Master's thesis

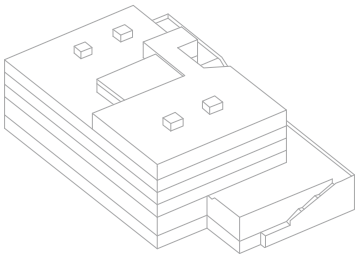
NTNU
Norwegian University of Science and Technology
Faculty of Architecture and Design
Department of Architecture and Technology

Helene Grøttveit Lunde

TRANSFORMING CISSI KLEIN VGS INTO AN OFFICE BUILDING

FOCUS ON FLEXIBILITY

Master's thesis in Master of Science in Sustainable Architecture
Supervisor: Fransesco Goia
Co-supervisor: Luca Finocchiaro
June 2024



BUILDING DIAGRAM

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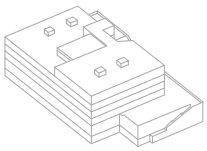

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MASTER`S THESIS

AAR4993 - MS.C IN SUSTAINABLE ARCHITECTURE

HELENE GRØTTVEIT LUNDE

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I would also like to thank my family and friends for their support and encouragement during this project. A special gratitude to my mom for unconditional love and support, and for always believing in me.

ABSTRACT

Cissi Klein Videregående is an upper secondary school that is currently being built in Falkenborgvegen 32 in Trondheim. The school was designed with flexible design solutions so that the building`s layout and functions easily can be changed into other functions in the future. Trøndelag fylkeskommune made a table of potential uses in the future, where a cultural building or an office building was considered the most potential uses within the next 50 years. In this project, the flexibility of the building was investigated, and the school was transformed into an office building set 50 years in the future.

The flexibility of the building was investigated by these methods: Transforming the building into an office building, and investigating the existing building`s flexibility. Adding an additional 5th floor, and investigating the existing ventilation system and access to daylight.

The building was relatively easy to transform into an office building. The existing building layout offered a lot of flexibility and worked well with the changes to open landscape offices and open activity-based offices. The building was less flexible with changes to smaller cell and team offices. The design of the window layout and facade, structure and material choices in U1 and 1st floor, and the expansion possibilities on the 5th floor should have been taken more into account during the early design phase of the building.

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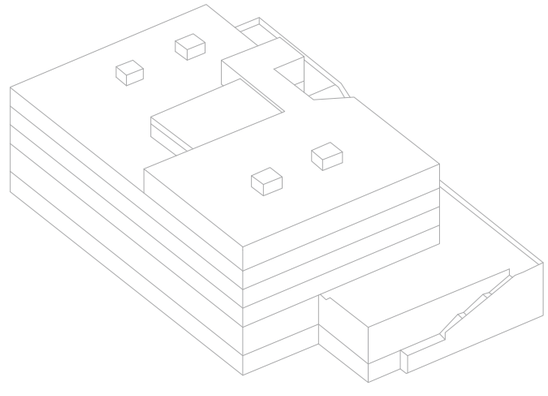
INTRODUCTION

37% of global C02 emissions come from the building and construction sector, making it the largest emitter of greenhouse gases (UNEP, 2023). To reduce the emissions we have to rethink how we design new buildings today. New buildings should last for a minimum of 60 years and the life span must be considered from an early stage. To save emissions from the building sector, we need to reuse materials and transform more buildings. New buildings must therefore be designed with optimal flexible design solutions, to make it easier to re-use materials and change the buildings for other uses in the future.

Cissi Klein Videregående (vgs) is a new upper secondary school that is currently being built in Falkenborgvegen 32 in Trondheim. The client is Trøndelag fylkeskommune / county authority. Cissi Klein vgs has been designed with flexible design solutions so that the building`s layout and functions easily can be changed in the future. In 50 years, it should therefore be an optimal building to transform for other uses. During the planning stage, Trøndelag fylkeskommune made a table of potential uses in the future, where a cultural building or an office building was considered the most potential uses within the next 50 years. In relation to this, Cissi Klein vgs will be transformed into an office building set 50 years in the future in this project. The flexibility of the building will be investigated by transforming it into an office building.

Map of Trondheim and site.

Exterior render of Cissi Klein vgs, by Hus Arkitekter.



New building shape.

GOAL & SCOPE

Goal:

The goal is to find out how well the flexible design solutions are integrated into the building for future changes, by transforming it into an office building and adding an additional 5th floor.

Research question:

How optimal are the flexible design solutions in Cissi Klein vgs integrated for future changes into an office building?

Hypothesis:

The building was well planned with flexible design solutions from an early phase, so the expected results would be that it functions well as an office building. The existing ventilation system may have challenges with changes to other functions.

Methods:

The flexibility of the building will be investigated by these methods:

1. Transforming the building into an office building, and investigate if the floor layout allows for easy changes into different office types. This will be shown by providing new architectural drawings of the building.

2. Investigate the existing building`s structure and floor layout, and investigate if interior walls can be re-used in a new additional 5th floor.

3. Add an additional 5th floor and investigate how flexible this is. This will be shown by providing a new floor plan for the 5th floor.

4. Look at the existing ventilation system, and investigate if the existing duct layout is flexible towards changes to different office types. The flexibility of providing a new ventilation system on the additional 5th floor will also be investigated. This will be shown in schematic ventilation drawings.

4. Undertake a daylight factor analysis of spaces in the existing building and on the new additional 5th floor. This will be shown with a daylight factor analysis on the floor plans.

Flexibility goals:

- Work with existing structures & minimize demolition
- Provide adaptable interior solutions
- Possibilities to re-use materials & interior walls
- Ensure sufficient floor heights

Environmental goals:

- Be a ZEB O ÷ EQ building
- Promote greenery
- Integrate PV panels
- Re-use of materials & interior walls
- Minimize demolition
- Conserving structural elements.

Architectural goals:

- Universal design
- Good circulation
- Good accessibility
- Provide sufficient zoning
- Public and private zones
- Good natural lighting

CHALLENGES IN THE PROJECT

In this project, there are many challenges. The existing building has to be investigated before changing it into an office building and adding an additional 5th floor. The following points and questions will be investigated throughout this project:

1. ACCESS, CIRCULATION & VERTICAL CONNECTIONS

- Where do you access the building?
- How is the vertical connections and circulation in the existing building?

2. FUNCTION DISTRIBUTION & ROOM SIZES

- How are the room sizes and grid inside the building?
- What are the usual sizes for spaces in schools and offices?
- How are the functions distributed in the existing building?
- Does the existing spaces allow for easy changes into office spaces?

3. ”HARD” STRUCTURES

- Where are the ”hard structures” located in the building and how does it affect flexibility?

4. RE USE, MATERIALS & DEMOLITION

- How much can be re-used within the existing building?
- What measures were implemented to allow for more reuse?
- Which parts are difficult to demolish within the existing building?

5. VENTILATION SYSTEM

- Where is the existing ventilation system located in the building?
- How does the ventilation system work with different office types?
- Does the existing ventilation system have to be changed a lot when changing the spaces to different office types?

6. DAYLIGHT & ADDING A 5TH FLOOR

- Is the daylight optimal for different types of offices in the existing building?
- What areas in the building have challenges with access to daylight?
- How can daylight be optimized on the new 5th floor?

SITE ANALYSIS

HISTORY OF SITE

The site is located on Falkenborgvegen 32, next to Leangen and Lade area east of Trondheim centrum. Lade area has a special and historical significance close to the fjords and has many historical farms. The farms played an important role as a center of power in Norway when the Earls of Lade ruled here during the Viking Age/Dlig Middle Ages. In the 18th century, the farms in the area got their own distinctive architectural character, which is a magnificent architectural part of Trondheim today (Trondheim Kommune, 2023).

Louiselyst Gård is situated near the site and has a lot of historical value. Louiselyst was separated from Devle Gård. In the years 1808 – 1812, merchant Otto Fredrik Owesen lived here and built the outbuildings on the farm. The main building was opened under the name Louiselyst Gård, selskapshus and restaurant on 1st of March 1996. It was run by the restaurateur couple Gunda Sømliøy and Helge Værnes until 2018. The house is now run by Mojo Event (Louiselyst Gård, 2019).

”Lade Airport was built during the Second World War by the German occupation. On the 9th of April 1940, the Germans landed on Ladejordene. In 1940, the Germans built a permanent airport at Lade with runways, hangars and a roof of cast in concrete. The runway was 1,150 meters long and the width was 40 metres. Lade Airport was closed in 1965. The old airport area was then developed for industrial and commercial activities” (Wikipedia, 2023).

Today the area around the site is mostly occupied by shopping malls and commercial and industrial uses.

Photograph of Lade area around 1870, Litografi J. M. Berg UBiT (Trondheim Kommune, 2023).

Photograph of Lade airport and area in 1951, by photographer Fjellanger Widerøe A/S (Wikipedia, 2023)

Photograph of site around 1920 (Trøndelag fylkeskommune, 2024).

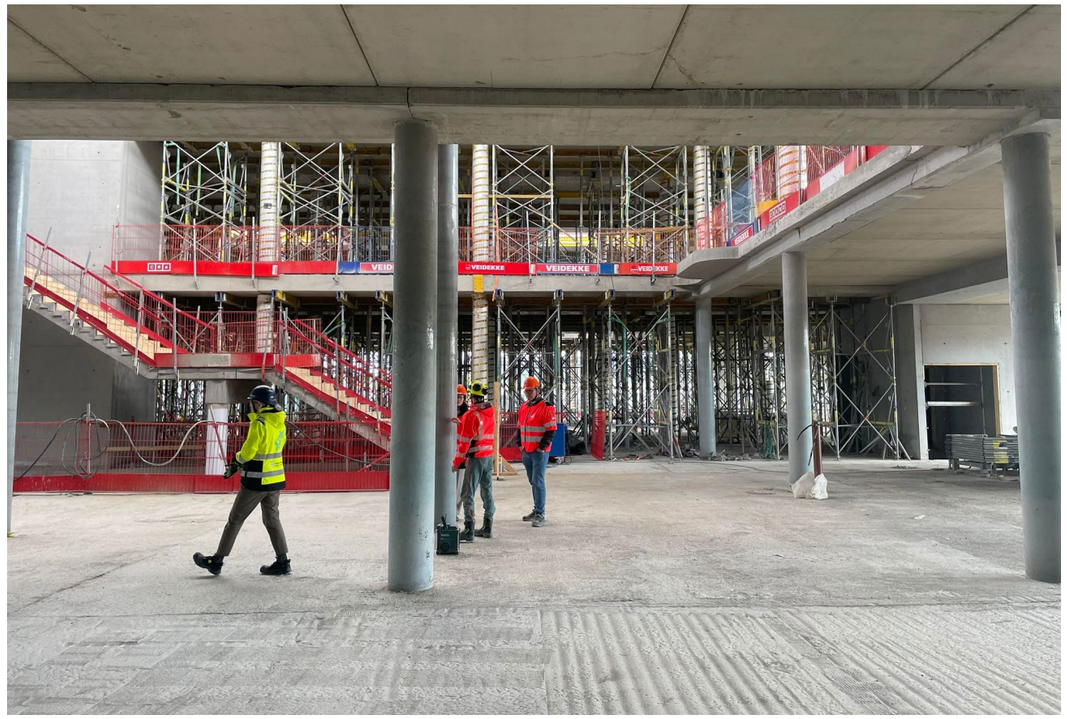
Photograph of site around 1970 (Trøndelag fylkeskommune, 2024).

SITE MAP

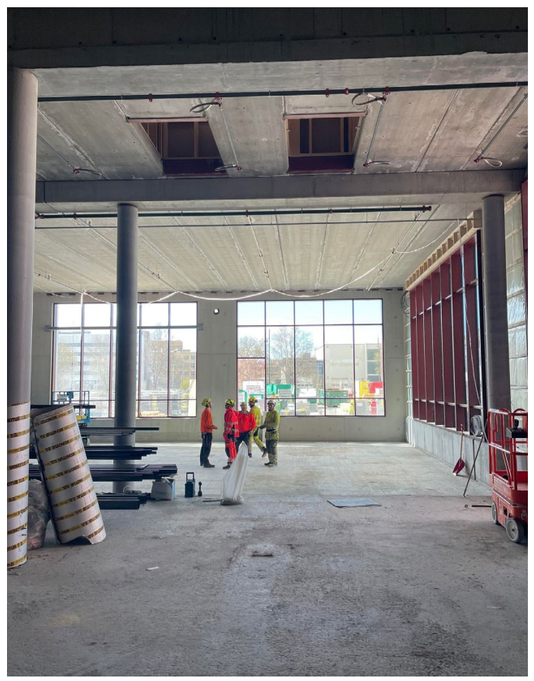
SITE IMPRESSIONS

PICTURES INSIDE OF BUILDING

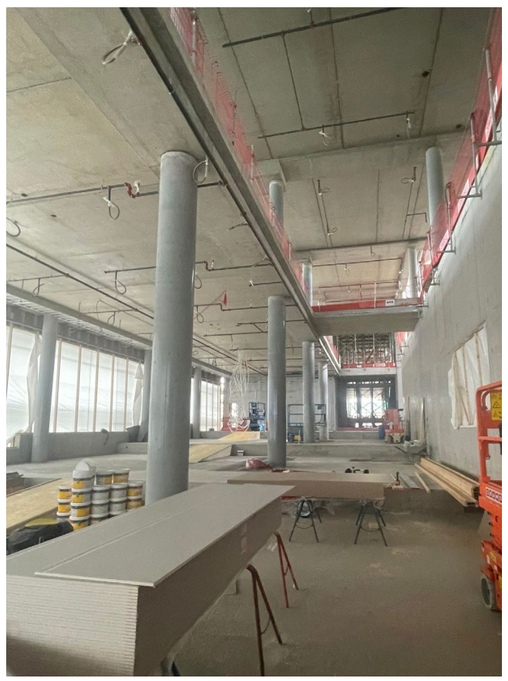
Atrium, view from 3d floor.



Cantina, view from 2nd floor.

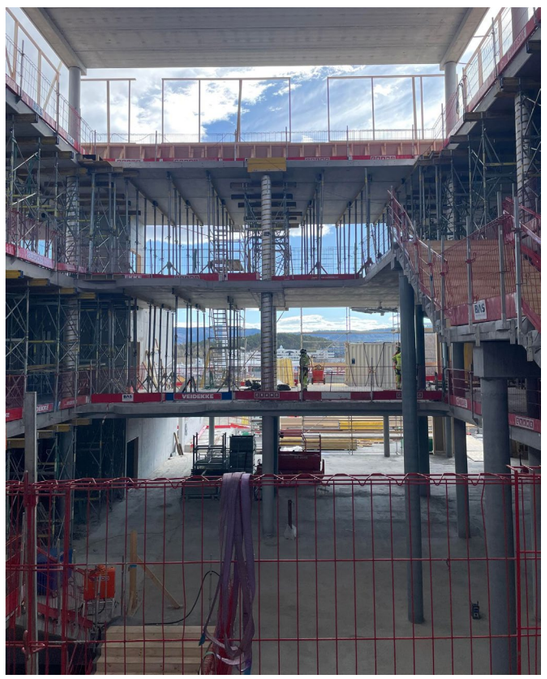


Mechanical workshop, view from 1st floor.



Main entrance, view from 1st floor.

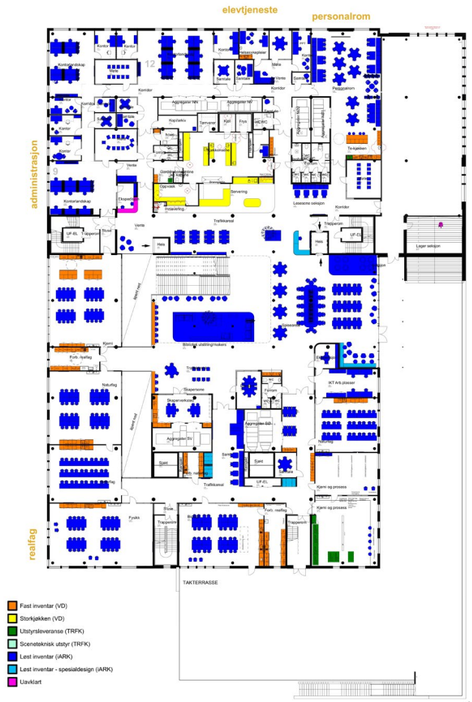
Dance Hall, view from 1st floor.



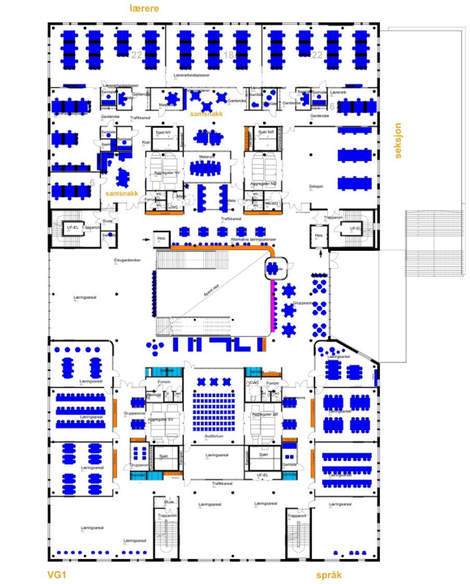
Atrium, view from 3d floor.

CISSI KLEIN VGS - FURNISHED FLOOR PLANS

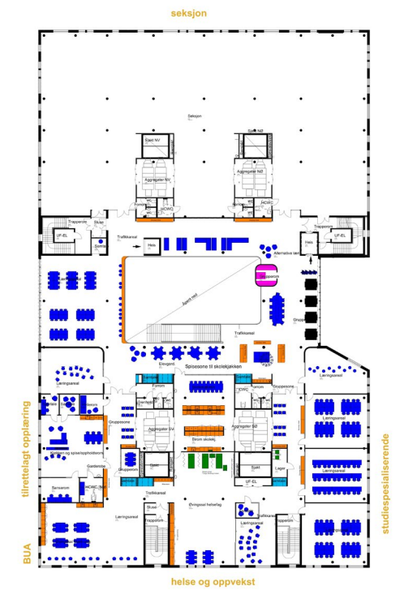
2ND FLOOR



3D FLOOR



4TH FLOOR



U1 BASEMENT

1ST FLOOR

1,5 MEZZANINE

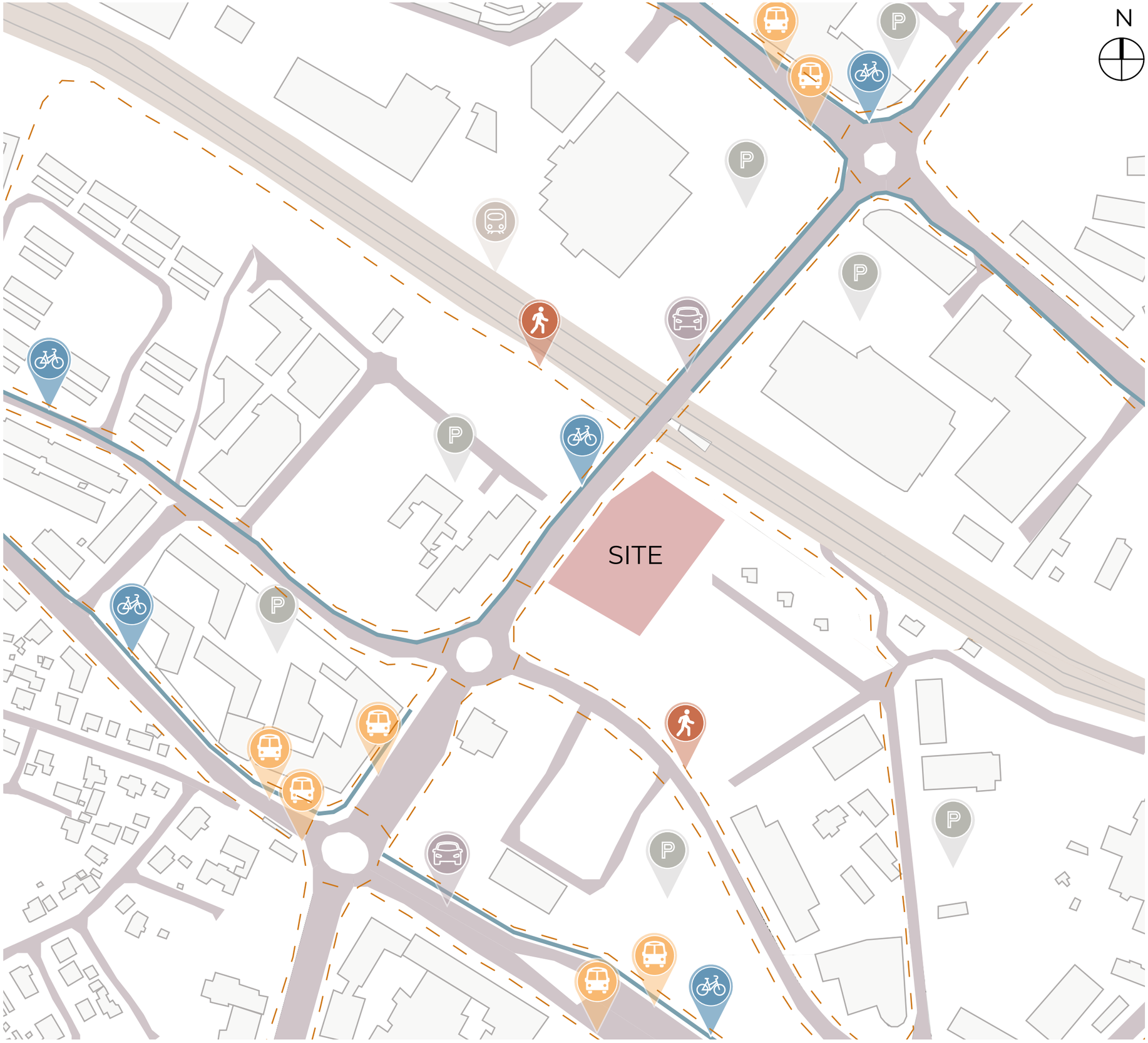
Existing floor plans by HUS arkitekter (Trøndelag fylkeskommune, 2024).

ACCESS MAP

The site is located right next to the main road and train line and is therefore located in the center of traffic and noise. The area has many parking spaces and bus stops. Around the site, there are also many optimal walking and cycling routes.

SIGNS:

- Main walking routes
- Cycling routes
- Bus stops
- Main roads
- Train line
- Parking spaces



FUNCTION MAP

The site is located in a commercial, industrial and retail area surrounded by many shops, offices and malls. Sirkus shopping mall is located on the other side of the road near the site. Nav is located right in front of the site across the road. There are also some sports facilities, factories and farms in the area.

FUNCTIONS:

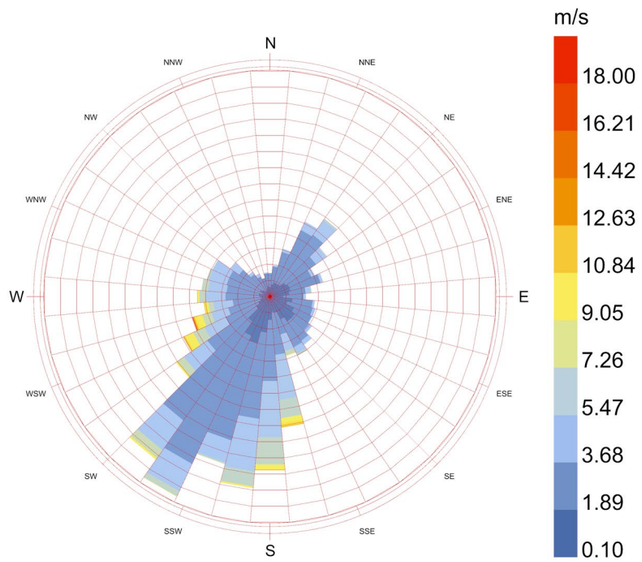
- Residential
- Malls
- Schools
- Offices, shops & services
- Sports
- Farms
- Factories

CLIMATE ANALYSIS

Trondheim has a subarctic climate with cold winters and mild summers. The city is located in the central part of Norway with a latitude of 63°26'N (Climates to Travel, n.d).

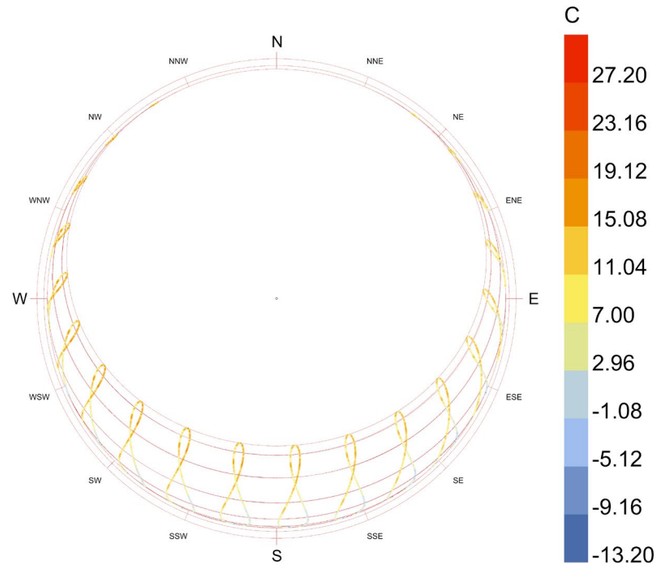
"On the shortest day of the year, December 21st, the sun rises at 10:00 am and sets at 2:30 pm. On the longest day, June 21, the sun rises at 3:00 am and sets at 23:40 pm." The average temperature in July is 15,6 °C and - 1.1 °C in January. Trondheim has about 845 millimetres of precipitation per year. In the driest month April, it ranges from 40 mm, while in September it can go up to 90 mm (Climates to Travel, n.d). The wind rose indicates that most of the wind comes from the south-west.

WIND ROSE



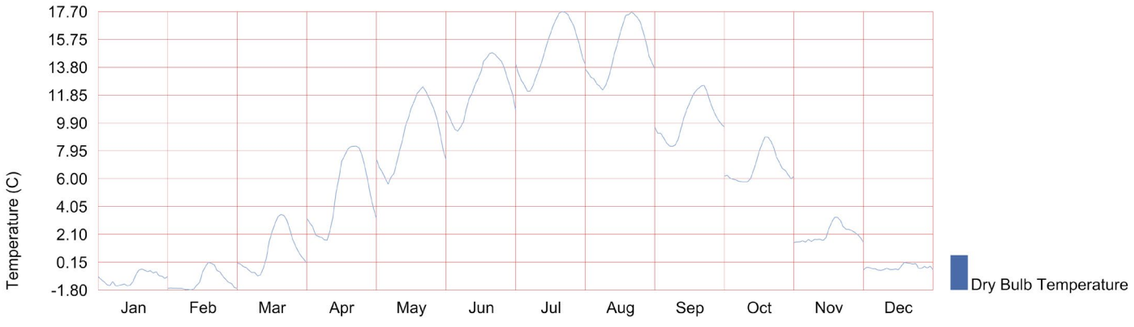
Wind Speed (m/s)
city: Trondheim-Voll
country: NOR
time-zone: 1.0
source: SRC-TMYx
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 1.87% of the time = 164 hours.
Each closed polyline shows frequency of 0.6% = 50 hours.

SUN PATH



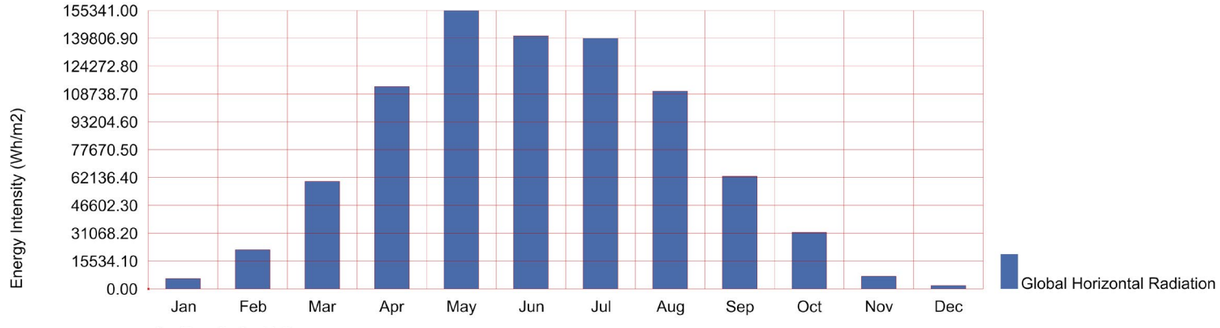
Dry Bulb Temperature (C)
city: Trondheim-Voll
country: NOR
time-zone: 1.0
source: SRC-TMYx

TEMPERATURE



city: Trondheim-Voll
operation: average
source: SRC-TMYx
time-zone: 1.0
country: NOR

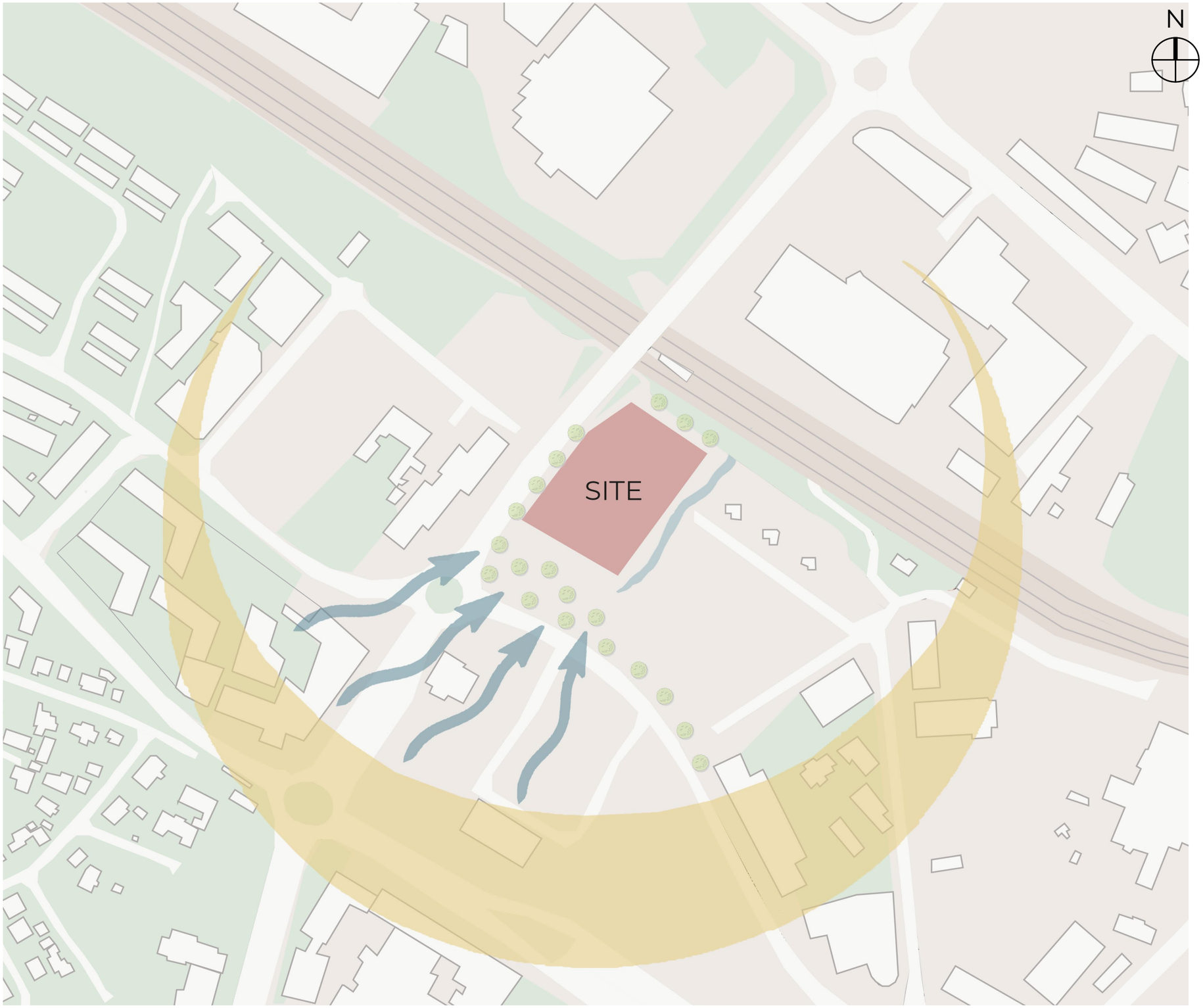
ENERGY INTENSITY



city: Trondheim-Voll
operation: total
source: SRC-TMYx
time-zone: 1.0
country: NOR

MICROCLIMATE MAP

This map shows the microclimate around the site with the sun path, wind conditions, vegetation and stormwater management. The wind mainly comes from south-west. A public park will be built in south-west next to the site, which will help against the wind. On the east side of the site, it is planned for stormwater management.



BACKGROUND & RESEARCH

CISSI KLEIN VGS

Cissi Klein Videregående (vgs) is a new upper secondary school that is currently beeing built in Falkenborgvegen 32 in Trondheim. The school is designed by HUS arkitekter for Trøndelag Fylkeskommune / county authority. Veidekke, Bygg, Rambøll, Bryn Byggklima, K. Lund, Fjeldsett, Olav Olsen and Plan arkitekter (LARK) has also been commissioned with the development and construction of the school. The new upper secondary school is planned to be finished in 2025 (Tandstad, 2023).

The name of school is a tribute to Cissi Klein, who was a 13 year old jewish girl that was arrested in the classroom and killed in Auschwitz (Valum, 2021).

Cissi Klein Videregående will offer education programs such as music, dance and drama, science and technology, industrial subjects, health and care, and study spesialisation. It will offer a large auditorium, dance halls, a muliti purpose hal, a bicycle cellar and usable outdoor area on both ground and roof (Byggeindustrien, 2022).

Sustainablity and reducing C02 emissions were some of the main goals in the new school building. The buildig becomes a zero emission building (ZEB-0 ÷ EQ). The goal was to reduce 45% emissions in relation to a reference building. It has PV panels on the roof and produces as much energy as it consumes. To ashieve the goals, low-carbon extreme concrete is used, also in the flat decks. This is completely new and developed in collaboration with Veidekke's subsidiary Grande Entreprenør in Verdal. Another measure was to re-use 100 year old brick from the margarine factory in Buran, for the facades (Byggeindustrien, 2022).

The upper secondary school is planned for 700 students, but has the capasity for 900 students. From an early stage the school was designed to be flexible and have a resuable building body. This was integrated in the project so that the building`s layout and function easily can be changed in the future. During the planning stage, Trøndelag fylkeskommune made a table of potential uses in the future, where a cultural building or a office building was considered the most potential uses within the next 50 years. Within the next 10 to 25 years it is more likely for changes within the school functions. Residential uses and a shopping mall was considered to be less potential uses in the future (Byggeindustrien, 2022).

Picture of Cissi Klein (Valum, 2021).

Exterior render of Cissi Klein vgs, by Hus Arkitekter.

Exterior render of Cissi Klein vgs, by Hus Arkitekter.

Funksjon	Sentrale konsekvenser	Sannsynlighet innen 10år	Sannsynlighet innen 25år	Sannsynlighet innen 50år
Endring i skolens behov	1) Mindre endringer i etg	1) Høy 100%	1) Høy 100%	1) Høy 100%
	2) Større endringer i etg	2) Middels 50%	2) Høy 100%	2) Høy 100%
	3) Arealbehov	3) Lav 25%	3) Høy 100%	3) Høy 100%
Kulturbygg (U1 og 1)	1) Ny inndeling 2) Orientering og rømning	Lite aktuelt	Lav 10%	Poteniselt
Kontorbygg	1) Økt møte/stillerom 2) Åpent landskap/cellekontor	Lite aktuelt	Lite aktuelt	Potensielt
Bolig	1) Våtrom 2) Lydkrav 3) Parkeringsmuligheter	Lite aktuelt	Lite aktuelt	Lite aktuelt
Kjøpesenter	1) Volum - himling 2) Felles areal og rømning 3) Varelogistikk 4) Parkeringsmuligheter	Lite aktuelt	Lite aktuelt	Lite aktuelt

Table of possible functions in the future, by Trøndelag Fylkeskommune.

FLEXIBLE DESIGN

Recently, the focus on flexible design and adaptable solutions in buildings has increased. The society and uses within organizations are constantly changing, which leads to the needs of adapting more buildings. Adaptable buildings have a longer functional life, so the desire for adaptability therefore applies to most building types. To accommodate different types of functions and furnishing solutions, adaptable building must have some form of spacius dimensions (SINTEF Byggforsk, 2004).

According to Sintef byggforsk, 2004 the term flexibility means the ability to change the building to meet changing functional requirements. This takes into account the cordination of measures to facilitate stuctural or technical changes or replacements with low costs and a short work period. By for example changing the building by moving interior walls, you can create new layouts and combination of spaces. See figure 24 below (SINTEF Byggforsk, 2004).

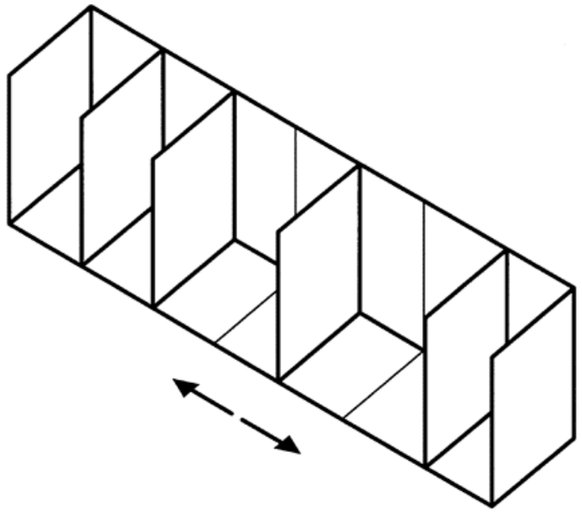


Fig. 24 Flexibilty (SINTEF Byggforsk, 2004).

BREEAM NOR v6.1 new construction is a techinal manual document that sets environmental performance standards for new buildings. Point M2 in the document describes design for disassembly and functional adaptability. It says that there is an advantage to undertake a study of the buildings adaptability and usability early in the design process. Changes later in the process will often be limited and incur additional costs. M2.1 says that the following points must be considered in a evaluation study of a buildings functional adaptability: ”Planned functions and the potential adaption to the needs of future building occupants, superstructures, building envelope, core and local services, interior design and technical installations” (Norwegian Green Building Council, 2010).

These points must be considered in relation to the three principles of functional adaptabilty; versatility, convertibility and elasticity.

1. ”Versatility, the ability to accommodate different functions without affecting the building’s structure”.

2. ”Convertibility, the ability to accommodate substantial changes in user needs by making modifications without altering the building’s structure”.

3. ”Elasticity, designing to allow for either vertical or horizontal additions to the building’s structure”. (Norwegian Green Building Council, 2010).

BREEAM NOR Mat 07 Design for disassembly and adaptability

Table Mat 07-01: Design measures allowing future adaptation

	Versatility	Convertibility	Elasticity
Planned functions and the potential adaption to the needs of future building occupants	Possibility for shared use, e.g. day/evening	Possibility to divide/ open room sections for different kinds of use	How is the building designed for the extensions in the event of functional changes?
Superstructures and floor height: - Constructive elements, e.g. frame, upper floors, load-bearing external walls - Foundations	A regular column layout and few or no load-bearing walls Equal floor height	Use of products or systems in which individual components are easy to adjust/move	Spacious floor heights that make it possible to change functions and technical solutions with regard to ventilation, etc. Adapted for extensions/ reuse through oversizing or the use of modular building/product systems
Building envelope: - External walls - Cladding - Ground - Roof	Optimal daylight conditions	Location of structural components within the floor space	Provision to add extensions or make modifications to increase the building's capacity and retain the cladding
Core and local services: - Toilet/kitchen cores - Stairs and lifts - Corridors	The building is planned so that these areas can preferably be fixed in the event of functional changes	Space to be able to upgrade, change or expand, for example, pipelines/and or electrical cables	Provision of infrastructure capacity to enable future expansion and adaptation
Interior design: - Finishes - Floors - Interior walls - Connections	General space solutions with regard to access, so that rooms can be used independently All type of rooms have optimal daylight conditions	Use of products or systems that can easily be replaced Layout in standardised grids Use of standardised material sizes Use of inherent finishes to allow replacement Floors are installed and finished before walls are installed	The use of standard and durable materials Efficient use of space to allow for any increase in occupancy
Technical installations: - Mechanical and electrical - Sanitary - Fire	A dense distribution network will provide opportunities for point extraction without major alterations or structural interventions	Use of products or systems in which individual components are easy to adjust, move or replace	Technical installations and guideways will be given good capacity to enable expansions and adaptions

This table is neither complete nor limited to the sample

Table Mat 07-01: Design measures allowing future adaptation, by (Norwegian Green Building Council, 2010).

CISSI KLEIN VGS - FLEXIBILITY

Cissi Klein vgs has been designed to be flexible and have a reusable building body. Trøndelag fylkeskommune describes flexibility as the ability of a building to meet different functional requirements by changing the characteristics of the building. They used Table Mat 07-01 and the REEAM NOR v6.1 new construction techinal manual as a guide in the design of the new school building. From an early concept and design phase to the detailed phase of the building project they looked at the following points: Floor heights, Load bearing system, structural span, building envelope, continuous vertical shafts and technical rooms, shared-use zones, acess/ people movement, expansion possibilities, floor plan, technical installations, material choices, universal design fire and sound (Trøndelag fylkeskommune, 2024).

In the detailed phase of the project they ended up with these measures to make the building more flexible:

1. Floor Heights:
Spacious floor heights ensures flexibility when changing functions. It makes it possible and easier to change functions and technical solutions in terms of ventilation etc. The floor height is 4,5 m on U1, 7 m on 1st floor, 4,5m on 2d floor and 4,2 m on 3d and 4th floor.

2. Load bearing system:
Cast in place concrete has been chosen as the load bearing system in the building. Cast-in-place concrete beams and girder system ensures good flexibility for changing functions later. It provides good fire and sound properties while also providing a low building height and greater span. In U1 there is cast in place concrete walls, which makes it difficult for undertaking changes. U1 has common functions that will mostly remain unchanged when the function is changed in the building. Low carbon-extreme concrete is used to reduce more emissions.

3. Structural span:
The building require to have more free length span in various room functions. High span gives increased flexibility and smaller columns. The structural load capacity is mainly 5 kN/m2 in U1 and in the main hall of 1st floor. In 2d, 3d and 4th floor it is 3 kN/m2. This ensures the flexibility and requirements for changing the spaces into an office space. The structural system also allows for an extenion on roof level of an additonal 5th floor.

4. Building envelope:
The building envelope is the part of the building that seperates the outside from the inside, the external walls, basement floor, cladding and roof. The columns are pulled into the cover structure. Daylight requirements of 2.5 % is ensured in rooms with permanent occupancy.

5. Continuous vertical shafts and technical rooms:
Use decentralised ventilation system with short guideways, which allows for easier devisions within the building. The decentralised shafts system is on both sides of the building. Use of separate shafts prevent later collision problems. The size of the shafts enables possible expanion.

6. Shared use zones:
Common areas in the building such as stairs, elevator, transport zones and toilet zones. Possibilities to go directly from shared use zones to individual zones. Make space for upgrade and extenion of pipes and electrical wiring.

7. Acess/ people movement:
3 to 4 escape stairs ensures good flexibility and the possibility of changing the floor plans for other functions.

8. Expansion possibilities:
Possibilities for renting out division of areas within the building. Possibilities of expanding the building on the roof and on the roof terrace on 2d and 3d floor.

9. Floor plan:
Furnishings such as floors, interior walls, surfaces and installations. Use standard meassurements on materials and grid. Plan for general rooms that easily can be adapted for other uses. Walls within the same functions can be dissasembled and re-used.

10. technical installations.
Technical installations and guideways provide good capacity for expansion and adaptations. A dense distribution network allows for point extraction without major changes. Pipes: grid heating solution with separate division for section. Ventilation: grid ventilation that follows the axis system and column placement. Electricial system: grid ligthing with sensor management, some areas with manual steering and motion sensors.

11. Material choices:
Choose materials that is robust and can easily be dissasembled and re- used. Make life cycle assesment of the emissions of materials.

12. Universal design:
Design for diversity and inclusion, good accessibility and lighting, and provide different zones for everyone.

13. Fire & sound:
Provide fire sprinklers and fire exits in the building. Provide sound proof sunken ceilings. Good sound dampering ensures good adaptability for new uses.

(Trøndelag fylkeskommune, 2024).

TECHNICAL GRID

Technical conduits and outlets are normally distributed into a technical grid system. The technical grid must correspond with the building`s planning module. All workplaces needs technical installations that may be possible to use in a long or short term. "A layout with a dense pattern of workplaces over the entire floor level requires many grid units. A dense technical grid structure provides a high level of generality in regard to use and decoration." A layout with workplaces along the facades and spesial and common uses in the middle, often have fewer grid units which provides lower generality. Each route in the technical grid system should have these components: monitoring of indoor climate and energy use, cooling, supply air and exhaust for ventilation, ligthing, electricity and ICT, and sprinkling (SINTEF Byggforsk, 2004).

A technical grid that facilitates different types of functions is often more expensive. Functions with different technical requirements than normal workplaces can be seperated into different zones in the building to limit the costs. Costs can also be reduced by determining the location of both open and closed workplace solutions in advance (SINTEF Byggforsk, 2004).

Grid in office spaces:
To allow for more office solutions and furnishings options, a planning module based on the workplace units (2.4 m x 2.4 m or 2.4 m x 3.0 m) provides better generality than a module based on cell offices. For a cell office the usual width is 2,4 m. The size of the offices can easier be varied if the planning module is based on half a cell office, 1,2 m. All the modules can be used both for open workplaces and closed rooms/cell offices if each module has the necessary technical installations (SINTEF Byggforsk, 2004).

Size requirements in Classrooms:
Classrooms are usually sized for approx. 25 students. The general teaching area is usually dimensioned by 2,25 m2 per student in the teaching area. Additonal common areas, group rooms, local storage etc is set to 0.7 m2 per student. The schools in Trondheim Commune is built with classrooms sized by 2,5 m2 per student, while the national norm is a minimum of 2 m2 per student (Trondheim Kommune, 2015).

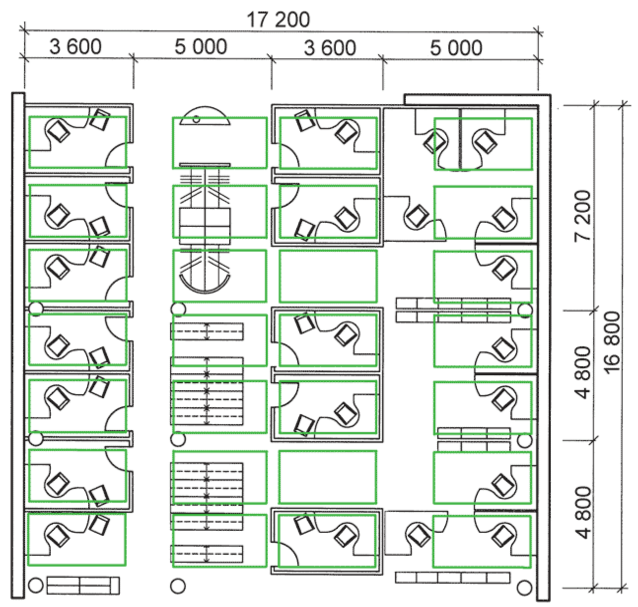
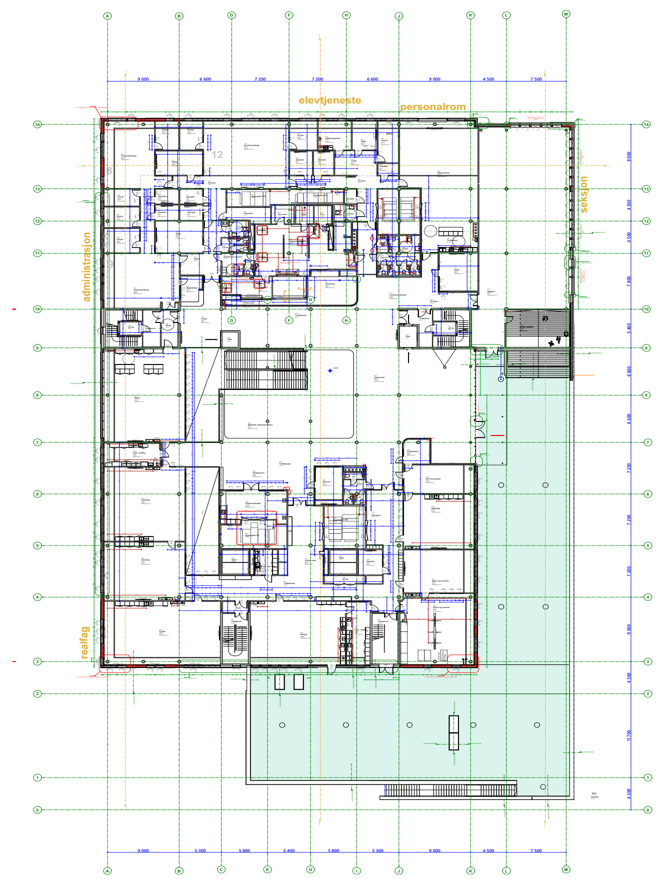


Fig. 53 Workplace analysis, where the technical grid is marked in green. Architect: SporDark Design AS (Sintef Byggforsk, 2024)

Grid in Cissi klein vgs:
The pictures to the right shows the grid system on 2nd floor in Cissi Klein vgs. Some offices are located In the top left corner of the floor plan. The offices are approximately sized by 2.9 m x 4 m, or 2.9 m x 4,4 m. These meassurements are bigger than the usual cell office sizes. This can allow for more people in one office. On the other side of the floor plan down to the bottom left, there are classrooms. These classrooms have different sizes. Some classrooms are sized by 10.1 m x 10.3 m, 10,1 x 8,1 m, or 8,8 m x 14,6 m. These classrooms are huge and allows for easier changes in the future. It is possible to make smaller rooms within the existing grid or demolish some walls and make a more open workplace landscape. Overall the building has very different sizes for all the rooms and don`t follow a strict grid with equal sizes for simular functions.



Grid on 2nd floor in Cissi Klein vgs, by Hus Arkitekter (Trøndelag fylkeskommune, 2024).

CISSI KLEIN VGS - FLOOR PLANS ANALYSIS

Access, circulation & vertical connections:

The building have 4 entrances on 1st floor. The main entrance is located in the south. This is connected to the public park and access from the main street. The main entrance leads to the auditorium and towards the main staircase in the middle of the building. The circulation flows well around the auditorium in the center of the building, but could be better in the north parth. On 2nd floor the circulation around the middle staircase stops. In some places you have to go through classrooms. This could be planned in a better way so that the corridors and circulation flows better. On 3d and 4th floor the circulation is better in the center and in the south of the building. It is possible to walk around the main staircase, and there are more clear corridors. In the north part the corridors could be planned better to improve the circulation. The building have 5 staircases, with one main staircase in the middle of the building. Many staircases makes it easier to make devisions and renting out spaces for multiple offices in the future. For one company it is questionable if that many staircases is needed.

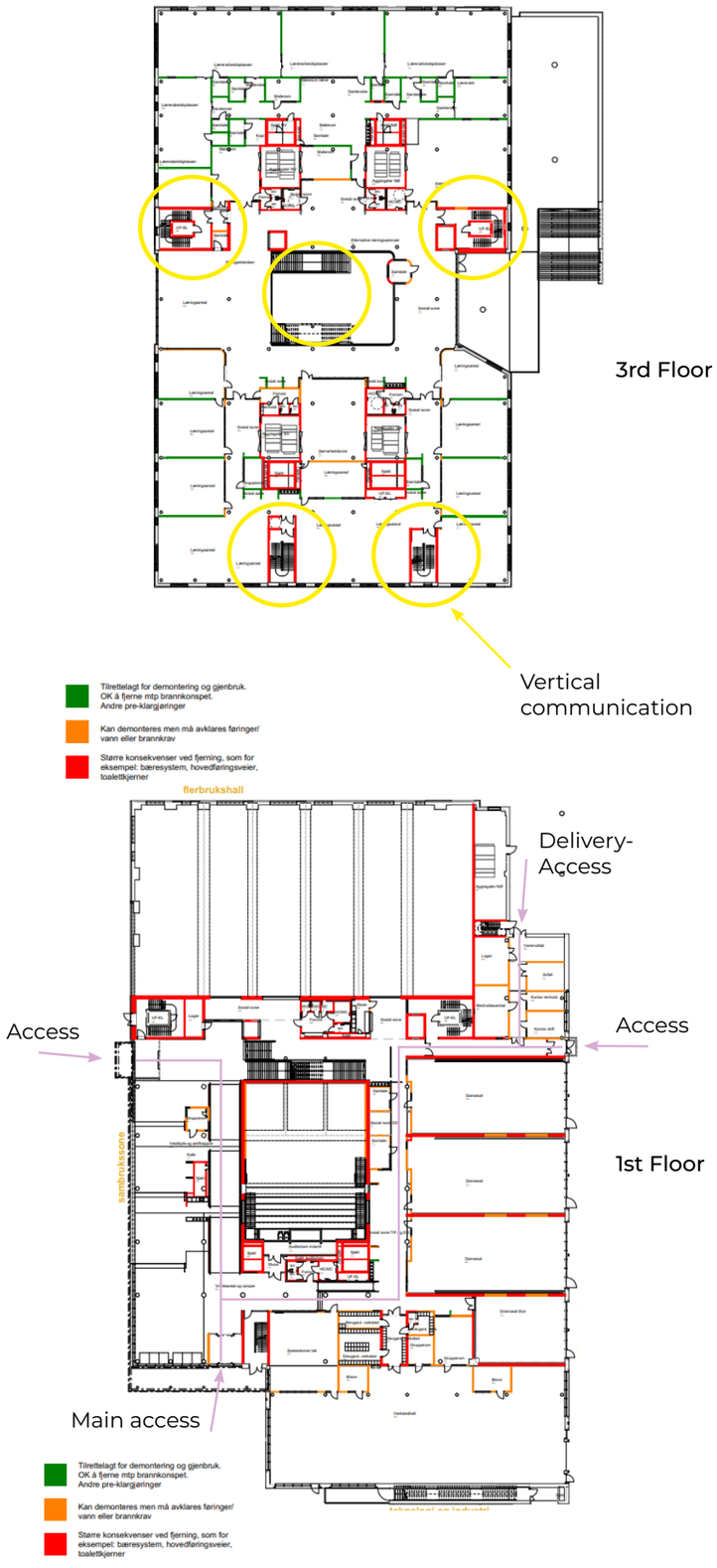
Function distribution & room sizes:

In the basement U1 there is a huge multiple-use gym hall, a smaller gym, several dance halls, changing rooms, auditoriums, storage spaces, and a storage room for bicycles. On 1st floor you enter the building straight to the auditorum on the right. The auditorium is located in the center of 1st floor, and around it there are several dance halls, a drama hall, workshop hall, gym hall, cafe and storage spaces. The size and location of these functions make it difficult to do big changes in the future. On 2nd floor there are offices and a nurse in the north part. The cantina and seating area is placed in the center of the floor. In the south there are classrooms meant for science, biology and physics.

On 3d and 4th floor there are classrooms along the facades, and some meeting rooms and silent rooms. The floors have aggregates with two desentralised shafts systems on both sides of the building. The location of these makes it easier to allow for devisions within the building, but they also take up much usable space. All the classrooms and offices have different sizes. Many of the spaces are huge which allows for easier changes. The windows have sufficient space between eachother which makes it possible to set up new partion walls between them. It is also possible to demolish several walls to make the spaces more open.

Hard structures:

The building has cast in place concrete as the load bearing system. Low- carbon extreme concrete was used to reduce emissions. According to Trøndelag fylkeskommune, 2024, this was chosen because it provides good fire and sound properties and greater span. Cast-in-place concrete beams and girder system also ensures good flexibility for changing functions later. In U1 they used cast in place concrete for the interior walls. This makes it less flexible to do changes in the future. In some places they have planned and made it possible to remove small parts of the concrete to make doors between the rooms. This is a smart meassure, but does not ensure bigger possible changes. They could have used other materials for some of the interior walls, to make it easier to do changes in the future. The main central auditorium has cast in place concrete walls. The staircases also have cast in place concrete walls around them. The placement of the auditorium and staircases and its concrete walls makes it difficult to do big changes around them in the future.



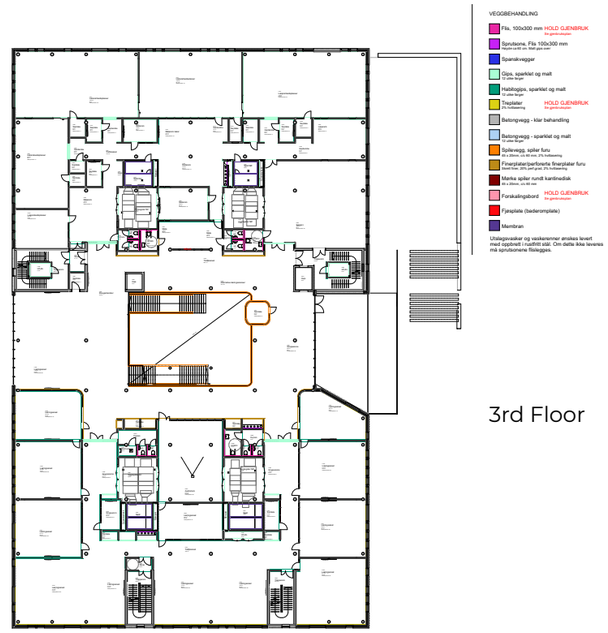
CISSI KLEIN VGS - REUSABILITY

Re-use, materials & Demolition:

One of the measures to ensure flexibility and re-use of materials within the building was to map out materials and reusable interior walls on the floor plans. This makes it easier to understand the building and transform it for other uses in the future. On the floor plans the interior walls are coloured by the difficulty levels of reuabilty and dissasembly. Red means there are bigger consequenses with removal, for example removing main conducts, toilet cores and load bearing systems. Orange means it is possible to dissasable but it has to be clarified with existing pipes, water and fire requirements. Green means it is okay to remove walls, and it is already adjusted for dissasembly and reuse (Trøndelag fylkeskommune, 2024).

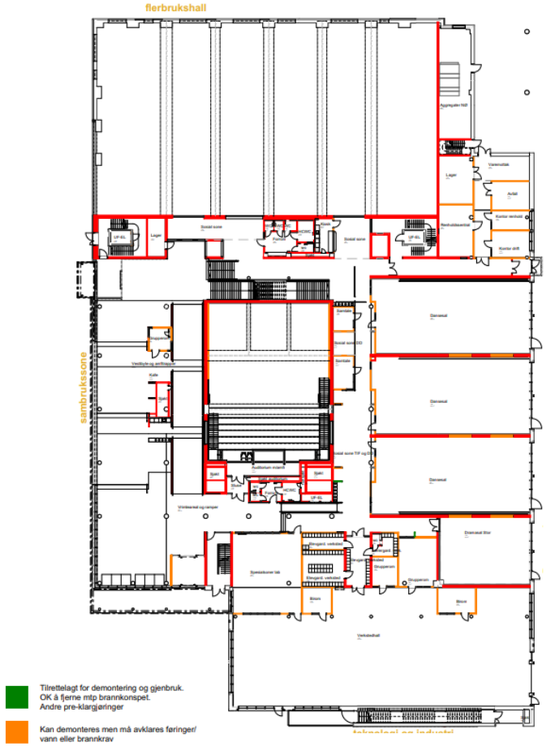
On U1 and 1st floor most of the walls are coloured red and the walls consist of cast in place concrete. This means it is very difficult to do big changes here in the future. On 2nd floor there are many green walls in the northern part, which can be re-used in the future. Most of the classrooms on 2nd floor have sinks and other technincal installations, which makes them more difficult to remove. These walls most likely have to be demolished and can not be re- used. On 3rd and 4th floor there are more green walls. The floor height is also the same on 3d and 4th floor, which makes it easier to re-use these walls for other purposes.

FLOOR PLANS - MATERIALS:

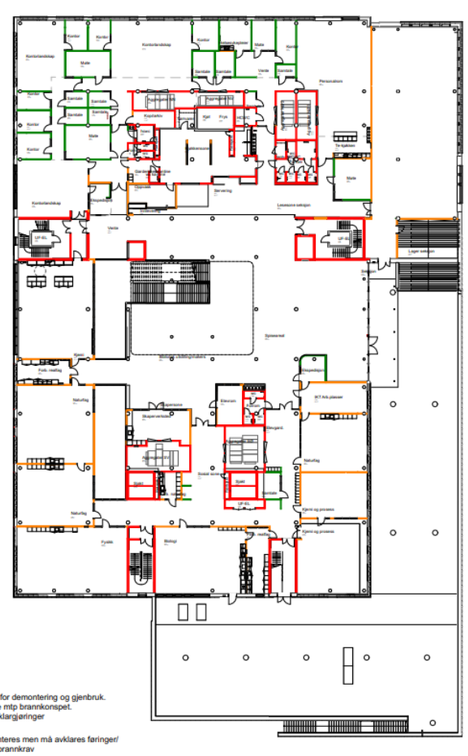


3rd Floor

FLOOR PLANS - REUSABILITY



1st Floor



2d Floor

3rd Floor

All floor plans by HUS arkitekter (Trøndelag fylkeskommune, 2024).

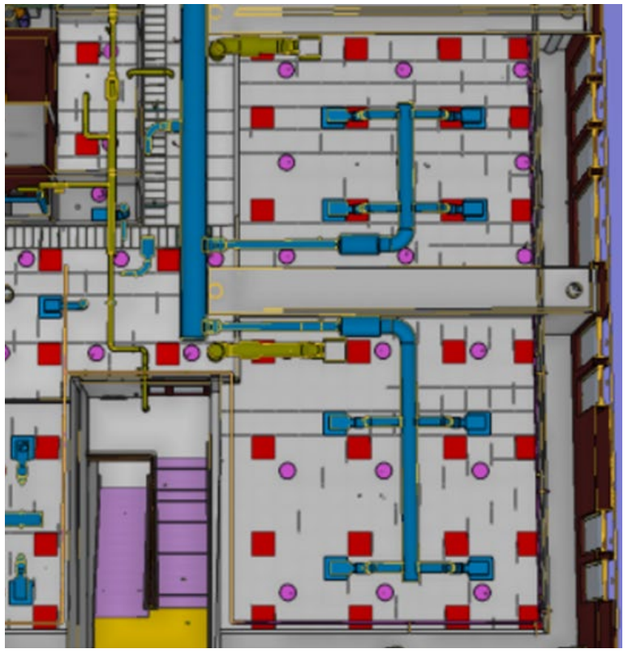
CISSI KLEIN VGS - VENTILATION SYSTEM

Cissi Klein vgs has a desentralised ventilation system with two desentralised shafts systems on both sides of the building. Separate shafts prevent later collision problems and allows for easier devisions within the building (Trøndelag fylkeskommune, 2024).

With a desentralised ventilation system the aggregates are distributed around near the spaces that needs to be ventilated inside of the building. A desentralised ventilation (DV) system has relativerly short air distribution passages. Reduzed air distribution duct space is one advantage of the DV system. It also reduzes construction volume and cost, and simplify indoor spaze zoning. This makes it an efficient and cost-effective solution for indoor air quality control (Kim, Liu and Baldini, 2024).

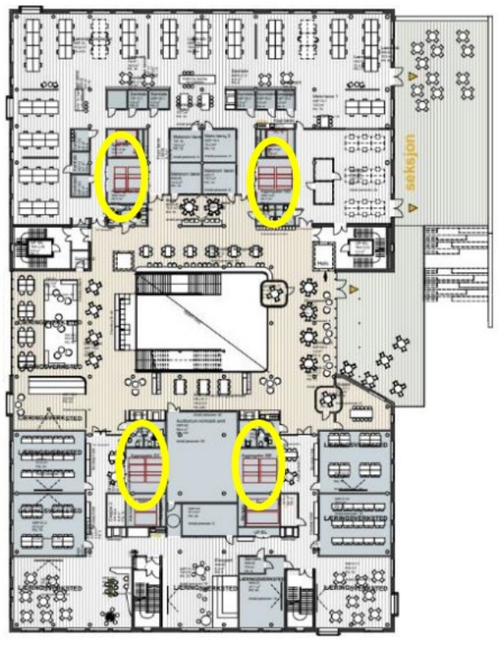
A desentralised ventilation system is suited for offices and schools because it easier can adapt to various indoor conditions. At some times there are less occupants in the building. A DV system can operate effectively with space zoning and supply fresh air to different occupied zones.
”A DV unit includes a compact air filter, fan, heat exchangers for cooling and heating, and a heat recovery device. A typical DV system can supply fresh outdoor air directly into a room without the need for heating and cooling energy demand in the intermediate season.” In the winter season in Norway, a DV systems`heat recovery is essentially useful because it can save thermal energy for ventilation. All building systems require mandatory ventilation with heat revovery for energy saving, according to TEK17 (Kim, Liu and Baldini, 2024).

Ventilation ducts in Cissi Klein vgs:



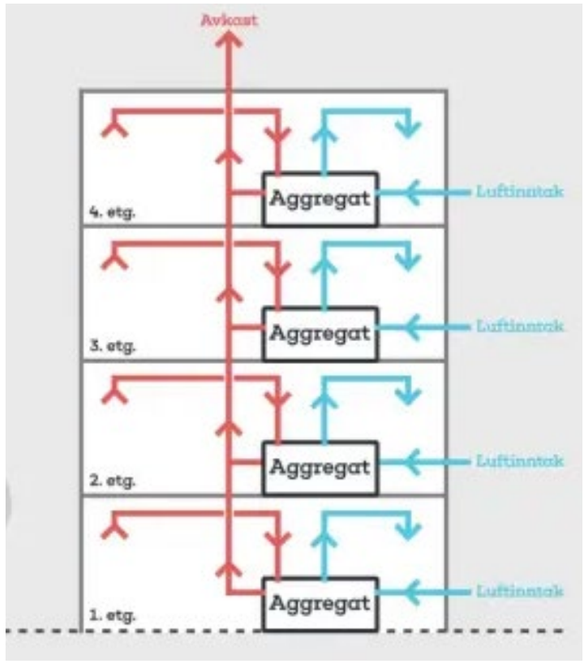
Picture of ventilation ducts on 4th floor, from BIM model of Cissi Klein vgs (Trøndelag fylkeskommune, 2024).

Ventilation shafts in Cissi Klein vgs:



Floor plan by HUS arkitekter (Trøndelag fylkeskommune, 2024).

Desentralised ventilation:



Desentralised ventilation system (TEKNA, 2021).

Ventilation ducts in Cissi Klein vgs:

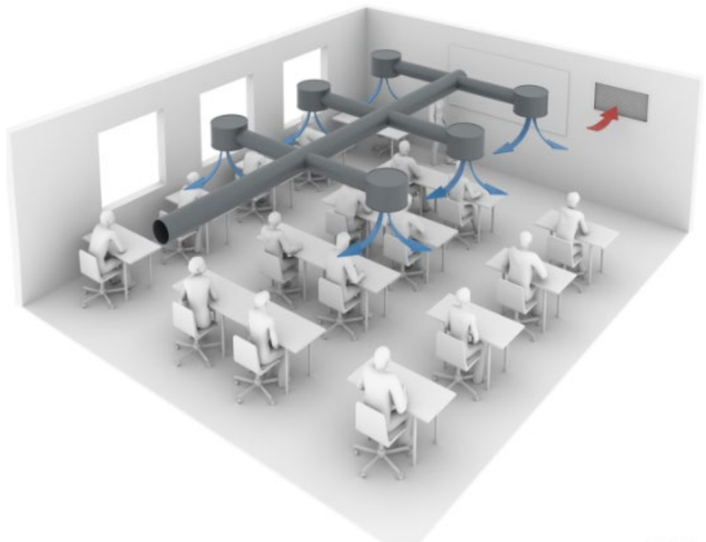
Picture of ventilation ducts in the corner of 3d floor, from BIM model of Cissi Klein vgs (Trøndelag fylkeskommune, 2024).

VENTILATION SYSTEMS IN SCHOOLS & OFFICES

The indoor climate in schools are regulated by laws and regulations, as TEK 17 for example. Pupils in schools have the right to a good physical environment that promotes learning, good health and well-being according to the Education Act. ”A good indoor climate can contribute to a better learning and teaching environment and redused sickness absence.” Normally it should be at least 0.8 m between pupils and ventilation openings, heating sources and windows to ensure satisfactory thermal comfort. Relative humidity (RH) should be below 70 % in summer and below 40 % in winter in classrooms. The risk of condensation and mold growth increases with high humidity, and this should not accour. Some common challenges in schools are varying and uncomfortably high temperatures in summer, and draft and cold radiation from windows in winter (SINTEF Byggforsk, 2022).

There are often many people in small areas in schools, which requires a large amount of air per square metre. The amount of people present varies a lot, and with less people there is a need for smaller supply of air. With large or reduced air volumes, it is important that the air is supplied so that unpleasant drafts do not accour. The air is brought to the room at high speed with a traditional mixing/ agitation ventilation. It is recommanded to place the supply air valves in the ceiling to ensure good stirring and least possible draft. With this system the air supply, pollutant concentration and temperature distribution is relatively uniform in the room. In classrooms larger than 50 m2 where large volumes of air are to be supplied, radial valves in ceilings are best suited. Another solution is to place the supply air vents in the wall facing the corridor. This solution has lower installation costs, but can increase draft problems near the windows (SINTEF Byggforsk, 2022).

Ventilation in classroom:



Ventilation in classroom (SINTEF Byggforsk, 2022).

Traditional mixing/ agitation ventilation in classroom:

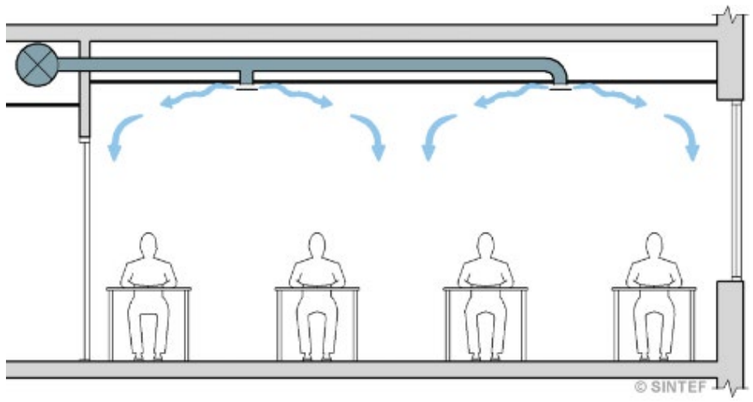


Fig. 42 a. Ventilation in classrooms with radial supply air valves in the ceiling (SINTEF Byggforsk, 2022).

FLEXIBLE OFFICE SPACES

When planning new office buildings, it is common to use a planning module. A planning module devides the building or floor into appropiate units in relation to functions, dimention of building materials and furnishings. It is usually divided into a central zone with shared functions, office zones and corridor zones. The planning module also gives guidlines for placement of walls, ceiling panels and technical installations. It should be cordinated along with the structural grid (SINTEF Byggforsk, 2004).

In office buildings the functions is often devideed into 3 categories: Common functions, workplaces with associated functions, and spesial functions. Common functions serves everyone in the building, like a reseption, cantina or resturant. Workplaces with associated functions is for example kitchenettes, small meeting rooms or toilets. Spesial functions is for example computer rooms, laboratories or teaching rooms. Common functions and special functions should be brought together, for example in the building`s entrance level. They should not be integrated into the workplace areas, because it provides a better generality and provides flexibility opportunities for selling and renting utility units. Fixed elements such as stairs, toilets, vertical shaft, lifts, and wet rooms should be placed at the edge of the workplace areas, so that they dont inhibit the flexibility of the workplace areas (SINTEF Byggforsk, 2004).

To facilitate high adaptability and flexibility in office spaces, the investment costs are often higher but the costs are lower in the long term. This is because the building can easier be changed for new user requirements in the future, which gives lower costs. If it takes long time to do changes inside the office building, rental income and vaulable production time can be lost. The investment costs difference between a office building with a high of generality and a office building with no measures for adabtability can be 20-25%. ” A building that can easily be divided into several utility units that can be rented out or sold independently of each other helps to give a building elasticity, and the building owner financial flexibility” (SINTEF Byggforsk, 2004).

To achieve generality and adaptable office spaces, the building width is important. To allow for different furnishing solutions and an acceptable area efficiency, a width of 15-17 m is optimal (SINTEF Byggforsk, 2004).

The floor height is also crucial to ensure flexibility and allow for different uses within a building. According to TEK17, the net ceiling height in permanent working spaces should be 2,7 metres. A gross floor height of 3.6 metres provides sufficient space for installations. See figure 431 (SINTEF Byggforsk, 2004).

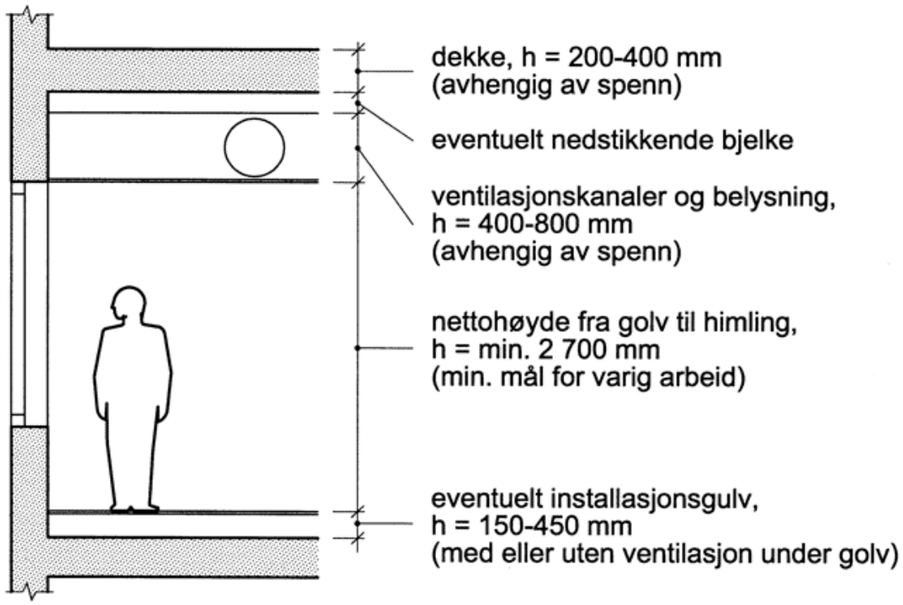


Fig. 431. Principle sketch with typical height requirements (SINTEF Byggforsk, 2004).

OFFICE TYPES

Workplaces in office buildings can have fixed spaces, closed cell offices, open office landscapes, activity based workspaces, shared or flexible office spaces. The workplace solutions fits different spesific work tasks and can affect the way people work. It can also affect the health of the employees (Arbeidstilsynet, n.d).

Cell offices:
”A cell office or private office is organized as closed rooms intended for one person. It is closed with a door and partition walls to other offices and the corridor.” To ensure suffucient daylight in all the offices, they are usually located along the facades (Arbeidstilsynet, n.d).

Cell offices can be more safe, controlled and quiet workplaces which gives better consentration without external noises. Other advantages of cell offices are; freedom of choise to opening or closening the door, more personal space to furnishing the room after own preferences and needs, individual adaptation of indoor temperature and climate, possibilities of having phone calls or video meetings without disturbing colleagues, and having confidential face to face conversations. Disadvantages with cell offices is less flexibility with regard to collaboration and alternative forms of work, less social and professional communication, glass walls facing corridors can cause auditoy and visual noise, and it can be experienced as more space consuming due to more corridor area (Arbeidstilsynet, n.d).

Open office landscape:
”Open office landscapes consist of workstations in open areas without complete partion walls.” The open landscapes can vary in size and the workstations are often arranged in rows or groups. Support rooms such as technical rooms with copiers and printers, warehouses and different sized meeting rooms are often directly connected to the open office landscape (Arbeidstilsynet, n.d).

One of the biggest challenges with open office landscapes is increased noise and more interruptions. This can often lead to less comminication and decreased individual work productivity. It is also more difficult to have intimate and personal conversations without everyone listening. Many often prefers home office solutions instead because of this. Some advantages with open landscapes are increased coperation and learning, faster training of new employees, more informal communication and sosial relationships. It often creates stronger group indentity and increased job satisfaction. Managers become more visible and accessible, which make employers feel closer to the management (SINTEF Byggforsk, 2001).

Activity-based workplaces:
Activity - based workplaces provide different workplaces and rooms which support different type of tasks. They allow employees to choose between different work zones and workplaces according to the tasks they are to solve. Activity based workplaces can consist of open areas, small or large meeting rooms, quiet zones, cell offices or project areas. The spaces should support various functions and employees usually dont have fixed seats (Arbeidstilsynet, n.d).

Some advantages with activity based workplaces are more flexibility and variation, opportunities for better communication and collaboration, opportunity to choose workplaces for different tasks and activities, and providing different zones for tranquility or interaction. Some disadvantages is less personal space, lack of belonging and miss of permanent workspace, worries about queues at the most popular workplaces, annd it can be more time consuming with rigging up and down at various worlplaces (Arbeidstilsynet, n.d).

Team offices:
Team offices have many common features with both cell offices and open landscapes. They are closed rooms intended for a limited group of people. The team offices are often located along the facades and are closed with partion walls and a doors from the corridor, other workplaces or a central area. The spaces usually have fixed and predictable seats. In comparrison with cell offices they provide better utilization of areas, and provide better coperation and communication between employees that shares offices. Some disadvantages is more noise, less personal space, less flexibility with regard to collaboration and alternative forms of work, and less opportunity for individual adaptation of physical conditions such as temperature (Arbeidstilsynet, n.d).

OFFICE TYPES - EXAMPLES

1. Open office landscape with some cell offices:

Fig 321. Office solution for the IT department in Telenor phone. Architects: Andersen & Flåte ANS interiørarkitekter (Sintef Byggforsk, 2001).

2. Team/ group room offices:

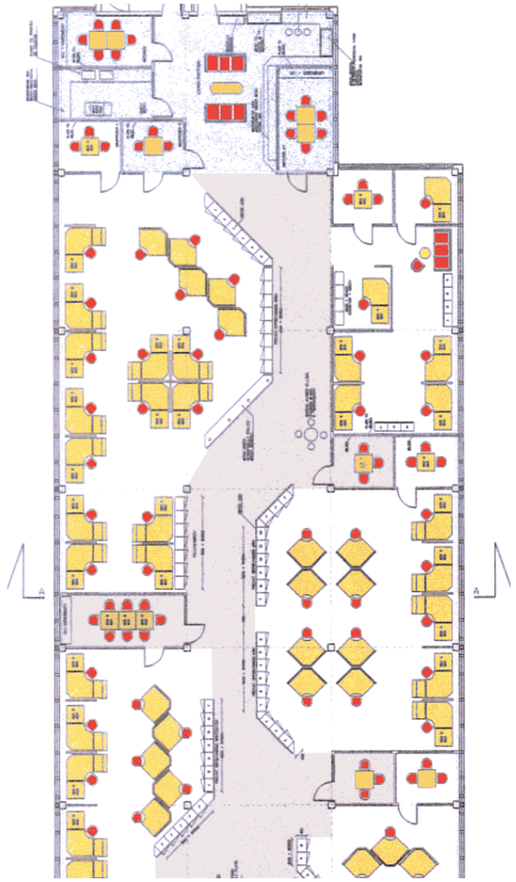


Fig 331. Office solution for the pilot project to Hydro Data. Interior Architect: Morten Kaels (Sintef Byggforsk, 2001)

3. Activity - based workplaces:

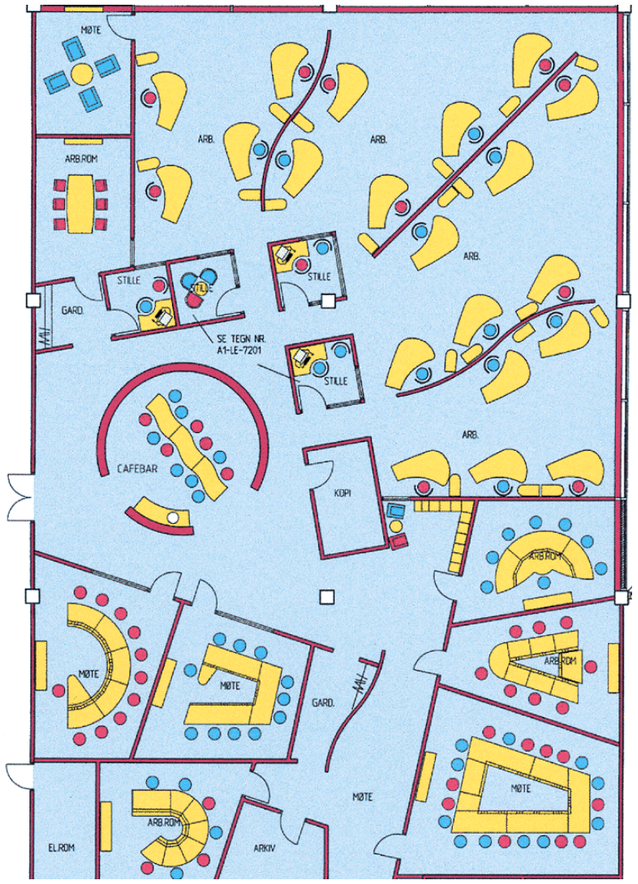


Fig 431. Office solution for the department of Group strategic development in Statoil. Architects: AROS AS & HRTB AS (Sintef Byggforsk, 2001)

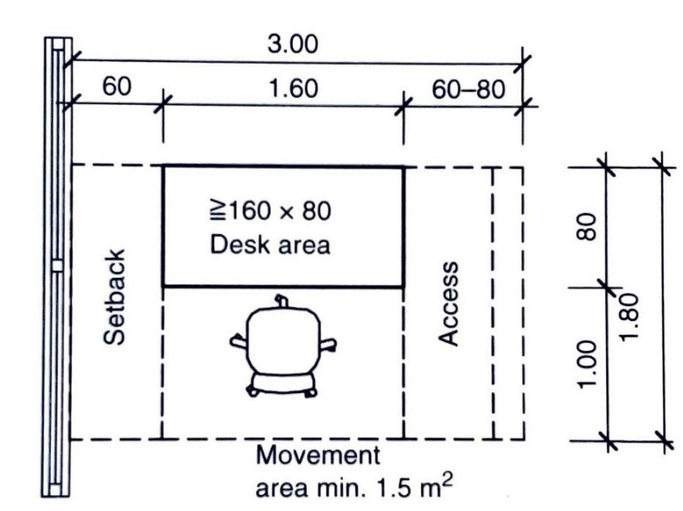
SPACE REQUIREMENTS IN OFFICES

”According to the new Workplace Regulations, there are no longer any fixed minimum dimenions for workplaces.” The standards require that workplaces have sufficient movement areas for changing positions at work. The free movement area should be at least 1,5 m2. The area should also be planned for the work area/tables, furniture such as shelfs, space required for doors and drawers, and for traffic and through-passages. ”The total space requirement per workstation varies between 23 and 45 m2, depending on organisational and status requirements” (Neufert, 2012, page 235 & 238).

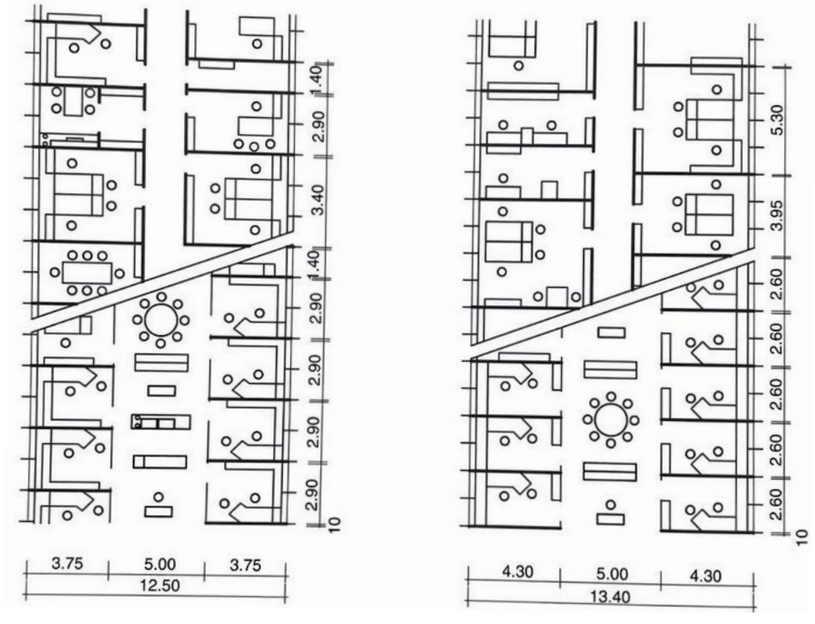
The room layout and building structure can have a huge influence on use. Buildings with a central corridor usually have a depth of 12-13 m. Reduction of area per workstation can gain efficiency. A workstation is defined as a work space that needs elements such as a computer screen and a keyboard to to undertake work (Neufert, 2012).

Spaces of columns and facades defines possible room sizes and grid module spacings. To enable the partitions to connect to the windows, the fitting out and facade grid must be the same. The space between the windows should be wide enough to allow for new partitions (Neufert, 2012).

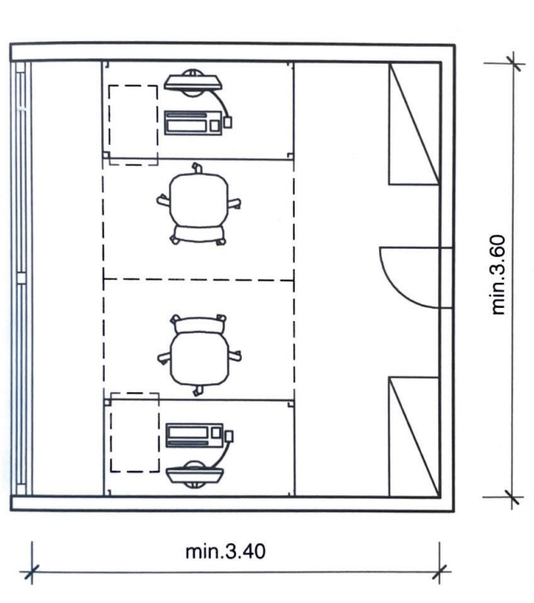
Office room sizes should be planned based on a grid module. A modular dimension of 1.5 m for single room offices and 1.35 m for combi offices, have been proved successful in recent years. Chosing an adaptable building module is recommended, because of different lifecycles of building parts. For single- room offices with some double workstations, the modular dimension of 1.5 m is the most economical module dimension. With a modular dimension of 1.35 m the room widths are 3.80 m. This offers high flexibility of use without moving partitions, because it can fit most usual workstations (Neufert, 2012).



Minimum space requirement for a single workstation (Neufert, 2012).

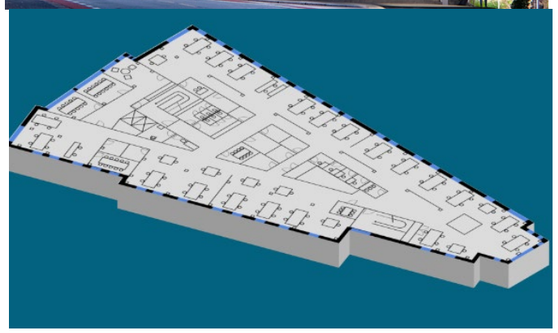


Example of grid module 1.5 m with a building depth of 12.5 m, and a grid module of 1.35 m with a building depth of 13.40 (Neufert, 2012).



Example of double office with wall-oriented workstations (Neufert, 2012).

OFFICE BUILDINGS - EXAMPLES



Images of Krohnen (AG& GC Rieber Eiendom, 2024)

Krohnen:

Krohnen is a new office building that is currently beeing built in Solheimsviken in Bergen. The project is by AG & GC Rieber Eiendom. The floor plans has not been finalized yet, because future tenant 's wishes and needs will influence the office design. But there is some proposals for floor layouts (AG & GC Rieber Eiendom, 2024).

The first proposal is by AG & GC Rieber Eiendom. The floor plan shows the 4th floor. It has a open landscape design, with meeting and silent rooms in the center of the floor. This floor is designed for 70-80 people. It has 3 meeting rooms, 6 silent rooms, and 2 toilets.

The other floor plan proposal is by HLM Arkitektur. This is a flexible floor plan layout with both open landscape and cell offices. This will be investigated more, because it contains functions and room layouts that is wanted to integrate in this project. The cell offices are sized 2.3 m x 4 m and have 9.2 m2 userarea. Each cell office has a window size of 2.25 m. The open office landscape in the corner to the east is 140 m2 and consist of 5 workstations with 6 spaces for people per workstation. This means 30 people can work in a space of 140 m2. tThe meeting rooms are plazed in the center, and does not have sufficient access to daylight. One meeting room is 25.4 m2 and the other is 17.8 m2

Krohnen floor plan proposal (HLM Arkitektur, 2024).

Midtbygget Kronstadparken:

Midtbygget is a competition proposal for a new commercial building in Kronstadparken in Bergen. The proposal is designed by Arkitektgruppen Cubus AS. The building has 17 400 m2 and offers cell offices, restaurants, meeting rooms and a auditorium (Arkitektgruppen Cubus AS, 2019).

This office proposal is chosen as a precedent study, because it contains many of the same functions and room layouts that was wanted to integrate in this project.

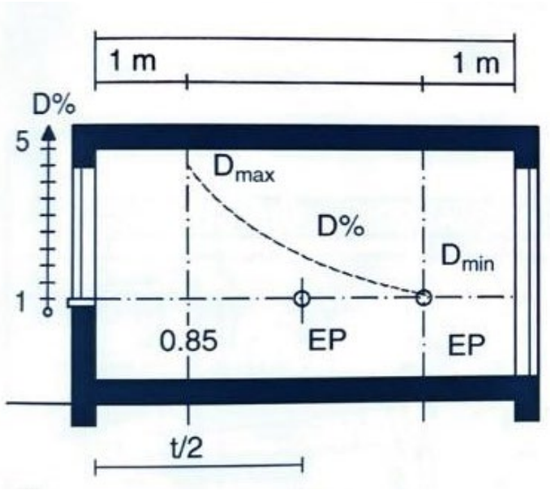
The floor plan to the left shows 2nd floor in the building. It contains cell offices along the facades and mostly meeting rooms in the center parts of the floor plan. The west part of the floor plan is beeing investigated more. This part has 27 cell offices, 4 meetings room, 2 copy rooms, 2 small kitchens and a sozial zone. The toilets and staircases are placed in the center. The cell offices here are mostly sized 2.6m x 2.6m, and have 6.76 m2 userarea. Each cell office has a window size of either 2.1 m or 1.2 m. The corridors are 2m or 1.5 m wide. The meeting rooms have different sizes, some are 13.3 m2, 22.5 m2, or 6.08 m2. They are placed in the center between the cell offices, and does not have sufficient access to daylight.

Midtbygget floor plan proposal (Arkitektgruppen Cubus AS, 2019).

DAYLIGHT & LIGHTING

According to the state building regulations and Workplace Guidlines, all rooms should be lit with sufficient daylight when there is a permanent human occupation. A visual connection with the outside should also be present (Neufert, 2012).

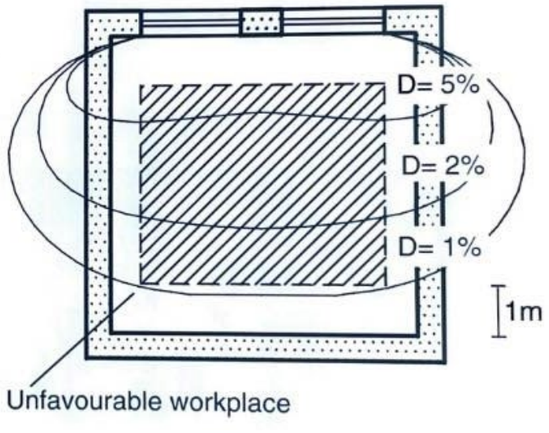
Good light conditions is crucial in workspaces, and also for human`s health and well-being. Tek 17, point 2 under § 13-7. Lys, "states that rooms for permanent use must have satisfactory access to daylight". According to TEK 17 the minimum average daylight factor must be 2 % in rooms for permanent use. Daylight factor indicates how much light there is inside of a room under overcast sky. The amount of daylight can be determined by factors such as; the location of windows and area, room depth and height, screening from other buildings and terrain, and reflection properties of different surfaces in the room (Direktoratet for byggkvalitet, 2017).



Daylight factor D with reference plane in section (Neufert, 2012).

Daylight factor D is meassured by daylight entering a room through a window at the side. It is always constant because is it meassured under overcast sky. "The daylight in interiors is always given in per cent". The aim is to have a room with optimal controlled daylight lighting, no glare, view out at all times, reduzed artificial lighting components, differentiated shadowing, and a balanced lighting environment at day and night (Neufert, 2012).

Glare can be avoided by providing external sun protection/ shades, matt surfaces, glare protection on both inside and outside, and correct positioning of daylight-enhancing lighting. Use of luminaires with shading angles of 30 degrees can help limit direct glare (Neufert, 2012).

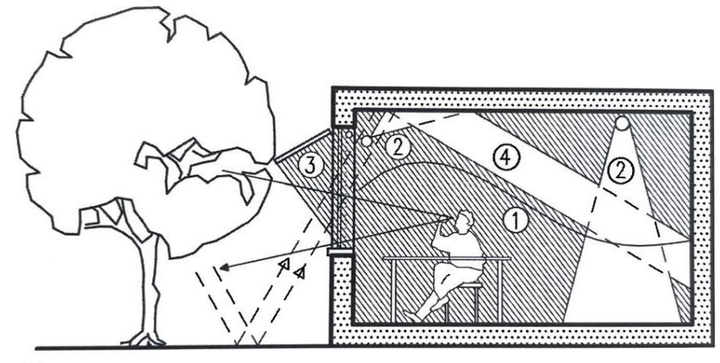


Daylight distribution D% on a plan with two side windows (Neufert, 2012).

In addition to daylight from windows, artificial lighting is needed in workspaces. Artificial lighting consists of a lamp and fitting. Various levels of illuminance is required to fulfill certain visual tasks and different types of activities. Illuminance is the amount of light falling on a surface. In offices with visual tasks with high demand, illuminance value should be between 500 - 1000. In meeting rooms, workrooms, and rooms with public access and traffic zones, it is preferred to have direct symmetrical lighting. In meeting rooms the shading angle of the light fittiings should be 30 degrees (Neufert, 2012).

Recommended illuminance			Area, activity
20	30	50	paths and working areas outdoors
50	100	150	orientation in rooms with short occupancy
100	150	200	workrooms not used constantly
200	300	500	visual tasks with few demands
300	500	750	visual tasks with medium demands
500	750	1000	visual tasks with high demands, e.g. office work
750	100	1500	visual tasks with high demands, e.g. fine assembly
1000	1500	2000	visual tasks with very high demands, e.g. checking activities
	over	2000	additional lighting for difficult and special visual tasks

Recommended illuminance values, Commission International de l`Eclairage (Neufert, 2012).

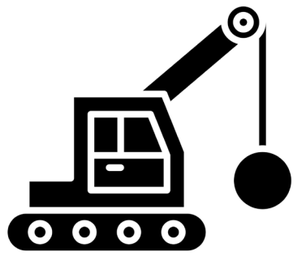


1 Control of daylight and artificial lighting: 1, daylight pattern D%; 2, daylight-enhancing lighting; 3, prevention of glare; 4, reflecting surface

Control of daylight and artificial lighting (Neufert, 2012).

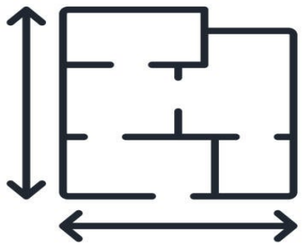
CONCEPT DEVELOPMENT
&
DESIGN CHOICES

PROJECT STRATEGIES

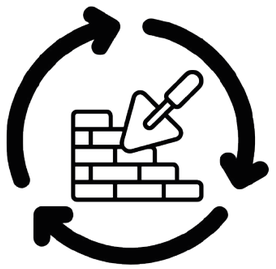


Minimize demolition and keep as much as possible of the existing building structure and interior walls to save emissions, and investigate the building`s flexibility.

Keep existing facade materials & use simular materials for the 5th floor to save emissions.



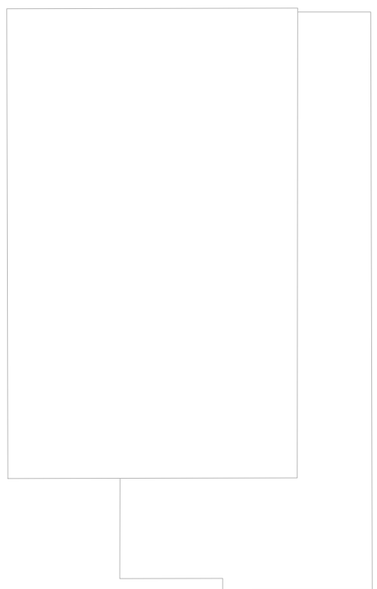
Have a flexible design & check the existing building`s flexibility towards changing functions.



Remove & Reuse walls for the 5th floor to save emissions.

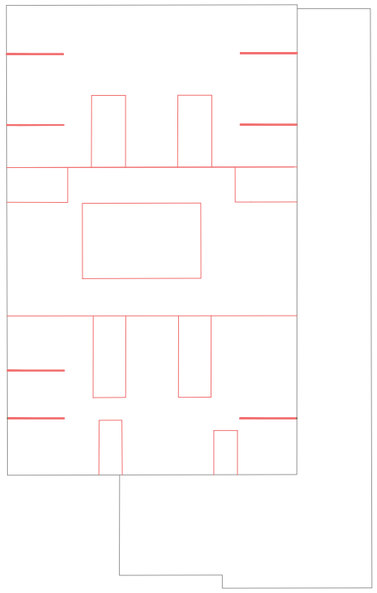
CONCEPT DEVELOPMENT - DESIGN CHOICES

U1 AND 1,5 FLOOR



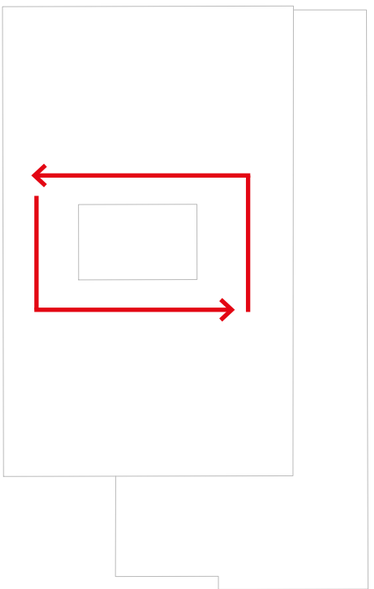
Keep existing U1 basement and floor 1,5 the same, bacause of existing limitations.

STRUCTURE & LAYOUT



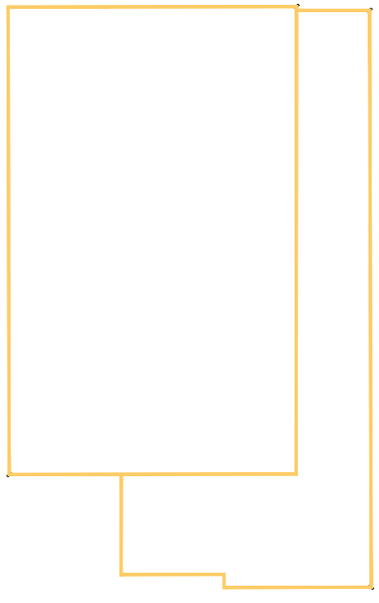
Keep as much of existing structure, internal floor layout, vertical connections and technical rooms as possible.

CIRCULATION



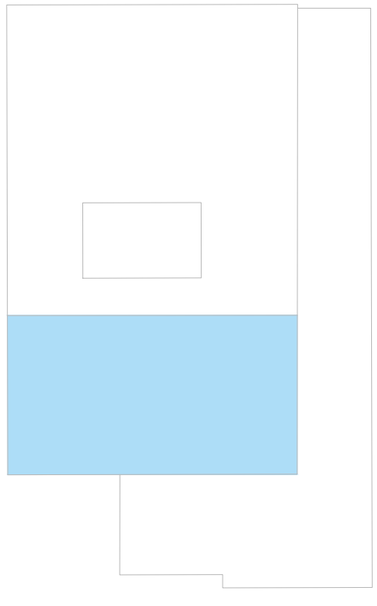
Keep circulation/ people movement around the atrium open on all floors.

EXISTING FACADE



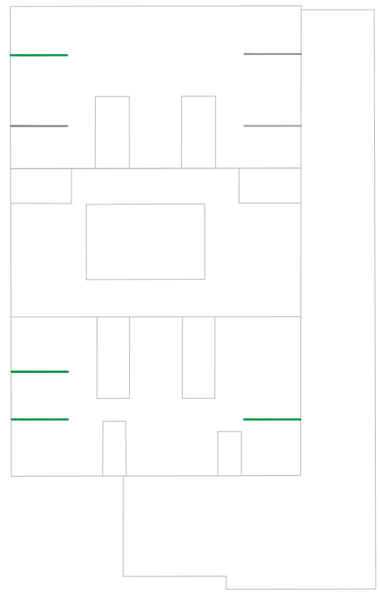
Keep the existing facades of the building, because they are relatively new.

ADDING A 5TH FLOOR



Adding an additional 5th floor to the existing building.

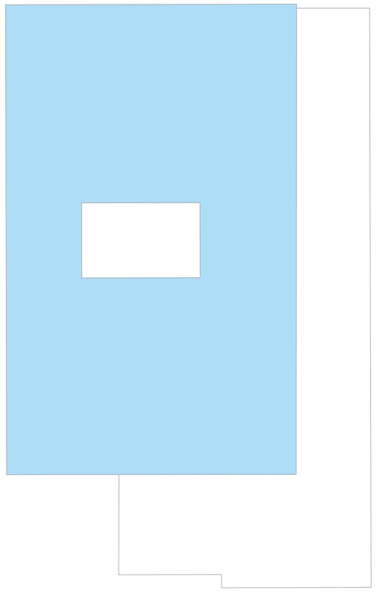
RE-USE OF WALLS



Remove and re-use some of the existing walls in 3rd and 4th floor to the new 5th floor.

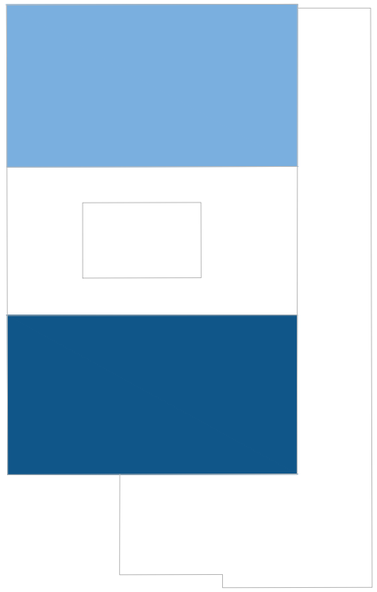
CONCEPT DEVELOPMENT - ONE OR MULTIPLE OFFICE SPACES

3RD & 4TH FLOOR:



OPTION 1:

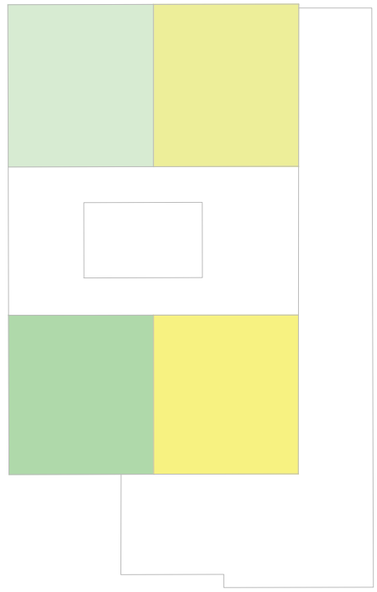
One office space to rent out to one single company.



OPTION 2:

Two possible office spaces to rent out to multiple companies.

Option 2 was chosen because it could provide larger spaces to rentout and provide better office layouts.

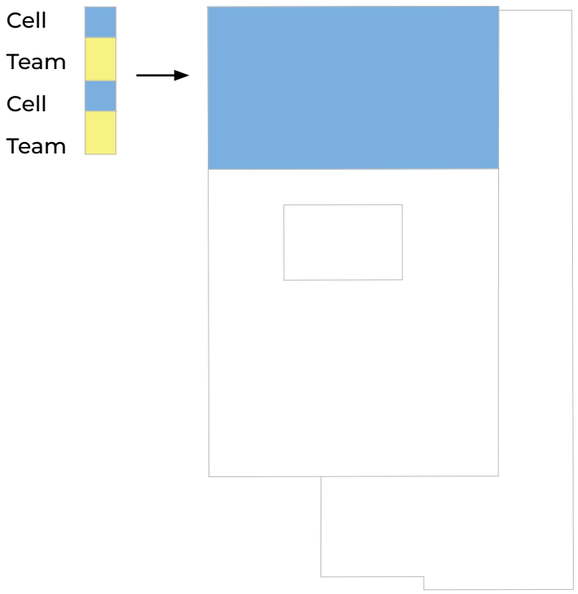


OPTION 3:

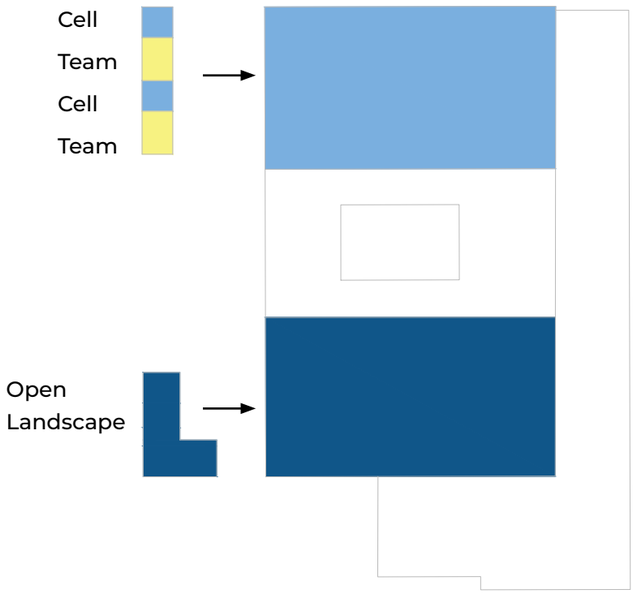
Four possible office spaces to rent out to multiple companies.

CONCEPT DEVELOPMENT - OFFICE LAYOUT

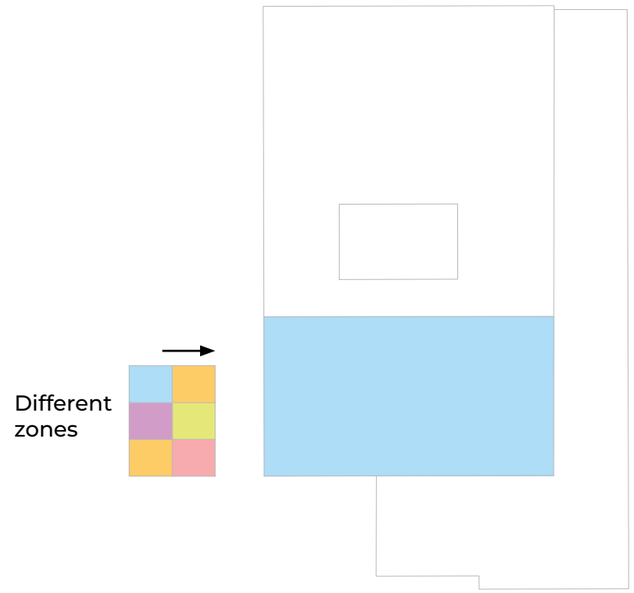
2ND FLOOR



3RD & 4TH FLOOR



5TH FLOOR



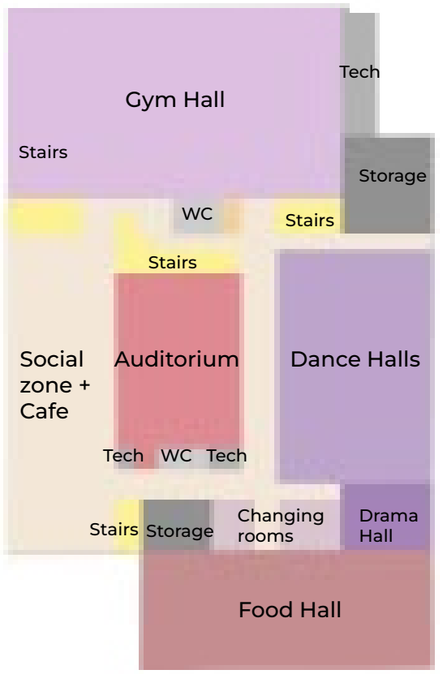
Cell & team office

Landscape office

Activity-based office

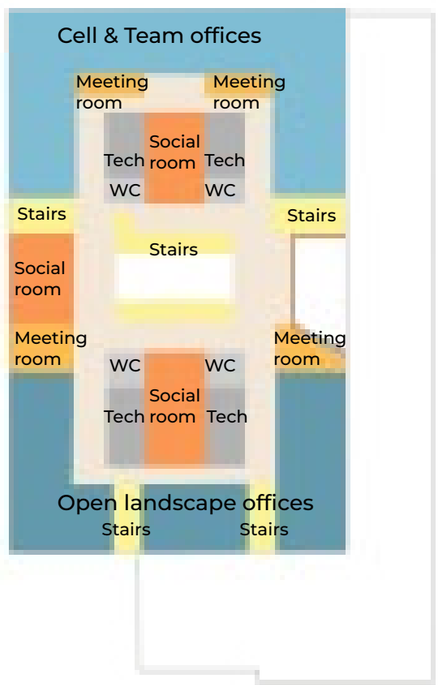
CONCEPT DEVELOPMENT - DETAILED FUNCTIONS

1ST FLOOR



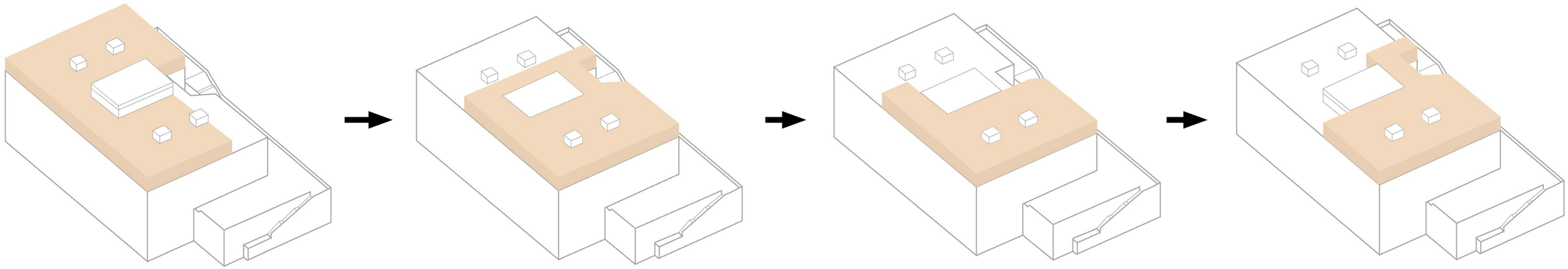
2ND FLOOR

3RD FLOOR



5TH FLOOR - SHAPE OPTIONS

SHAPE DEVELOPEMENT:



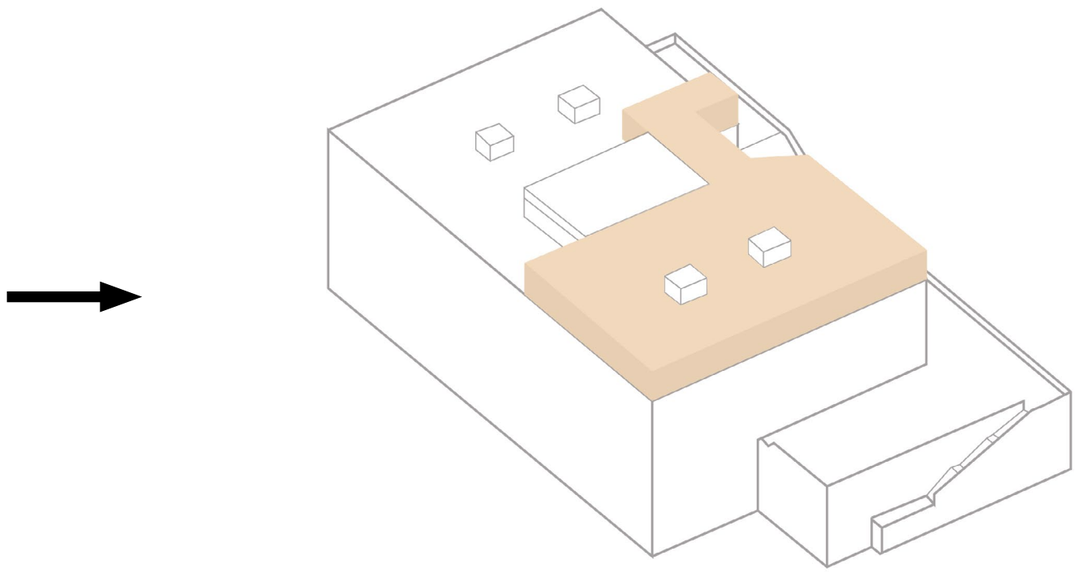
Without any consideration to structural limitations this shape was considered the most optimal shape, because the roof terrace was protected from wind and noise. The shape also provides larger user area for offices and PV panels on the roof.

It was not possible to build on top of the entire gym hall on the roof, because of the structural span properties. This new shape was considered, but would not give much efficient and usable space inside. It would also block much of the daylight in the atrium.

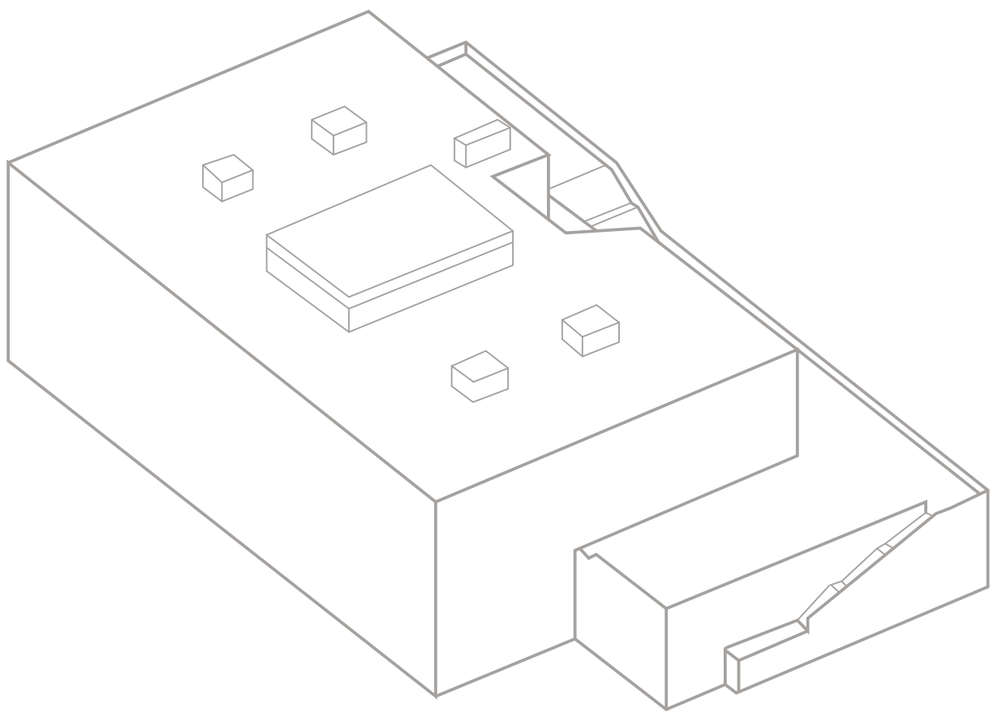
A new shape was made to get more daylight from two sides into the atrium. It provides a relatively large space for offices. The shape did not work as well with the circulation, stairs and elevator on the inside.

This shape allows for optimal daylilght into the atrium from two sides. The circulation flows better, and the stairs and elevator fits well in. The space was maximized as much as possible to provide larger user area for the offices.

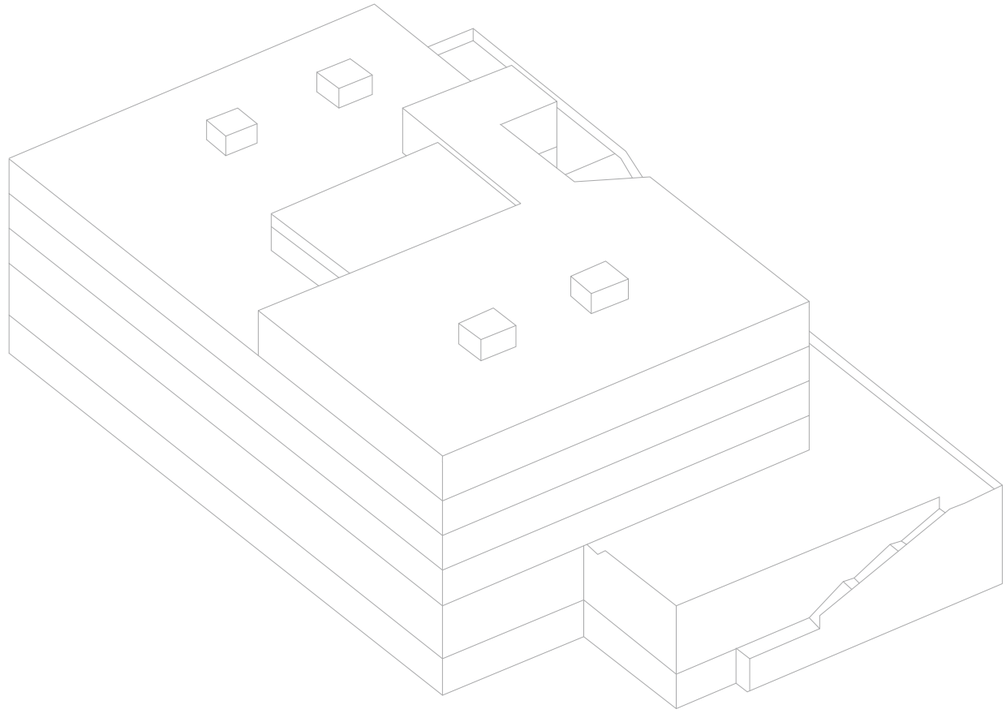
FINAL SHAPE :



FINAL BUILDING SHAPE



EXISTING SHAPE



FINAL SHAPE

DESIGN CHOICES

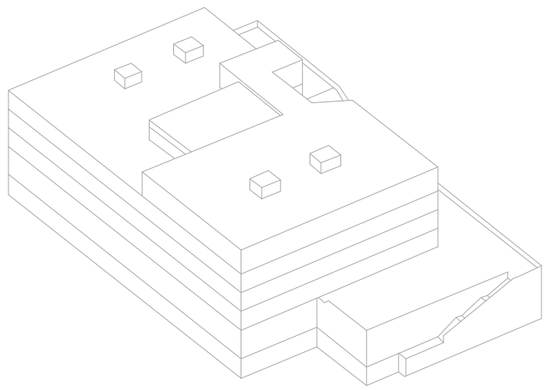
DESIGN STRATEGY:

The overall strategy of this design project was to keep as much as possible of the existing building structure and interior walls, and design with the existing building layout. This strategy was chosen to minimize demolition and lower C02 emissions. It was also a strategy to check how flexible the existing building layout was. According to ”Sintef byggforsk, 2004” the term flexibility means the ability to change the building to meet changing functional requirements. By keeping as much as possible of the existing building, it is possible to check if the existing building layout would meet functional requirements for different types of office spaces. An important part of the design choices was to design different types of office spaces. Office types such as cell offices, team offices, landscape offices and activity-based offices were integrated into the design, to check how well the existing building fits different types of office spaces and requirements.

The floor plans for basement U1 and mezzanine 1.5 are not shown in the final design and in this project, because they remain the same as they are today. At an early stage of the project it was decided to keep the floor plans the way they are. The reason for this was the lack of flexibility in changing the floor plans for other functions, because of the existing concrete structure and interior walls. See existing floor plans for U1 and 1.5 on page 9.

1ST FLOOR:

1st floor mainly has the same functions and layout as before. The food hall, cafe, activity halls and changing rooms are the only functions that have changed. In Cissi Klein vgs the space where the food hall is now used to be a workshop space and the changing rooms used to be group rooms and changing rooms for the workshop. The activity halls used to be dance halls only. The new changing rooms were made to be closer to the activity halls etc. All the existing changing rooms are in the basement U1. One reason for keeping many of the existing functions and the layout is because of the large floor height and concrete structure. This floor height of 7.2 m makes it perfect for activity halls, dance halls, a drama hall and a food hall. The building structure of concrete makes it difficult to make large changes to the existing gym hall and auditorium, so therefore it was decided that this should be kept. The food hall and cafe are right at the entrance to attract more people. 1st floor is meant to be a public space that is open from morning to evening, where some spaces can be rented out for dance or yoga classes for example.



2ND FLOOR:

2nd floor mainly has the same building layout and structure as before, but many of the functions have changed. The kitchen and cantina remain the same as before. It was decided that most of the floor should be public and the part in the north should be a private space for office rent out. The reason for this is because the parts in the south are connected to the public roof terrace and cantina, and is therefore a nice space that attracts more people. It was decided to have a restaurant next to the cantina and the roof terrace so that people could choose between the cantina or restaurant and have the opportunity to sit outside and enjoy the food on the roof terrace as well. Next to the restaurant is a public library with a study room and computer room connected to it. The library would also be a space that attracts more people. All the public spaces on this floor would be open from morning to evening. In the northern part of the floor, there were already designed some office spaces and silent rooms in Cissi Klein vgs. It was decided to keep as many of these spaces as possible because they could fit well with a cell office layout.

DESIGN CHOICES

3RD & 4TH FLOOR:

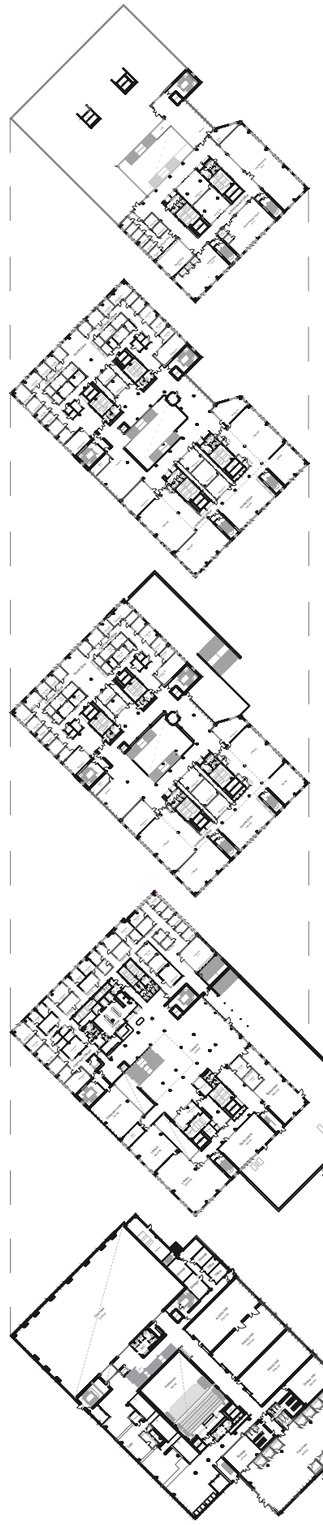
3rd and 4th floors almost have the same floor plan layout, the same functions and a floor height of 4.2 m. The new layout was decided based on the existing atrium in the middle of the floor and the placement of technical rooms. It was decided to keep the circulation free around the atrium, and have two office spaces for rentout, one on each side of the building. In the north there are cell and team offices, and in the south a landscape office. This was chosen to allow for the rentout of different office spaces and to check how the existing building layout functions with different office types.

On each side of the building, there are two ventilation aggregates and also ventilation shafts. These take up much of the space in the center of the floor but also allow for easier division of spaces around them. In the space between these technical rooms, it was decided to have meeting rooms. This space does not have sufficient access to daylight, and therefore no permanent workspaces could be here.

In the northern part, there are cell and team offices, and some meeting rooms placed along the facades to get sufficient daylight. Most of these spaces have new walls because the existing layout would not work. The sizes of these spaces were compared with other office projects and minimum office room requirements. The existing facade and window layout made it difficult to work with a specific grid and therefore some of the spaces had more challenges. The window layout is different in 3rd and 4th floor.

In the center of the cell and team offices, there are group rooms, silent rooms and meeting rooms. In Cissi Klein vgs some of these rooms were already implemented. It was decided to keep as much as possible of the existing layout and interior walls. This would also make it easier to keep the existing ventilation systems here.

In the southern part, there are landscape offices. Some of the existing walls here were taken away to allow for a more open office landscape. It was decided to reuse some of these walls for the 5th floor.



5TH FLOOR

4TH FLOOR

3RD FLOOR

2ND FLOOR

1ST FLOOR

DESIGN CHOICES

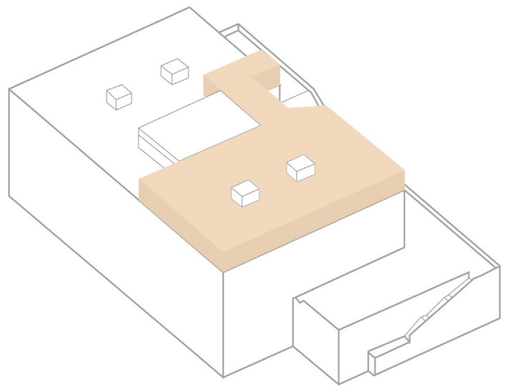
5TH FLOOR:

5th floor is a completely new floor added to the building. The existing structural system in Cissi Klein allowed for an extension on the roof level. Trøndelag fylkeskommune had an interest in adding a 5th floor to this project. It was therefore decided to make a 5th floor to see how flexible the building was for making an extension on the roof. Early in the project different shapes were considered, but it was not possible to build on top of the entire gym hall on the roof. This had a huge influence on the design. The new shape for the 5th floor was designed to give optimal daylight in the atrium and maximize space for activity -based offices.

The floor layout is almost the same as the 3rd and 4th floors because the stairs and technical rooms had to be in the same place. By having a similar floor plan layout it becomes clearer and easier to understand.

The 5th floor was designed for an activity-based office. An activity-based office gives people the opportunity to choose between different types of workspaces for different types of activities. The layout on the 5th floor therefore provides different zones for different activities. It has a creative zone, a communication zone, a silent zone, and a private zone. The private zone has closed cell offices and group rooms. The creative zone is a space for collaborative creative workshops. The communication zone is a laud space where people can work and collaborate together. The silent zone is a space for doing individual work in silence. In the center of the floor, there are meeting rooms and technical rooms. The circulation flows around the central functions.

On the 5th floor, it is also possible to go outside to a roof terrace. This space is public. On the northern part of the roof, there are PV panels and shafts for ventilation.



The materials for the new facade on the 5th floor are supposed to be the same or similar materials to the existing building. It can be assumed that these materials or similar materials will exist in the next 50 years. The window layout is the same as the 3rd floor to make the facade more interesting. The reason for keeping the facade materials similar is to make the 5th floor extension fit well in with the existing building facade. It was a design choice to make it look like it was always there.

Another reason for having the same materials was because of life cycle emissions. The existing facade materials of Cissi Klein vgs was selected as the best materials after a life cycle analysis. The 5th floor should therefore also have similar materials.

FINAL DESIGN

BUILDING`S USER SPACE

1ST FLOOR

ROOM PROGRAM	NUMBER	AREA m2	PERCENTAGE
FOOD HALL	1	636	14,42 %
CAFE	1	340,1	7,71 %
AUDITORIUM	1	340	7,71 %
DRAMA HALL	1	108,7	2,46 %
DANCE HALL	1	218,3	4,95 %
ACTIVITY HALL	2	436,6	9,90 %
GYM HALL	1	1138	25,80 %
OFFICE	2	31,2	0,70 %
KITCHEN	1	15,3	0,34 %
TECHNICAL ROOM	4	100,3	2,27 %
CHANGING ROOM	2	78,3	1,77 %
STORAGE	5	154,2	3,49 %
WC ROOM	5	62,3	1,41 %
CORRIDOR		750	17 %
TOTAL	27	4409,3	99,93 %

2ND FLOOR

ROOM PROGRAM	NUMBER	AREA m2	PERCENTAGE
LIBRARY OFFICE	1	22,9	0,68 %
CELL OFFICE	11	122,5	3,65 %
TEAM OFFICE	8	149,14	4,44 %
MEETING ROOM	6	153,65	4,57 %
GROUP ROOM	5	91,75	2,73 %
SILENT ROOM	8	61,12	1,82 %
COPY ROOM	2	47,3	1,40 %
SOCIAL ZONE	1	60	1,78 %
CANTINA	1	730	21,75 %
KITCHEN	2	115	3,42 %
RECEPTION	1	11,3	0,33 %
RESTAURANT	1	164,7	4,90 %
LIBRARY	1	317,3	9,45 %
COMPUTER ROOM	1	131	3,90 %
STUDY SPACE	1	133	3,96 %
COLD STORAGE	4	26,4	0,78 %
STORAGE	4	86,41	2,57 %
TECHNICAL ROOM	10	160,7	4,78 %
WC	6	61,2	1,82 %
CORRIDOR		709,97	21,15 %
TOTAL	74	3355,34	99,88 %

3RD FLOOR

ROOM PROGRAM	NUMBER	AREA m2	PERCENTAGE
CELL OFFICE	8	84,78	2,93 %
TEAM OFFICE	9	134,37	4,65 %
MEETING ROOM	11	359,35	12,45 %
GROUP ROOM	5	66,28	2,29 %
SILENT ROOM	17	78,88	2,73 %
COPY ROOM	2	28	0,97 %
SOCIAL ZONE	2	231,4	8,01 %
LANDSCAPE OFFICE	1	492	17,04 %
RECEPTION	1	91,1	3,15 %
ADMIN	1	19	0,65 %
WC	6	62,77	2,17 %
TECHNICAL ROOM	8	163,3	5,65 %
CORRIDOR		1074,6	37,23 %
TOTAL	71	2885,83	99,92 %

4TH FLOOR

ROOM PROGRAM	NUMBER	AREA m2	PERCENTAGE
CELL OFFICE	8	86,9	3 %
TEAM OFFICE	9	136,08	4,70 %
MEETING ROOM	11	359,35	12,43 %
GROUP ROOM	5	66,28	2,29 %
SILENT ROOM	17	78,88	2,72 %
COPY ROOM	2	28	0,96 %
SOCIAL ZONE	2	231,4	8 %
LANDSCAPE OFFICE	1	492	17,02 %
RECEPTION	1	91,1	3,15 %
ADMIN	1	19	0,65 %
WC	6	62,77	2,17 %
TECHNICAL ROOM	8	163,3	5,65 %
CORRIDOR		1074,6	37,18 %
TOTAL	71	2889,66	100 %

5TH FLOOR

ROOM PROGRAM	NUMBER	AREA m2	PERCENTAGE
CELL OFFICE	6	47,74	3,21 %
MEETING ROOM	2	123,3	8,29 %
GROUP ROOM	2	23,4	1,57 %
SILENT ROOM	5	21,57	1,45 %
SOCIAL ZONE	1	65	4,37 %
SILENT ZONE	1	124	8,34 %
COMMUNICATION ZONE	1	128	8,61 %
CREATIVE ZONE	1	253	17,02 %
RECEPTION	1	98,5	6,62 %
ADMIN	1	23	1,54 %
WC	2	35,36	2,37 %
TECHNICAL ROOM	6	107,5	7,23 %
CORRIDOR		435,45	29,30 %
TOTAL	29	1485,82	99,92 %

VERTICAL COMMUNICATION & MAIN CIRCULATION

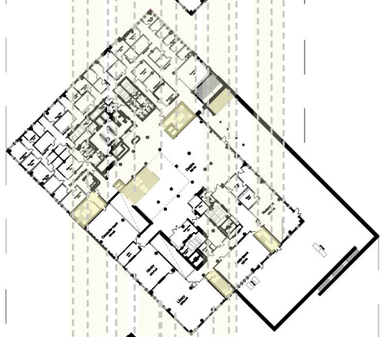
VERTICAL COMMUNICATION:

5TH FLOOR

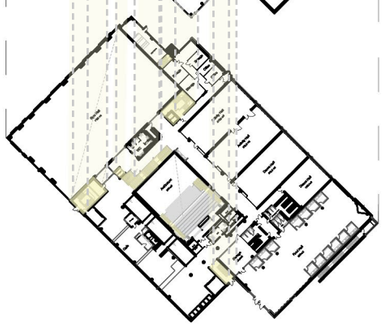
4TH FLOOR

3RD FLOOR

2ND FLOOR

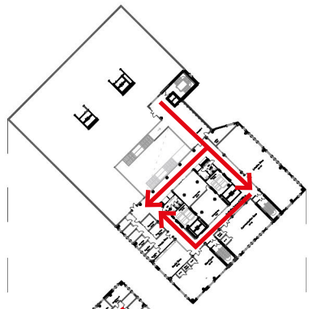


1ST FLOOR

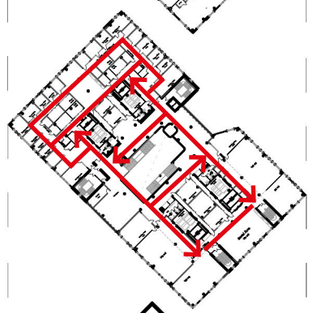


MAIN CIRCULATION:

5TH FLOOR



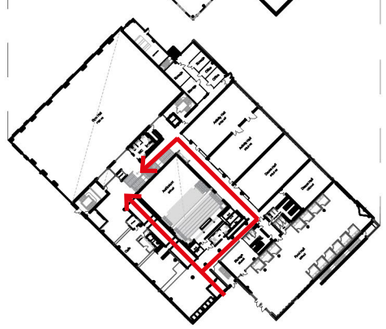
4TH FLOOR



3RD FLOOR

2ND FLOOR

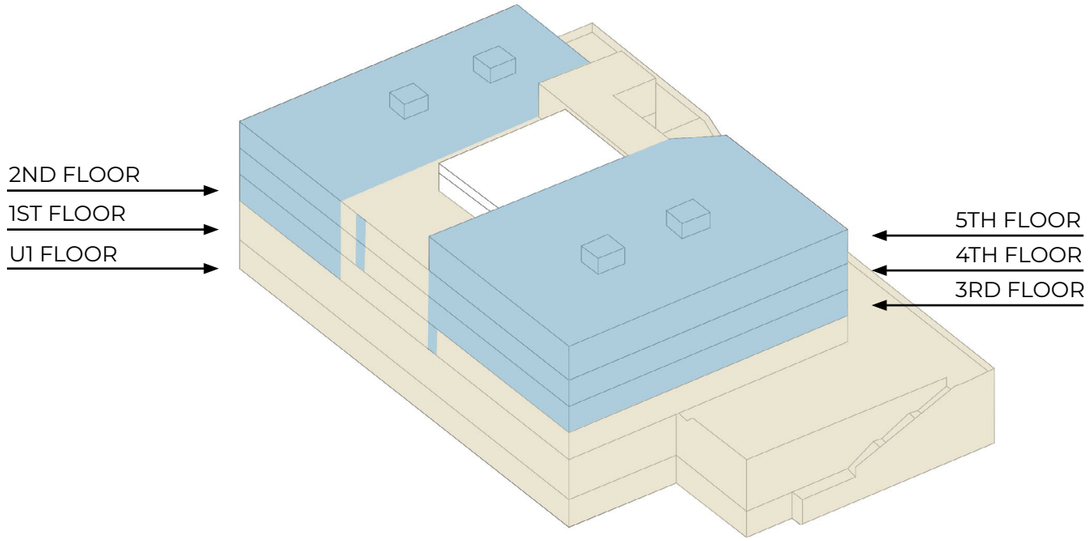
1ST FLOOR



SCALE: 1 TO 1800

PUBLIC & PRIVATE FUNCTIONS

BUILDING DIAGRAM:



PUBLIC

PRIVATE

PUBLIC & PRIVATE FUNCTIONS:

FUNCTIONS

FUNCTIONS:

- ROOF TERRACE
- ACTIVITY - BASED OFFICE
- ADMINISTRATION
- LANDSCAPE OFFICE
- CELL & TEAM OFFICES
- OTHER OFFICES
- VERTICAL COMMUNICATION
- STUDY SPACE
- LIBRARY
- COMPUTER ROOM
- STORAGE
- TECHNICAL ROOMS & WC
- COMMON SPACES & CORRIDORS
- CANTINA
- CAFE
- CHANGING ROOMS
- PUBLIC MEETING ROOMS
- KITCHEN
- RESTAURANT
- GYM HALL
- ACTIVITY HALL
- DANCE HALL
- DRAMA HALL
- FOOD HALL
- AUDITORIUM

5TH FLOOR

ACTIVITY - BASED OFFICE:
- Creative zone
- Communication zone
- Silent zone
- Private zone
- 2 Meeting rooms
- 5 Silent rooms

4TH FLOOR

CELL & TEAM OFFICES:
- 8 Cell offices
- 9 Team offices
- 6 Meeting rooms
- 5 Group rooms
- 12 Silent rooms
- 2 Copy rooms
- 1 Social zone

LANDSCAPE OFFICE:
- Open landscape office space
- 1 Social zone
- 5 Meeting rooms
- 5 Silent rooms

3RD FLOOR

CELL & TEAM OFFICES:
- 8 Cell offices
- 9 Team offices
- 6 Meeting rooms
- 5 Group rooms
- 12 Silent rooms
- 2 Copy rooms
- 1 Social zone

LANDSCAPE OFFICE:
- Open landscape office space
- 1 Social zone
- 5 Meeting rooms
- 5 Silent rooms

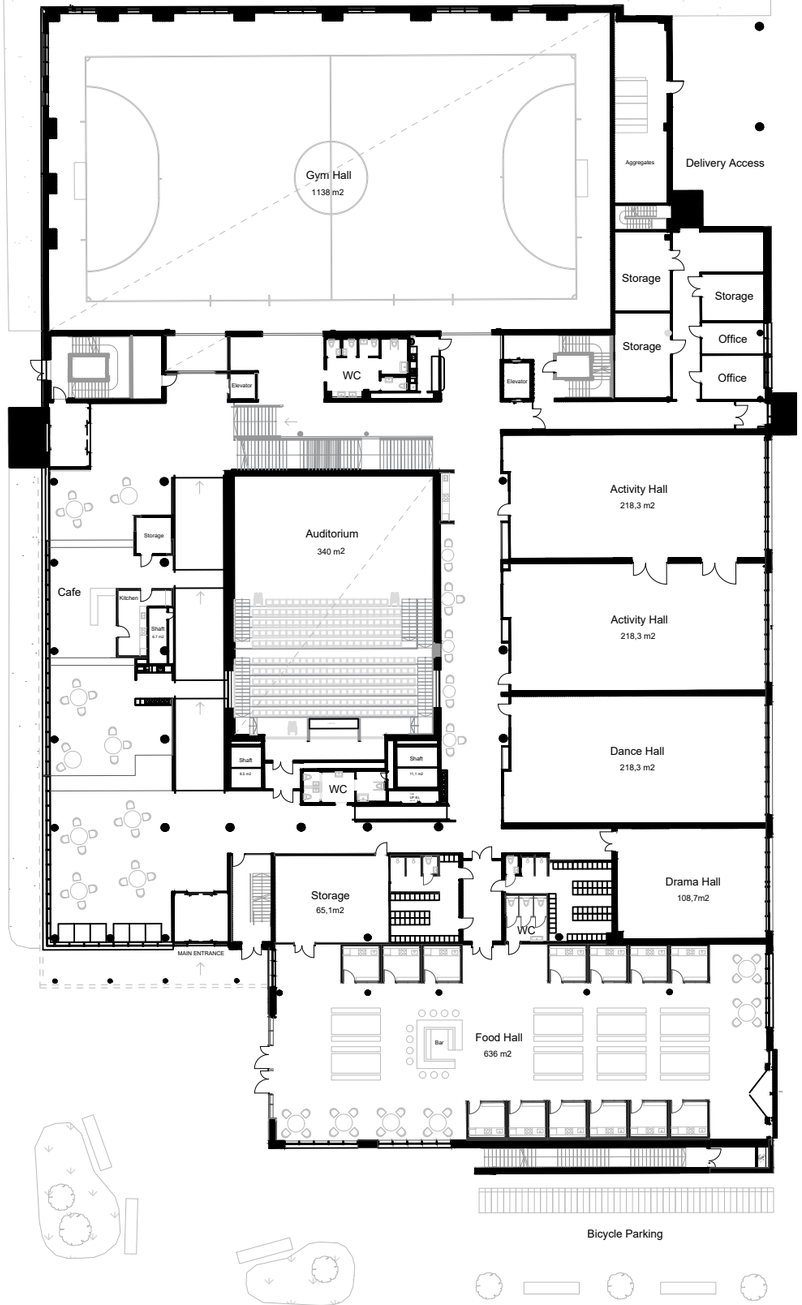
2ND FLOOR

CELL & TEAM OFFICES:
- 11 Cell offices
- 8 Team offices
- 4 Meeting rooms
- 5 Group rooms
- 8 Silent rooms
- 2 Copy rooms
- 1 Social zone

1ST FLOOR

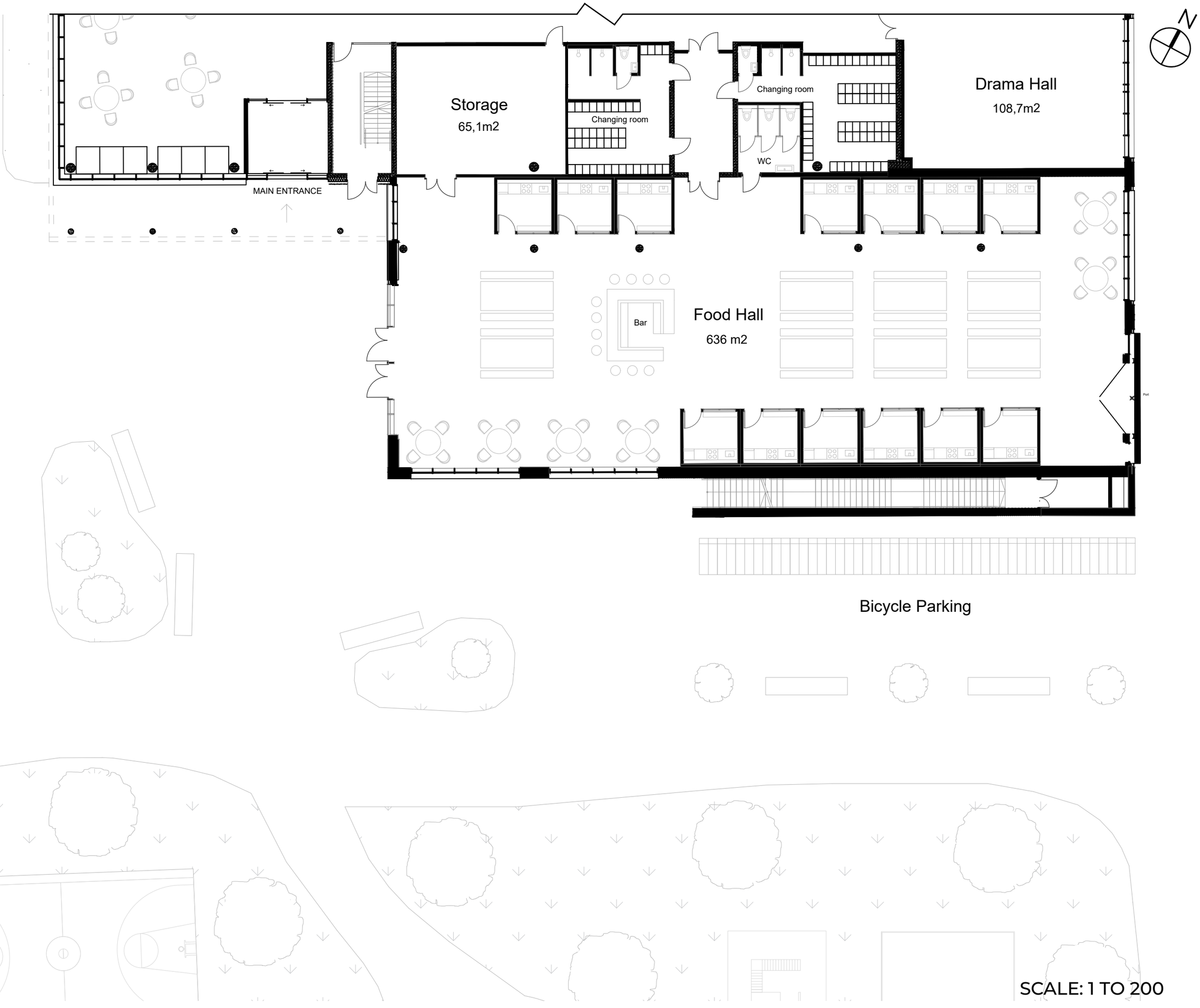
SCALE: 1 TO 1800

1ST FLOOR



SCALE: 1 TO 500

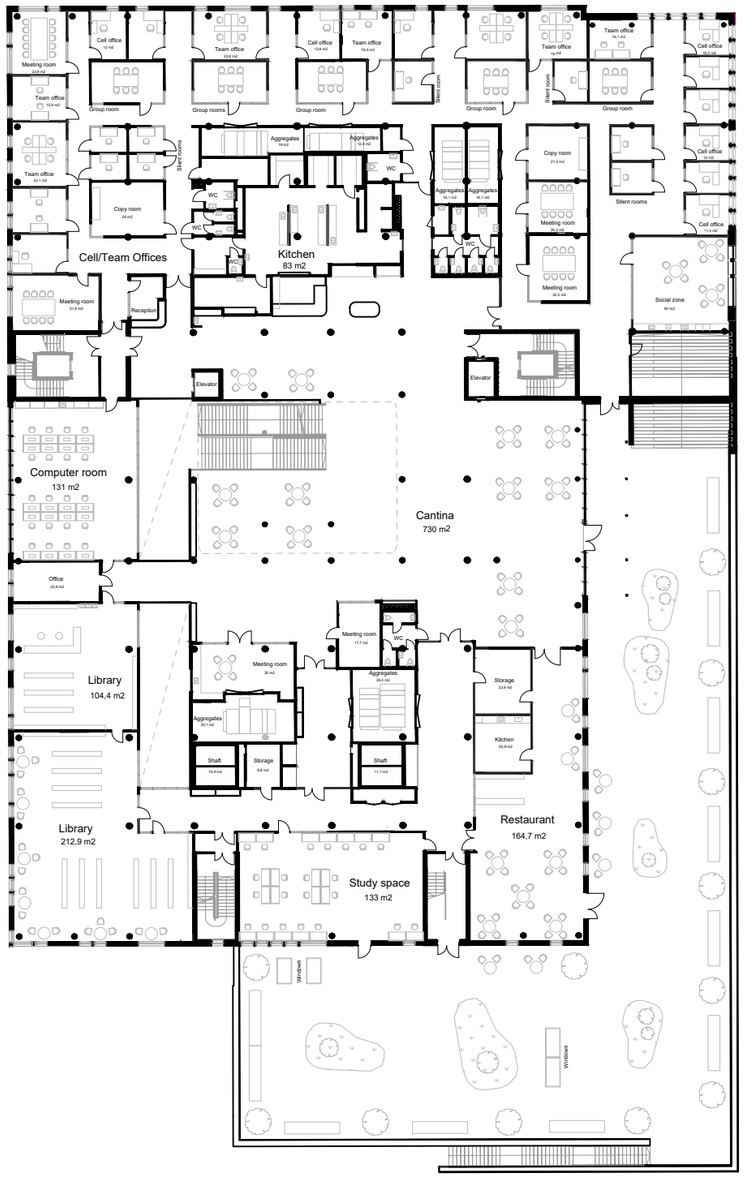
MAIN ENTRANCE



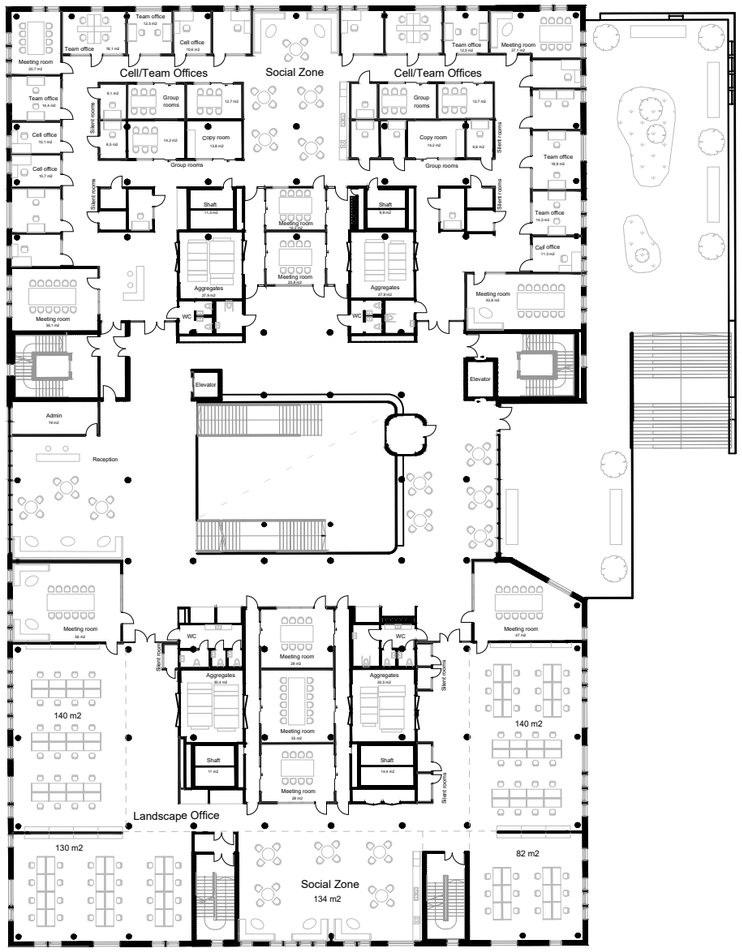
SCALE: 1 TO 200

2ND & 3RD FLOOR

2ND FLOOR



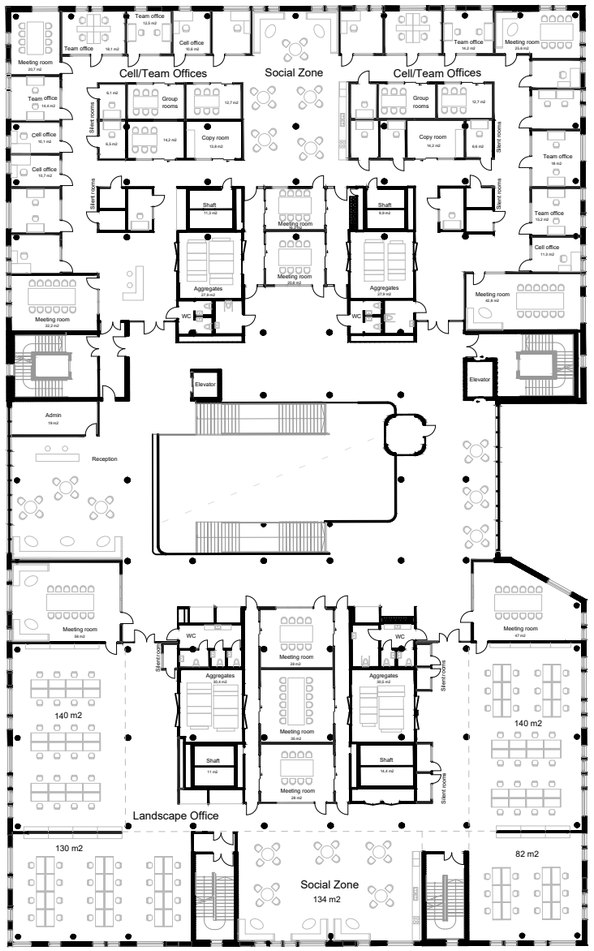
3RD FLOOR



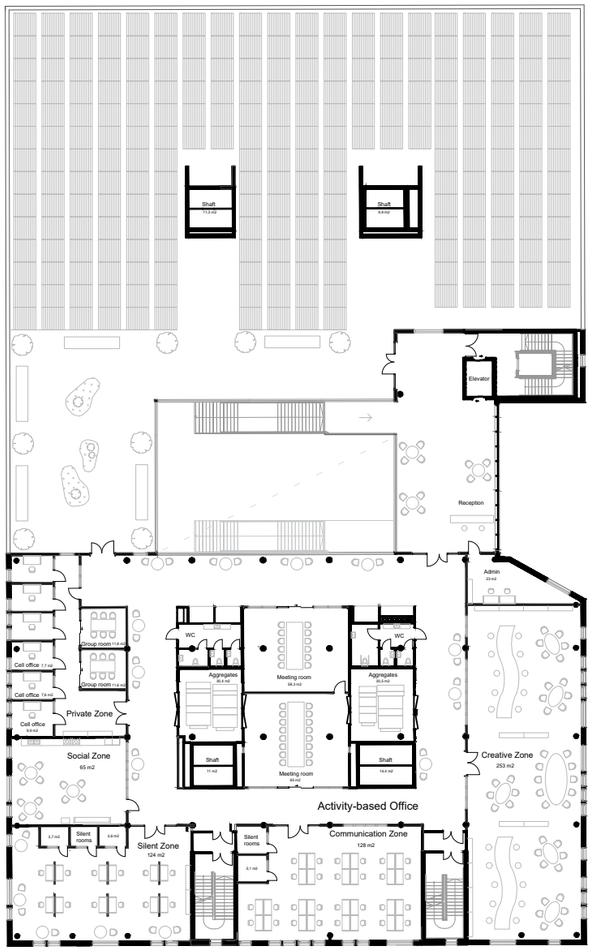
SCALE: 1 TO 500

4TH & 5TH FLOOR

4TH FLOOR

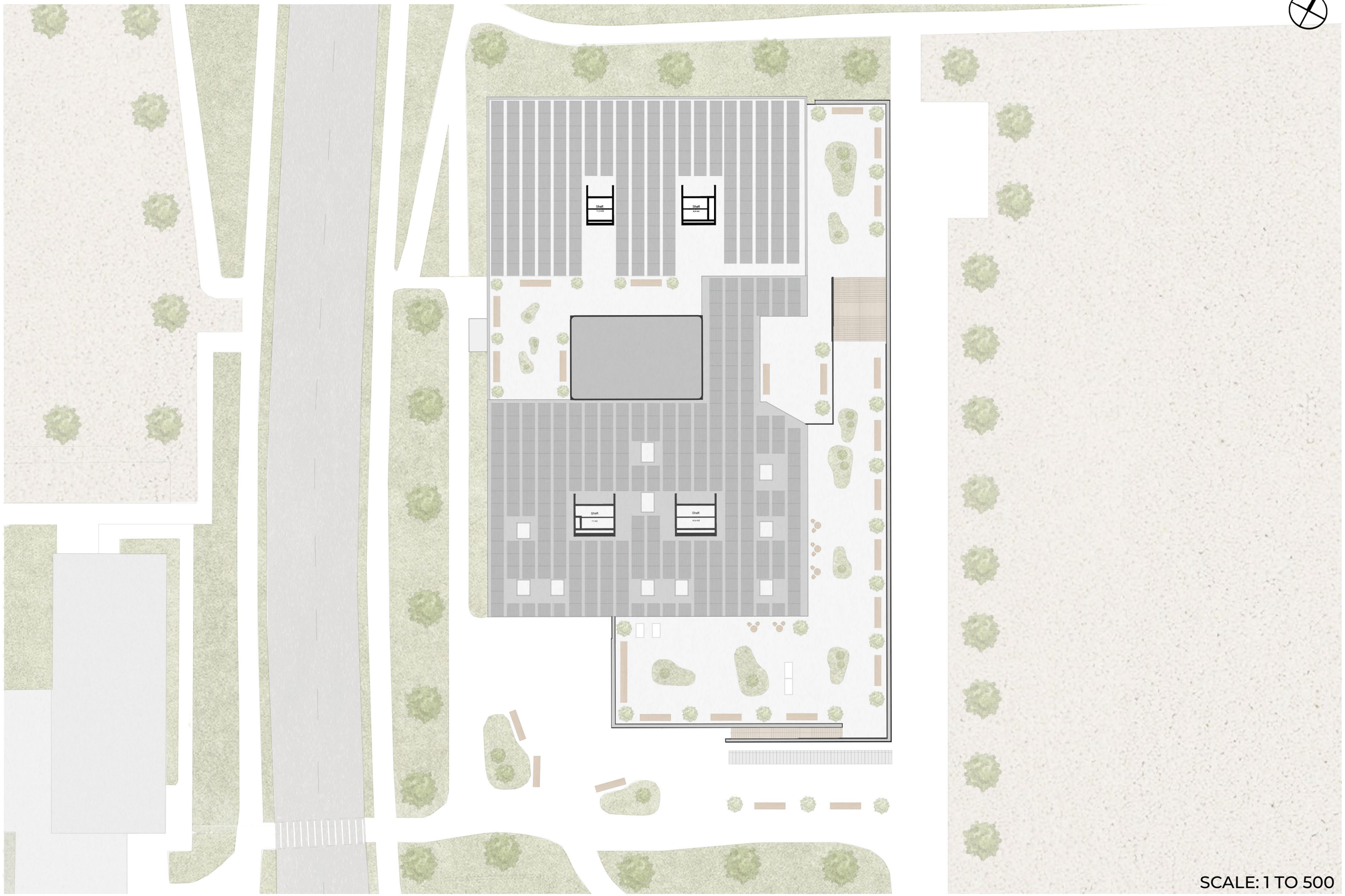


5TH FLOOR



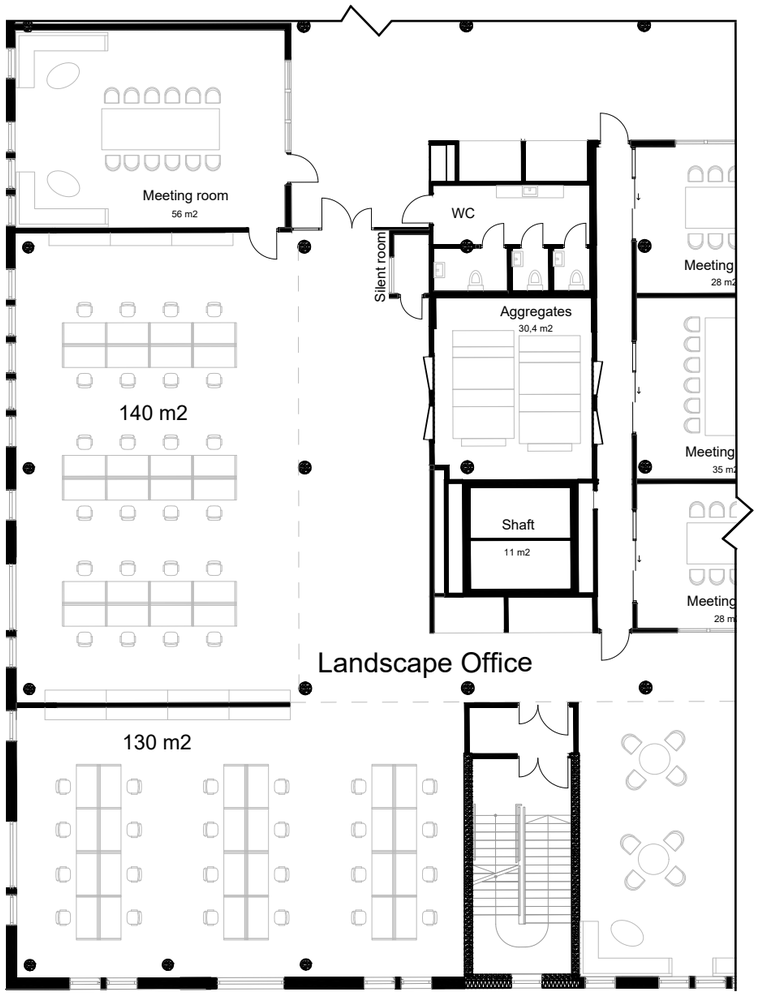
SCALE: 1 TO 500

ROOF / SITE PLAN

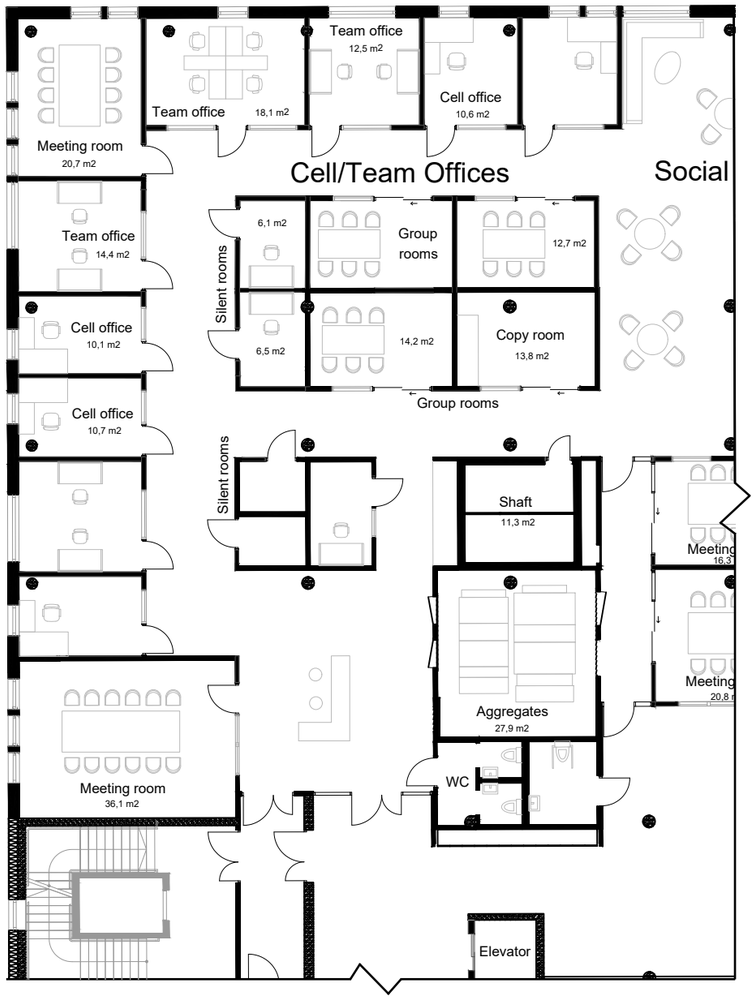


OFFICE TYPES

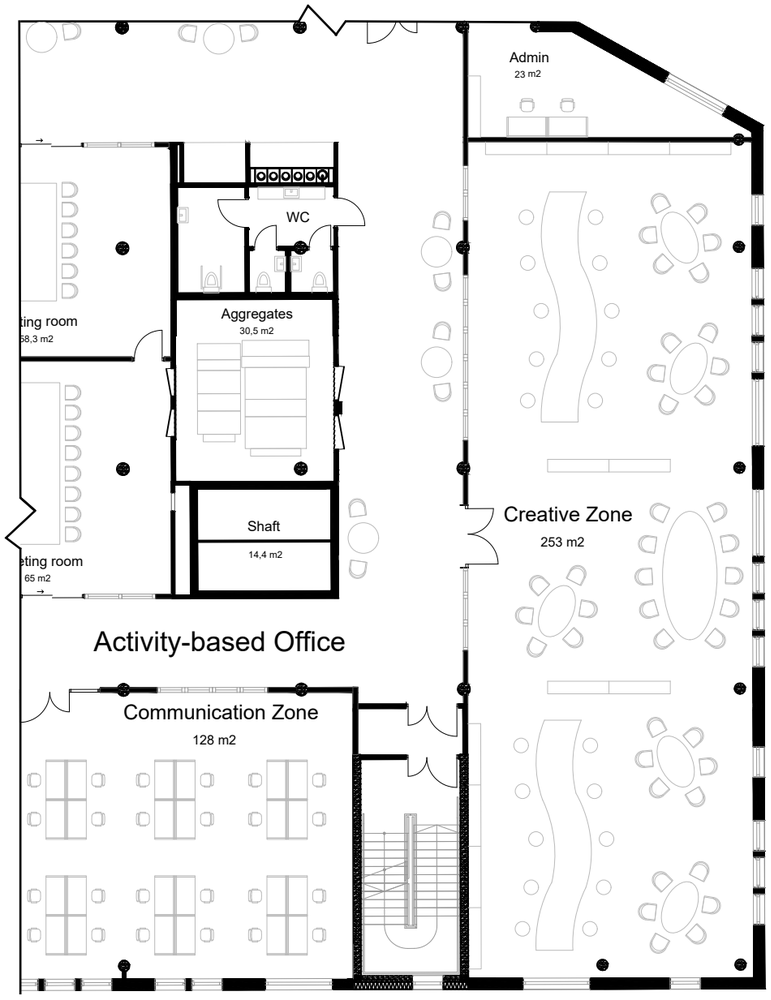
LANDSCAPE OFFICE



CELL & TEAM OFFICES

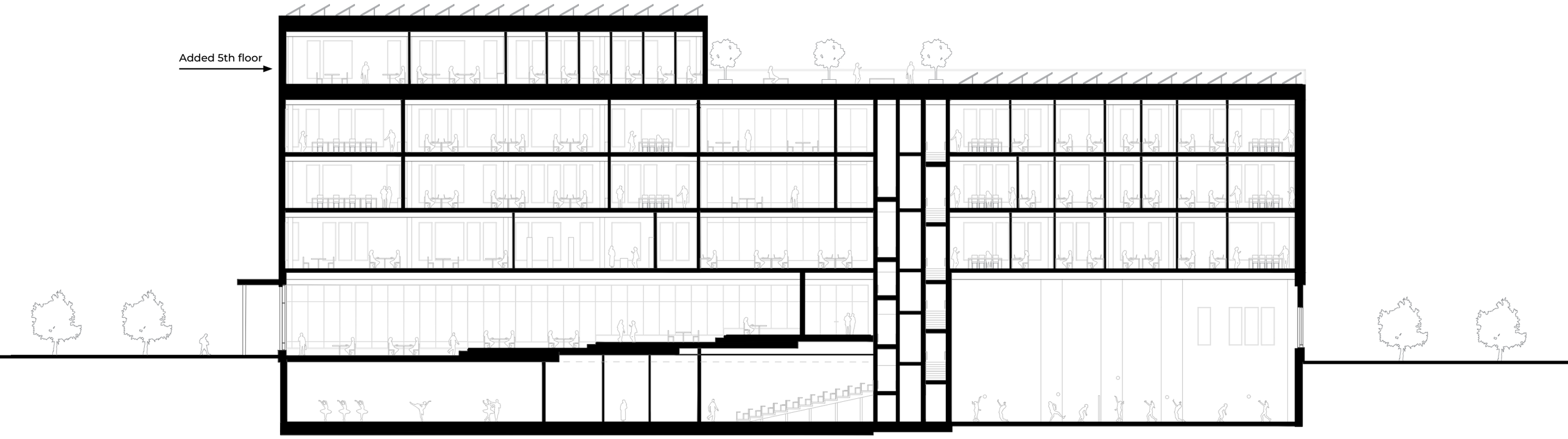


ACTIVITY - BASED OFFICE



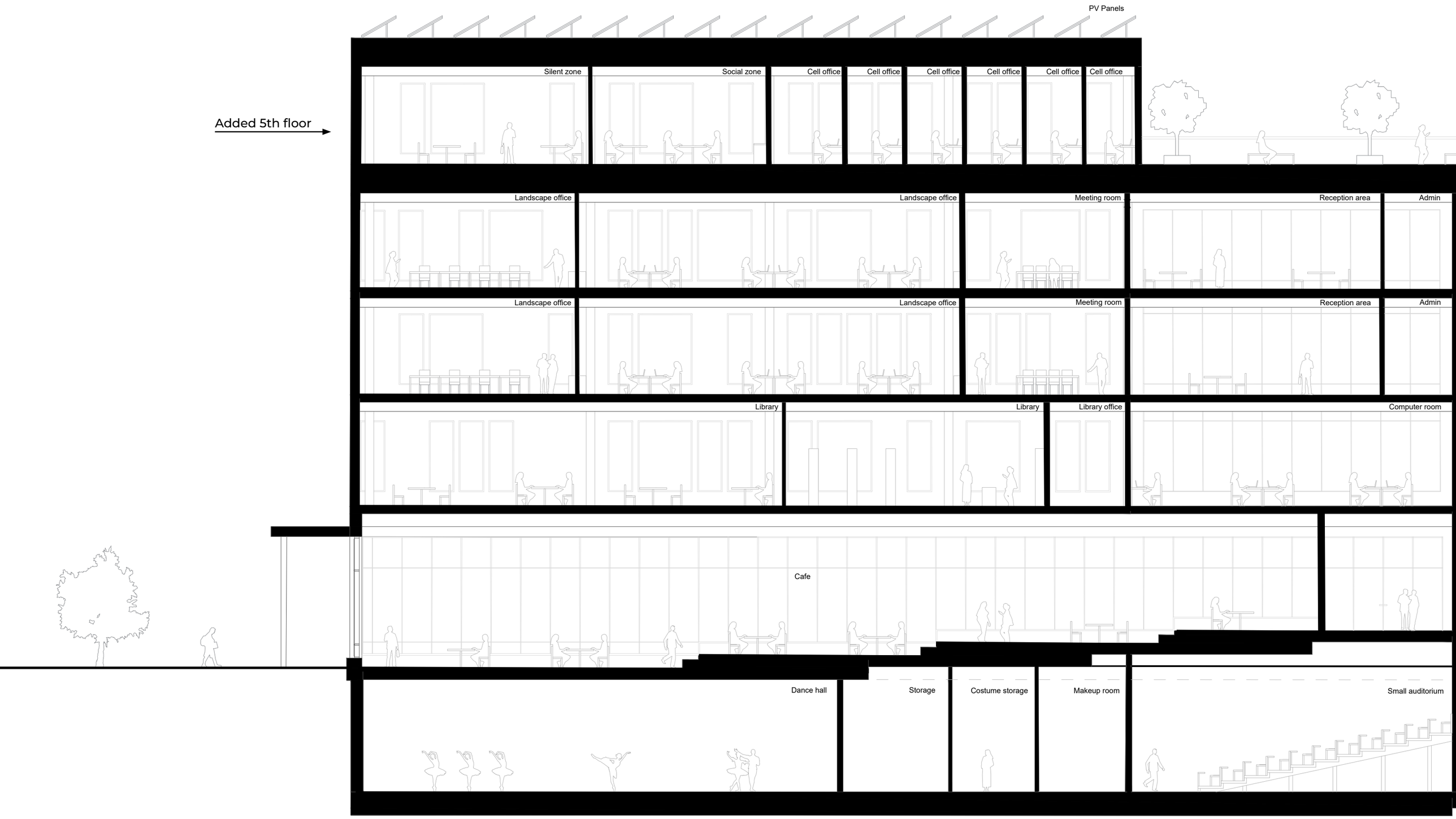
SCALE: 1 TO 200

SECTION AA



SCALE: 1 TO 300

SECTION AA - ZOOMED IN



SCALE: 1 TO 150

ELEVATIONS

WEST ELEVATION

EAST ELEVATION

SCALE: 1 TO 500

ELEVATIONS

SOUTH ELEVATION

NORTH ELEVATION

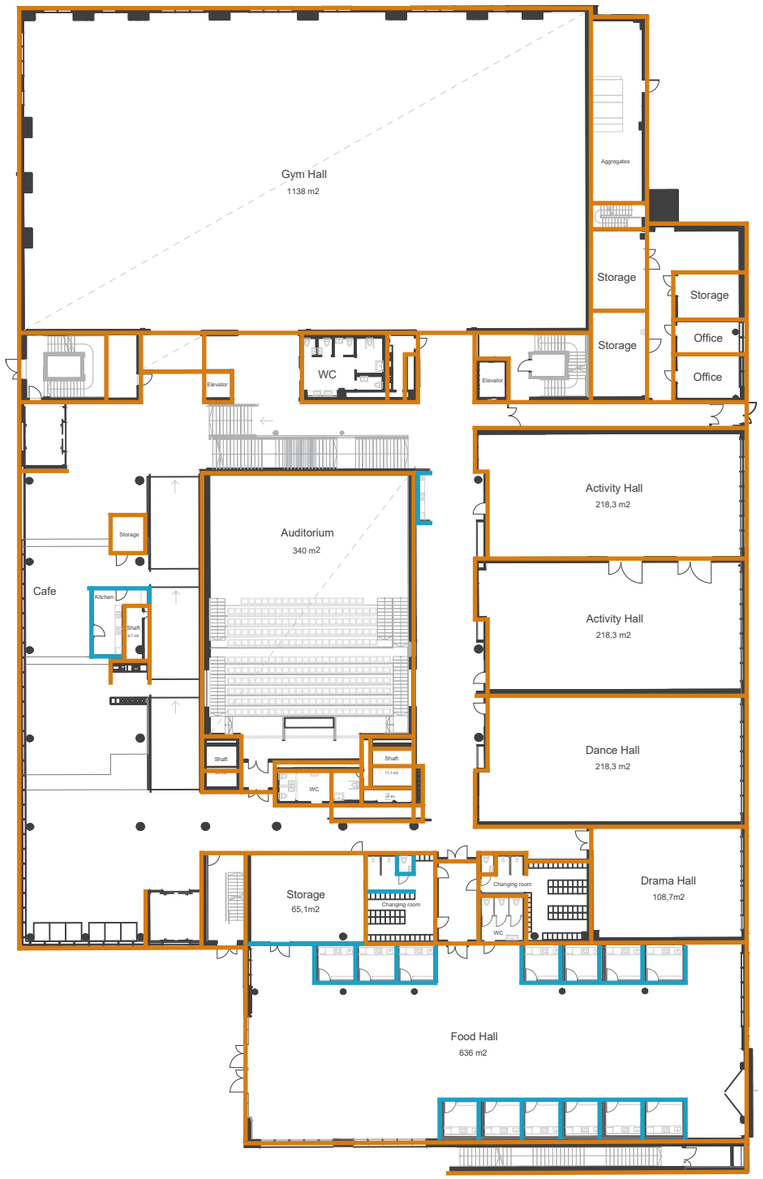
SCALE: 1 TO 500

INTERIOR PERSPECTIVE

View towards atrium on the 3d floor.

EXISTING, NEW & RE-USED PARTS

1ST FLOOR



2ND FLOOR

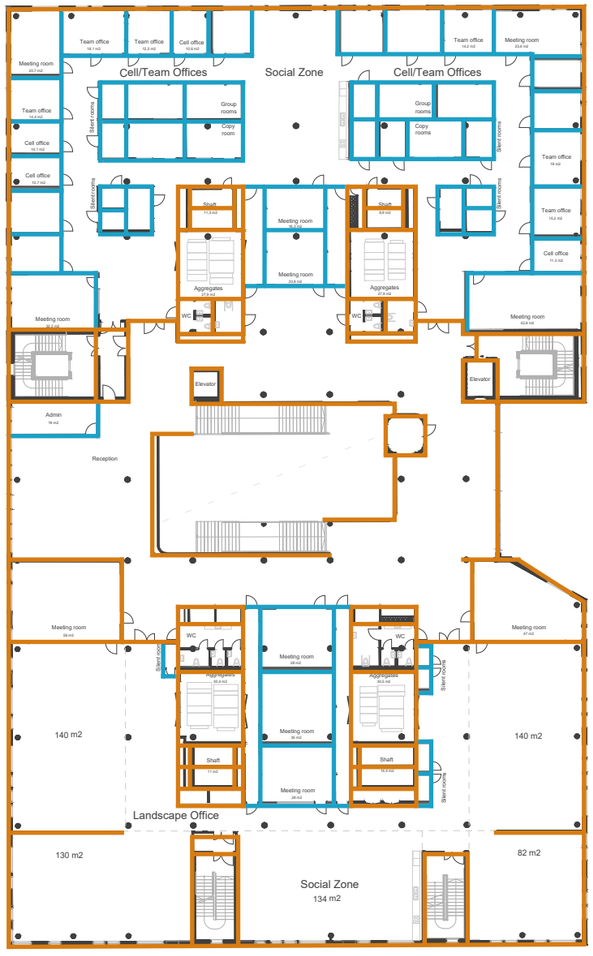
3RD FLOOR

EXISTING NEW RE-USED

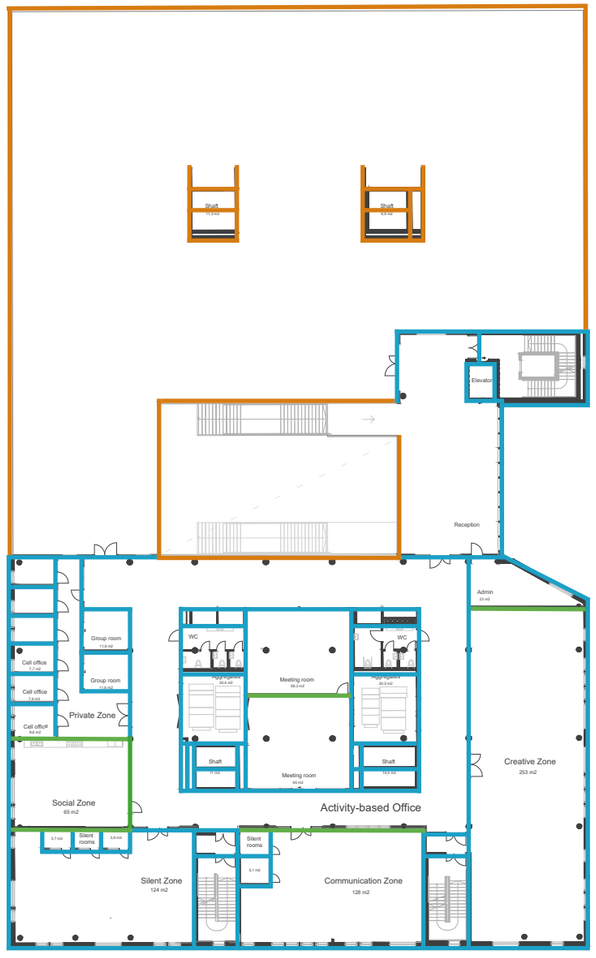
SCALE: 1 TO 500

EXISTING, NEW & RE-USED PARTS

4TH FLOOR



5TH FLOOR



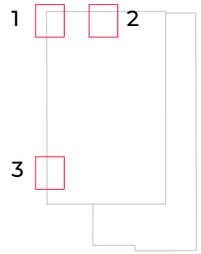
EXISTING

NEW

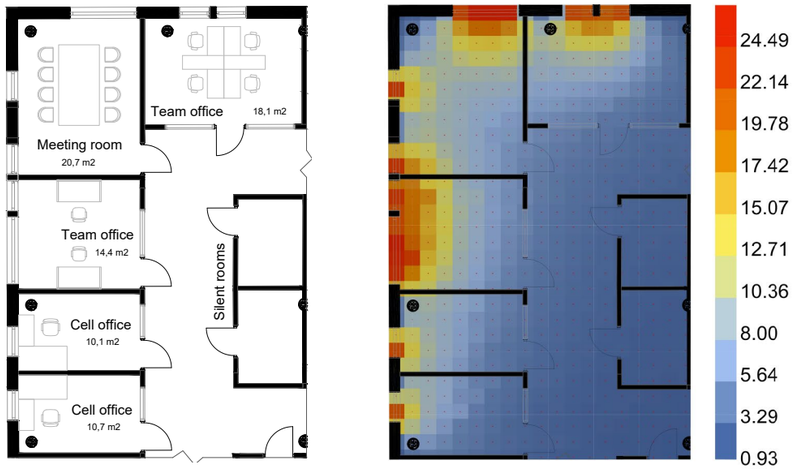
RE-USED

SCALE: 1 TO 500

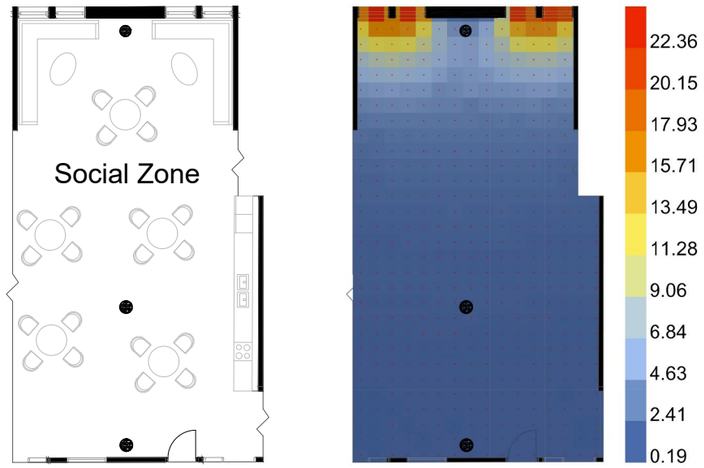
DAYLIGHT FACTOR - 4TH FLOOR



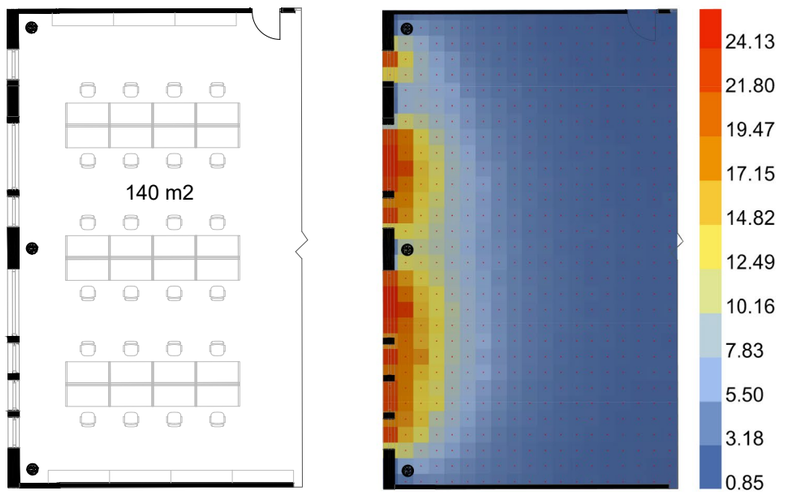
1. CELL & TEAM OFFICES



2. SOCIAL ZONE

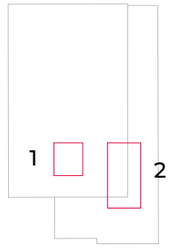


3. LANDSCAPE OFFICE

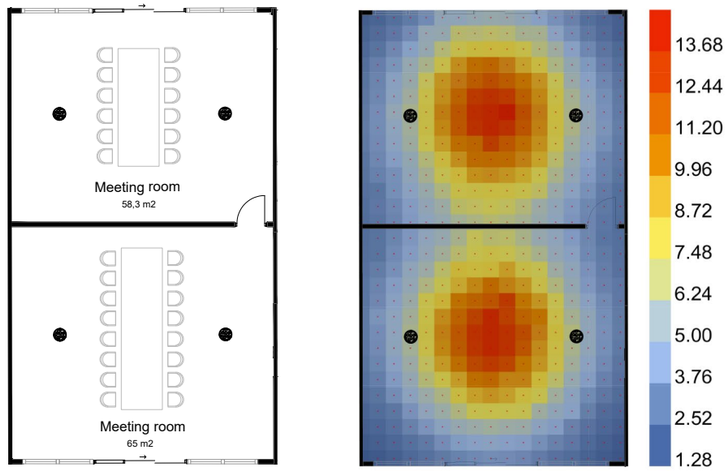


SCALE: 1 TO 200

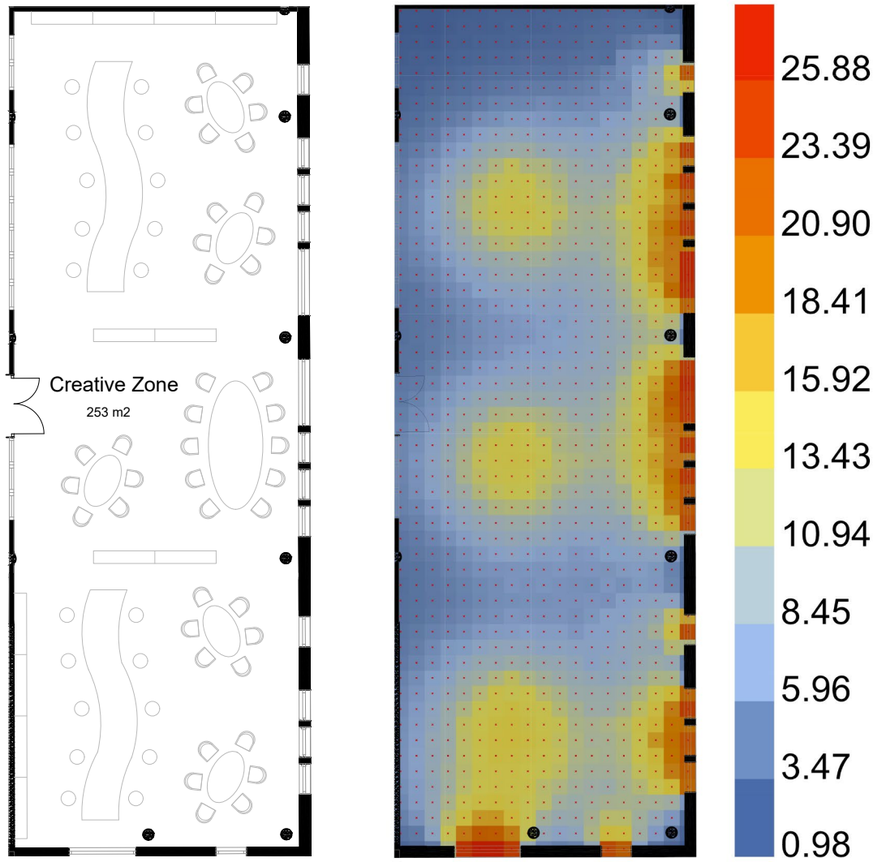
DAYLIGHT FACTOR - 5TH FLOOR



1. MEETING ROOMS



2. CREATIVE ZONE



SCALE: 1 TO 200

DAYLIGHT ANALYSIS

Access to daylight is crucial for human health and well-being and for ensuring optimal work conditions in offices. The daylight factor indicates how much daylight a room gets under overcast skies. According to TEK 17, the minimum average daylight factor must be 2 % in rooms for permanent use (Direktoratet for byggkvalitet, 2017).

Cissi Klein was designed with consideration into sufficient daylighting. A daylight analysis was therefore done to check the access to daylight in some of the spaces inside the building. 3 spaces were checked on the 4th floor. In the cell & team offices, most offices get sufficient daylight. Most of the cell and team offices have a daylight factor above 3,29 %. In some of the offices, the daylight factor is below this in the areas furthest away from the windows. The existing window layout made it difficult to design offices with the same amount of windows. In some of the offices, there is only one window, which is not as optimal. It was decided to have large windows next to the doors in each office, to allow for more daylight into the corridors.

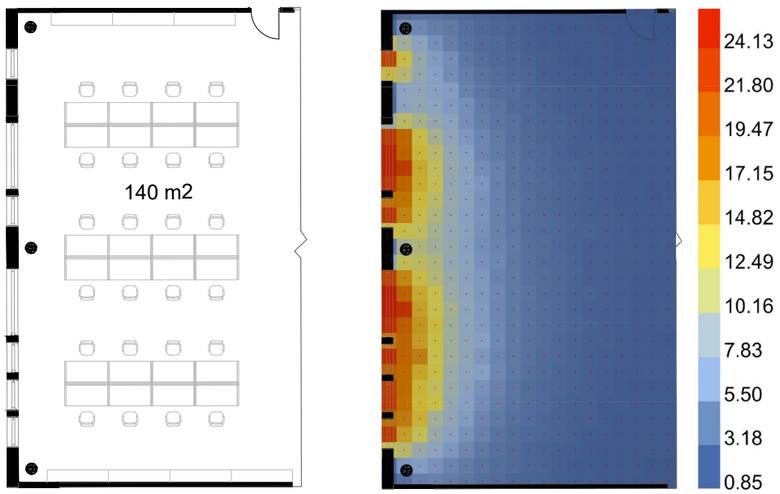
One of the most challenging areas in relation to optimal daylighting was the social zone located in the center of the cell and team offices. This space is very wide and only has 4 windows. Most of this space has a daylight factor below 2 %, which is not optimal. Electrical lighting would therefore be needed. This central space could have been designed in a different way to allow for more daylight. They could for example have implemented more atriums in the central parts to allow for more daylight.

In the landscape office, the daylight factor is above 2,41 close to the windows, but further away it is much below this. This space is 140 m2 and very wide. Wide spaces make it difficult to ensure optimal access to daylight, and this is something they should have considered when designing the building. The space is probably very wide because it was meant to fit larger classrooms.

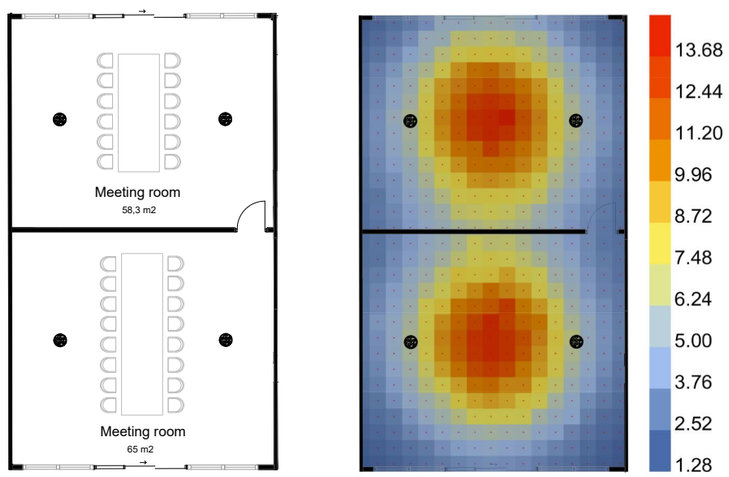
On the 5th floor, the access to daylight was checked in two different spaces. It was decided to implement two roof windows in the meeting rooms in the central part. This space would normally not have any access to daylight, and therefore this was a measure to improve this. The daylight factor is mostly above 3,76 % in these spaces.

In the creative zone, three roof windows were added to improve the daylight. This space was very wide and would therefore have challenges with getting optimal daylight without access to the skylight. Because of the added skylight, most of this space has a daylight factor above 5, 96 %.

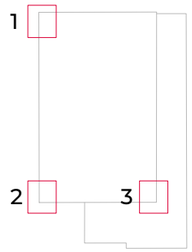
LANDSCAPE OFFICE



1. MEETING ROOMS

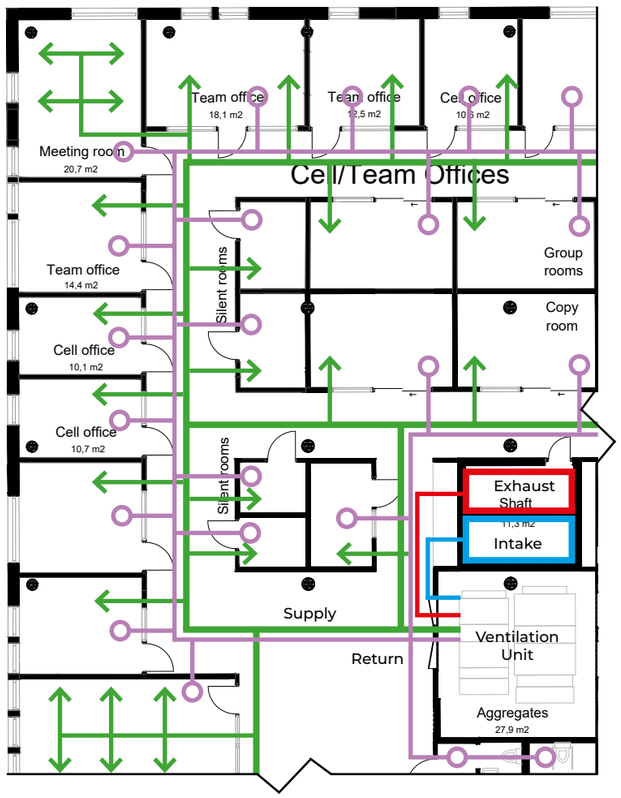


VENTILATION SCHEME



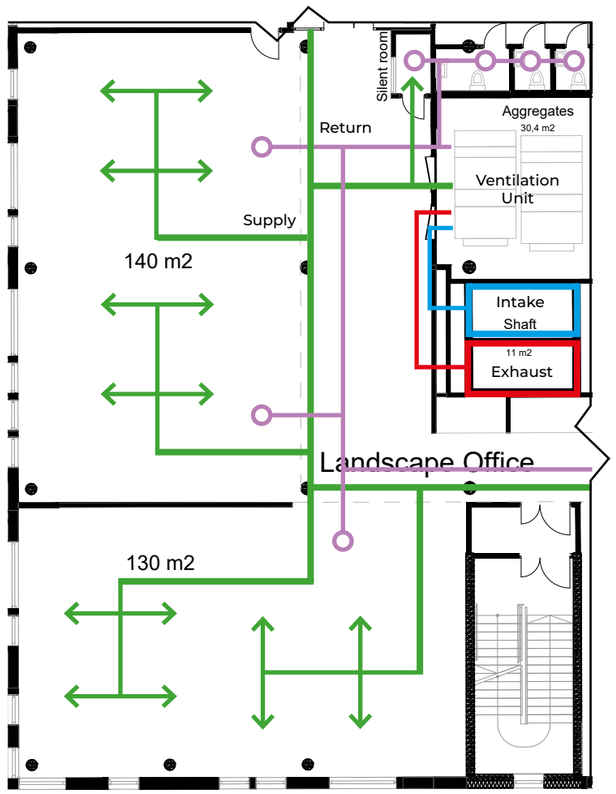
DECENTRALIZED VENTILATION:

4TH FLOOR



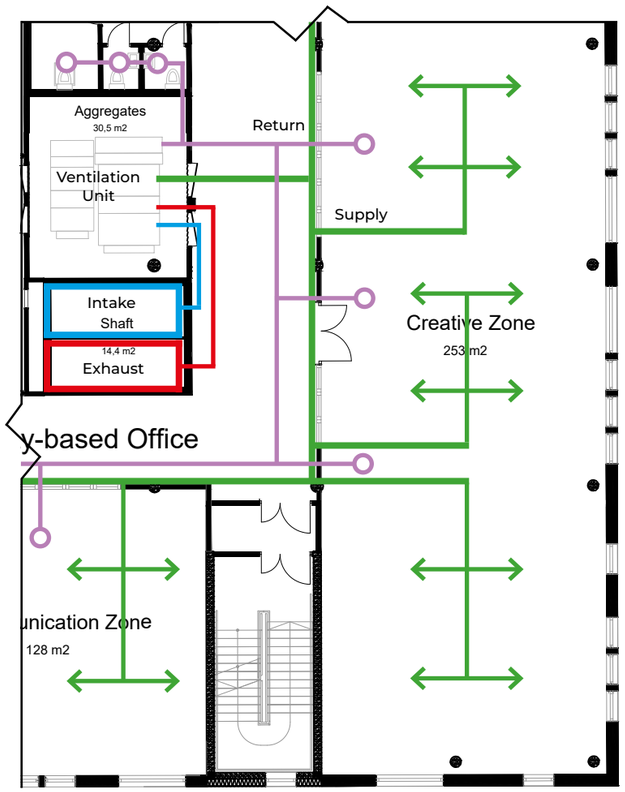
1. CELL & TEAM OFFICES

4TH FLOOR



2. LANDSCAPE OFFICE

5TH FLOOR



3. ACTIVITY - BASED OFFICE

SUPPLY RETURN INTAKE EXHAUST

SCALE: 1 TO 200

VENTILATION ANALYSIS

AIR VOLUME:

The building has a decentralised ventilation system. This system is suited for offices and schools because it can adapt to various indoor conditions. A DV system can operate effectively with space zoning and supply fresh air to different occupied zones (Kim, Liu and Baldini, 2024).

When changing the building`s floor layout and functions into offices, the amount of occupants would change. This would have an impact on the needed air flow rate, and this must be considered in the future. The decentralised system makes it easier to supply air to different zones and adapt to different indoor conditions.

AGGREGATES AND SHAFTS:

The central location of the existing aggregates and shafts on both sides of the building makes it easier to divide and use all the spaces along the facades. This location also makes the duct guideways shorter to all the spaces that need to be ventilated.

DUCT LAYOUT & DISTRIBUTION:

The ventilation system and ducts In the existing building are mostly designed for classrooms. The ducts in the classrooms are more similar and suited for open landscape offices and activity-based offices. It was decided to keep as much of the existing duct layout as possible in the new landscape offices. Only a few ducts were changed here, and overall the existing duct layout worked well with the open landscape office.

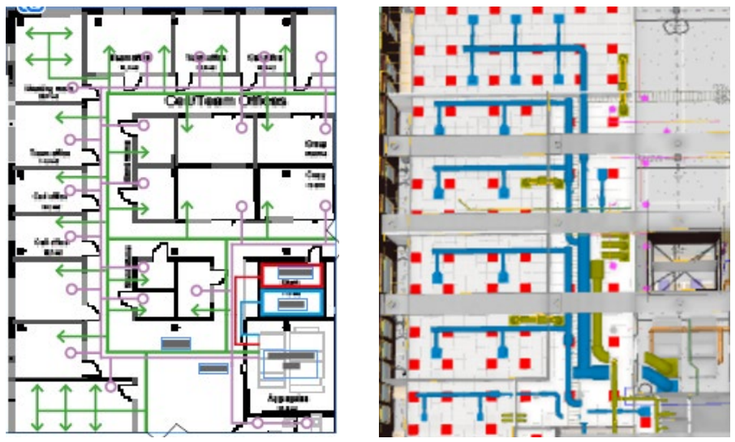
In the northern part of the building some areas were designed for silent rooms and meeting rooms, but most of the areas were classrooms. It was decided to make cell and team offices along the facades here, where the classrooms used to be. To keep as much of the existing ventilation ducts as possible, most of the silent rooms and meeting rooms were kept. The size of the cell and team offices is much smaller than the classrooms, so the duct layout and distribution had to be changed a lot in this area.

Overall the existing duct layout did not work as well with the cell and team offices and had to be changed. The new duct layout works better, but in some places the ducts could possibly be too far away from the aggregates and shafts. The existing floor height of 4,2 m makes it easier to do large changes here because it can fit new ducts and other technical systems.

ADDING A 5TH FLOOR:

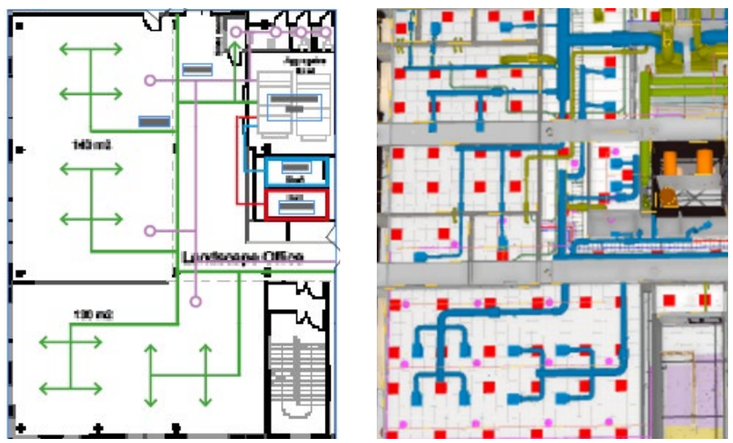
It was decided to add two more aggregates and shafts on top of the existing ones on the 5th floor. The shafts had to be in the same place. By having them located in center it was easier to navigate the ducts almost the same way as on the 3rd and 4th floors. The spaces on the 5th floor are more open and similar to the open landscape offices. This made it easier to design the duct layout similar to the landscape office duct layout.

1. CELL & TEAM OFFICES



Existing ducts, picture from BIM model (Trøndelag fylkeskommune, 2024).

2. LANDSCAPE OFFICE



Existing ducts, picture from BIM model (Trøndelag fylkeskommune, 2024).

DESIGN COMPARISON

As a part of the background of this project, other floor plans with various office layouts were investigated. The floor plans that was investigated were the office proposal for the building ”Krohnen” by HLM arkitektur, the office proposal for Midtbygget Kronstadparken by Arkitektugruppen Cubus AS, and the example of an activity-based office by architects: AROS AS & HRTB AS.

OFFICE SPACE REQUIREMENTS:

General space requirements for cell & team offices were also investigated. The cell and team offices in this project were designed based on a mix of the different office examples and office space requirements that were investigated. The minimum space requirement examples by Neufert, 2012, show that a movement area of 1.5 m2 is needed from the desk. In a team office with two workstations, the space should minimum be 3.40 m x 3,60 m. According to ”Neufert, 2012” a grid module of 1.5 m would be the most sufficient cell office layout. See space requirement examples.

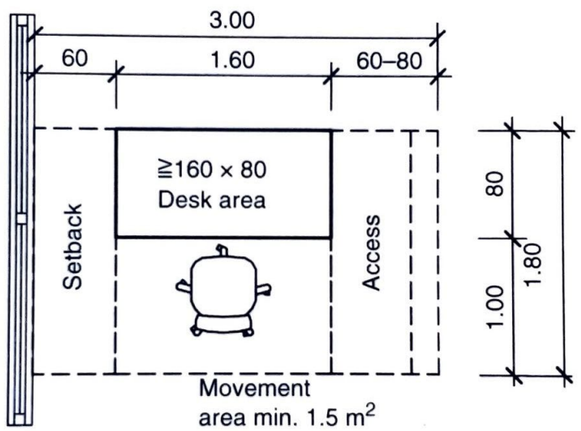
CELL & TEAM OFFICES:

When investigating the floor plans by HLM arkitektur it was discovered that the cell offices were sized 2.3 m x 4 m, and each cell office had a window size of 2.25 m. The floor plan by Cubus As mostly had cell offices sized 2.6m x 2.6m. Here each cell office had a window size of either 2.1 m or 1.2 m. The layout of the cell and team offices in this project was influenced by these examples.

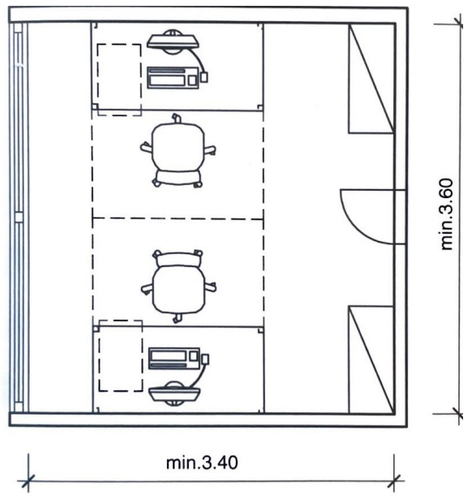
The new design has a mix of individual cell offices, team offices, meeting rooms, silent rooms, and group rooms. In both floor plans by HLM arkitektur and Cubus AS the cell offices are located along the facades and meeting rooms and silent rooms are mostly located in the center. The layout is similar in this project. Silent rooms & group rooms are located in the center. These spaces have no access to daylight, which is not optimal. According to TEK 17, only spaces for permanent use must have access to daylight (Direktoratet for byggkvalitet, 2017). These spaces are not for permanent use, so the location of these would therefore work.

The size of the meeting rooms varied a lot in the different examples, and therefore different-sized meeting rooms were implemented in this project too.

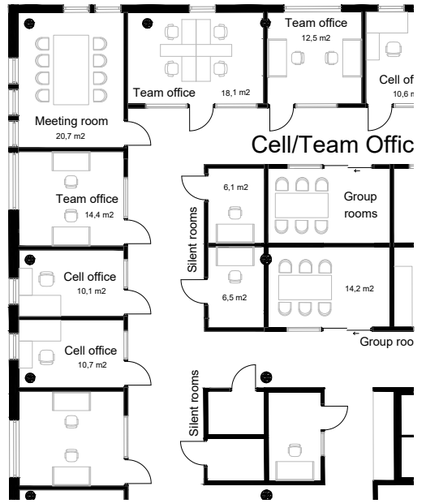
The cell offices in this project are mostly sized 4m x 2.5 m or 4m x 3.5 m x 3 m. It was decided to make the offices a bit bigger, to reduce the corridor area. Most of the corridors in the cell and team office space are now between 1.5 m to 2 m wide. Some of the team offices have a similar size and layout to the example by Neufert. These new team offices are sized 4m x 3,60 m. See examples. It was not possible to follow a strict grid with equal sizes for each cell and team office, because of the existing facade and window layout. The windows do not follow a specific layout and vary a lot. A grid module of 1.5 m for cell offices would therefore not work for example. Some of the offices ended up having columns inside of the room, which is not optimal. The cell and team offices ended up with this layout and mixed measurements because they had to fit in with the existing structure and windows.



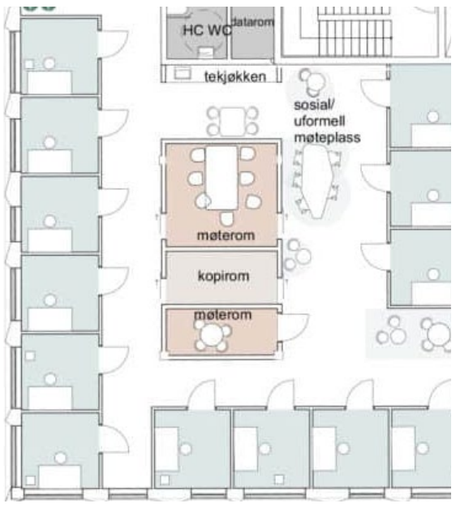
Minimum space requirement for a single workstation (Neufert, 2012).



Example of double office with wall-oriented workstations (Neufert, 2012).



Cell & team offices in 4th floor.



Midtbygget floor plan proposal (Arkitekt-gruppen Cubus AS, 2019).

DESIGN COMPARISON

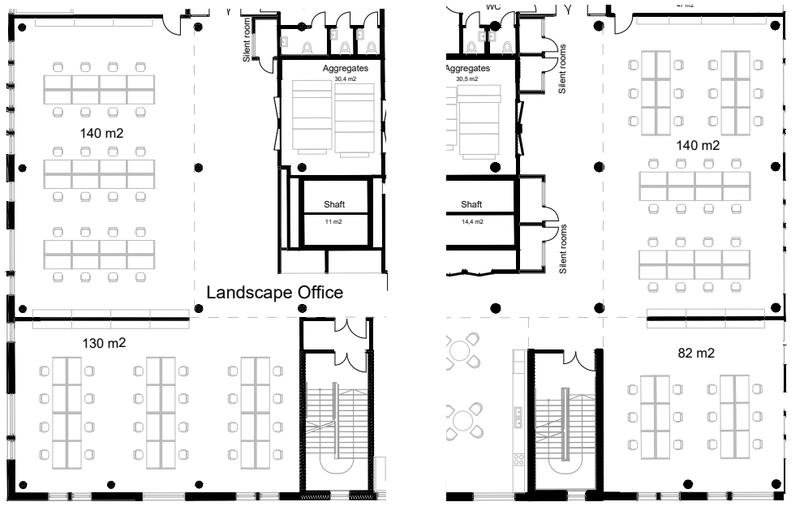
LANDSCAPE OFFICE:
The floor plan by HLM arkitektur has both cell offices and landscape offices. The open office landscape in the corner to the east is 140 m2 and consists of 5 workstations with 6 spaces for people per workstation. A space of 140 m2 could therefore fit workstations for 30 people. These numbers were taken into account when designing the landscape office in this project.

The open landscape office has two zones with 140 m2. In one zone, there are workstations for 28 people and in the other zone there are workstations for 24 people. The two zones have different layouts for the workstations, and therefore one zone could fit a little less people. It was decided to have less people in one of the zones because of the access to daylight

The daylight factor analysis showed that the spaces furthest away from the windows would not get sufficient lighting. It was therefore decided to have fewer workstations here to provide a better space for the users. See floor plans of landscape office zones.

ACTIVITY-BASED OFFICE:
The Activity-based office in this project was influenced by the existing floor plan layouts in the building and by the activity-based office example by architects AROS AS & HRTB AS. The example shows different zones for different work activities. Some of the spaces have larger user areas with bigger collaborative workstations, while other spaces are meeting rooms, group rooms and cell offices. These types of zoning influenced the activity-based office design in this project. See the activity-based office example.

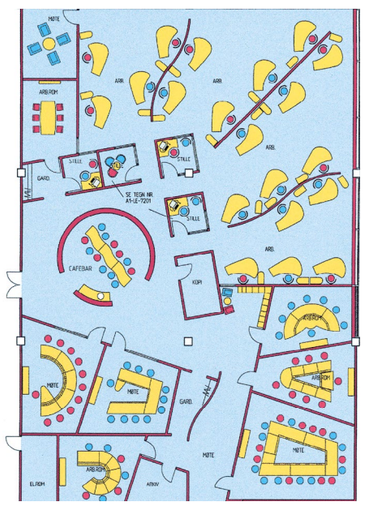
The activity-based office on the new 5th floor has a creative zone, communication zone, silent zone, and a private zone. The floor layout here is much more strict and not as playful as the layout in the office example. This is because it was decided to keep the stairs and technical rooms in the same locations as in 3rd and 4th floor. The spaces then became similar to the floor layout on 3rd and 4th floors. See the floor plan of the activity-based office.



Landscape office zones in 4th floor.

Krohnen floor plan proposal (HLM Arkitektur, 2024).

Activity- based office zones in 5t floor.



Activity-based office by architects: AROS AS & HRTB AS (Sintef Byggforsk, 2001)

DISCUSSION
&
CONCLUSION

DISCUSSION

How optimal are the flexible design solutions in Cissi Klein vgs integrated for future changes into an office building?

The existing building structure and floor layout are some of the most important parts when it comes to the building`s flexibility towards changes to other functions. The spaces on U1 and 1st floor are mostly oversized & consist of open halls for sports and auditoriums. These halls are made of cast-in-place concrete. The size and location of these functions make it less flexible and difficult to make big changes here. The choice of materials for the interior walls could have been different to make it easier to make changes here in the future.

The building has very different sizes for all the rooms and doesn`t follow a strict grid with equal sizes for similar functions. This can make it more difficult to do changes in the future. Some of the spaces in the building are very huge and open which allows for easier changes to other functions. It is possible to demolish several walls to make the spaces more open in 3rd and 4th floors. In some areas, it is more difficult to remove interior walls.

The flexibility of removing and re-using walls was mapped out by the architects, which was a good measure to make it easier to know where it is possible to make changes in the future.

The central location of the aggregates and shafts on both sides of the building makes it easier to divide and use all the spaces along the facades. This location also makes the duct guideways shorter to all the spaces that need to be ventilated. In general, the location of the aggregates and shafts works well, the only challenge with these locations is how to make use of the spaces in the center between the aggregates and shafts. These spaces have no access to daylight and could therefore not have permanent uses.

Another important measure to ensure flexibility in the building was the large floor heights on all the floors. The large floor height makes the building more flexible because it makes it easier to design for different functions, new ventilation ducts and other technical systems. It can be discussed whereas some of the spaces may be too high. The height is for example 7 m on the 1st floor. Maybe they could have saved some materials and expenses in this space with less floor height.

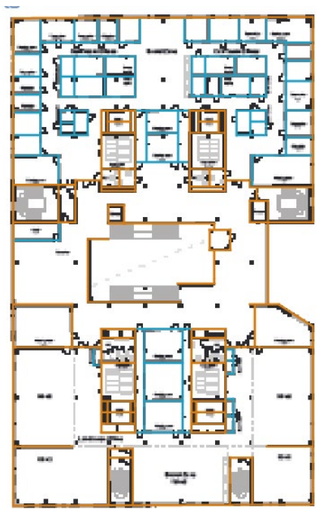
All the floors in the building have different window layouts. The windows have sufficient space between each other which made it possible to set up new partition walls between them. When changing the functions into different office spaces it was discovered that the window layout was not optimal in the cell and team offices. The window layout worked better for the open landscape office and the activity-based office. The window layout made it difficult to design with a grid and make equal -sized spaces and therefore made it less flexible to design smaller offices. It can be assumed that the current design of the facade and window layout was more for aesthetics. In the early design phase of the project, they should have taken different office spaces and possible changes in the future more into account.

DISCUSSION

Overall the floor plan layout and central location of technical rooms made it possible to design different office spaces along the facades. The main design strategy was to keep as much as possible of the existing structure and floor layout to see how flexible the existing building was. Only a few walls were removed to make the open landscape office, and some of these were re- used on the 5th floor. The existing spaces here is therefore very flexible to transform into a landscape office.

In the northern part of the building, a lot of the existing spaces along the facades had to be changed to be able to have cell and team offices. Only some of the silent and meeting rooms in the center were kept. The existing window layout did not work well with designing cell and team offices either. This indicates that the existing spaces here were not as flexible to transform into cell and team offices.

4TH FLOOR



EXISTING NEW RE-USED

One of the flexible solutions that was considered was the possibility of adding an additional 5th floor. This came as a bonus because of the structural properties in the existing building. It was not originally planned for a 5th floor from the early stage of the design of the building. The lack of planning for a 5th floor from the beginning has become evident and gives less flexibility when designing for the 5th floor.

It is not possible to design any big structures on top of the entire gym hall. The spaces that are left in the northern part do not have sufficient space for offices, because of the existing location of technical rooms, stairs and elevators. The atrium would also get less daylight if the 5th floor was built on both sides in the northern and southern parts of the roof. This shows that the existing structural properties only gave flexibility for adding office spaces in the southern part of the roof. This space works well as an activity-based office. If they purposely designed for a 5th floor from the beginning of the design phase, there would probably be opportunities for having more office spaces here.

Overall most of the spaces along the facades had optimal daylight according to the daylight factor analysis that was done. Wide spaces and central areas had more challenges with getting optimal daylight. It would therefore be recommended to not have too wide spaces, to ensure better daylighting. Measures to improve this could also be to implement roof windows and atriums in spaces that allow this. It is also recommended to design a window layout that allows for more daylight in each cell office. Each cell office should preferably have two windows.

The decentralised ventilation system and location of aggregates and shafts overall work well with the new office functions. Only a few ventilation ducts were changed in the landscape office. The existing duct layout worked well here and can therefore be considered flexible towards changes to open landscape offices. In the cell and team offices, the existing duct layout had to be changed a lot. This indicates that the existing ducts are not so flexible towards changes into smaller cell and team offices. On the 5th floor the new ventilation aggregates and shafts were placed in the same locations as the existing ones, this worked well when designing new duct layouts.

CONCLUSION

Cissi Klein Videregående is an upper secondary school that is currently being built in Falkenborgvegen 32 in Trondheim. It was designed with flexible design solutions so that the building`s layout and functions easily can be changed into other functions in the future. How optimal are the flexible design solutions in Cissi Klein vgs integrated for future changes into an office building?

The flexibility of the building has been investigated by transforming it into an office building and adding an additional 5th floor. The existing building was also investigated.

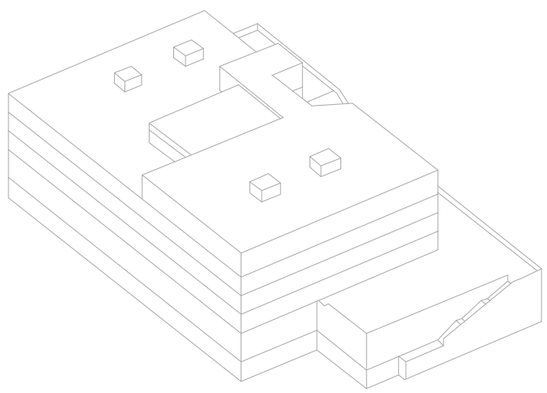
Overall the building was relatively easy to transform into an office building. The integrated flexible design solutions have relatively made the building become more flexible towards changing the functions into different office types. The floor layout and placement of technical systems made it possible to design different office types along the facades. In the southern part of the building, it was possible to demolish walls to make an open landscape office. The existing ventilation system and duct layout worked well with this change.

Some of the most challenging parts of the building to change were the spaces in the northern part into cell and team offices. The existing floor and window layout here made it very difficult to design equal-sized cell and team offices based on a grid. The existing ventilation ducts also had to be changed a lot here. The flexibility of adding an additional 5th floor was limited. It was only possible to use the southern part of the roof as a new 5th floor.

To conclude, the integrated flexible design choices are relatively optimal. The building can relatively easily be transformed and changed into an office building. The existing building layout offers a lot of flexibility and works well with changes to open landscape offices and open activity-based offices. The building is less flexible and does not work as well with changes into smaller cell and team offices. In general, they should have taken more consideration into the design of the window layout and the facade, structure and material choices in U1 and 1st floor, and the expansion possibilities on the 5th floor. They should have taken more consideration into future possible function changes in the early stage of the design.

The overall lesson in regards to designing a flexible building is to implement flexible design solutions early in the design phase of the building project. When designing for flexibility, possible function changes in the future should be considered at an early stage. Once the building is built, it is more difficult to make large changes. An example of this is the design of the facade and window layout in Cissi Klein vgs. The window layout works well with open landscape offices and activity-based offices, but not as well with the cell and team offices. The window layout could have been more optimal if they had considered different office types in the early design phase of the building.

For further research, it would be recommended to investigate other materials and structure options. It would be interesting to see how the building would work if they used completely different materials for the structure and interior walls. Other functions and floor plan options could also be investigated. A flexibility checklist and recommendations table have been made based on the lessons from this project. See the next page.



FLEXIBILITY CHECKLIST & RECOMMENDATIONS

FLEXIBILITY CHECKLIST	RECOMMENDATIONS:
GRID	-Decide on a specific grid in the early design phase of the building project. -Use a grid that allows for easy internal changes in the building in the future.
LOAD BEARING SYSTEM & STRUCTURE	-Decide on a building structure that allows for easy changes in the building in the future. -Use materials that make it easier to undertake internal building changes. -Cast-in-place concrete structures can make the flexibility of the building more limited.
FLOOR HEIGHT	-Design for spacious floor heights on all floors in the building. -Entrance level (1st floor) should have a more spacious floor height than the other floors. -Spacious floor heights make the building more flexible with changing functions, ventilation ducts, and technical installations in the future.
MATERIALS	-Make a life cycle analysis (LCA) of possible materials early in the design phase of the building project. -Decide on long-lasting materials and materials that can be reused in the future.
TECHNICAL ROOMS	-Technical rooms for ventilation etc. could be placed in the central parts of the building to utilize all the spaces along the facades. -Location of ventilation aggregates and shafts should be placed near spaces that need to be ventilated.
FLOOR PLAN	-Have a universal design and provide different zones in the building. -Design for good circulation and accessibility in the building. -Design with a grid and use standard measurements for different room sizes. -Decide on public and private zones early in the design phase of the building project.
FACADE & WINDOW LAYOUT	-Design a window layout early in the design phase that allows for easy changes in the future. -Consider possible function changes in the future when designing the window layout. -Have sufficient space between each window to make it possible to make new partition walls between them. -Design an aesthetically pleasing and practical window layout and facade. -Use long-lasting materials for the facade, that can be removed and re-used in the future.
VENTILATION	- Make a simple schematic ventilation drawing early in the design phase of the building project. - Plan ventilation ducts for the room layouts and consider possible changes in the future early in the design phase of the building project. - Location of ventilation aggregates and shafts should be placed near spaces that need to be ventilated. - When designing additional floors to a building, new ventilation systems and ducts could be placed in the same locations as the existing floors. This makes it easier to design new duct layouts.
DAYLIGHT	- Make daylight factor analysis early in the design phase to optimize daylight inside spaces. - Design a window rhythm early in the design phase that allows for easy internal changes for other functions in the future. - To ensure optimal daylight conditions, don`t design too wide spaces. - Implement roof windows to optimize daylight conditions. - Implement atriums to optimize daylight conditions.
EXPANSION POSSIBILITES	-Decide on expansion possibilities early in the design phase of the building project. -Design and plan structural properties early in the design phase that allow for maximal utilization of the expansion.

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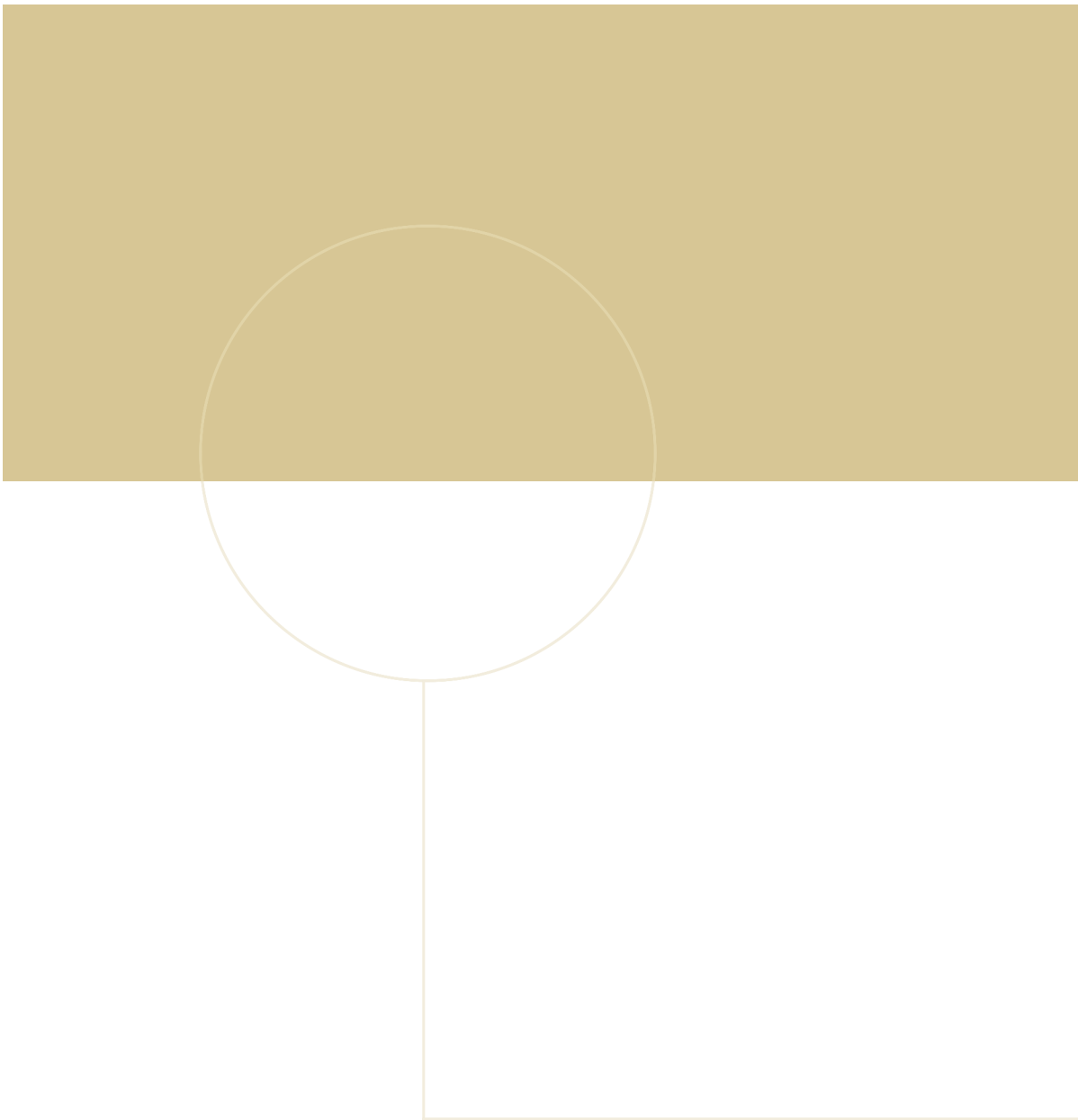
Note!
- Existing floor plans and other architectural drawings of Cissi Klein vgs by Hus Arkitekter was provided by Trøndelag fylkekommune in this project.
- All existing architectural drawings of Cissi Klein vgs has been edited by Helene Grøttveit Lunde in this project.
- An existing BIM Model of Cissi Klein vgs was provided by Trøndelag fylkeskommune in this project. Renders was taken from the existing BIM model and has been edited by Helene Grøttveit Lunde in this project.

THANK YOU



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