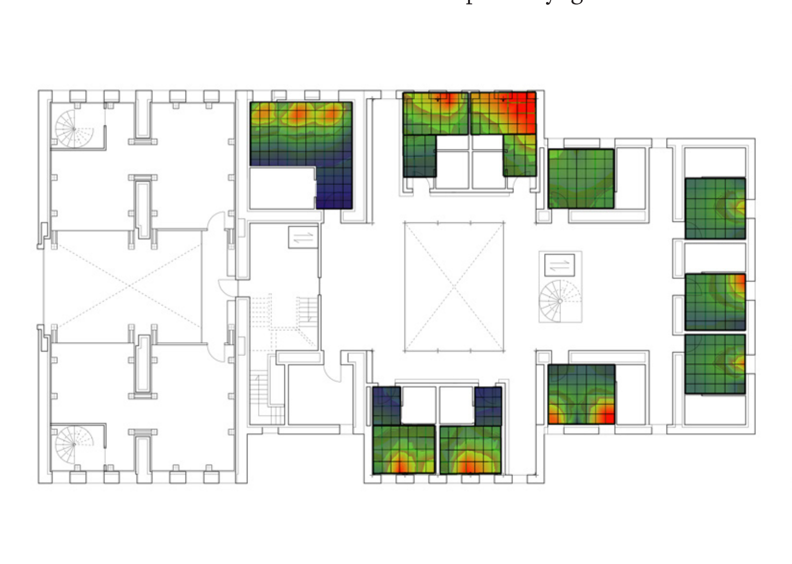
ill. 153.06: Structure

The rest of the envelope have been designed in a lightweight timber framing system, clad with cobber panels. The windows are placed with equal spacing in between the frames, allowing for a vast range of possible spatial plan reconfigurations, while maintaining a view and daylight intake. The steel structure have been iteratively investigated using the parametric modelling tool GH2R, allowing for Finite Element Analysis in Autodesk Robot Analysis. The loads and load combinations have all been calculated according to Eurocode standards, and can be found in appendix 2. These are set up in the parametric model, to correspond with the specific load definitions that each member or area in the building are reacting against, and with the corresponding load case combinations.

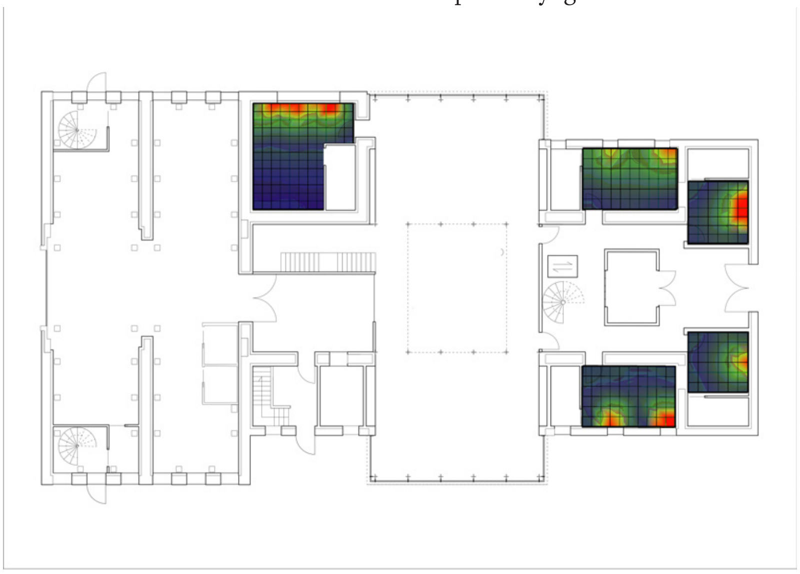
This have allowed for a simplified global analysis of the structural performance, while maintaining information on each beam and column member, and have been used to both structural optimization and to ensure that the present configuration is working in both ULS and SLS. The structure is over dimensioned in some areas as to keep a uniformity in the steel profiles and columns used- a decision based on the conceptual framework of “the generic”, enhancing the presence of the structure as a unified entity. This is also to ensure that future uncertainties in load reconfigurations are less likely to cause instability or structural failure.



ill. 154.01: 2nd floor plan daylight factor units



ill. 154.02: 1st floor plan Daylight Factor Units

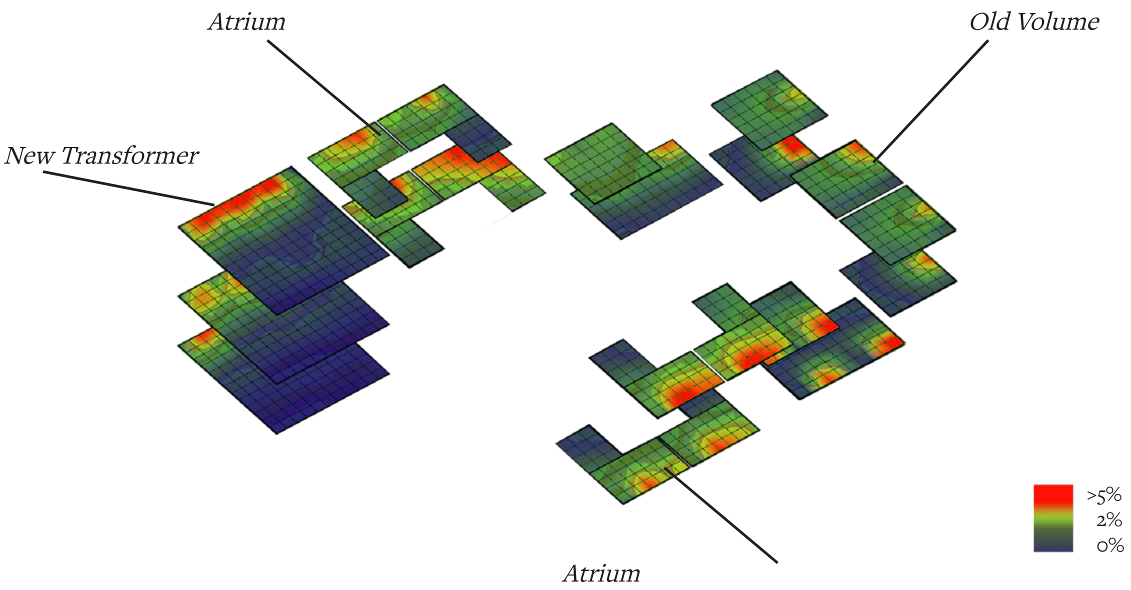


ill. 154.03: Ground floor Daylight Factor Units

New Transformer:
Min: 2,01 DF in 50% of the room
Max: 2,36 DF in 50% of the room

Old Volume:
Min: 2,07 DF in 50% of the room
Max: 3,02 DF in 50% of the room

Atrium:
Min: 2,47 DF in 50% of the room
Max: 4,87 DF in 50% of the room



ill. 155.01: daylight factor units isometry

UNITS DAYLIGHT ANALYSIS

Investigations by simulation were made to accomodate requirements and recommendations of the Danish Building Regulation, having at least 2% Daylight Factor in half of the living space.

Since this is not a main focus of the thesis the investigated areas are primarlity the units to allow necsessary interventions granting good living conditions.

The implementation of the program creates three different categories of units emerging in the plan; the ones situation in the original building in a U-shaped form on the Southern part, the ones in the atrium, and the ones placed in the *New Transformer Room*.

Whereas the ones in the original building already have window openings in a certain rythm and detailing, the two others are entirely constructed for the purpose of this transformation.

These investigation are done with similar setup to the preliminary studies of the daylight factor of the building, and the goal of the investigation is to utilize the output as an information generator on how to alter, adjust or insert windows to allow for satisfactory conditions. This information is further used to generate principles for how windows for these spaces will be in the project.

Chapter 7
epilogue

This chapter seeks to conclude on the project and reflect on a given set of topics. These range from the discourse on restoration to direct consequences of the instituted program.

This chapter contains:

CONCLUSION

This project has sought to investigate and propose an example of a building alteration, driven by a constant reflection on how to approach such a task. The process has been guided through a distilled set of theoretical discourses, seeking to map out not only the questions; if, where and how one is to engage with the existing built fabric, but also how to engage with the implementation of new additions.

The primary framework of the project has been to make a building alteration with the essential goal is to make the building “live” (Violet-Le-Duc, 2000) while adopting the responsibility to enable/catalyze its translation through the past, present, and into the future (Scott, 2008).

This have been achieved through reprogramming Kløvermarkens Transformer Station with a contemporary case study; sojourners in the current growing precariat, mixed with communal spaces driven by bottom up user management. Combined with an investigatory design process on tectonics conceptualized with “the specific, generic, and polyvalent” (Hertzberger, 2015) as a means of addressing future usages and alterations.
The reprogramming has been enabled though a carefully considered cut corresponding approximately to 1/3 of the building mass along its longitudinal axis. This allows for the preservation of the highly valuated areas of the original building, while illuminating the inner core of the building enabling the spaces for a variety of utilizations previously impossible.

This leaves the building recognizable to its original state, yet altered into a new and much different shape and appearance. Rather than implementing anachronistic imitations, the building has been altered in a complimentary way, while still apperaring in a contemporary way and sometimes contrasting manner, thus leaving a clear mark in its temporal continuum. The interior has been drastically reconfigured to make it usable to a diverse set of situations, rather than the highly specialized functions of its previous program. The building is further upgraded to meet contemporary building standards in building performance and accessibility.

The new implemented structure is designed with the aim to allow and encourage future alterations and reprogramming, though separating the shearing layers. (Brand, 1995) This seeks to enhance the buildings adaptability to the imagination of the users, maintaining and prolonging its relevancy, and hopefully the joyous experiences it can enable in an unknown future, while living up to current standards.

REFLECTION & DISCUSSION

Although having aimed towards making a holistic approach in the process of developing of Kløvermarken Transformer Station, certain aspects of the building have been down-prioritized to maximize the quality of the primary areas of interest.

This means that the project proposal would require more thorough investigations to ensure that it meets all the requirements of contemporary building standards and regulations, within or before the detailing and procurement phase.

Having had tectonics as the main area of focus, elements as sustainability, energy performance, and indoor atmospheric quality have been touched conceptually in varying degrees. This means that some of this would potentially require further design iterations thus further altering on the spatial configuration of the transformation design.

While it has been the intention to upgrade the existing building towards present standards, some of these can be of great difficulty within the balance of preservation and alteration. In some areas this have resulted in less optimal solution, e.g. the use of spiral stairs as a fire staircase, however, less optimal solutions can be expected in transformation projects. Fire solutions for the top floor have proven especialle challenging, and it can be discussed whether the current configuration is adequate.

While having a thorough understand of the building anatomy is essential to a success of an architectural transformation, the tectonic focus of this project have been on the newly implemented structures, as the specifics of the transformation site serves as more of an example. Thus, static analysis and a thorough knowledge of the existing services, building limitations e.g. have been of lesser focus and is touched conceptually.
This is also partly through the lack of material regarding the detail specifics of the project, these being of essential character when gaining the initial understanding of the building to be altered.

As the implemented program is intended to serve as an example of a contemporary zeitgeist, thus should not be regarded as a primary focus of this project.

When decicing in preferable transformation solutions, the economical consequences have not been the main focus of the discussions, however utilization of relatively standardized elements have been sought. This would have been the main essential aspect of such a project if to be realized, and is critical in when aiming to maintain the architectural qualities throughout the project realization.

This also means that the local plan would have to be rewritten to change the plot from a technical facility to a residential/commercially intended zone. Due to this lack of an appropriate local plan, the existing one have been omitted in this project, thus it has been designed on the assumption that such a local plan would have been developed.

When working towards implementing and detailing the conceptualized notions of "the specific, generic and polyvant" one should reflect on the actual success of the goal as it has been proposed in the project design. The area of temporality and adaptability is generally difficult to quantify.

As it is a balance between designing towards a specified situation, which enhances the quality of such a product in a present state, while potentially being maladaptive in a future desired scenario and vice versa, one needs to seek a position on this gradient. The proposed transformation thus exemplifies how it has been interpreted into a tectonic design implementation, and showcases the intended temporal character of the different elements. This could have been developed with further experimentations and detailing, which could have illuminated many interesting design possibilities and further strengthened the conceptual framework of the project.

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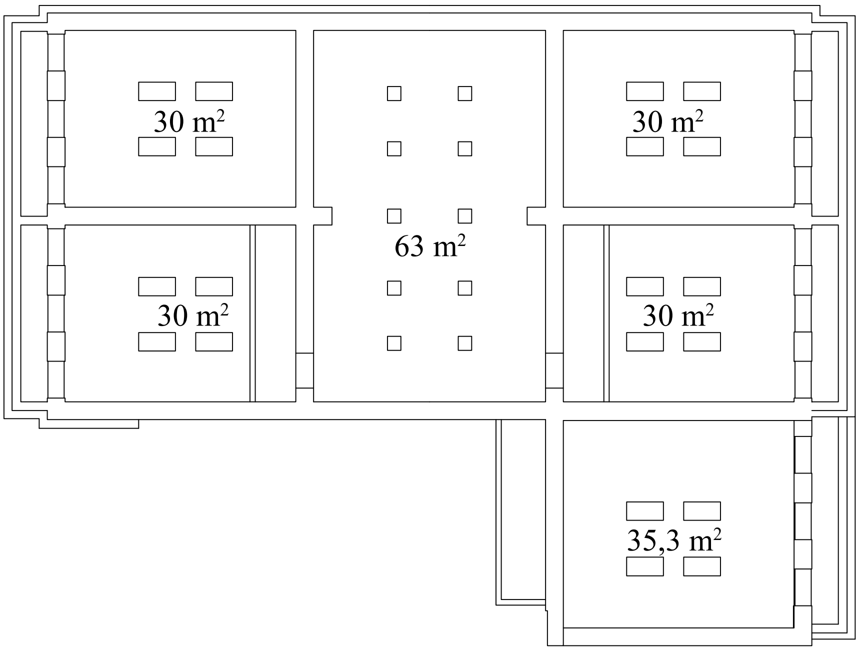
ILLUSTRATIONS

APPENDIX 1.0 : ORIGINAL PLANS

0,49m altitude

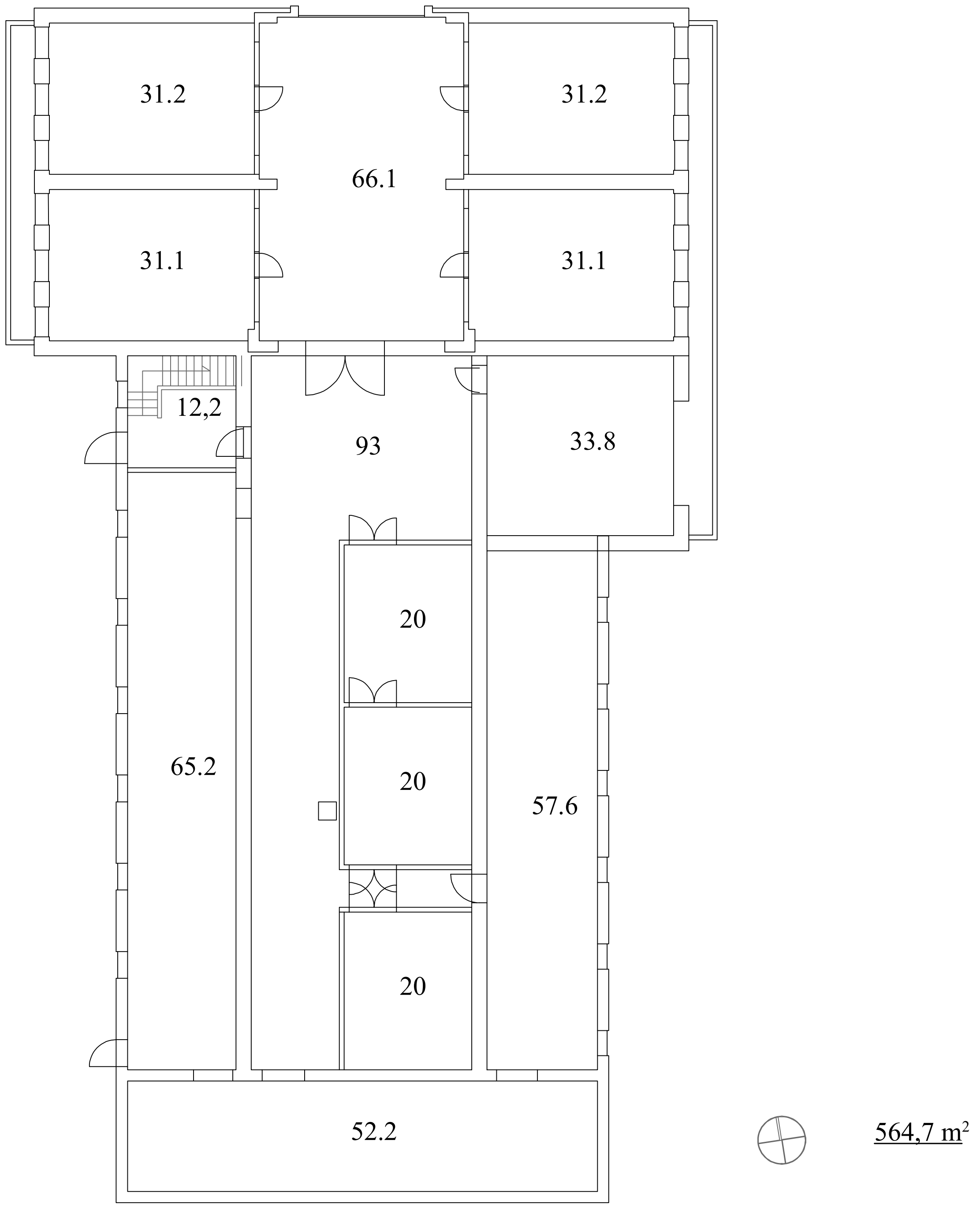


218,3 m²

ill. 164.01: Existing Basement Plan

APPENDIX 1.1 : ORIGINAL PLANS

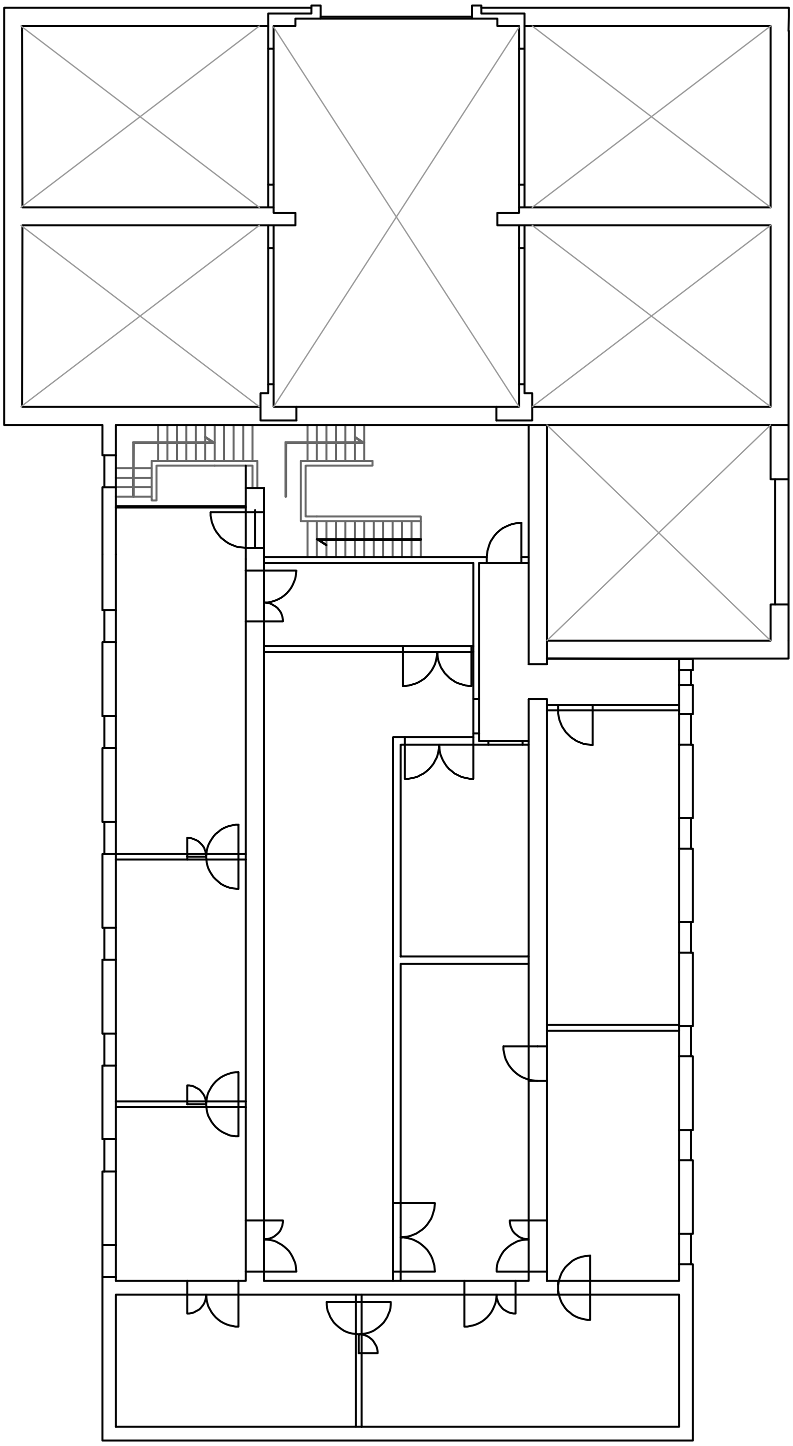
2,15m altitude



ill. 165.01: Existing Ground floor plan

APPENDIX 1.2 : ORIGINAL PLANS

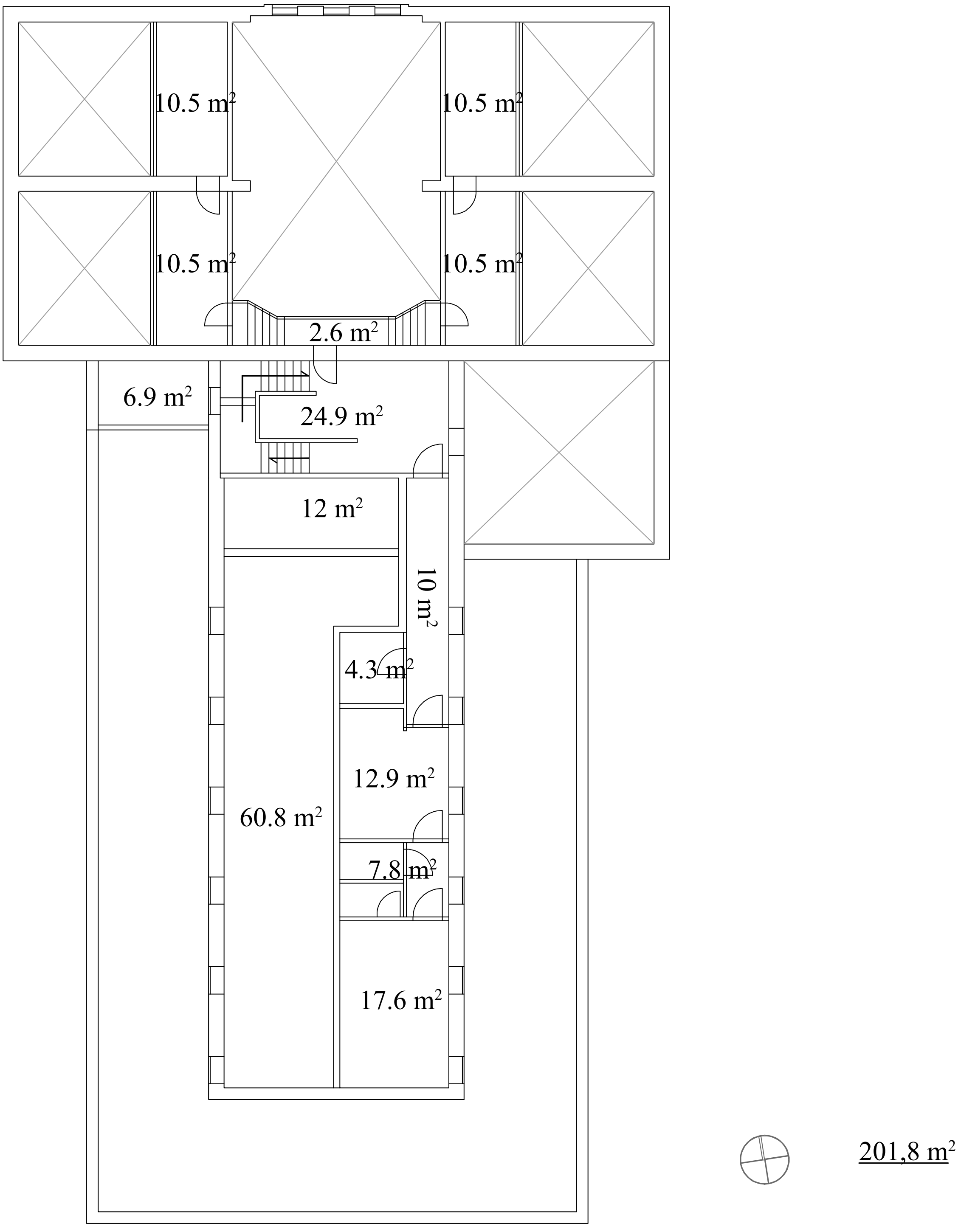
4,85m altitude



ill. 166.01: Existing 1st floor plan

APPENDIX 1.3 : ORIGINAL PLANS

8,05 m above sealevel



ill. 167.01: Existing 2nd floor plan

APPENDIX 2 : STRUCTURAL CALCULATIONS

The global structural analysis performed in robot verifies that the structure is withstanding the load combinations in SLS and USL within the acceptable limits within Eurocode Standards. The ratios are all below the limit of 100% usage capacity, meaning that they are performing without structural failure or instability. Though some ratios indicate that elements are not utilizing the upper realm of its structural capacity, these are dimensioned towards maintaining the architectural unity of the project, while enabling alternate load distributions so far future spatial reconfigurations would require it. The Timber elements are all performing with a potential increase in their load distribution with their section of 75 x 200 mm, while a heavy increase could require a denser number of bars. The top steel beams are the only ones being given another dimension, as they are solely used for maintaining the atrium glazing, thus only required a smaller section. The steel columns are 240 x 240 mm and the beams are 210 x 240mm. each with a thickness of 20 mm steel. This is clearly visible when looking at the deformation acting onto the structure, where the deformation as a result is much higher in these areas than the rest of the structure. When looking at the applied moment forces in along the y-axis the beams containing the decks, live loads and the roof are the ones taking the highest amount of moment forces, though showing lesser amounts of deformation than the upper beams containing the glazing. Looking at the shear forces the beams containing the decks are the ones having most impact resulting from forces in the z-direction for the same reason.

	Section	Material	Lay	Laz	Ratio	Case	Ratio(uy	Case (uy)	Ratio(uz	Case (uz)
OK	2 CAE 120x12	S 235	104.34	66.66	0.83	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.11	13 lastkombination sl
OK	2 CAE 120x12	S 235	104.34	66.66	0.83	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.11	13 lastkombination sl
OK	2 CAE 120x12	S 235	104.34	66.66	0.81	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.11	13 lastkombination sl
OK	2 CAE 120x12	S 235	104.34	66.66	0.81	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.11	13 lastkombination sl
OK	CROSS_1	S 235	202.74	202.74	0.81	9 lastkombination uls dominere	-	-	-	-
OK	2 CAE 120x12	S 235	104.34	66.66	0.81	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.12	13 lastkombination sl
OK	CROSS_1	S 235	202.74	202.74	0.81	9 lastkombination uls dominere	-	-	-	-
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OK	2 CAE 120x12	S 235	104.34	66.66	0.79	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.12	13 lastkombination sl
OK	2 CAE 120x12	S 235	104.34	66.66	0.77	10 lastkombination uls dominer	0.00	5 Windload	0.09	4 snow
OK	2 CAE 120x12	S 235	104.34	66.66	0.77	10 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.10	13 lastkombination sl
OK	CROSS_1	S 235	202.74	202.74	0.76	9 lastkombination uls dominere	-	-	-	-
OK	CROSS_1	S 235	202.74	202.74	0.76	9 lastkombination uls dominere	-	-	-	-
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OK	CROSS_1	S 235	202.74	202.74	0.75	9 lastkombination uls dominere	-	-	-	-
OK	CROSS_1	S 235	202.74	202.74	0.74	9 lastkombination uls dominere	-	-	-	-
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OK	CROSS_1	S 235	202.74	202.74	0.61	9 lastkombination uls dominere	-	-	-	-
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OK	CROSS_1	S 235	202.74	202.74	0.61	9 lastkombination uls dominere	-	-	-	-
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OK	2 UPE 240	S 235	65.68	134.05	0.34	11 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.24	12 lastkombination sl
OK	2 UPE 240	S 235	38.59	78.75	0.34	9 lastkombination uls dominere	0.00	17 dl left front eccentric	0.05	14 lastkombination sl
OK	2 UPE 240	S 235	38.59	78.75	0.33	9 lastkombination uls dominere	0.00	5 Windload	0.05	12 lastkombination sl
OK	2 UPE 240	S 235	38.59	78.75	0.33	9 lastkombination uls dominere	0.00	17 dl left front eccentric	0.05	14 lastkombination sl
OK	2 UPE 240	S 235	38.59	78.75	0.33	9 lastkombination uls dominere	0.00	18 dl right front eccentric	0.05	12 lastkombination sl
OK	2 UPE 240	S 235	65.68	134.05	0.33	11 lastkombination uls dominer	0.00	13 lastkombination sls dominerende snelast	0.24	12 lastkombination sl
OK	CROSS_1	S 235	186.09	186.09	0.33	10 lastkombination uls dominer	-	-	-	-

ill. 169.01: Robot Steel Structure Verification

	Section	Material	Lay	Laz	Ratio	Case	Ratio(uy	Case (uy)	Ratio(uz	Case (uz)
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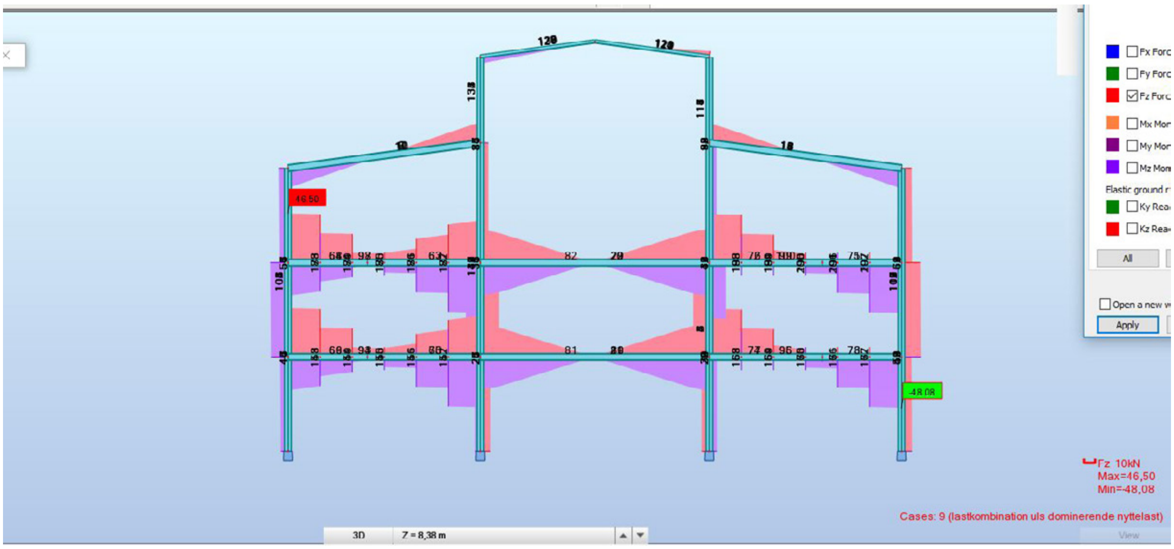
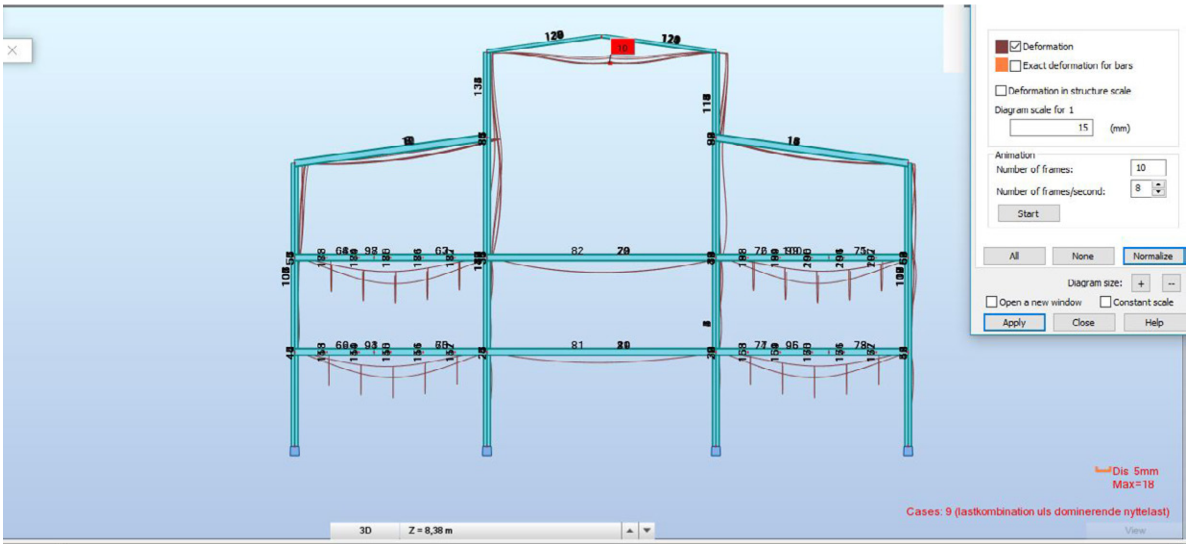
OK	kerto 75 200	KERTO S	66.06	176.15	0.76	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.76	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.76	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.76	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.76	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.88	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.87	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.87	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.87	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.75	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.87	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.01	(1+0.6)*1 + (1+0*0.6	0.85	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.84	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.84	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.84	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	66.06	176.15	0.73	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.84	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	33.03	88.08	0.55	9 lastkombination uls	0.00	dl right front eccentr	0.35	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	33.03	88.08	0.55	9 lastkombination uls	0.00	Windload	0.35	(1+0.6)*1 + (0.3+0*0
OK	kerto 75 200	KERTO S	33.03	88.08	0.55	9 lastkombination uls	0.00	(1+0.6)*1 + (1+0*0.6	0.34	(1+0.6)*1 + (0.3+0*0

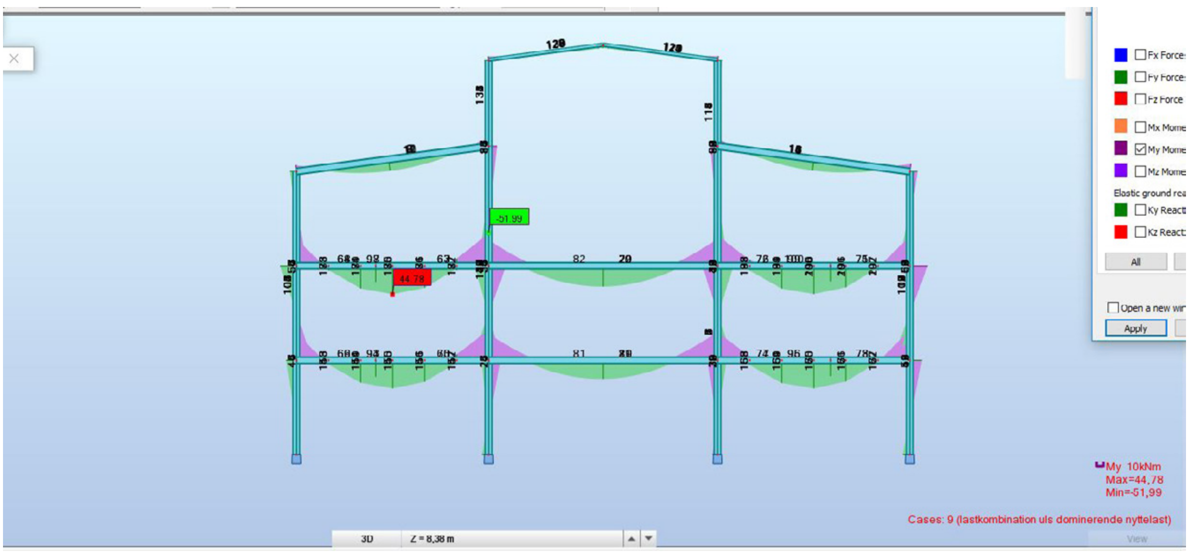
ill. 170.01: Robot Timber Structure Verification



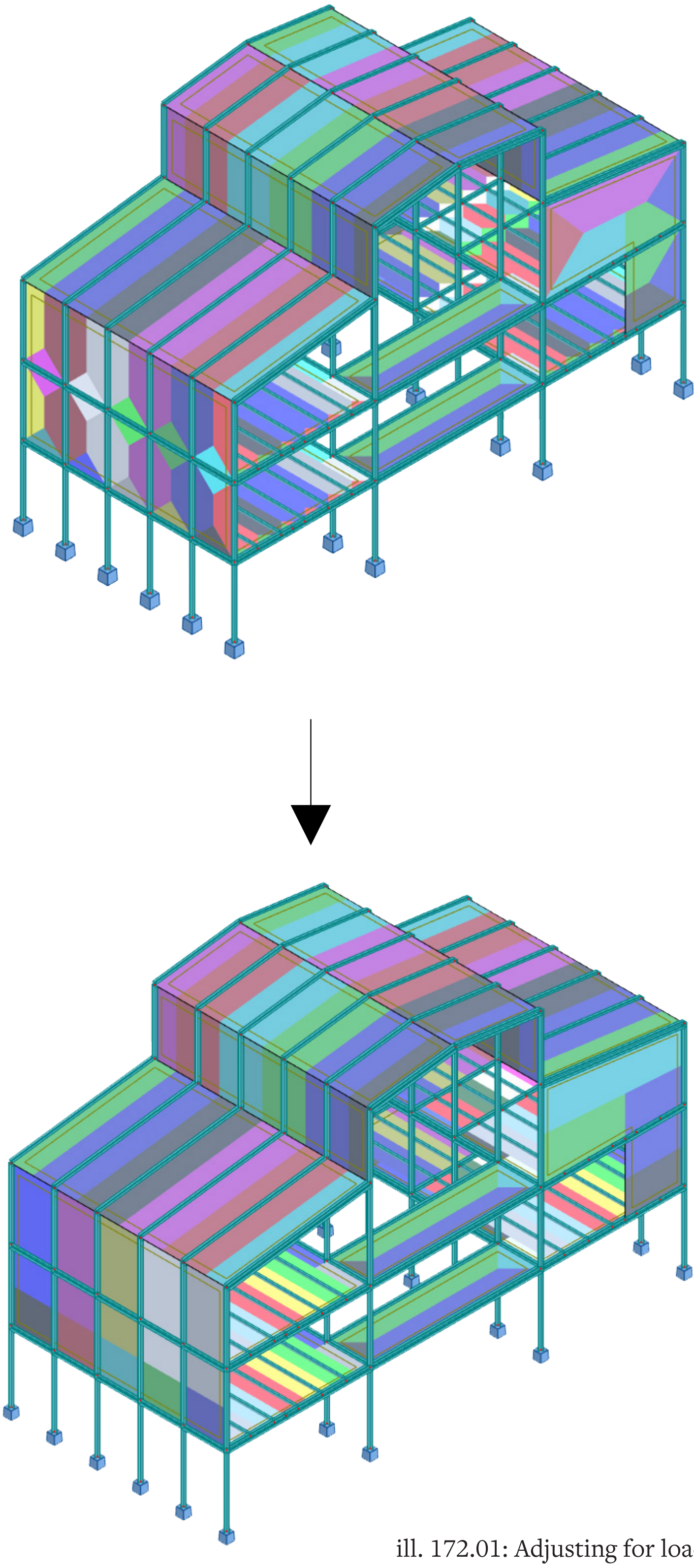
ill. 171.01: Robot Simulation: Shear



ill. 171.02: Robot Simulation: Deformation



ill. 171.03: Robot Simulation: Moment



ill. 172.01: Adjusting for load distribution

APPENDIX 3 : LOAD CALCULATIONS

Liveloads: *(Teknisk Ståbi, 2011, p.167)*

Category A:
areas for residential intent

1.5 q_k [kN/m²]

Category B-D:
Common access routes:

5 q_k [kN/m²]

Snowloads: *(Teknisk Ståbi, 2011, p.168)*

$s = \mu_i C_e C_t s_k$

where,

μ_i : *Roof shape coefficient*
C_e : *Exposure coefficient*
C_t : *Thermal coefficient*
S_k : *Char. value of the ground snow for the relevant altitude*

a	=	7,5 °	
$0° \leq a \leq 30°$	=>		
μ_i	=	0,8	
S_k	=	1,2	[kN/m²]
C_e	=	1,0	
C_t	=	1,0	

S (0,8 • 1,2 • 1 • 1) = **0,96** [kN/m²]

Windloads: *(Teknisk Ståbi, 2011, p.168-171)*

$$q_p(z) = \left(1 + \left(7 / \ln(z/z_0)\right)\right) \tfrac{1}{2} p \left((vb \cdot kr \cdot \ln(z/z_0)\right)^2$$

where,

$q_p(z)$: *Peak velocity pressure*
p : *Air density (1,25 [kg/m³])*
Z : *Reference height for the external pressure*
C_{pe} : *Pressure coefficient for the external pressure*

Z_0 (Terrain Category 4)	=	1
k_r	=	$0,19\ (z_0 / z_{0,II})^{0,07}$
k_r $0,19\ (z_0 / 0,05)^{0,07}$	=	0,2324
v_b	=	$C_{dir} \cdot C_{season} \cdot v_{b,0}$
C_{season}	=	1
$C_{dir,West}$	=	1

$C_{dir,East}$ = 0,8

$v_{b,0}$ = 24 [m/s]

$v_{b,West}$ = 1 • 1 • 24 [m/s]

= 24 [m/s]

$v_{b,East}$ = 0,8 • 1 • 24 [m/s]

= 19,2 [m/s]

$q_{p(z),west}$ =

$$(1+\left(7/(\ln 13.8[m] / 1)\right)) \cdot ½ \cdot 1.25\ [kg/m^3] \left(24\ [m/s]*0.2324*\ln(13.8m/1)\right)^2$$

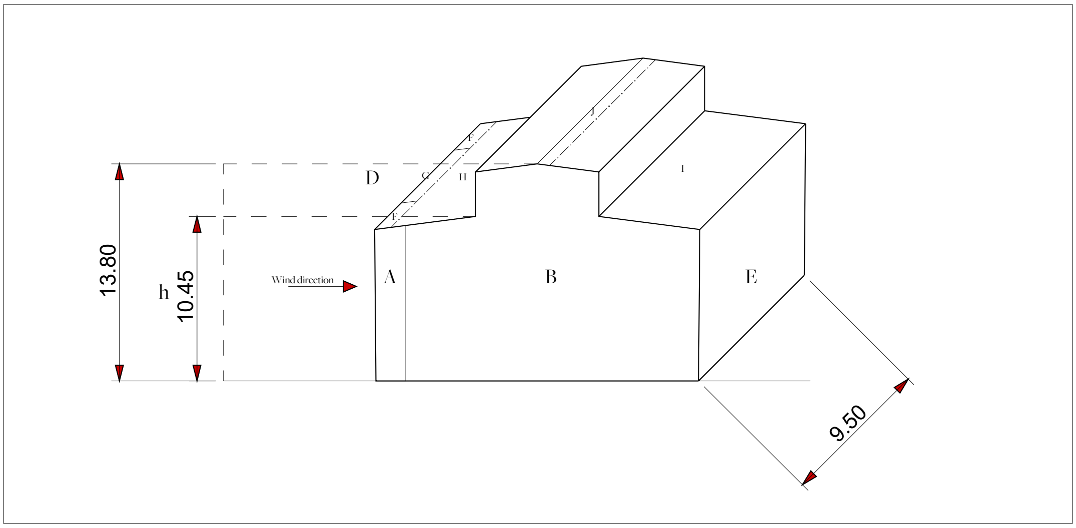
= **0.358** [kN/m²]

$q_{p(z),east}$ =

$$(1+\left(7/(\ln 13.8[m] / 1)\right)) \cdot ½ \cdot 1.25\ [kg/m^3] \left(19,2\ [m/s]*0.2324*\ln(13.8m/1)\right)^2$$

= **0.229** [kN/m²]

A	B	D	E	F	G	H	I	J
- 1,2	- 0,8	0,8	- 0,5	- 1,7	- 1,2	- 0,6	- 0,6	- 0,6



ill. 174.01: Wind Loads

Load Combinations: *(Teknisk Ståbi, 2011, p.163-166)*
K_{FI} = CC2 = 1.0

ULS DOMINANT LIVELOAD
$K_{FI} \bullet \gamma_{Gj,sup} \bullet G + K_{FI} \bullet \gamma_{Q.1} \bullet Q_{live} + K_{FI} \bullet \gamma_{var} \bullet 0.3 \bullet Q_{snow} \bullet K_{FI} \bullet \gamma_{var} \bullet 0.3 \bullet Q_{wind}$
$1 \bullet 1.1 \bullet G + 1 \bullet 1.5 \bullet Q_{live} + 1 \bullet 1.5 \bullet 0.3 \bullet Q_{snow} \bullet 1 \bullet 1.5 * 0.3 * Q_{wind}$

ULS DOMINAT SNOWLOAD
$K_{FI} \bullet \gamma_{Gj,sup} \bullet G + K_{FI} \bullet \gamma_{Q.1} \bullet Q_{snow} + K_{FI} \bullet \Psi_{0,1} \bullet \gamma_{var} \bullet Q_{live} + K_{FI} \bullet \gamma_{var} \bullet 0.3 \bullet Q_{wind}$
$1 \bullet 1.1 \bullet G + 1 \bullet 1.5 + Q_{snow} + 1 \bullet 0.5 \bullet 1.5 \bullet Q_{live} + 1 \bullet 1.5 \bullet 0.3 \bullet Q_{wind}$

ULS DOMINAT WINDLOAD
$K_{FI} \bullet \gamma_{Gj,sup} \bullet G + K_{FI} \bullet \gamma_{Q.1} \bullet Q_{wind} + K_{FI} \bullet \Psi_{0,1} \bullet \gamma_{var} \bullet Q_{live} \bullet K_{FI} \bullet \gamma_{var} \bullet 0 \bullet Q_{snow}$
$1 \bullet 1.1 \bullet G + 1 \bullet 1.5 \bullet Q_{wind} \bullet 1 \bullet 0.5 \bullet 1.5 \bullet Q_{live} + 1 \bullet 1.5 \bullet 0 \bullet Q_{snow}$

SLS DOMINANT LIVELOAD
$G + Q_{live} + \Psi_{0,1} * Q_{wind} + \Psi_{0,1} * Q_{snow}$
$G + Q_{live} + 0.6 * Q_{wind} + 0.6 * Q_{snow}$

SLS DOMINANT WINDLOAD
$G + Q_{wind} + \Psi_{0,1} \bullet Q_{live} + \Psi_{0,1} \bullet Q_{snow}$
$G + Q_{wind} + 0.5 \bullet Q_{live} + 0.6 \bullet Q_{snow}$

SLS DOMINANT SNOWLOAD
$G + Q_{snow} + \Psi_{0,1} \bullet Q_{live} + \Psi_{0,1} \bullet Q_{wind}$
$G + Q_{snow} + 0.5 \bullet Q_{live} + 0.6 \bullet Q_{wind}$

DEADLOADS

Element	Volume m^3	Layer Width[m]	kN/m^2
Facade with window			
1. Cobber	0,192	0,004	0,006
2. Joist 25X25mm	0,08	0,025	0,007
3. Joist 45X45mm (ventilated)	0,3	0,045	0,0486
4. Windboard	0,56	0,01	0,0005
5. Joist 45X110 700mm Spacing	0,51	0,11	0,201
7. Rockwool Insulation	4,1	0,11	0,1845
8. Joist 45X110 700mm Spacing	0,51	0,11	0,201
9. Rockwool Insulation	4	0,11	0,18
10. Rockwool Insulation	3,7	0,11	0,166
11. Doublelayer Fermacell Gypsum	0,6	0,02	0,108
12. Glass Double Layer	0,44	0,022	0,228
		SUM	1,3306

Element	Volume m^3	Layer Width[m]	kN/m^2
Deck			
1. Flooring	1,4	0,022	0,19
2. Soundmat	1,2	0,025	0,012
3. Chipboard	1,2	0,022	0,163
4. Rockwool Insulation	5,6	0,11	0,246
5.Chipboard	1	0,02	0,123
6. Rockwool Insulation	1,56	0,022	0,0137
7. Wooden Studs 25x25mm	1,28	0,02	0,092
8. Doublelayer Fermacell Gypsum	1,22	0,022	0,2415
		SUM	1,0812

DEADLOADS

Element	Volume m^3	Layer Width[m]	kN/m^2
Roof			
1. Cobber	0,236	0,004	0,008
2. Joist 25X25mm	0,11	0,025	0,0099
3. Joist 45X45mm (ventilated)	0,38	0,045	0,0615
4. Windboard	0,56	0,01	0,00056
5. Joist 45X110 700mm Spacing	0,39	0,11	0,1544
7. Rockwool Insulation	5,7	0,11	0,25
8. Joist 45X110 700mm Spacing	0,46	0,11	0,182
9. Rockwool Insulation	5,4	0,11	0,236
10. Rockwool Insulation	5,7	0,11	0,25
11.Chipboard	0,53	0,022	0,079
12 Rockwool Insulation	1,1	0,025	0,011
13. Wooden studs 25X25	0,1	0,025	0,009
14. Doublelayer Fermacell Gypsum	0,53	0,02	0,0954
15. Gyproc Aluminum element	0,05	0,001	0,0013
		SUM	1,34806

DEADLOADS

Element	Volume m^3	Layer Width[m]	kN/m^2
Facade without windows			
1. Cobber	0,012	0,004	0,0004
2. Joist 25X25mm	0,11	0,025	0,0099
3. Joist 45X45mm (ventilated)	0,38	0,045	0,0615
4. Windboard	0,56	0,01	0,00056
5. Joist 45X110 700mm Spacing	0,39	0,11	0,1544
7. Rockwool Insulation	5,7	0,11	0,2508
8. Joist 45X110 700mm Spacing	0,46	0,11	0,1821
9. Rockwool Insulation	5,4	0,11	0,2376
10. Rockwool Insulation	5,7	0,11	0,2508
11. Doublelayer Fermacell Gypsum	0,53	0,02	0,0954
		SUM	1,24346

Element	Volume m^3	Layer Width[m]	kN/m^2
Interior Walls			
1. Doublelayer Fermacell Gypsum	1,7	0,02	0,306
2. Rockwool Insulation	11,09	0,1	0,443
1. Doublelayer Fermacell Gypsum	1,7	0,02	0,306
		SUM	1,055

APPENDIX 4 : U-VALUE CALCULATION

Element	Layer Width[m]	Lambda W/mK
New Facade		
Cobber	0,004	400
Air	0,06	0,024
Windboard	0,01	0,08
Rockwool Insulation	0,33	0,03
Doublelayer Fermacell Gypsum	0,02	0,025
U-value	0,066	
Original Facade with Isover Retrowall System		
3- layer brick	0,36	0,7
Air	0,06	0,024
Chipboard	0,02	0,1
Rockwool Insulation	0,07	0,03
Doublelayer Fermacell Gypsum	0,02	0,025
U-value	0,24	

Original Wall with Isover Retrowall Insulation System

$$U = \left(\frac{1}{0.04 + \frac{0.36}{0.7} + \frac{0.025}{0.024} + \frac{0.07}{0.03} + \frac{0.02}{0.25} 0.13} \right) = 0.24 \text{ W/(m}^2\text{K)}$$

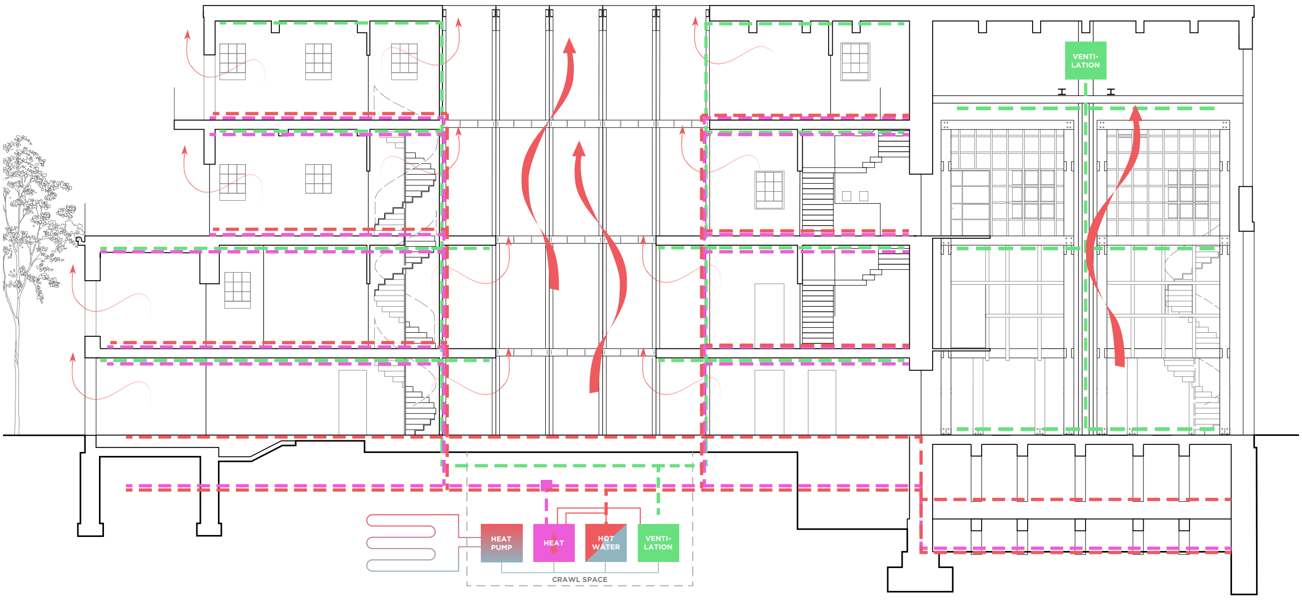
Façade

$$U = \left(\frac{1}{0.04 + \frac{0.004}{400} + \frac{0.06}{0.024} + \frac{0.01}{0.08} + \frac{0.33}{0.03} + \frac{0.02}{0.25} 0.13} \right) = 0.066 \text{ W/(m}^2\text{K)}$$

APPENDIX 5 : FIRE

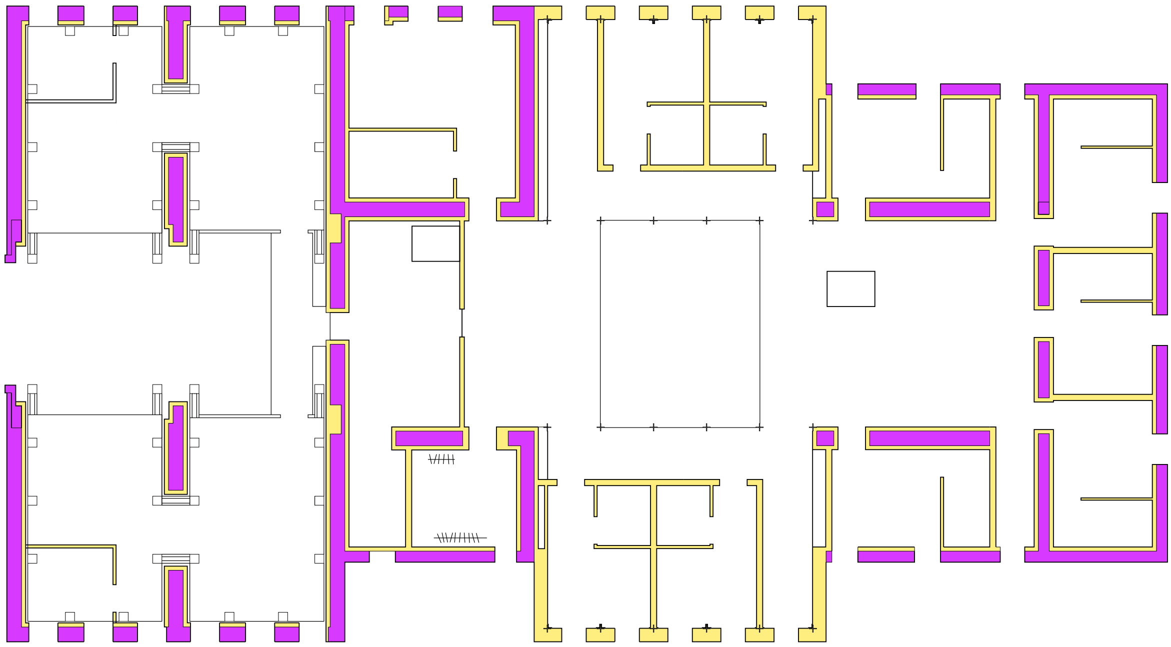
ill. 180.01: Fire Routes

APPENDIX 6 : VENTILATION

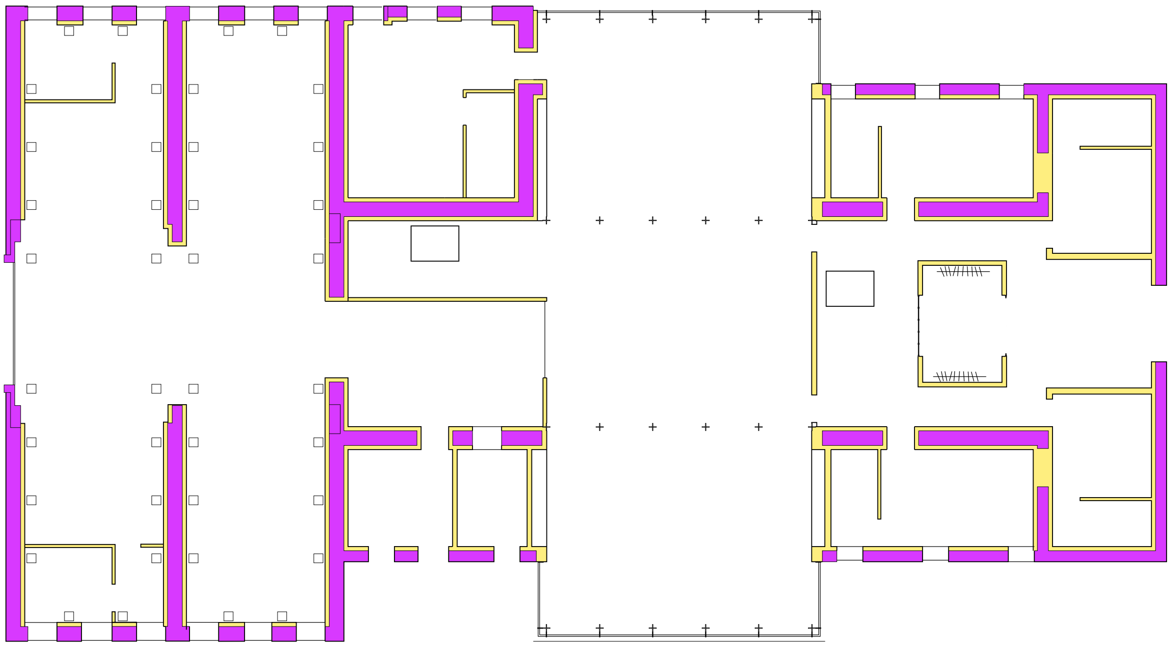


ill. 181.01: Ventilation and Piping

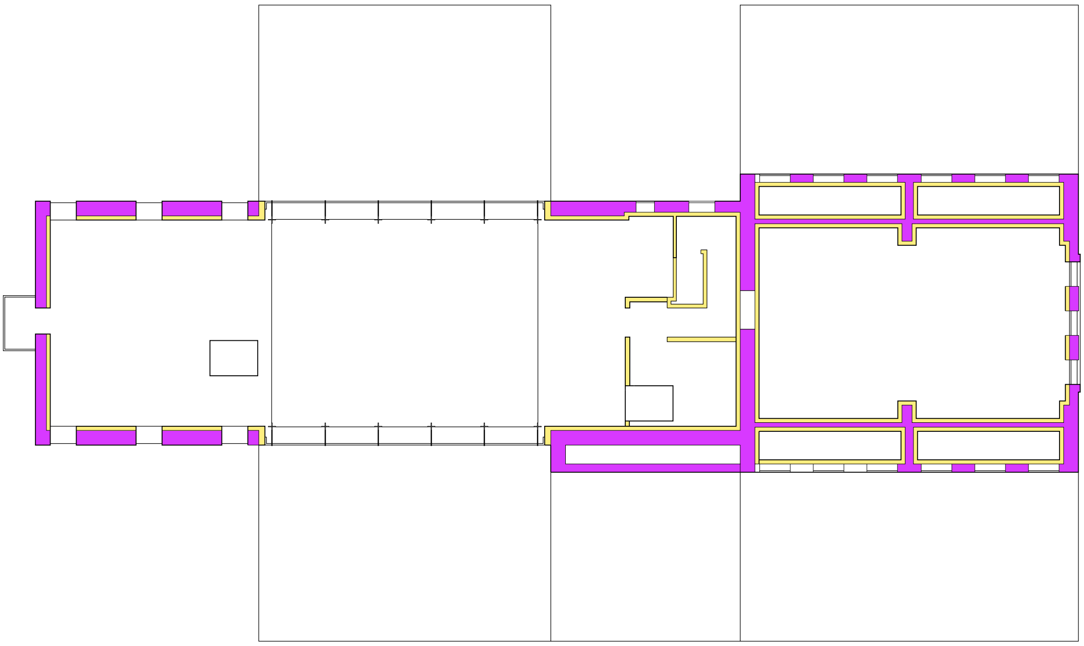
APPENDIX 7 : OLD & NEW WALLS



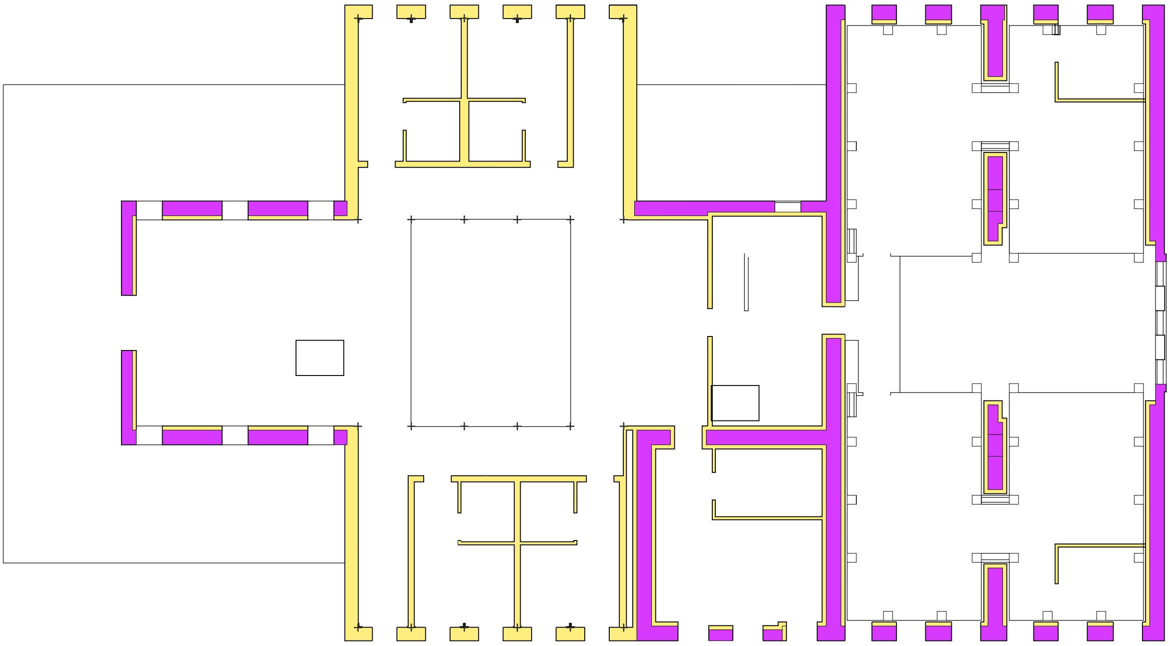
ill. 182.02: Old & New 1st floor



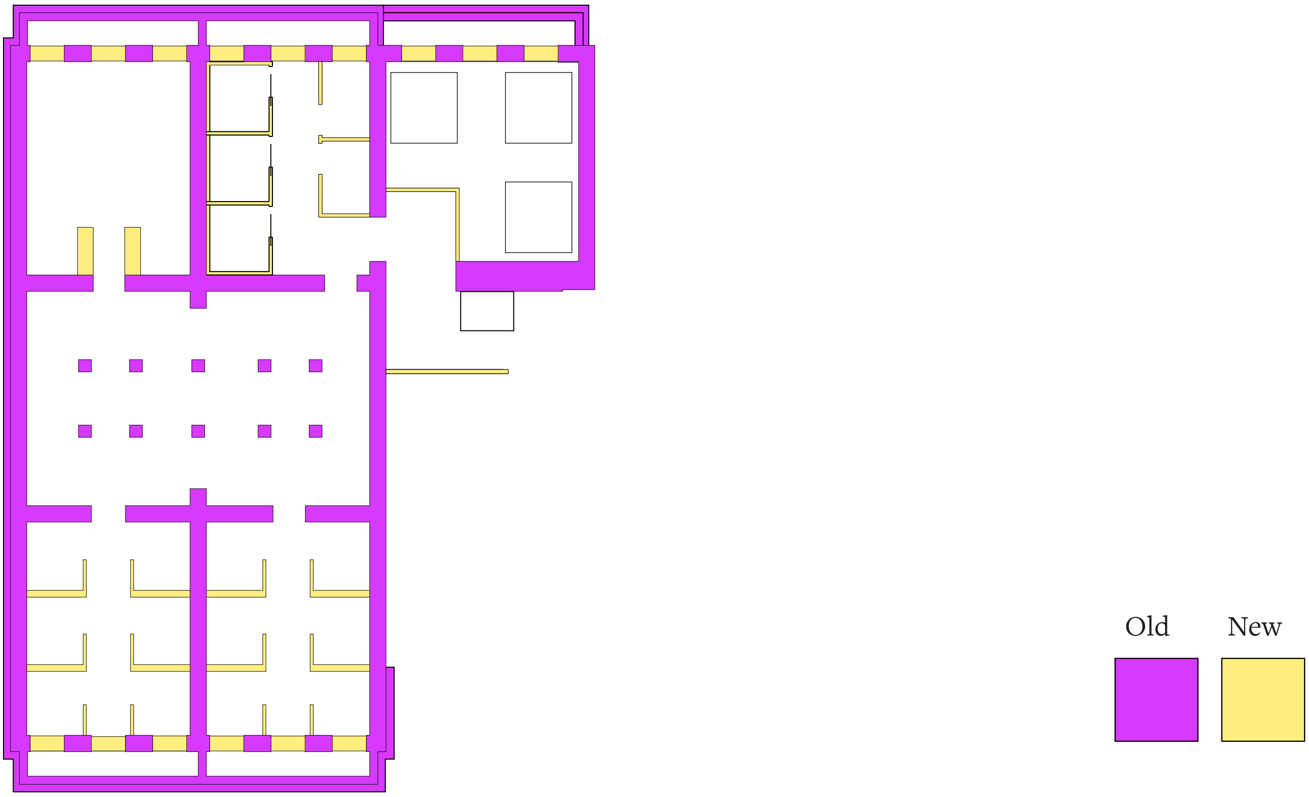
ill. 182.01: Old & New Ground floor



ill. 183.02: Old & New 3rd floor



ill. 183.01: Old & New 2nd floor



ill. 184.01: Old & New Basement

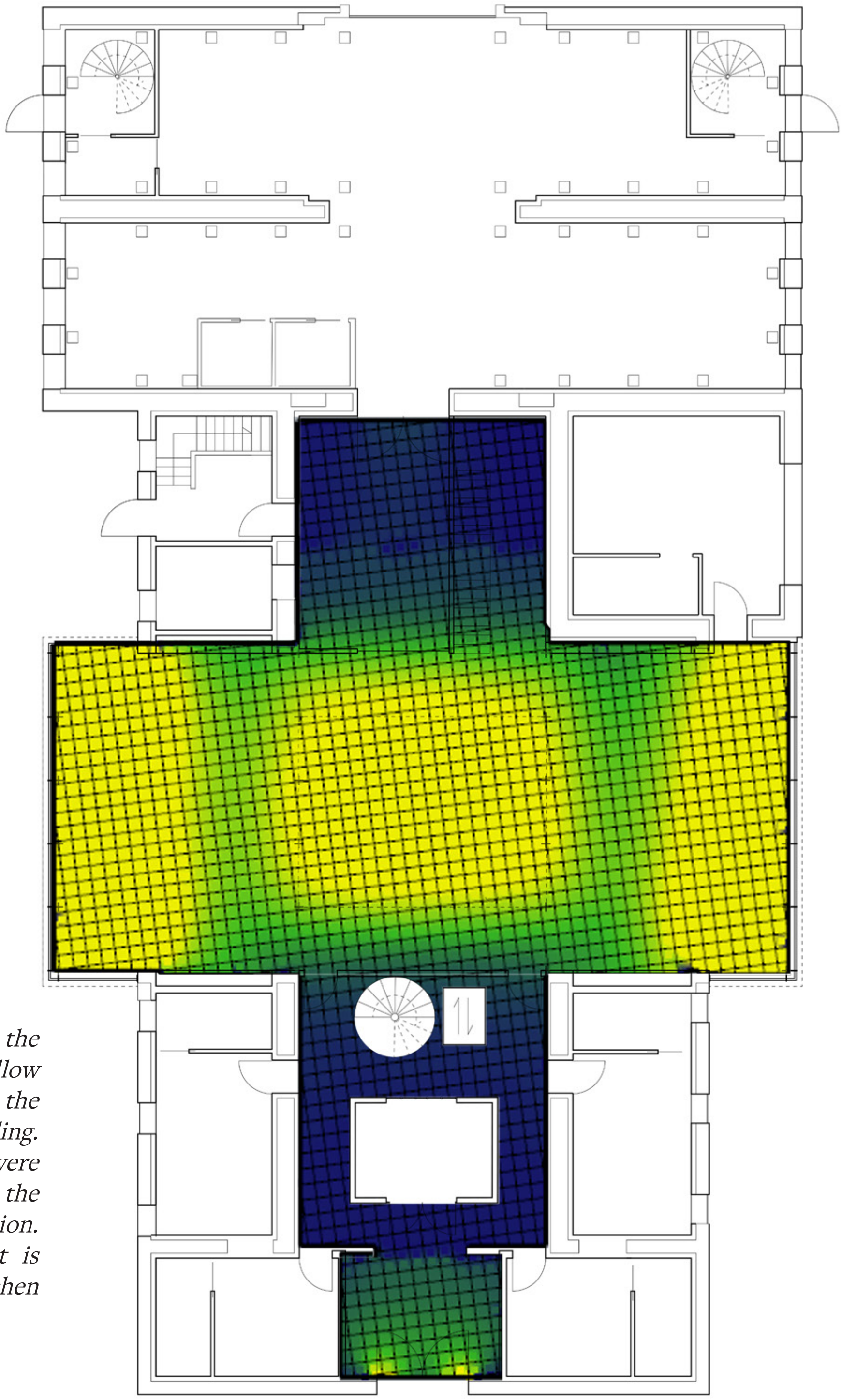
APPENDIX 7 : VALUATION

		Historical	Technical	Phenomen..
Exterior	1. Northern Facade (Overall Composition)	***	*	***
	1. Northern Facade (Windows)	**	*	***
	1. Northern Facade (Entrance)	x	*	*
	1. Northern Facade (Entrance)	**	*	---
	1. Northern Facade (Ornament)	***	x	x
	1. Norther Facade (Lamps)	x	x	x
	2. Northwest Corner (Ventilation shutters)	x	*	*
	2. Northwest Corner (Volumetric Composision)	x	x	***
	3. Facade Detail (Brickwork)	*	*	***
	3. Facade Detail (Brick Window Recess)	x	x	**
	4. Facade Windows East-West(Composition)	x	*	*
	4. Facade Windows East-West(Brick Detail)	*	*	**
	5. Northeast Corner(New Addition)	*	x	*
	5. Northeast Corner(ventilationsriste)	x	*	x
	6. Southernfacade (Balcony)	x	*	x
	7. Temporary Platform	x	x	x
	8. Exterior Overall (Bricks)	**	***	***
	8. Exterior Overall (Roof)	x	*	x
Montagehallen	9. Montage Hallen (Spatial Volume)	***	x	***
	9. Montage Hallen (Entrance)	*	*	*
	9. Montage Hallen (Plateau)	*	*	***
	9. Montage Hallen (Railing)	x	x	*
	9. Montage Hallen (Openings)	*	x	*
	9. Montage Hallen (Columns)	x	*	x
	9. Montage Hallen (I-profiles)	*	*	*
	9. Montage Hallen (Crane)	***	*	**
	9. Montage Hallen (Surfaces)	*	x	*
	9. Montage Hallen (Rails in Floor)	*	*	x
	9. Montage Hallen (Basement Trapdoor)	x	x	x
	9. Montage Hallen (Ceiling Beams)	x	***	***
	9. Montage Hallen (Platau- Gate detail)	*	*	x
	9. Montage Hallen (Hook)	*	x	x
	9. Montage Hallen (Doors)	**	x	x
	9. Montage Hallen (Div. Inventior Objects)	*	x	x
	9. Montage Hallen (Windows)	**	*	**
Transformer Old	10. Transformer Room Old (Spatial Volume)	***	**	***
	10. Transformer Room Old (Surfaces)	x	x	***
	10. Transformer Room Old (Div. Interior Objects)	x	x	x
	10. Transformer Room Old (Platau)	*	x	**
	10. Transformer Room Old (Railing)	x	*	**
	10. Transformer Room Old (Lamellas)	*	*	**
	10. Transformer Room Old (Ladder and Opening)	*	x	**

		Historical	Technical	Phenomen..
Transformer New	11. Transformer Room New (Spatial Volume)	***	**	***
	11. Transformer Room New (Surfaces)	x	x	***
	11. Transformer Room New (Floor Grates)	**	*	**
	11. Transformer Room New (Cellar Room)	**	x	***
	11. Transformer Room New (Openings)	*	x	**
	11. Transformer Room New (Cellar Stucture)	x	*	**
Stair Room	12. Stair Room (Spatial Volume)	**	***	***
	12. Stair Room (Surfaces)	*	*	***
	12. Stair Room (Corner Detail)	x	x	*
	12. Stair Room (Railing)	x	*	*
	12. Stair Room (Window)	x	*	*
	12. Stair Room (Structure)	*	***	**
	12. Stair Room (Crane)	*	*	*
	12. Stair Room (I-Profiles)	*	*	*
	12. Stair Room (Ceiling Windows)	x	*	*
Reyrollerum low	13. Reyrollerum (Spatial Volume)	x	x	*
	13. Reyrollerum (Surfaces)	x	x	*
	13. Reyrollerum (Windows)	x	*	*
Reyrollerum high	14. Reyrollerum (Spatial Volume)	x	x	**
	14. Reyrollerum (Surfaces)	x	x	*
	14. Reyrollerum (Windows)	x	*	*
	14. Reyrollerum (Div. Inventior Objects)	x	x	x
	14. Reyrollerum (Trapdoor)	*	*	**
	14. Reyrollerum (Crane)	*	*	*
	14. Reyrollerum (I-profiles)	*	*	*
	14. Reyrollerum (Corner Column)	x	*	*

		Historical	Technical	Phenomen..
Basement	*15. Basement (Spatial Volume)*	*	x	***
	15. Basement (Surfaces)	x	x	**
	15. Basement (Structure)	x	*	**
	15. Basement (Oiltanks)	*	x	**
	15. Basement (Div. Interior Objects)	x	x	x
The Yellow Room	*16. The Yellow Room (Spatial Volume)*	*	x	***
	16. The Yellow Room (Surfaces)	*	x	***
	16. The Yellow Room (View from Balcony)	x	x	**
	16. The Yellow Room (Ceiling Structure)	x	***	***
	16. The Yellow Room (Emergency Exists)	*	*	*
	16. The Yellow Room (Div. Interior Objects)	**	x	*
	16. The Yellow Room (Windows)	x	**	**
Functional Spaces	18. Functional Spaces (Spatial Volume)	x	x	x
	18. Functional Spaces (Surfaces)	x	x	*
	18. Functional Spaces (Toilet Interior)	x	x	*
	18. Functional Spaces (Lounge Interior)	x	x	x
	18. Functional Spaces (Fire Solution)	x	*	x
	18. Functional Spaces (Window)	x	*	x
Overall Building	19. Structural Exterior Walls	**	***	x
	20. Non Structural Interior Walls	x	*	x
	21. Concrete Deck	x	*	x
	22. Stuctural Interior Walls	**	***	x
	23. Cobber Earth Connections.	***	x	*

APPENDIX 9 : DAYLIGHT ATRIUM



The purpose of the atrium was to allow natural lighting into the core of the building. These simulations were done made with the intention of verification. The average daylight is 4.1% DF in the kitchen and atrium area.

ill. 188.01: Atrium Daylight