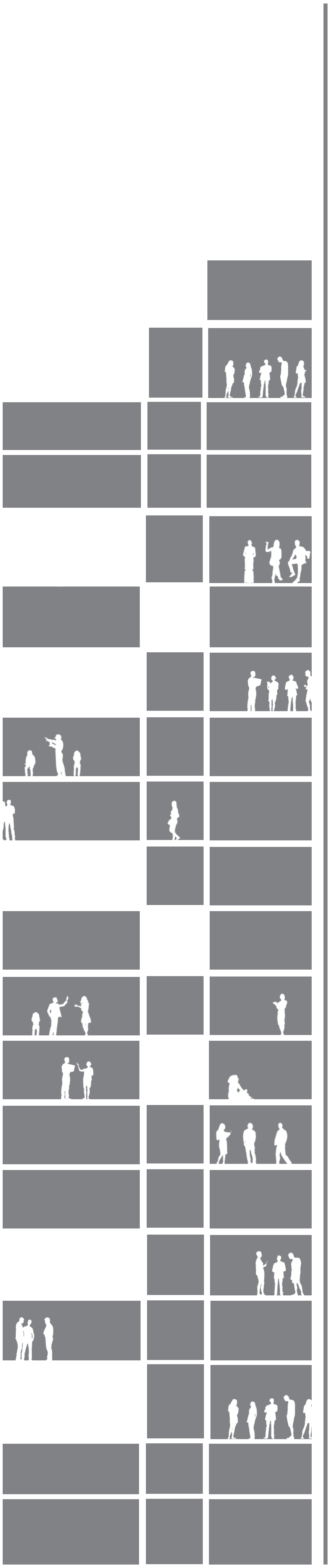

CIRCLE Tower

- Vienna`s first circular communal housing project

SOCIAL HOUSING // TRANSFORMATION

Lemuela Wutz
Chalmers University of Technology
Department of Architecture & Civil Engineering
Superviser: John Helmfridsson
Examiner: Walter Unterrainer

Circle Tower

Lemuela Wutz

Superviser: John Helmfridsson
Examiner: Walter Unterrainer

Master Thesis 2024

Chalmers Univeristy of Technolgy
Department of Architecture & Civil Engineering
Direction: Building design for sustainability

ABSTRACT

CIRCLE TOWER
-Transformation & Circular Economy

The project is taking place in the 19th district of Vienna, Austria. The APA-Tower, which previously served as an office building, is being transformed into a mixed-use space, with a predominant focus on providing housing.

The location holds significant development potential due to its excellent connectivity to public transportation, cycling routes, and its proximity to the city center. Furthermore, the surrounding area has undergone substantial redevelopment efforts, offering convenient access to a range of services such as shops, schools, and sports facilities, all within walking distance.

The project's objective is to revitalize a neglected building by transfomring it into social housing and integrating circular prinicples. Furthermore while also considering social, economic, governmental, and behavioral aspects. This goal will be achieved through various scales of intervention, from the adaptive reuse of the entire structure to smaller-scale space planning.

The project seeks to investigate ways how to make use of the city stock and reintegrate not only a structure but also materials within the urban fabric.

KEYWORDS:

Circularity - Transformation - Social Housing - Adaptability - LCA - Flexibility

“As an architect, you design for the present, with an awareness of the past for a future which is essentially unknown”

- Norman Foster

AUTHOR

Lemuela Wutz

I grew up in Austria, did my Bachelor's Degree in the United States, and moved to Sweden for the Master's program 'Architecture & Planning Beyond Sustainability.' These experiences allowed me to reflect not only on the impact of climate change in different countries but also on how sustainable practices are embraced in certain environments.

Especially, my time on the east coast of the United States highlighted the necessity to put sustainable practice at the core of my education and ambitions. Numerous evacuations due to hurricanes or flooding made me realize the ever-increasing natural disasters and extreme weather conditions. These not only impacted me through fear and evacuation but also showed me how this global problem, caused by first-world countries, has an enormous effect on less fortunate people and pushes them further into poverty. Utopian thinkers like Joachim Mitchell and Neri Oxman inspired me to explore differentapproaches in order to tackle the climate emergency.

M.Sc - Architecture & Planning Beyond Sustainability
Chalmers, Gothenburg, 2022-2024

- Sustainable architectural design
- Planning and design for a sustainable development in a local context
- Sustainable Building Renovation
- Design and performance optimization for buildings

Architecture intern - Birrer Architekten
Zürich, Switzerland, 2020, 3 months

B.F.A - Architecture
Savannah/Georgia, United States, 2017-2021

Architecture intern - Syntax Architektur
Weidling, Austria, 2016, 2 months

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READING INSTRUCTIONS

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INTRODUCTION
Presents the chosen field of research and how the subject fits into the discussion of circular economy. This section includes the research question, delimination, method and theory.

2

SOCIAL HOUSING IN VIENNA
This chapter gives an overview of the history of social housing in Vienna, the challenges and opportunity that come with living in a high rise as well as the principles of circular economy.

3

APA TOWER/VIENNA
Introduction to the context of the project location and design object. It features an condesnsed site and climate analysis for the urban context.

4

SUMMARY
Summary and reflection on how the thesis has been answered. The potential for circular builing in an urban environment with the focus on social housing.

CIRCLE TOWER GLOSSARY

CIRCULAR ECONOMY
A circular economy is an economic system designed to eliminate waste and promote the continual use of resources. In this model, products, materials, and resources are reused, repaired, refurbished, or recycled to extend their lifespan and minimize the extraction of new resources.

LCA
Life Cycle Assessment: a methodology used to evaluate the environmental impacts of a product, process, or activity throughout its entire life cycle, from the extraction of raw materials to production, use, and disposal.

LUXURIOUS LIVING STANDARDS
High quality living spaces with various communal areas and areas for activites which are usually associated with high porperty prices like swimming pools, gym, eventspaces, etc.

SOCIAL HOUSING VS. MUNICIPAL HOUSING
Social housing in the context of Vienna includes all subsidized housing which is accessible to the majority of the population. Municipal housing on the other hand is only available to the lower income class.

PART 1

INTRODUCTION // BACKGROUND

Problem Statement
Aims & Objectives
Research Question/Deliminiations
Method

INTRODUCTION

BACKGROUND

Personal Motivation

Growing up right on the border between Vienna and Lower Austria allowed me to witness the city's expansion over the last two decades. The tower, which will be discussed later (see Part 3), is a structure one passes when driving from my hometown to the city. Despite its plain appearance, the tower stands out due to its height compared to its surroundings. Nowadays, locals and newspapers often describe the tower as "aestetically unpleasing" and there have been proposals for its demolition. However, I believe there is immense potential to rejuvenate the structure and transform it into a significant asset for the local community and the city as a whole.

With sustainability as its cornerstone, this tower aims to serve as an exemplar of the circular economy within a high-rise context. Additionally, it seeks to promote functional and social diversity, with a specific emphasis on fostering new communities. By repurposing an unused high-rise into social housing while adhering to circular principles, the project aims to set a precedent for the future of urban housing construction.

Educational Background

After completing my Bachelor's degree in Architecture at an art college in the US, I realized I lacked the necessary knowledge to address contemporary issues such as global warming. Recognizing the significant role of the construction sector in contributing to climate change, I chose to deepen my understanding of sustainable design before entering the professional realm.

This decision led me to pursue my MSc in Architecture and Planning Beyond Sustainability at Chalmers University in Gothenburg, Sweden. During my studies there, I acquired comprehensive knowledge of the intricate relationship between architecture and the environment, as well as various tools and methods to create structures while considering factors such as resource scarcity, biodiversity loss, and embodied carbon.

This project serves as a means to not only integrate and explore these tools and methods but also to align them with two personal interests: social sustainability and circular economy. Emphasizing how spatial design influences daily human interaction and community development, I aim to integrate circular principles that place sustainability at the forefront of this project.

DILEMMA

Role of the future Architect

Following the regulations and rules;
Figuring out how to challenge them.
Setting modest and limiting goals;
Aiming to over archive them.

Believing in innovation and technology,
Creating for the future generations.
Using the past as philosophy,
Green design as decoration.

Will we ever be wiser,
Will we ever get it right?
Lines drawn, each wall and each riser,
Catching the air and the light.

What do we perceive as success,
Whom do we credit the fame?
Can an only individual
Create a successful domain?

What if all the choices,
What if all the lines
Are drawn from the collective,
Questioning what the role defines.

The system unable to connect,
Historical facts taught all around,
Highlight the one architect
Without the people in the background.

Is it the dedicated individual
Designing the best lines, the best walls
Or can only the the communal
Create harmony for all?

Problem Statement

Urban centers are growing around the world . Cities are struggling to meet the increasing need for affordable housing. In order to meet this demand in a state of climate emergency, there is a need to look for new design solutions.

Urbanization

Cities worldwide are experiencing rapid growth, leading to a significant increase in new construction, primary resource consumption, and biodiversity loss. To address this development, it is crucial to repurpose neglected structures within urban areas and rejuvenate the cityscape.

In Austria, unused land is continually being converted into construction sites, while approximately 400km2 of properties across the country remain unused, representing untapped potential for space conservation.

Climate Emergency

The construction boom accompanying urban expansion, though necessary to meet housing demands, has contributed to nearly 40% of global emissions and significant construction waste. These challenges pose environmental threats, emphasizing the need for a transition to a circular economy. This shift is essential not only for reducing the environmental impact of construction activities but also for fostering sustainable and resilient urban development.

This thesis advocates for the adoption of a circular economy approach to address the challenges of global warming. By reforming the design process, materials, and planning practices, this approach prioritizes resource scarcity and global emissions reduction.

Location: Vienna/Austria

Vienna, with a population exceeding 2 million, stands as the second-largest city in the German-speaking world and is among the fastest-growing cities in Europe.WThe municipality faces immense pressure to provide its residents with attractive and affordable housing within a healthy, safe, and livable environment.

Vienna serves as a beacon of successful housing policies for many, having been consistently ranked as one of the most livable cities globally. According to the global livability index, which evaluates 173 cities based on residents' standard of living, Vienna is renowned for its unmatched combination of stability, robust infrastructure, quality education and healthcare services, and rich cultural offerings (Economist Intelligence Unit, 2023).

Given the city's rapid expansion, there's a pressing need to maintain Vienna's historically developed living standards. This project exemplifies the creation of affordable yet luxurious living spaces while integrating circular design principles, which represent the future of the construction industry.

The project explores the potential of repurposing an unused office tower in Vienna into social housing while adhering to circular principles. It aims to serve as a model for a new approach to design and construction.

1 CIRCULAR ECONOMY

ADAPTIVE REUSE

The goal of this project is to create a concept for a circular building encompassing not only environmental and technological advance but also social, economical, governmental and behavioral. This aims to be achieved by looking at different scales of the building ranging from the urban scale, integrating the project into its context, to the structural scale which includes the overall adaptive reuse of the structure to the human scale, creating flexible living spaces which can be adapted to future needs.

2 SOCIAL HOUSING

LIVING IN A HIGH RISE

Furthermore, the transformation takes place in an urban high-rise which is being converted into a mixed use, having social housing as its core function. The project aims to explore the opportunities for functional flexibility as well as creating communal spaces, which encourage interaction as well as allowing for social variabiliity. The programs focus is rooted in the history and advancements of the local housing stock.

3 URBAN ENVIRONMENT

VIENNA/AUSTRIA

The high-rise is located on the border of Vienna in Austria. The tower, formerly used as office space, has been neglected and unused for more than a decade. The project aims to revitalize not only the building space but also the surrounding area. The great connections to public transport as well as bike and pedestrian paths, give the site a huge potential for adaptive reuse. Additionally, the secondary functions of the building are not only valuable for its inhabitants but also for the local community.

RESEARCH QUESTION

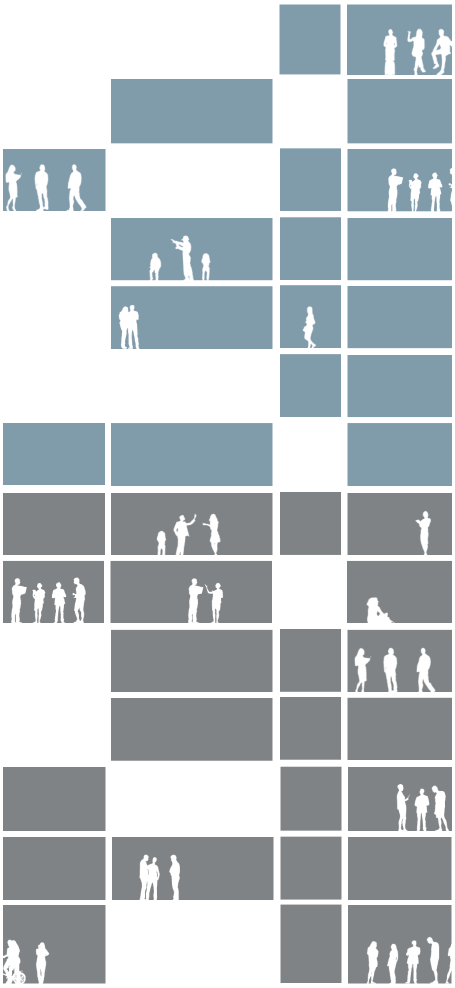
How can the transformation of an unused high-rise into communal housing serve as a model for circular economy in an urban context?

DELIMINATIONS

Focus and Scope of Action

+ presenting a new way of designing through the integration of circular principles
+ identifying and understanding aspects of social sustainability within the urban environment

Defining what the thesis **WILL DO**



GIVE AN UNUSED BUILDING A NEW LIFE
-with a focus on social housing

USE CIRCULAR PRINCIPLES
-identifying challenges and opportunities with adaptive reuse to shape the design

USE AND APPLY CIRCULAR FRAMEWORKS
-with a focus on social housing

FOCUS ON SOCIAL SUSTAINABILITY
-by creating spaces for interaction

FOCUS ON PROFIT
-from Real Estate

PROTOTYPES FOR DISSASSMBLY
-of wall, furniture, etc.

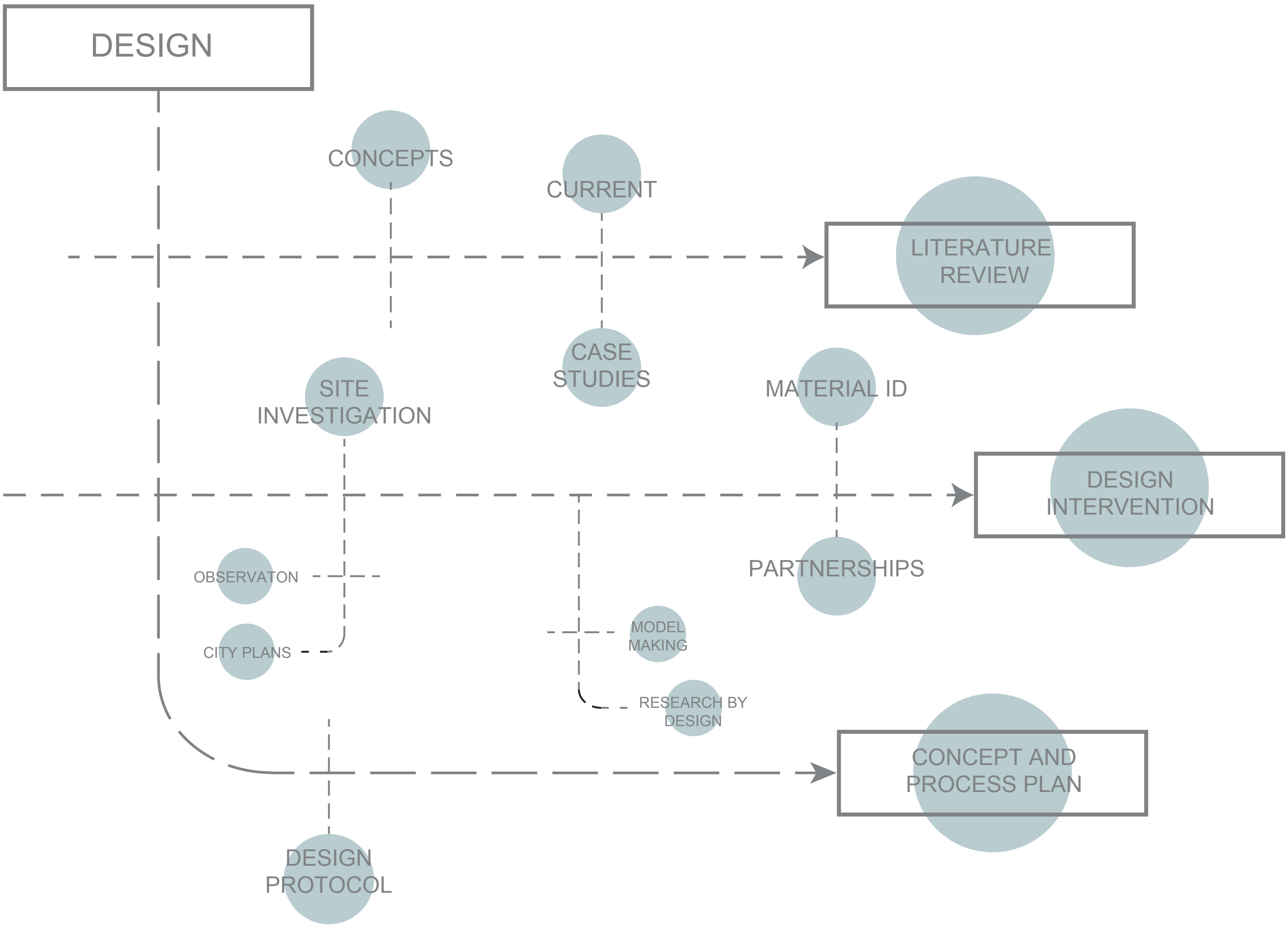
GUIDEBOOK FOR CIRCULAR ECONOMY
-clear guidelines of circular design

SPECULATE DISTRICT DEVELOPMENT
- exhibits considerable variability and flux

THE UNIVERSIAL SOLUTION

Defining what the thesis **WILL NOT DO**

METHOD(S)



Diagrammatic Research plan for development of design proposal; Source: created by author

The primary strategy of this research includes a qualitative approach, case studies as well as corelational research. Therefore "design" serves as a culmination of these methods. First, the meta-tactic research of literature review (square) is being conducted. It includes looking at existing concepts for circular economy, current examples and case studies. Second, an intervention for the design will be formed by conducting a site investigation, selecting specific materials and creating a digital model of the transformation. This also results in the process of research by design and involves exploring ways to design with disassembly in mind.

For the final delivery, the project will include a design proposal for the transformed tower, concepts for circular economy on different scales as well as detailed program outline of the new functions. For the 2D material, plans, sections, elevations as well as details of connections of building parts will be presented. For the 3D material prototypes of connections of these components will be exhibited as well as a digital model, including the site and the tower.

PART 2

THEORY

Social Housing in Vienna
Forms of urban Living
Circular Economy

SOCIAL HOUSING

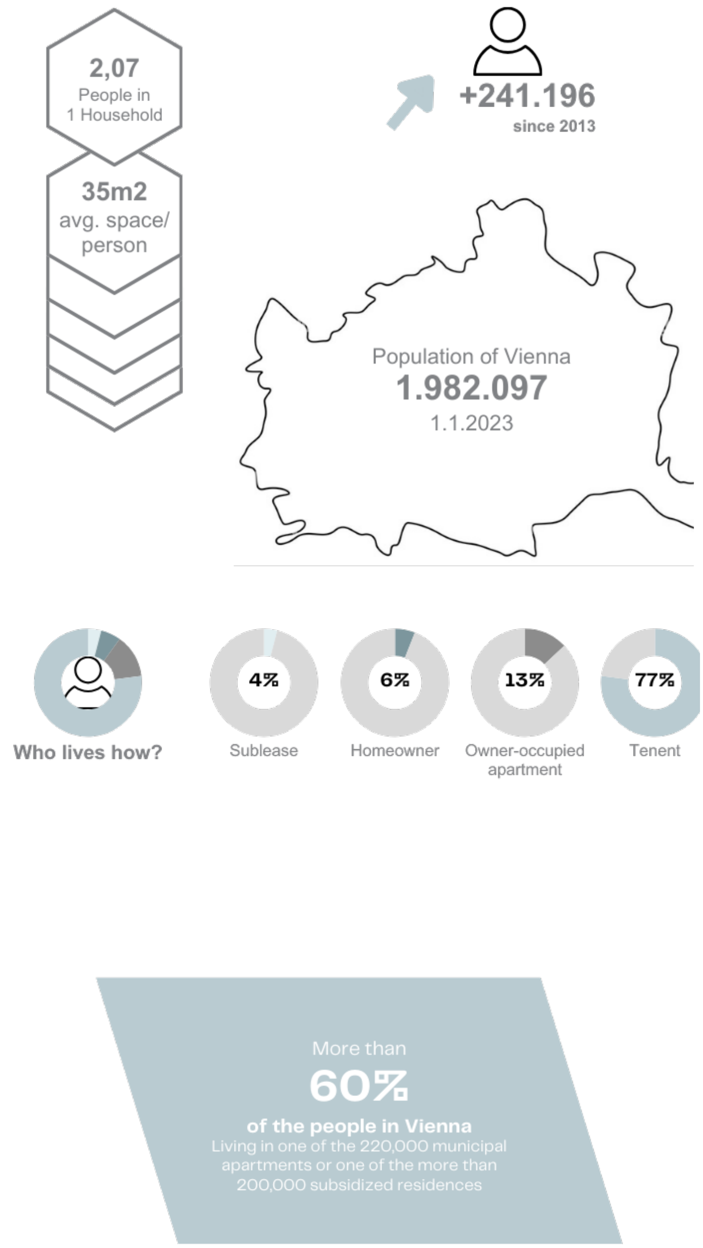
CONTEXT OF VIENNA

Introduction

Vienna stands as a prime example of affordable housing solutions within a major city. Despite the ongoing urban expansion and population growth, housing costs in Vienna remain relatively stable for most residents, thanks largely to municipal and subsidized housing initiatives. This tradition, dating back a century, persists through programs like the New Municipal Housing and the city's housing strategy for the 21st century.

As of 2023, Vienna's population totaled 1,982,097—an increase of 241,196 individuals since 2013. The city predominantly comprises tenants, with 77 percent residing in rented accommodations. Only 13 percent own condominiums, while 6 percent are homeowners, and the remaining 4 percent live as subtenants (Statistics Austria, 2022).

Approximately 45 percent of Vienna's housing market is dedicated to subsidized housing, encompassing nearly 220,000 municipal apartments, residences developed by nonprofit housing organizations, and units renovated through the "gentle urban renewal" initiative. Overall, 60 percent of Vienna's population resides in subsidized housing, with 500,000 individuals living in municipal apartments scattered across the city's 1,800 housing complexes. This equates to one in every four Vienna residents residing in a municipal apartment (Wiener Wohnen - Gemeindewohnungen).



Source: Wiener Wohnen edited by author

VIENNESE HOUSING POLICY

Vienna's housing policy can be best described as "housing for all," a concept that originated during the era of Red Vienna (see Historical Overview p.28). The Austrian Social Democratic Workers Party (SDAP, now SPÖ) leveraged the city's progressive tax structure to finance innovative policies aimed at meeting social needs such as improved housing, healthcare, and education (Holzer and Huberman, 2022).

Central to these policies was the development of a sizable social rental sector coupled with stringent rental regulations in the private market. As a result, both public and private rentals remained affordable for a significant portion of the population. This approach was underpinned by the belief that adequate housing is a fundamental human right, and the aim was to provide satisfactory and affordable housing options to as many people as possible. This was achieved through strict rent controls in the private housing sector and the substantial size of the social housing sector (Litschauer and Friesenecker, 2022). Moreover, the city government aimed to promote social diversity and prevent residential segregation, evident in the distribution of Vienna's municipal housing stock across the entire city (Lévy-Vroelant and Reinprecht, 2014).

However, like many European cities, Vienna has faced challenges in recent decades that threaten its "housing for all" approach. These challenges include rising income inequality, escalating property prices, demographic shifts, and immigration. Consequently, significant policy adjustments have been made, which will be discussed in the subsequent section.

Political Framework

In Vienna, political institutions wield significant influence over housing governance. These institutions comprise the bodies of the federal government, provincial governments, district heads, and municipalities, including cities.

Austrian housing policy has evolved within a historically complex multilevel setting. The federal government holds overarching responsibility for housing, encompassing Tenancy Law and regulations governing Limited-Profit Housing Associations (LPHAs). Consequently, rent controls fall under federal jurisdiction, while both federal and municipal governments shape social housing policies, with housing subsidies managed exclusively by the city (Litschauer and Friesenecker, 2022).

Reforms

Over the past two decades, Vienna has undergone two noteworthy housing policy reforms.

Firstly, the city transferred housing construction to Limited-Profit Housing Developers to mitigate public debt in accordance with European regulations such as Competition Law and the Maastricht criteria. Additionally, it was argued that LPHAs offer comparable low rents. However, a significant difference resulting from this shift lies in rent determination, which is contingent upon land, building, and financial costs, as opposed to a fixed rate. While rents remain relatively consistent, substantial down payments can pose accessibility barriers (Litschauer and Friesenecker, 2022).

Furthermore, Limited-Profit Housing, with its high income thresholds, ensures a more balanced mix of social classes, while municipal housing is primarily targeted towards households with limited financial resources (Litschauer and Friesenecker, 2022).

Another significant change resulting from the transfer of housing construction is the diminished influence of the municipality on new construction. Instead, the city governs the allocation of subsidies, enabling the federal government to earmark one-third of new housing units for the duration of the subsidy loan, typically 40 years. These subsidies also empower the city to shape subsidy programs like the SMART apartment model, introduced in 2017. Designed to benefit low-income households, the model features compact floor plans to reduce housing costs and facilitate lower down payments. The city aims for half of all apartments in Vienna to be SMART apartments. Through subsidy allocation, the city ensures rental affordability, enabling a large portion of the population to access the housing market.

The second major reform pertains to the national level and involves the deregulation of private rental housing. With a focus on ensuring affordable housing for the maximum number of people, stringent rent controls are enforced on private rental units. This regulation originated from the Keynesian welfare strategy and applies to private apartments built before 1945, which constitute 42% of total rentals and two-thirds of private rentals (Kadi, 2015). However, the past three decades have witnessed significant deregulation and erosion of tenants' rights within the private rental market (Litschauer and Friesenecker, 2022).

During the 1990s, the government aimed to streamline regulations, a goal further reinforced by efforts from the right-wing and conservative national government (ÖVP-FPÖ) at the beginning of the 21st century (Litschauer and Friesenecker, 2022).

The most notable reform in the private sector was the establishment of the Tenancy Law in 1994. Instead of determining rent based on amenities, the new law introduced the concept of reference value rent. This allowed landlords to adjust prices according to building plot prices in specific areas, known as location premiums. Additionally, the law introduced time-limited rental contracts, setting a maximum duration of 10 years with a 20% rent discount, aimed at addressing short-term housing supply issues. In 2000, the government abolished limited rent regulation, resulting in a 25% rent discount. The ÖVP-FPÖ coalition subsequently eliminated regulations on contracts, leading to a reduction in the rent-controlled sector. As the reforms of the Tenancy Law were phased in over time, the new regulations only affected new contracts, leading to greater disparities between the municipal and private segments (City of Vienna, 2022).

In summary, housing costs within the rent-controlled private housing segment are influenced by land price developments and the contract's date. The introduction of limited rent contracts may have also presented challenges for tenure.

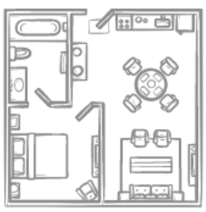
SUBSIDIZED HOUSING

Aside from offering direct assistance through subsidies, the City of Vienna actively and sustainably directs investments into new housing development and the renovation of residential buildings via the Vienna Housing Promotion program. All supported new construction initiatives undergo assessment based on criteria like architecture, economics, ecology, and social sustainability. The objective is to safeguard quality, diversity, and affordability. Additionally, supporting renovation efforts contributes to the continual enhancement of the housing inventory (City of Vienna, 2022).

Since 2011, a significant supplement to subsidized housing has been the Vienna Housing Initiative model. It presents a unique approach to privately financed housing, providing favorable conditions akin to subsidized housing through cost-effective loans from the City of Vienna. The city has linked the allocation of these loans to property developers with mandatory equity and rent limits, as well as stringent quality criteria (City of Vienna, 2022).

Social housing in Vienna boasts a rich tradition spanning over a century. The organization "Stadt Wien – Wiener Wohnen" is tasked with managing, renovating, and overseeing the administration of Vienna's urban residential complexes. Half a million Viennese inhabitants call social housing their home, making "Wiener Wohnen" the largest municipal property management entity in Europe. The legacy of social housing in Vienna is deeply intertwined with the city's history and the lives of its residents. Vienna is globally recognized for its exceptionally high quality of life, with the affordable and tailored apartments provided by Viennese municipal housing playing a pivotal role in this reputation (City of Vienna, 2022).

13.441.914 m2
rented space by "Wiener Wohnen"



220.000
municipal apartments in over 2000 Apartment complexes

67.00
trees are located on the properties

6.000
restaurants are managed by "Wiener Wohnen"

Source: Wiener Wohnen edited by author

SPECIAL HOUSING TYPES

Municipal Housing

The most significant and well-known housing type in regards to social housing in Vienna is the sector of municipal housing (Gemeindebauten). These are distributed throughout the whole city and consist of around 1800 structures containing 220,000 apartments, providing living spaces for half a million of Vienna's population (Wiener Wohnen, 2022). These are managed by the city as well as Limited-Profit Housing Associations (LPHAs), whereas the flats administered by the city are specifically for low-income households, while the LPHAs target the middle class.

To gain access to municipal housing in Vienna, one must obtain the Viennese housing ticket (Wiener Wohn-Ticket) by meeting certain criteria, such as staying below the maximum threshold of the yearly net household income. Additionally, proof of at least two years of main residency in Vienna and Austrian citizenship or one with equal status (including EU citizenship) are required (Wohnberatung Wien, 2022).

By setting the income thresholds rather high, stigmatization of living in municipal housing is prevented. Another key aspect is the even distribution of the apartments in the city, which similarly prevents segregation from occurring (Verwiebe, 2021).

Municipal Housing Characteristics

Over the last few decades, the characteristics of social housing in Vienna have evolved, but the fundamental concept has remained unchanged. Although architectural expression and construction have adapted to the times, it remains easy for Viennese residents to recognize social housing by certain characteristics. These include the almost village-like structure with ample green space, playgrounds, meeting areas, and spaces for interaction.

Social housing from "Red Vienna"

The most typical social housing was constructed during the "Red Vienna" era, which lasted from 1918 to 1934. These structures are clustered around inner courtyards and feature large openings to access green spaces. During the construction years, these designs were heavily criticized for their "castle-like" characteristics, which are now highly valued for creating barriers and forming quiet and protected spaces for residents. One example is the Karl-Marx Hof (1927-30) (City of Vienna, 2022).

Similar to structures like the Karl-Marx Hof, the Metzleinstalerhof (1916-25) presents both similarities and contrasts. It features a large, square courtyard reminiscent of Baroque-era architecture. However, loggias, balconies, bay windows, as well as various colors and artworks, break up the facade, giving the building a unique character (City of Vienna, 2022).

Each social housing project incorporates numerous communal areas such as childcare facilities, swimming pools, and laundry rooms, as well as essential services like doctors' offices and pharmacies. The integration of green spaces has not only attracted humans but also animals. Today, social housing in Vienna constitutes the largest protected social living habitat in Europe, complete with a hiking path traversing the city (City of Vienna, 2022).

Naming of municipal housing

The names of the housing projects were often inspired by individuals of great significance, such as Sigmund Freud, Wolfgang von Goethe, and Friedensreich Hundertwasser, serving as memorials to their legacies. Each social housing project possesses its unique character and represents the spirit of its time.

Additionally, each housing structure not only received a unique name but also utilized different typologies to express its character. Some letters appear strictly geometric, while others adopt a more poetic form. Even if no name is explicitly stated, each facade prominently displays the date of construction in red letters, along with the owner "Gemeinde Wien" (Municipality of Vienna) (City of Vienna, 2022).

CO-OPERATIVE FLAT (GENOSSENSCHAFTSWOHNUNG)

Co-operative flats are not owned by the municipality or the private sector but rather by a co-operative housing association (Genossenschaft). To gain access to a flat within the association, one must become a member (City of Vienna, 2022). One of the main benefits of renting a co-operative flat is the possibility to buy the apartment after a specific period of residency. This type of apartment targets people whose financial situation doesn't allow them to buy a condominium and who prefer not to rent within the private sector (Wiener Wohnen, 2022)

To gain access to a co-operative apartment, one must make a financial contribution, pay a membership fee, and meet certain requirements such as a yearly net income below the set limit and Austrian citizenship or equivalent. The membership fee is usually easily affordable, whereas the initial financial contribution might pose a barrier for a certain part of the population (City of Vienna, 2022).

Co-operative apartments also offer the option to buy the apartment, but this option typically becomes available after 10 years of residency, as regulated by the Housing Non-profit Act. There is a common misconception that the rent paid during the period of residency will be ultimately deducted from the purchase price, which is incorrect. Instead, the initial financial contribution, reduced by 1% per year, will be deducted (Wiener Wohnen, 2022).

Furthermore, another advantage of obtaining a co-operative apartment is the lower rent compared to privately financed apartments. This is due to the involvement of non-profit building associations. These developers can apply for housing funding from the city, resulting in them having to invest less of their own funds (Wiener Wohnen, 2022).

SMART APARTMENTS

The SMART apartments initiative was introduced in 2022 by the city of Vienna with the aim of providing pragmatic and compact housing units tailored to specific living situations. These so-called “smart” housing solutions involve the most efficient arrangement of apartment structures to meet the needs of specific household configurations, targeting groups such as young families or single individuals. The cost and requirements to access this type of housing are similar to municipal housing in Vienna, including the necessity of obtaining a Viennese housing ticket (Wohnservice Wien, 2022).

Characteristics:

SMART apartments prioritize high practicality alongside remarkably affordable equity and rents. They serve as an exemplary model for compact and economical housing. Through well-thought-out floor planning, every square meter is optimally utilized. SMART apartments can be fully furnished with standard furniture, providing a complete basic infrastructure including sanitary and electrical facilities. Notably, there are opportunities for space optimization in the sanitary area, such as opting for a shower instead of a bathtub or merging the bathroom and toilet. Rental prices are comparable to municipal housing (City of Vienna, 2022).

Category A (1 Room)

- Useable condition
- Floor space: at least 30 square metres
- Bedroom, kitchen or kitchenette, hallway, toilet, up-to-date (small) bathroom
- Common heating system, or floor heating, or stationary heating of the same standard
- Water heating system
- max. 40 m2

Category B (2 Rooms)

- Useable condition
- Bedroom, kitchen or kitchenette, hallway, toilet, up-to-date (small) bathroom
- max. 55 m2

Category C (3 Rooms)

- Useable condition
- Indoor water supply and toilet
- max. 75 m2

Category D (4 Rooms)

- Useable condition
- Indoor water supply and toilet
- max. 85 m2

Category E (5 Rooms)

- max. 100 m2

(Wohnservice Wien, 2022)

HISTORICAL OVERVIEW OF SOCIAL HOUSING IN VIENNA

A brief history

The following section covers essential key points throughout the history of Viennese municipal housing, from the construction of the first Viennese municipal housing to the present day.

1900
300.000 people in Vienna are homeless

before 1918
Housing shortage during founding area

1918
After the first democratic municipal council election, Vienna becomes the world's first social democratic metropolis.

RED VIENNA

1925
Metzleinstaler Hof: first municipal housing project in Vienna,

1930
Karl-Marx Hof: is one of the best-known Gemeindebauten in Vienna

1/10 Viennese live in municipal housing.

1934
Interruption during Austrofascism and National Socialism.

1945
After WWII 87,000 apartments are destroyed in Vienna, leaving 35,000 people homeless.

RECONSTRUCIÓN

1950
Start of fast construction program: The first small, collapsible "duplex apartments" are created, providing a significant amount of new living space.

1957
Construction of the residential high-rise at Matzleinsdorfer Platz.

1960s
On average, 9,000 new municipal apartments are constructed each year.

1963
Residential complex Leopoldau

1970s
Large-scale projects such as the Wohnpark Alt-Erlaa and Am Schöpfwerk are being built. They represent the new reform projects in municipal housing.

1976
Residential complex "Am Schöpfberg"

1980s
Completion of the first residential complex heated with solar energy in Johann-Gottek-Gasse.

1985
Residential Park Alt-Erlaa

1990s
Increase of housing construction in the north-eastern parts of Vienna.

1992
Handelskai 296–298: Europes first Low-energy building

2000 until today
The entire subsidised housing segment is transferred from the city of Vienna to non-profit and limited-housing developers.

2002
Last municipal housing in Rösslergasse 15 in Liesing

2012: Start of the Smart Living Program

2020
21 municipal housing projects in the planning & construction. Completion by 2026

2021
First social housing project transformed into passiv house

Today
1/4 of all people in Vienna live in social housing

(City of Vienna, 2022)

IN-DEPTH ANALYSIS OF SOCIAL HOUSING EXAMPLES

1925

METZTALER HOF

ROBERT KALESA

The first “true” municipal housing complex in Vienna was equipped with direct light for all rooms, a central public bath and laundry, a kindergarten, a library, club rooms, and a workshop.

1930

KARL-MARX HOF

KARL EHN

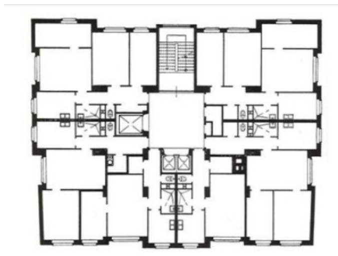
Originally, the Karl-Marx-Hof had 1,382 apartments accommodating approximately 5,000 people.
Its facilities included 2 central laundries with 62 stations each, 2 baths with 30 showers each, 2 kindergartens, a dental clinic, a maternal care center, a library, a youth center, a post office, a pharmacy, and 25 commercial spaces.

1957

MATZLEINSDORFER PLATZ

LADISLAUS HRUSKA

The first high-rise built as municipal housing in Vienna was a 20-story building. It was also the first residential building equipped with central heating and connected to district heating. Initially, there was a restaurant with a terrace on the top floor.

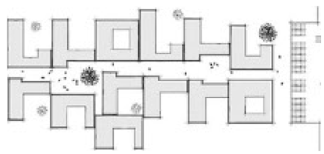


1963

GROSSFELDSIEDLUNG LEOPOLDAU

PETER CZERNIN AND HARRY GLÜCK

With 5,516 apartments, it is one of the largest municipal housing complexes in Vienna. It serves as a “housing city” for 21,000 residents, featuring a center comprised of high-rise buildings, a community center, kindergartens, schools, a retirement home, and green spaces plus an indoor pool.

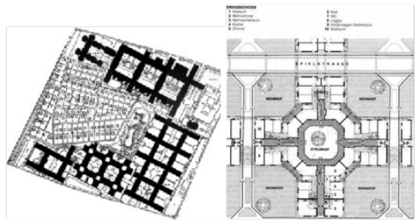


1976

RESIDENTIAL COMPLEX “AM SCHÖPFWERK“

VIKTOR HUFNAGL

The building blocks are geometrically arranged around courtyards. The complex is equipped with a dense infrastructure that includes an elementary/ secondary school, kindergartens, after-school care facilities, playgrounds, several clubs, diverse commercial infrastructure, and a church.



1985

RESIDENTIAL PARK ALT-ERLAA

HARRY GLÜCK

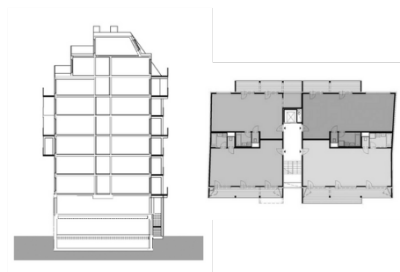
The three 400-meter-long blocks, ranging from 23 to 27 stories, follow the concept of the “stacked single-family house” in the form of terrace apartments. Each apartment features planter boxes of nearly 4 square meters extending up to the 12th floor, as well as at least one loggia per apartment.

1994

HANDELSKAI 296–298

HARRY GLÜCK

Europe’s first low-energy building, the apartments follow a simple layout with a central core connecting them to the vertical circulation. Each apartment has a balcony or a loggia, providing essential access to the outdoors.



2023

SONNWENDVIERTEL

GEISWINKLER & GEISWINKLER

116 SMART apartments out of 148 subsidized apartments, with SMART apartments distributed across all floors. The complex offers a diverse range of floor plans and features an extended balcony walkway serving as a communication zone, as well as an extensive range of open spaces.

(City of Vienna, 2022)

CASE STUDIES IN NUMBERS

KARL-MARX HOF

Site: 150.000m2
Building footprint: 39.000m2 (23% of Site)
Total building area: 175.500m2
Number of stories: 5
Number of units: 1.043
Inhabitants: 5.500 people
Avg. Sizes of Units: 30-60m2

Area designated to:
- Apartments: 168.629
- Communal Spaces: 16.871m2
- Green space: 111.000m2

RESIDENTIAL COMPLEX ALTE-ERLAA

Site: 240.000 m2
Building footprint: 62.117 m2
Total building area: 287.000 m2
Number of stories: 23-27
Number of units: 3.200
Inhabitants: 9.000 people
Avg. Sizes of Units: 74,5 m2

Area designated to:
- Apartments: 287.000 m2
- Communal Spaces:
- Green space: 123.000 m2

SARGFABRIK BKK-2

Site: 4.711m2
Building footprint: 2.870m2
Total building area: 7.570m2
Number of stories: 4-8
Number of units: 75
Inhabitants: 155 people (75 adults,45 kids)
Avg. Sizes of Units: 30-130m2

Area designated to:
- Apartments: 168.629
- Communal Spaces: 16.871m2
- Green space: 111.000m2

WOHNPROJEKT GLEIS 21

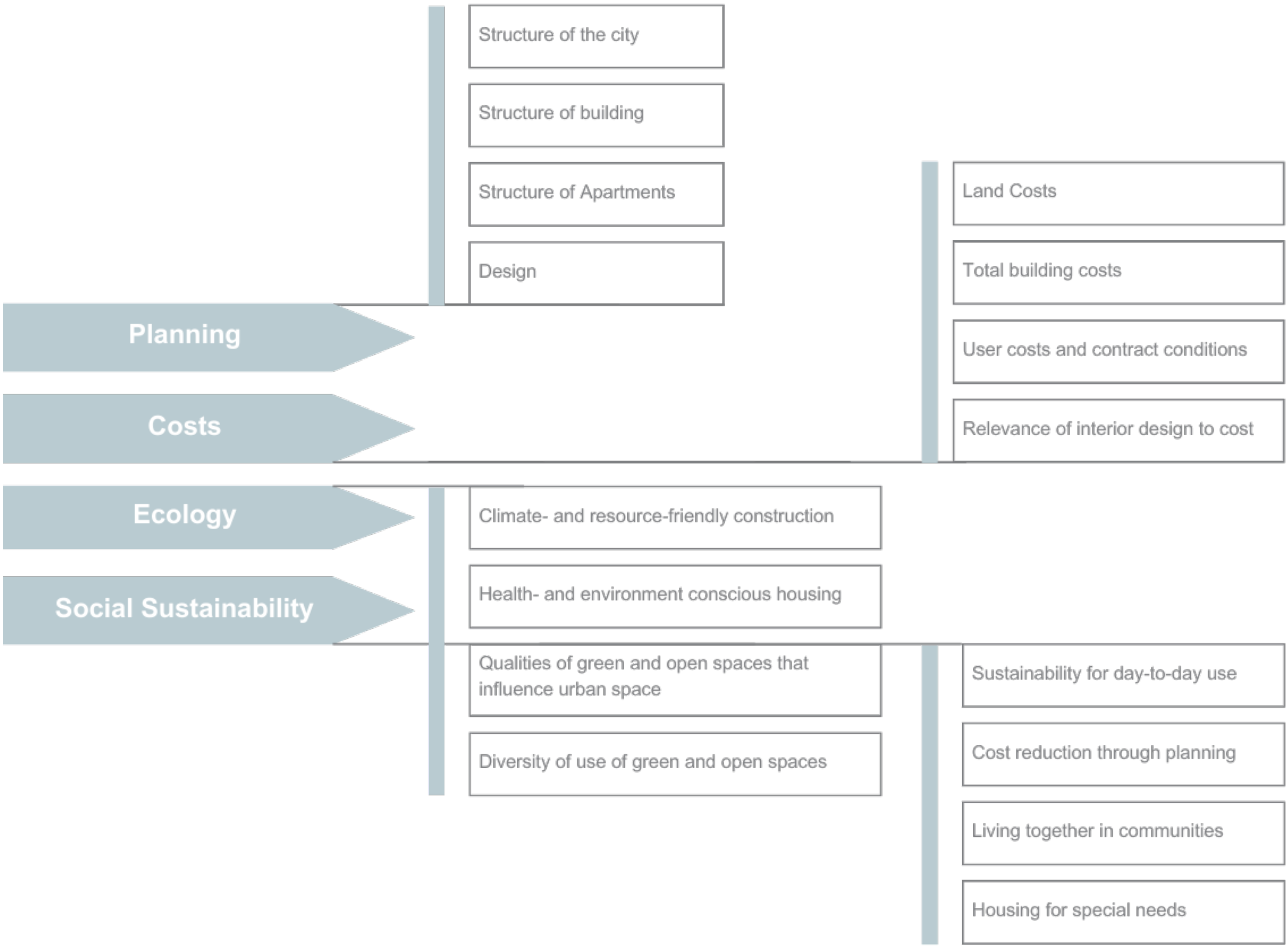
Site: 1691 m2
Building footprint: m2
Total building area: 4698 m2
Number of stories: 4
Number of units: 34 (1-6 rooms)
Inhabitants: 76 people (49 adults,27 kids)
Avg. Sizes of Units: 36-137 m2

Area designated to:
- Apartments: 287.000 m2
- Communal Spaces:
- Green space: 123.000 m2

Analysis conducted by the author

"The four pillar model"

In every subsidized housing initiative, an interdisciplinary panel evaluates the projects using four sets of criteria: planning, costs, ecology, and social sustainability, with the latter gaining prominence in recent competitions. The primary objective is to encourage both functional and social diversity, with a specific focus on establishing new communities. The panel comprises experts, including architects, landscape planners, ecologists, economists, and sociologists, most of whom are nominated by independent institutions for a two-year term (Förster et al., 2016).



Source: Förster edited by the author

HIGH-RISE LIVING

OPPORTUNITIES & CHALLENGES

DENSIFICATION

In his work, “Gegen Wegwerfarchitektur,” Vittorio Magnago Lampugnani highlights the advantages of higher densification within a city such as Vienna (2023). Among these are the elimination of long commute drives to work, home, school, essential services, or free time activities. This not only saves time and energy but also reduces car emissions and the need for parking. Additionally, the possibility of many people living in the same area encourages the formation of communities and therefore raises social sustainability. Furthermore, by creating space within the city, it saves untouched land from being developed, such as the Viennese Woods, which hug the outskirts of the city (2023). As Lampugnani said:

> “The most ecological house is the one that is not realized. To put it in a nutshell: No new construction is allowed anywhere. More precisely: In principle, construction can only take place where construction has already taken place. Even more precisely: no new building land may be designated any more.

(Lampugnani, 2023)

DISPUTE IN HOUSING CONSTRUCTION

The ideological clash between Roland Rainer and Harry Glück stands out as one of the most prominent debates in the realm of domestic housing construction in the post-1945 era. Rainer proposed a model of the modern garden city, characterized by densely packed low-rise housing units accompanied by extensive greenery, as a response to the mundane mass urban housing and rural urban sprawl (Seiss, 2015).

Urban Village: Puchenau by Roland Rainer

Conversely, Glück introduced an alternative model, the residential park, featuring multi-story terrace houses vertically arranged with private green spaces (Glück, 2017).

Alt Erlach "residential Park" by Harry Glück

Rainer accused Glück of introducing an "in-human" dimension to his housing complexes, prompting Glück to counter by highlighting the lower population density and the reduced affordability of Rainer's housing developments. Essentially, both architects were pursuing a shared objective: to create space-efficient, high-quality housing solutions accessible to the broader population, emphasizing proximity to green spaces and the absence of vehicular traffic. Notably, the principles that contemporary sustainable housing and urban planning aspire to achieve, yet often fall short of, were effectively realized by both architects as early as the 1960s, well before the concept of "sustainability" gained widespread recognition (Seiss, 2015).

PSYCHOLOGICAL AND SOCIAL IMPACTS

Rapid urbanization on a global scale has spurred a surge in high-rise construction, a trend expected to persist. Exploring the social, psychological, and behavioral implications of high-rise living and working is a relatively new field of systematic empirical study. Evaluated post-occupancy studies of high-rise buildings suggest adverse psychological and social effects, especially among lower-income demographics. However, innovative design approaches show promise in alleviating or eradicating these impacts.

Residential High-Rise
With a substantial increase in the percentage of the global population residing in high-rise structures in recent decades, scholars have initiated explorations into the concept of high-rises as 'homes' and their impact on individual identity, a sense of belonging, and various psycho-social aspects, which encompass social interaction, mental well-being, safety and crime, and the experiences of distinct population subsets (Baxter, 2017).

Mixed-use High-Rise
One advantage of high-rise structures lies in their capacity to integrate multiple functions in close proximity. Typically, the amalgamation of residential, office, entertainment, and commercial spaces within these settings aligns with contexts of considerable economic influence and elevated social status (Costello, 2005). Occupants generally respond positively to these settings. Individuals residing in mixed-use high-rises often perceive a sense of safety, community, and healthier living conditions.

SOCIAL INTERACTION

For years, the debate surrounding the impact of high-rise living on social isolation and fragmentation has persisted. Initially noted in the 1970s with connections between high-rise dwelling and feelings of loneliness (Yancey, 1971), recent studies conducted across diverse cultural and geographical settings reinforce this correlation. Musterd & Ronald (2007) highlighted reduced social engagement in a comparative European high-rise housing study, attributing the isolation to designs that foster ‘individualization and anonymity’. Research in Paris (Moser, 2003) found that overcrowding in high-rises led to strained relationships with neighbors, sparking irritability and conflict.

However, other studies have presented a more intricate view of the correlation between high-rises and social isolation. For instance, Huang (2006) observed that high-rise apartments featuring central courtyard areas exhibited notably higher levels of social interaction among residents compared to those without such communal spaces in their design. In a study conducted in Hong Kong by Forrest (2002), it was noted that high-rise occupants often maintained a strong sense of community, primarily centered around relationships with colleagues or schoolmates in proximity rather than familiarity with immediate neighbors. These studies suggest that various sociological factors and the overall environmental design, rather than high-rise structures themselves, might be more influential in shaping social interactions.

MENTAL HEALTH

Studies have shown a higher prevalence of mental health issues among residents in high-rise buildings compared to the general population (Evans, 2003). Bond (2012) corroborated this finding but introduced the notion that the inherent physical characteristics of high-rise settings might not be as influential on residents’ mental health as the broader social environment and perceptions of its inhabitants. Their proposition suggested that the primary cause of mental health disparities was the social stigma linked to specific types of high-rise residences.

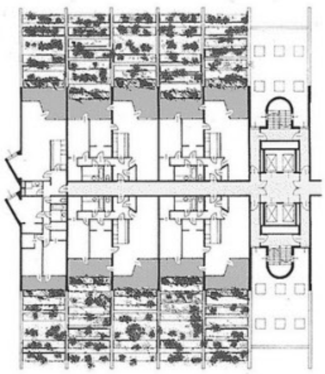
Another aspect highlighted in the literature is an expanding body of research pointing to the lack of vegetation and natural elements in the environment as contributors to stress and emotional instability (Kuo & Sullivan, 2001). Some researchers have investigated mental health outcomes from this perspective and found that integrating natural elements into high-rise residences can notably enhance residents’ psychological well-being (Wener & Carmalt, 2006).

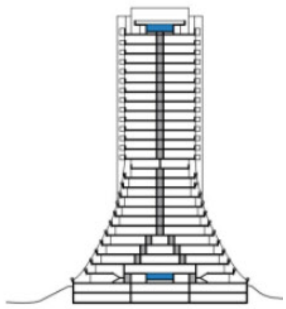
RESIDENTIAL COMPLEX ALT-ERLAA

Alt-Erlaa serves as an exemplary case of social housing complexes in Vienna, accommodating approximately 10,000 people in the city's 23rd district. Designed by Harry Glück and constructed between 1975 and 1986, the development comprises 2,300 family-oriented units arranged in three rows of high-rises of varying heights (AEAG, 2022).

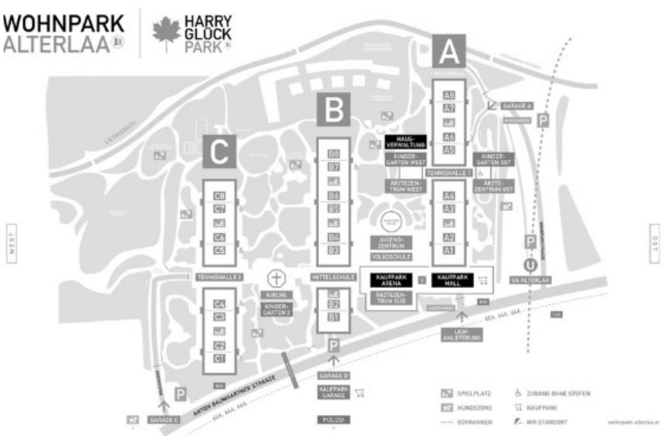
Each tower begins with a broad base that gradually tapers as it rises, creating generous terraces for the lower-level units. Residents have personalized these terraces with their own plants, adding a touch of greenery to the semi-circular planters lining the edges. As the towers ascend, they adopt a more linear form, culminating in subtle saw-tooth patterns that reach towards the sky.

The lower floors are designed with central storage areas to ensure that units don't become excessively deep, allowing natural light to penetrate the space. On the upper floors, the layout adopts a straightforward double-loaded-corridor structure, intersected by vertical circulation cores that are distinctly marked on the exteriors through contrasting-color tubular shapes. This consistent design approach is applied across the entirety of the project, with buildings of different heights and lengths to introduce visual diversity within the overall composition. (Burkhart, 2022).

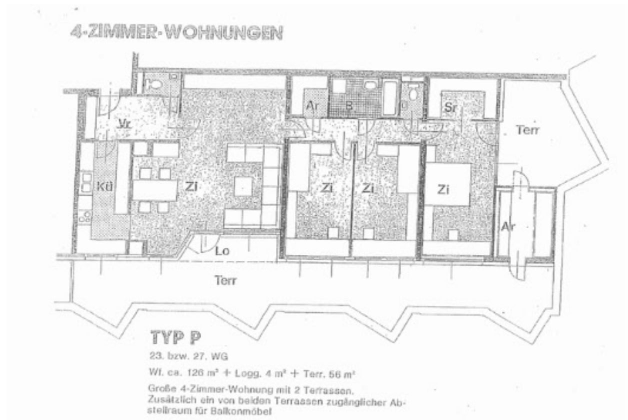




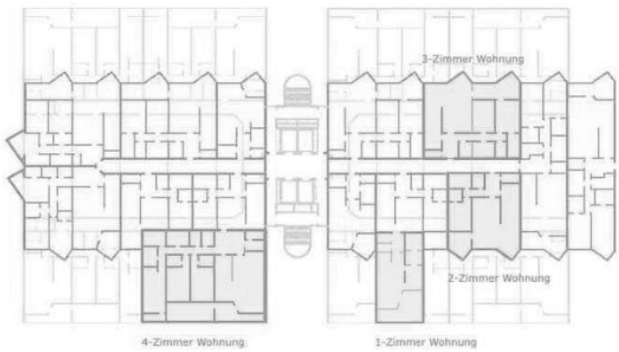
The layout’s open design serves to enhance the intrigue and quality of life within this masterplan. The considerable distance between each row of buildings creates a park-like ambiance. These areas are thoughtfully arranged with various playgrounds and sports facilities. The varying heights, informal pathways, and methodical plant placement collectively mitigate the potentially overwhelming appearance of the residential towers.



The location boasts seven rooftops and seven indoor swimming pools, along with twenty saunas, two indoor tennis centers, and four badminton courts. Additionally, it hosts several amenities, including a church, a local TV station, a shopping center, a newspaper office, medical facilities with a minimum of 12 doctors, kindergartens, schools, a library, playgrounds, and a park. The building entrance foyers showcase large art installations (AEAG, 2022).



The apartments adhere to the concept of combining living rooms with kitchens and separately accessible bedrooms, along with a significant number of storage spaces. Larger apartments are equipped with a second bathroom. In total, 35 different floor plans were designed (Hidden Architecture, 2022).



REFLECTIONS

SUMMARY

The reasons why the world looks to Vienna for its successful social housing model are numerous. Deeply rooted in history, the city has maintained a strong focus and provided financial support for housing since the early 1900s. Through developer competitions, projects are realized to a high standard, emphasizing architecture, ecological and economic aspects, and social sustainability.

While each social housing project has distinct characteristics related to its construction period, they share common traits such as luxurious communal spaces, private green areas for leisure, and a commitment to ensuring ample daylight throughout the buildings. As early as 1925, the first social housing project offered high-quality living spaces to people without discrimination based on their economic status.

CIRCULAR ECONOMY

FROM LINEAR TO CIRCULAR

INTRODUCTION

By emphasizing the potential for buildings and their components to revert to a previous state, this MT aims to maximize resource efficiency. The strategy encompasses two key aspects: a spatial dimension, which focuses on efficiently adapting a building to meet new spatial requirements, and a technical dimension, involving the refurbishment, disassembly, and potential reuse of building components, or their recycling and biodegradation.

When exploring the concept of circular buildings and the continuous flow of materials throughout all stages of a building's life and its components, there is a focus on the Spatial, Structural, and Material dimensions of transformation. These dimensions of design are underpinned by the core principles of reversible building design, which consist of disassembly, adaptability, and reuse (Durmiservic, 2019).

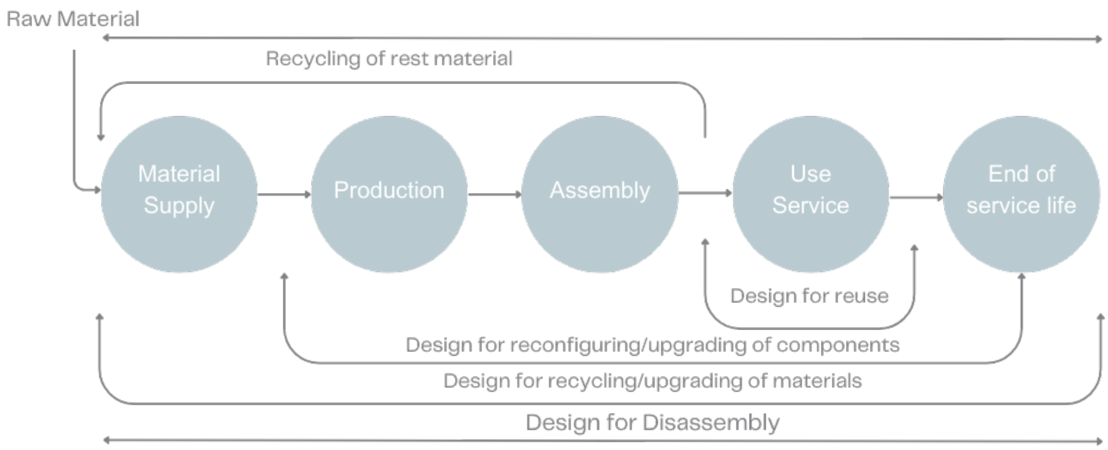
DESIGN FOR DISASSEMBLY

Design for disassembly refers to a feature of a product's design that facilitates the disassembly of the product at the conclusion of its useful lifespan. This disassembly should enable the reuse, recycling, energy recovery, or some other diversion from the waste stream of its components (Durmiservic, 2019).

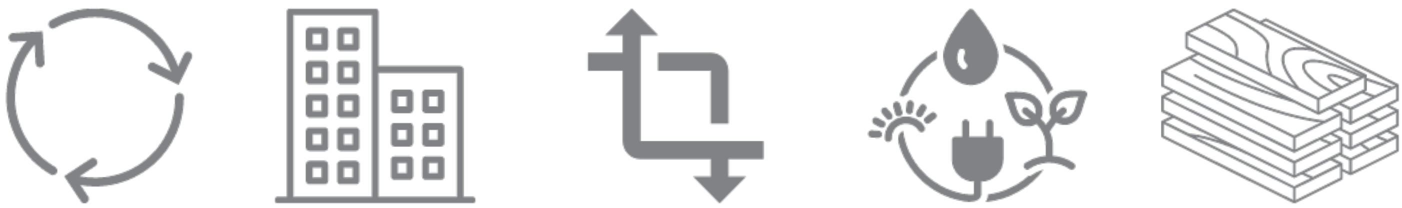
ADAPTABILITY & REUSE

In the realm of architectural design, adaptability denotes a building's inherent capability to embrace significant transformations. As a building progresses through its lifecycle, change is an inescapable reality, shaped by the evolving social, economic, and physical landscapes, as well as the ever-changing needs and preferences of its inhabitants (Russell & Moffatt, 2001).

LIFE CYCLE PHASES



DESIGN AND CONSTRUCTION



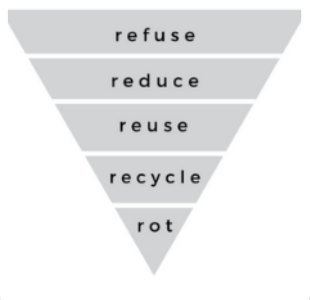
Circular Design | Transformation of building stock | Possibility for future re-use | Resource efficient Construction | Sustainable and local materials

For this Master's Thesis, five core principles are outlined, guiding the design process and supporting the shift towards sustainable and environmentally cautious design and construction. The first core principle focuses on circular design, incorporating the practice of creating durable, reusable, repairable, and recyclable components to eliminate waste. This involves specific material selection and a focus on flexible yet easily modifiable space.

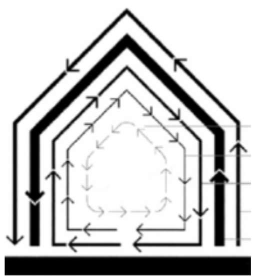
Additionally, the principle emphasizes the creation of material IDs for future component identification and reuse options. Moreover, by repurposing existing structures, the building stock gains a second life, thus preventing demolition. The design also considers potential future uses of the building, integrating energy-efficient construction methods and incorporating local and sustainable materials to reduce CO_2 emissions and global warming potential.

CIRCULAR DESIGN

Selection of Materials



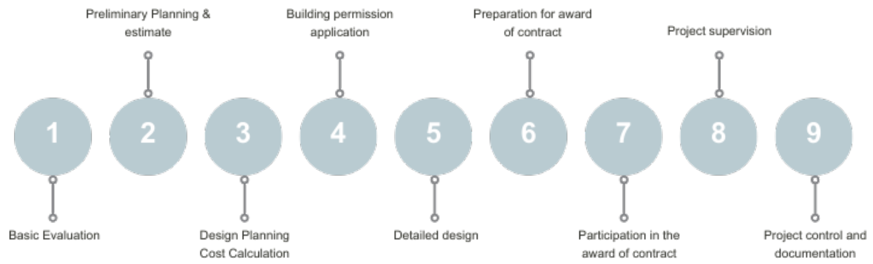
Design for Disassembly and Flexibility



Material and Product Passports

PLANNING

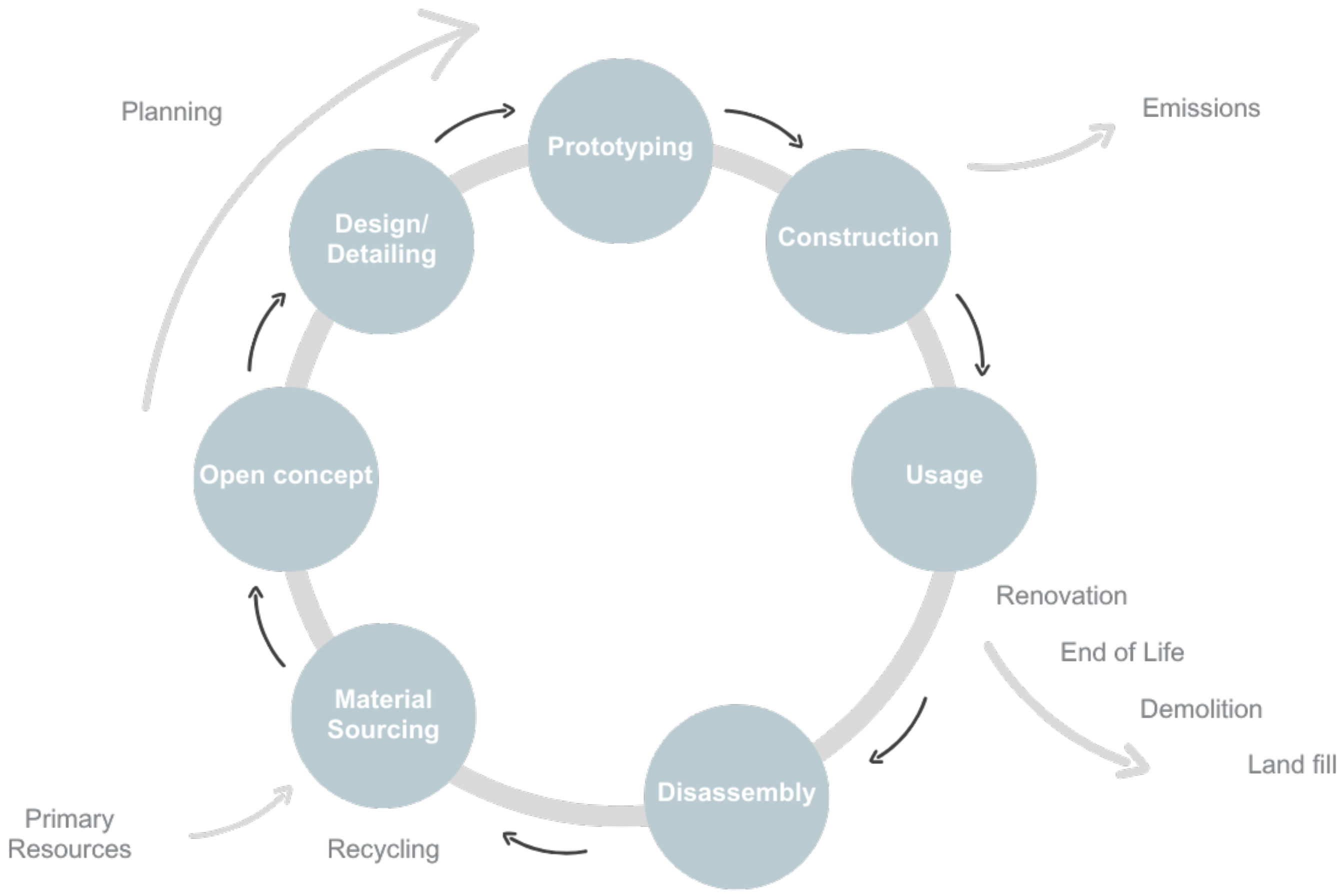
LINEAR MODEL



In traditional building construction in Austria, there were a total of 9 "construction phases." These construction phases are defined by the HOAI (Fee Scale for Architects and Engineers) and break down the overall services provided by architects into individual parts.

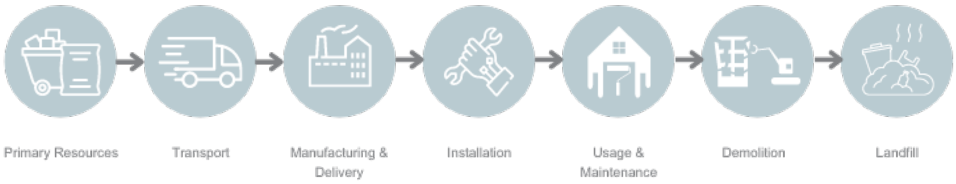
CIRCULAR MODEL

Since the EU legislation changed in 2021, it is no longer mandatory to follow these phases in Austria. Consequently, a new model is required to outline a future-oriented and sustainable construction process. For this project, a cyclic model for the planning track was identified, with material reuse at its core.



MATERIAL

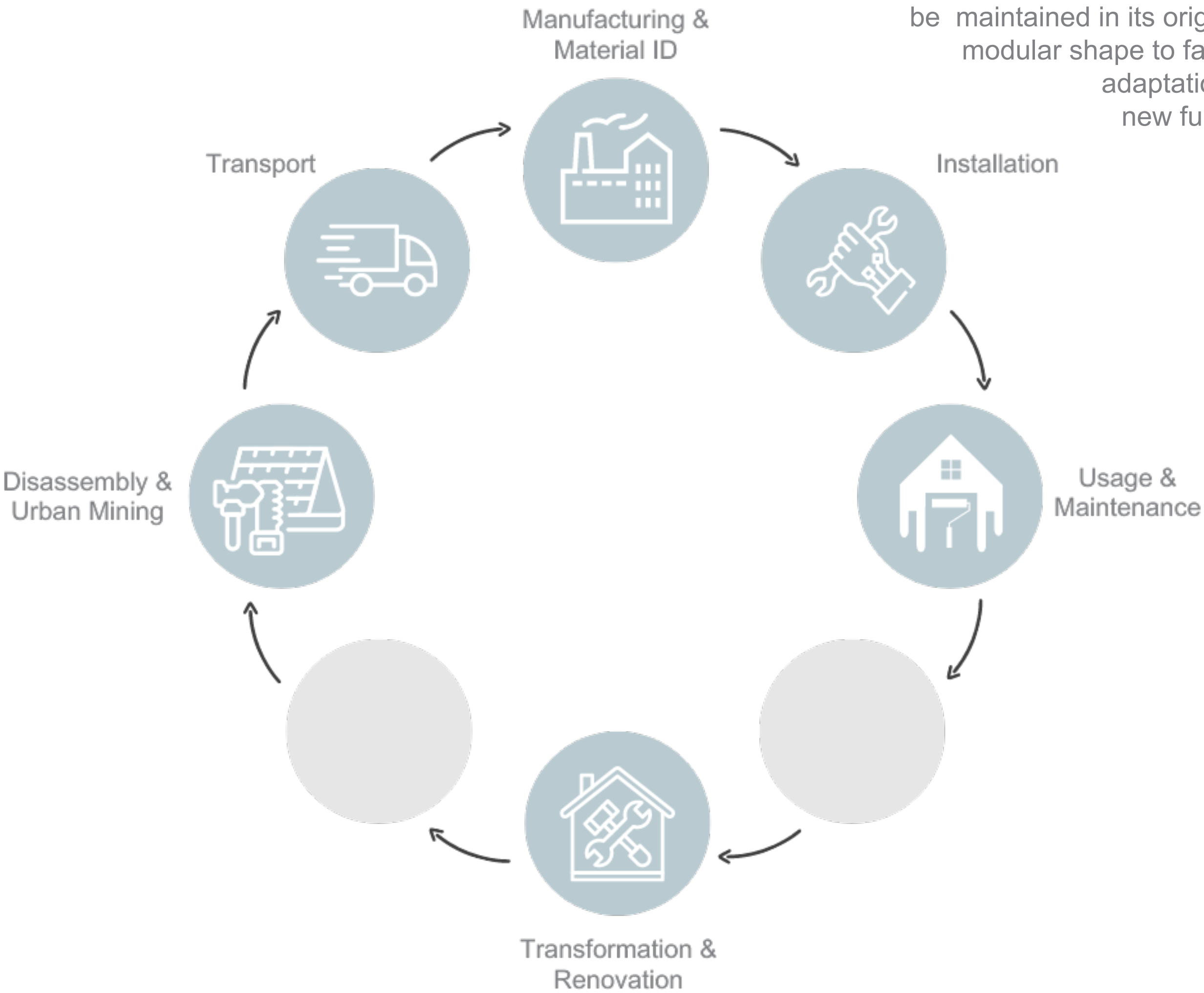
LINEAR MODEL



When considering the commonly utilized material track, the necessity for change becomes even more apparent. Given the scarcity of primary resources, the traditional linear material track no longer meets today's standards.

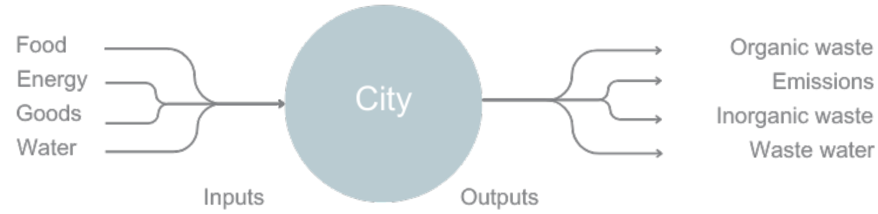
CIRCULAR MODEL

To close the loop for the material track, specific attention must be given to the possibility of disassembly and re-use, whether the material is extracted as a primary resource or sourced from urban mining. Ideally, the material should be maintained in its original or modular shape to facilitate adaptation to a new function.



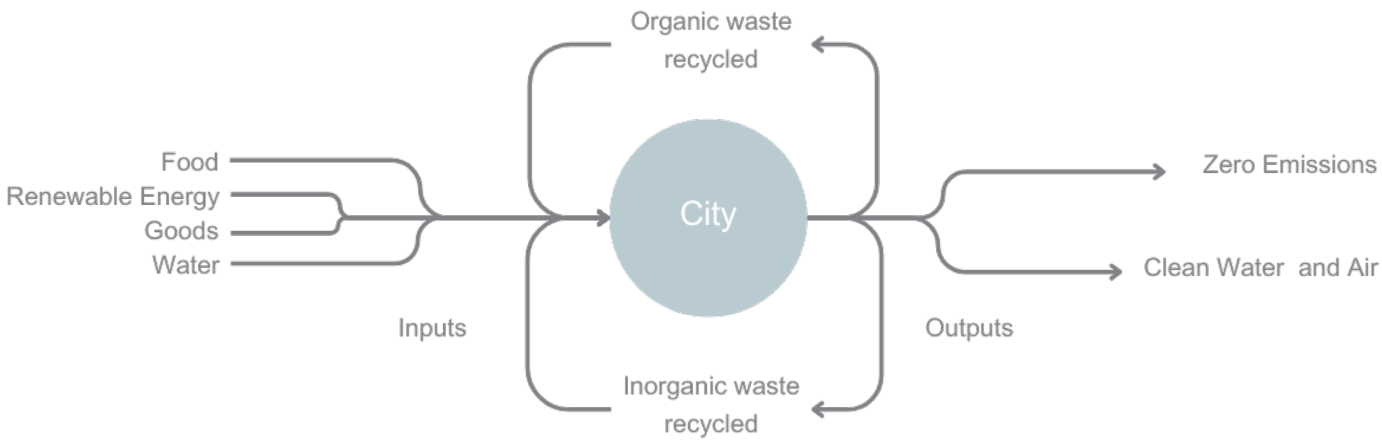
CIRCULAR METABOLISM OF CITIES

LINEAR MODEL



In contemporary times, cities exhibit a linear metabolism wherein non-renewable resources are imported, inadequately captured and transformed, and subsequently used. Following their use, waste is exported, leading to the loss of valuable resources (Lucertini & Musco, 2020).

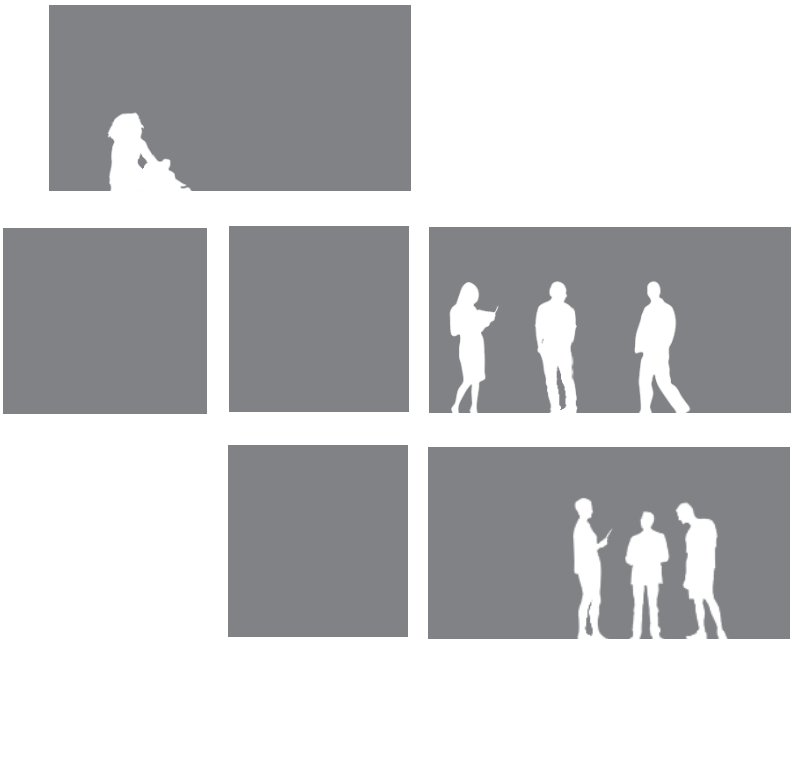
CIRCULAR MODEL



The acceleration of urbanization, increasing resource scarcity, and the effects of climate change all underscore the need for sustainable urban management and design. This entails moving towards closing cycles, minimizing environmental impacts, and strategically managing resources.

Circular metabolism involves capturing and transforming incoming renewable resources efficiently within the city. Waste is minimized through recycling and cascading practices. (Lucertini & Musco, 2020).

> “Cities are the mines of the future.
> (Jacobs, 1969)



PART 3

APA TOWER/VIENNA

Site Context
Preconditions
Analysis of local conditions

SITE CONTEXT

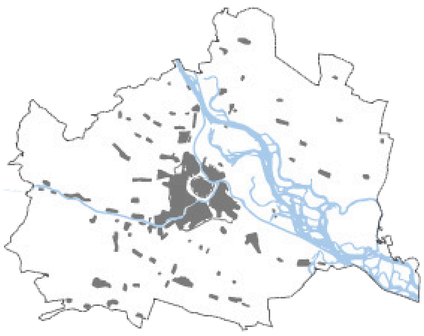
VIENNA/AUSTRIA

Maps of Vienna, highlighting project site
Source: created by author

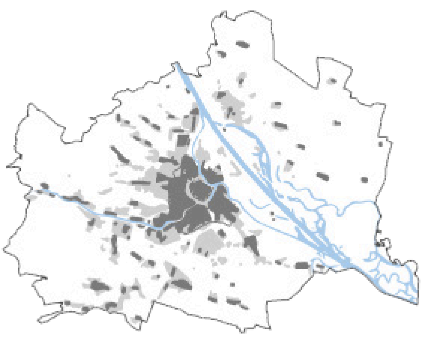
The project site is located in the 19th District of Vienna, which is called Döbling. It is in close proximitry to the danube canal as well as the viennese woods to the west.

Vienna, the capital of Austria, stands as a beacon of historical significance, cultural opulence, and architectural splendor. Ranking as the 5th largest city in Europe, it has experienced notable growth, with a remarkable 13.1% increase over the last decade. Demonstrating its commitment to housing, the city invests over 400 million Euros annually, resulting in the construction of approximately 7,000 new apartments and the renovation of 5,000 existing ones each year (Berger, 2022).

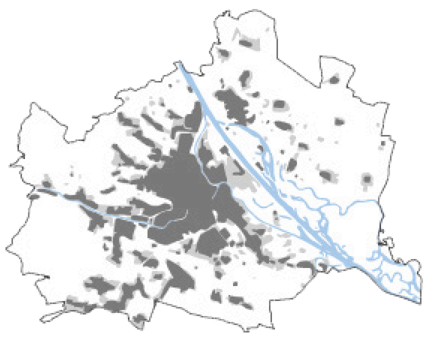
The transformation of the APA-Tower, as discussed in Chapter Preconditions, situated in Vienna's 19th district, will be a significant enhancement to the housing stock. Not only does it breathe new life into an unused high-rise, but it also reduces carbon emissions by repurposing the structure to meet current needs instead of resorting to demolition and new construction.



Wien, 1850



Wien, 1890



Wien, 1913

DOEBLING, 19TH DISTRICT

Döbling, nestled in the northwest of Vienna bordering the Vienna Woods, stands as the city's esteemed 19th district. Formed in 1892 through the amalgamation of several former Viennese suburbs, including Unterdöbling, Oberdöbling, Grinzing, Heiligenstadt, Nussdorf, Josefsdorf, Sievering, and Kahlenbergerdorf (Bezirksorganisation der SPÖ-Döbling), it embodies a rich historical tapestry.

Today, Döbling is celebrated for its prestigious ambiance, epitomized by its lavish residences nestled amidst the Vienna Woods, reminiscent of those in Währing and Hietzing. Notably, the district boasts a thriving wine-growing region. However, beneath its affluent veneer lies a diverse demographic, fostered by community-centric initiatives such as the Karl-Marx-Hof and cooperative housing complexes (WKO, 2023).

Within the Heiligenstadt operating area, the Muthgasse district emerges as a prominent urban locale distinguished by its array of business establishments. Its enduring significance owes much to its exceptional attributes, including accessibility to infrastructure, strategic positioning, and proximity to clientele (WKO, 2023).

As a pivotal focal point for Vienna, this city district stands on the cusp of significant transformation in the years ahead, poised to augment its stature as both a commercial nucleus and a vibrant residential community. As per the Vienna municipality's directives, the remaining undeveloped spaces within the district are earmarked for meticulous planning and development initiatives, contributing to the overall enhancement of the area (Smarte Stadtentwicklung).

Birdview of Tower; Source:Google Earth edited by author

PRECONDITIONS

APA TOWER

Historical use and function of the APA tower

The Austrian Press Agency's (APA) Tower, originally constructed between 1968 and 1970, was initially owned by the Federal State Insurance, later transitioning to the Uniqa Insurance Group. From its inception until 2005, the tower served as office space for APA, alongside neighboring prominent newspaper agencies such as "Krone" and "Heute" (APA).
In 2005, architect Heinz Neumann acquired the building with aspirations of transforming the area into a mini Manhattan. Regrettably, these plans never materialized due to conflicts with neighboring plot owners (Kurier, 2018).

APA Tower after construction 1970; Source: Stadt Wien

Current state & Challlenges

Presently, the building and its surroundings are owned by SIGNA Holding, Austria's largest privately owned real estate company, which has yet to disclose any development plans for the site (ORF, 2018). The tower has remained unused for over 15 years.

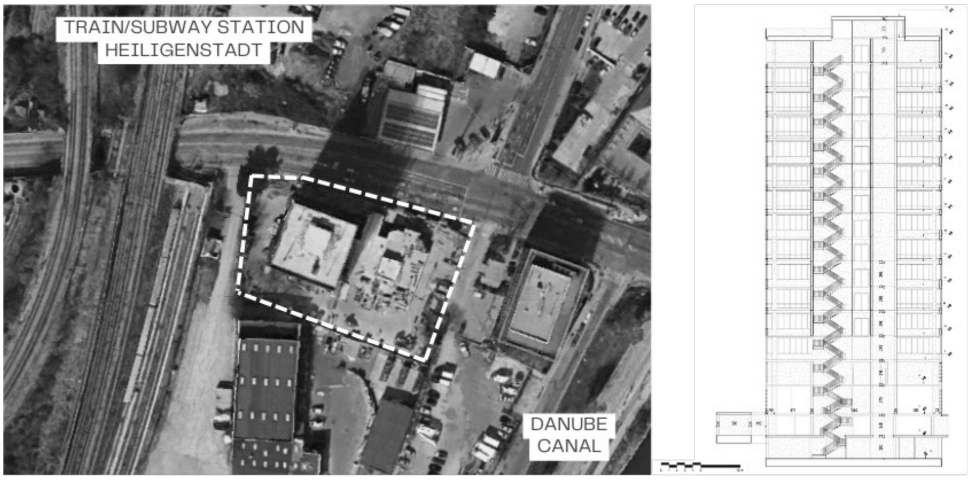
The initial transformation was impeded by surrounding building owners who did not agree to further development in the area. Although there is a general development proposal for the area, the specific plans for the surrounding buildings remain unclear, making it difficult to define a suitable program (Kurier, 2018).

APA Tower 2020; Source:Kronen Zeitung

APA Tower 2020; Source:Kronen Zeitung

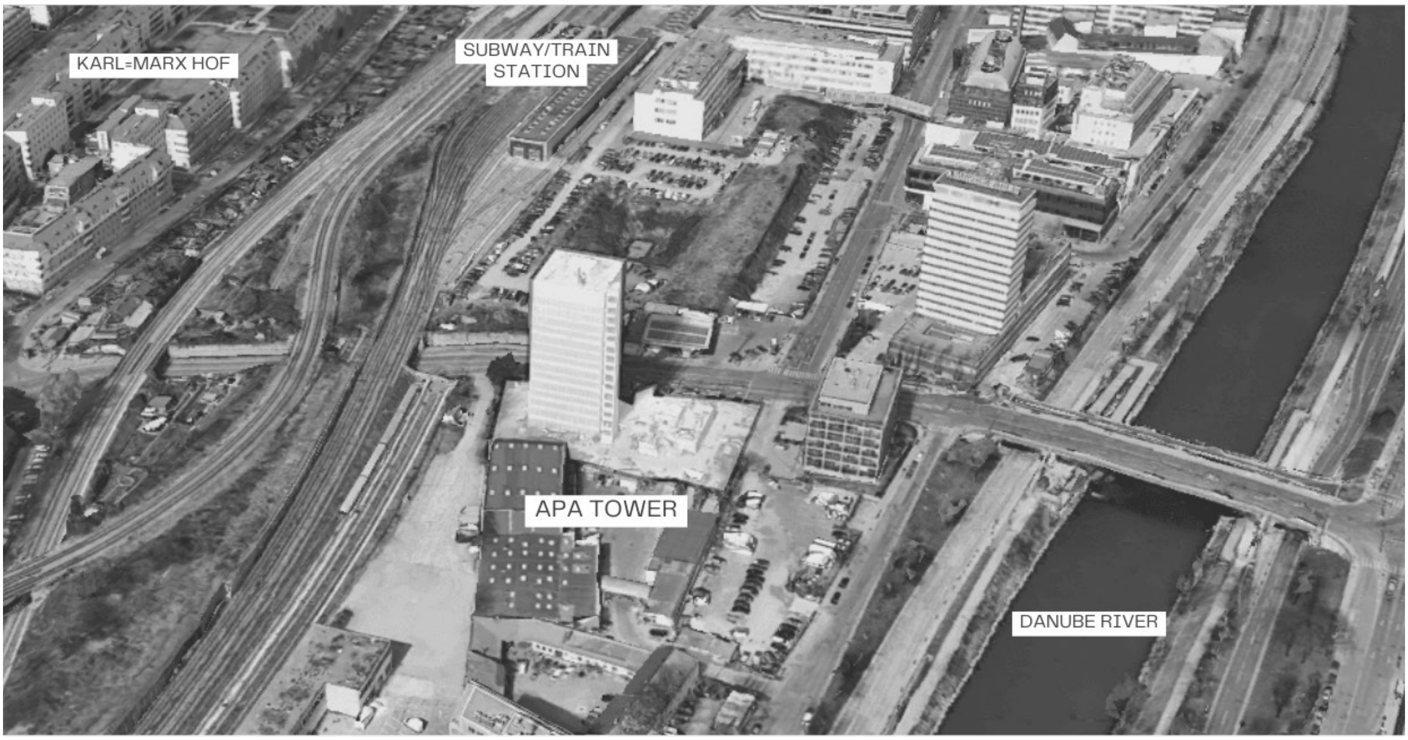
ANALYSIS OF LOCAL CONDITIONS

Gunoldstrasse 14, 1190 Vienna



The existing structure consists of two lower levels and 14 upper levels, including the ground floor, a service level, and a rooftop. With open floor plans on the upper levels, the building is highly adaptable for transformation. Given the average per capita living space, the building has the potential to accommodate 100-120 people.

Siteview and section of Tower with context; Source: Created by author

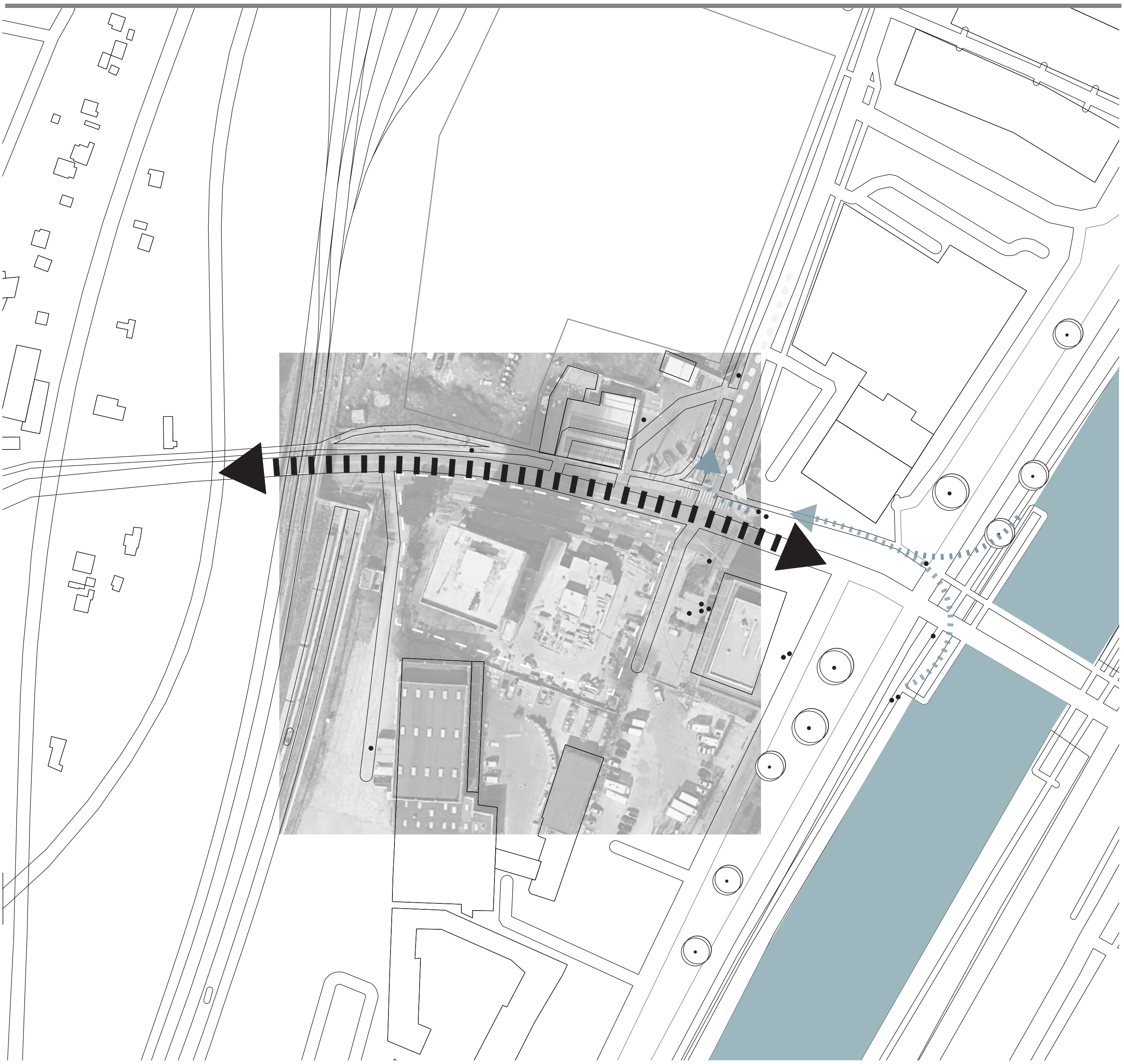


Birdview of Tower with context; Source:Google Earth edited by author

LOCAL CONDITIONS

SITE ANALYSIS

ANALYSIS OF MOVEMENT PATTERNS



Car Traffic
Bike Traffic
Pedestrian Movement

Project Site
Danube

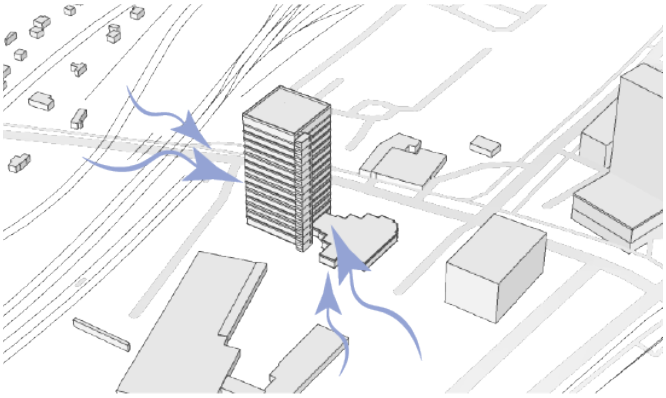
The map below shows the main pedestran, bike and car movement around the site.

Along “Gunoldstrasse” peak traffic hours occur at 8am and 5pm. There is a constant pedestrian and bike movement along the danuebe canal, especially southwards towards the city center.

The bike path leads from the danube river along Muthgasse towards the public transport hotspot “Heiligenstadt”. A similair movement can be observed for the pedestrian walkways.

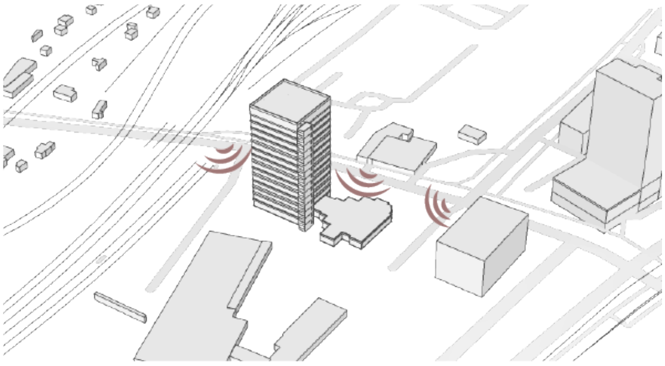
Existing Urban Parameters

CLIMATE



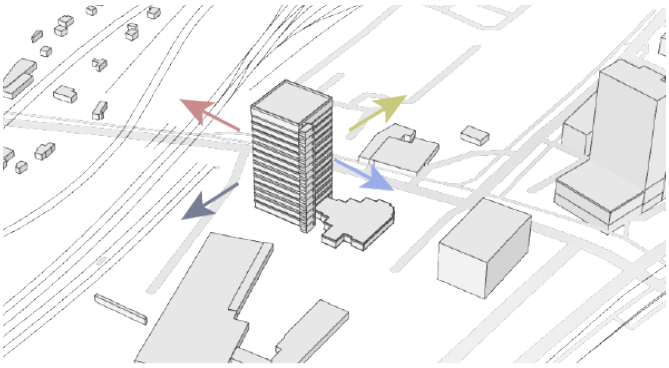
Strongest wind identified blowing from south-west and north-west.

SENSORY (Sound and Feel)

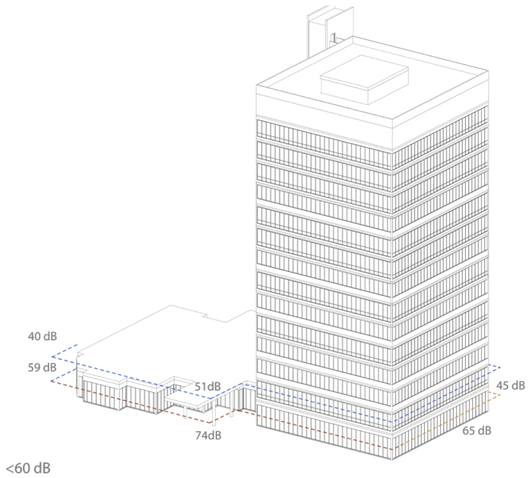


During peak hours, traffic along Gunoldstraße causes noise disturbance.

SENSORY (Views)



The views range from looking at the districts historic buildings to the view over the danube canal.



The noise intensity along Gunoldstraße ranges from 59dB to 74dB on the ground level.

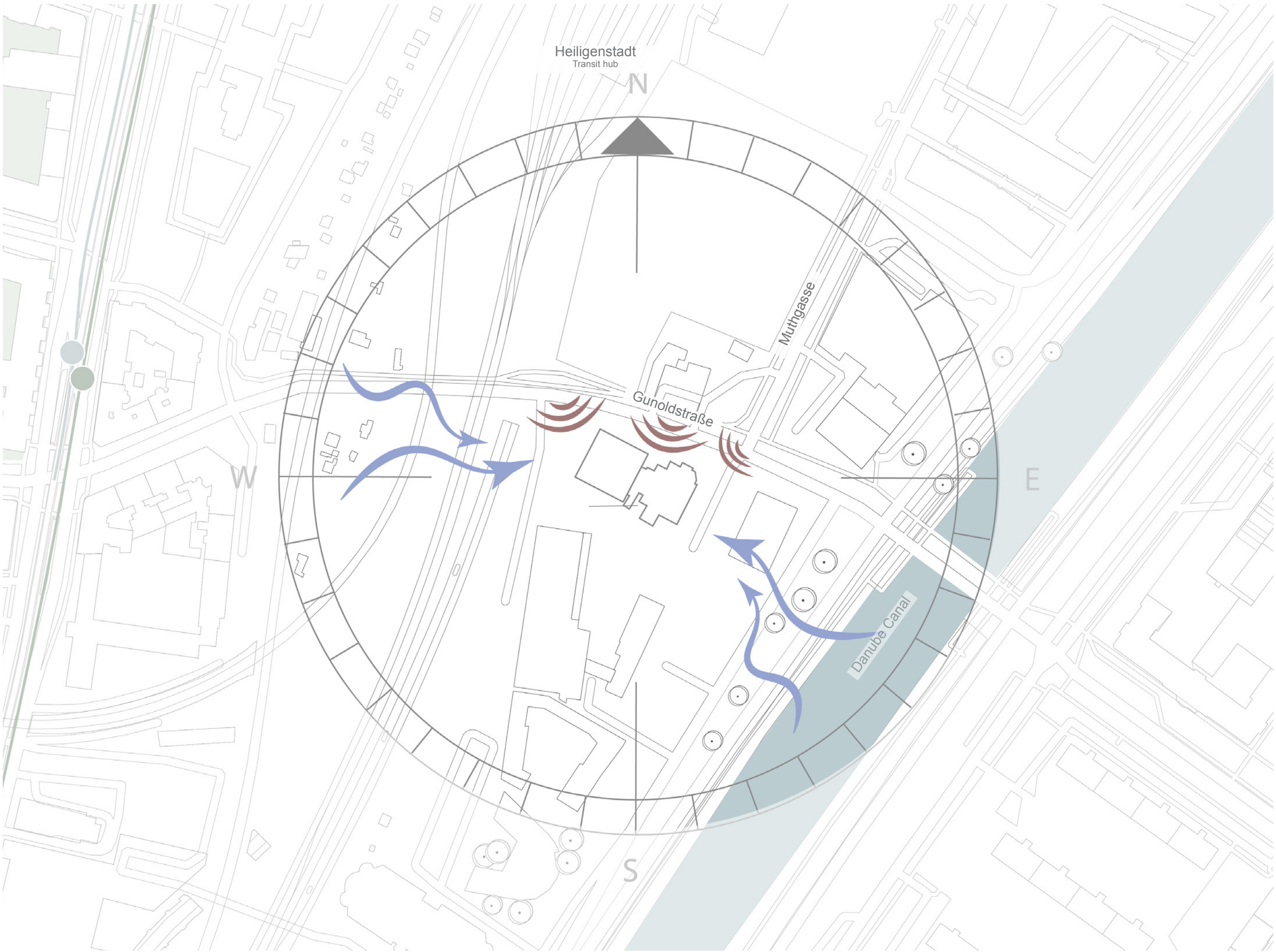
NorthView

East View

South View

West View

SITE ISSUE



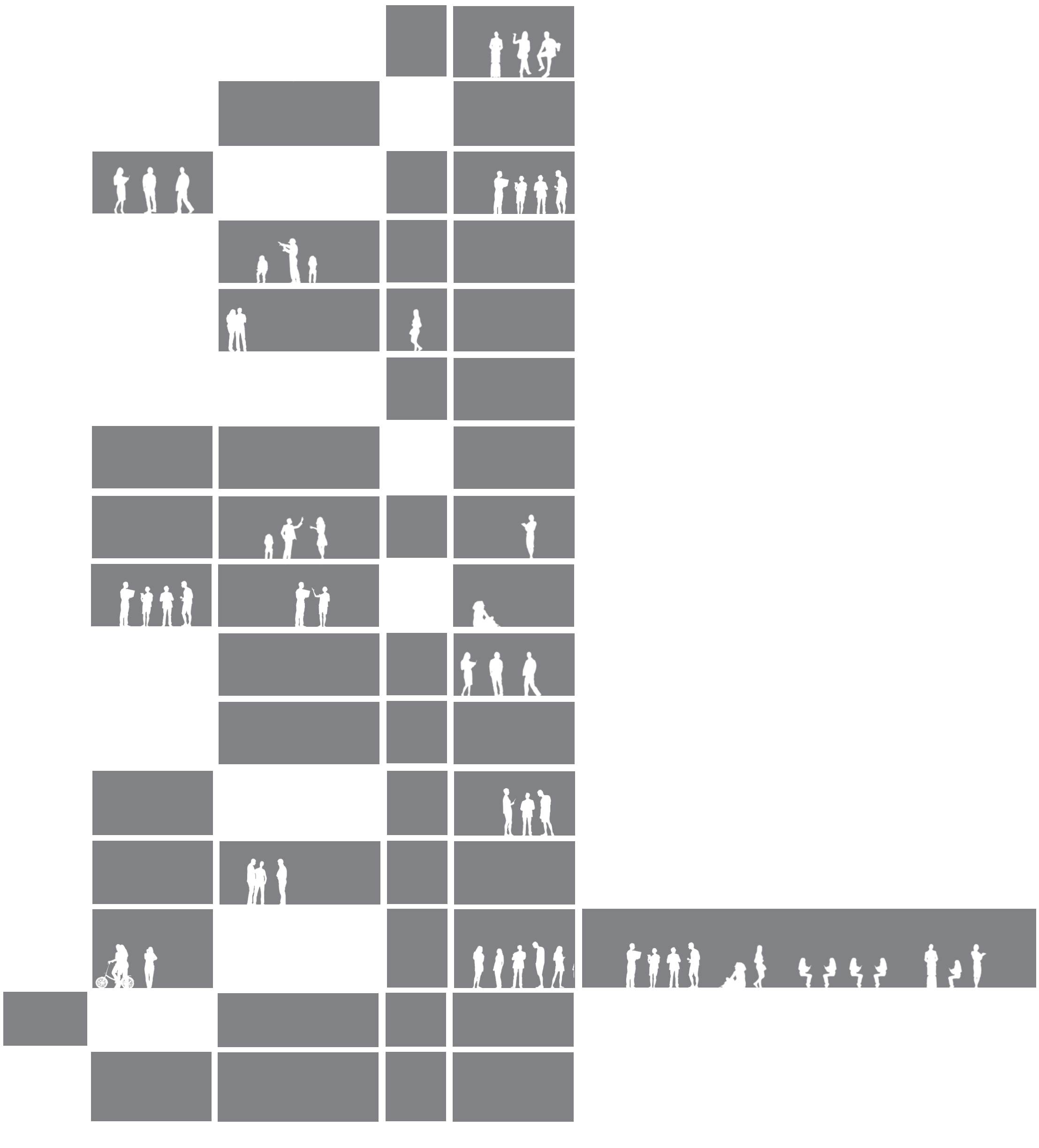
SWOT ANALYSIS

Strengths:
- Well connected location with transit hub 500m away
- Strong structure (reinforced concrete)
- Good sun conditions and location on site
- Slab-column structure with open floor plan allows for adaptable room layouts

Weaknesses:
- Future of surrounding sites is unclear
- Busy street passing site (unattractive for pedestrians)
- Noise levels on upper floors
- Poorly insulated building shell

Opportunities:
- Connecting greenery to green line (city development)
- Revitalizing unused industrial site into social hub
- Near development area “Nordwestbahnhof” can be used for urban mining
- Location allows for commercial activities on ground level
-

Threats:
- Concept might not fit with surrounding site developments
- Noise levels and traffic of neighboring road might effect well-being and safety of inhabitants
- Project might demand high financial resources



PART 4

THE CIRCLE TOWER

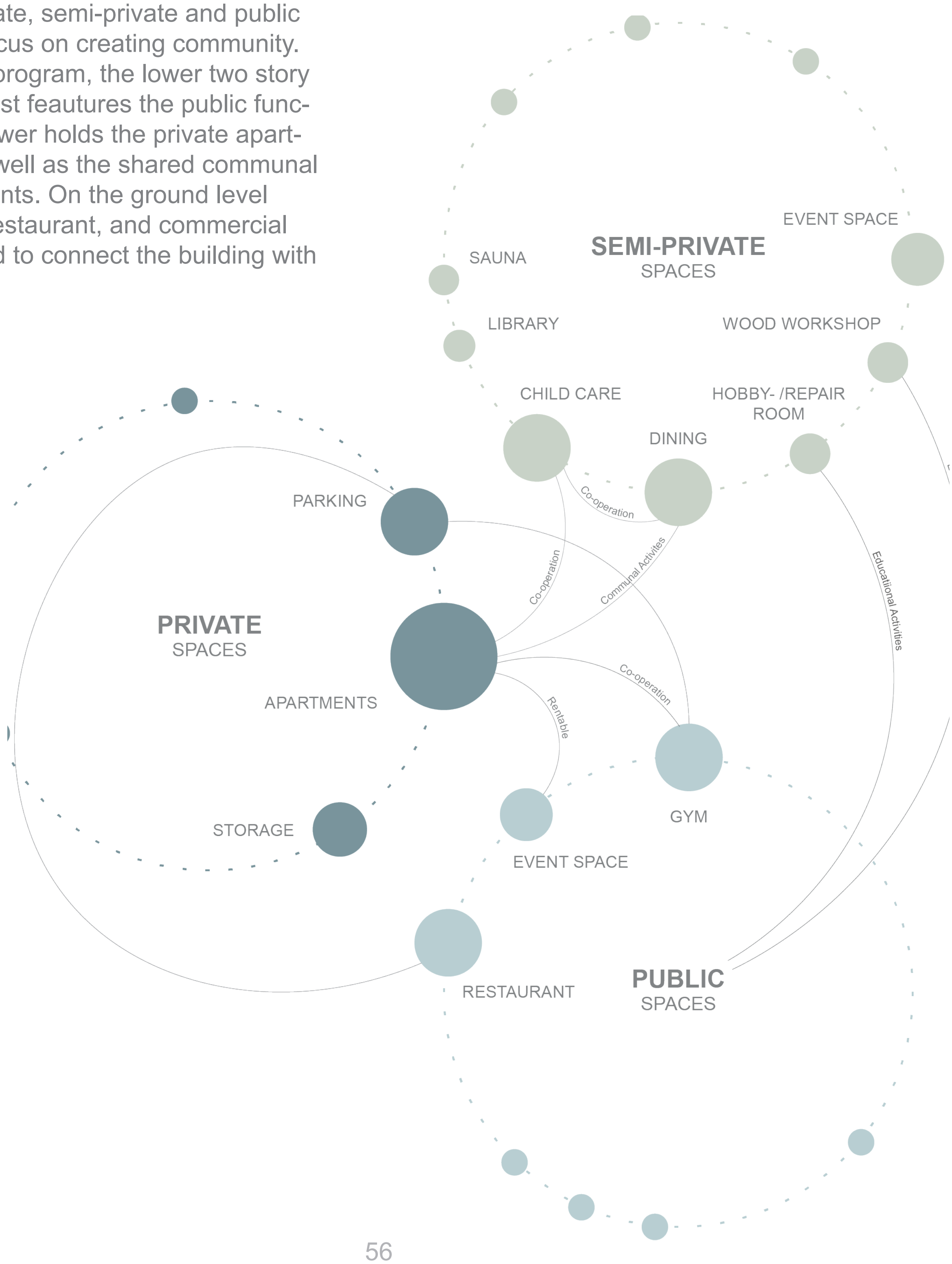
Design concept
Program
Design Development
Circular Construction

DESIGN CONCEPT

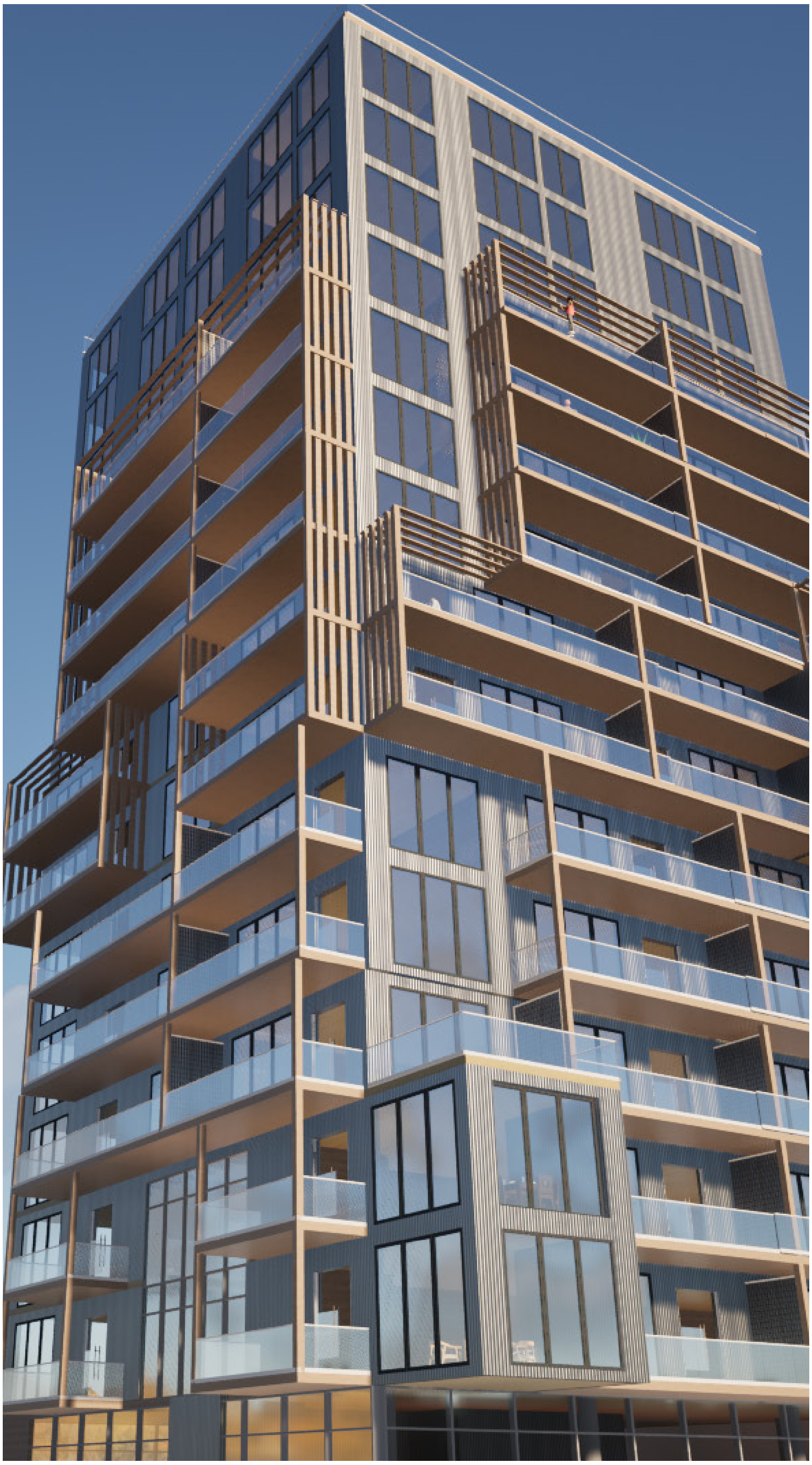
COMMUNAL HOUSING

INTRODUCTION

Due to the rapid growth of Vienna and the need for additional housing, the tower is transformed into communal housing. The new program is devided into private, semi-private and public spaces, which focus on creating community. Like the original program, the lower two story building to the east feautures the public functions while the tower holds the private apartment spaces as well as the shared communal spaces for residents. On the ground level functions like a restaurant, and commercial offices are placed to connect the building with the district.



APA Tower after construction 1970;
Source: Stadt Wien



Render of Circle Tower; Source: Created by author

PROGRAM

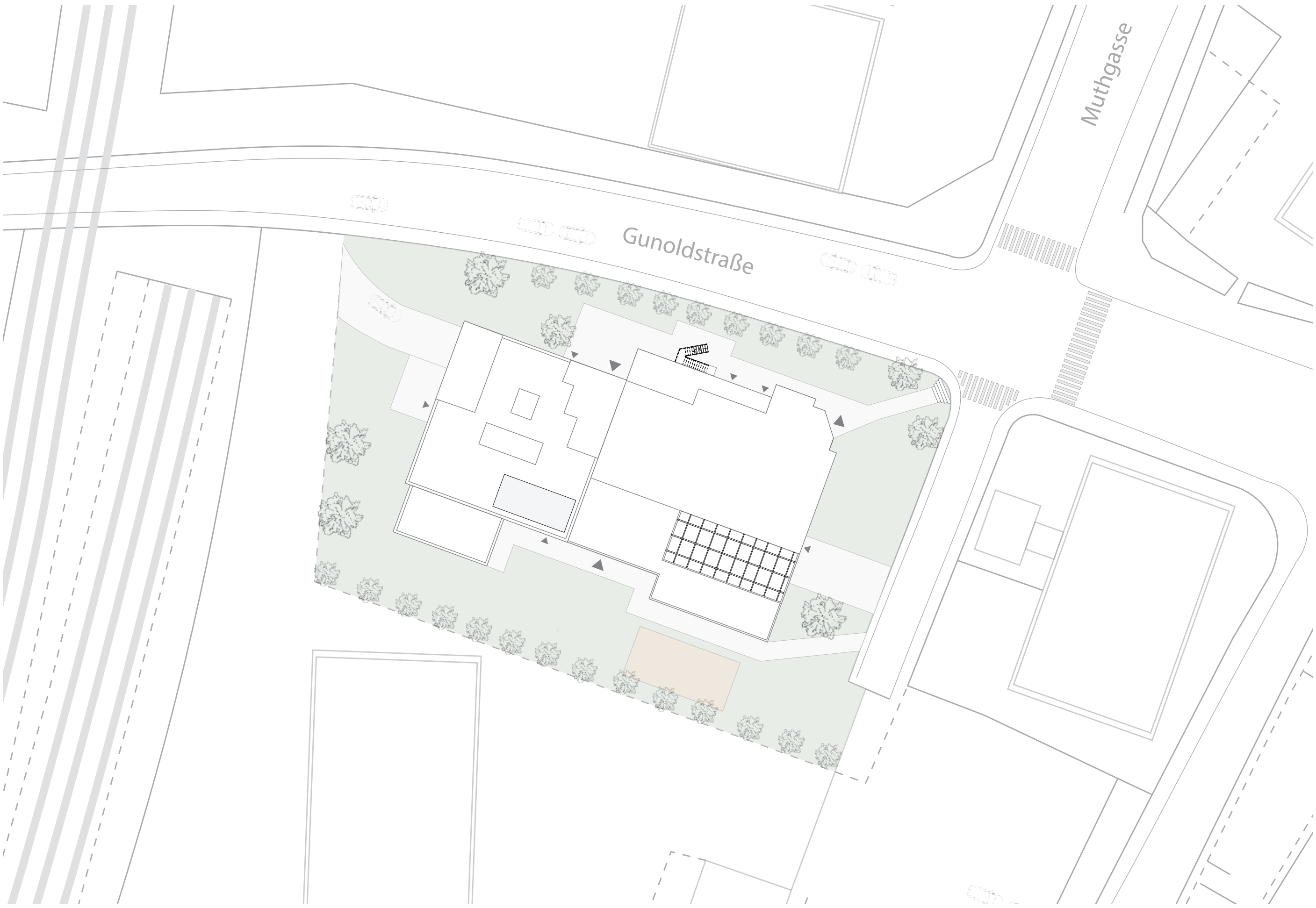
PLOT

Access Points

The main access point for pedestrians and cyclist is at the north-east cornert of the building. The crossing of Muthgasse and Gunoldstraße serves as the best place due to the passing of the cycling lane coming from the danube canal as well as the pedestrian path from the main public tranport hub `Heiligenstadt`. The first entrance, accessible from the path is leading to the restaurant. Further along, one can access the commercial offices which contribute to the variety of uses of the building.

To ensure for privacy, the new entrance for residents is placed to the north side of the tower, at the end of the path. Next to it is the access to the bike storage. From the south-east corner, a path leads to the child care as well as to an entrance to the dining hall. To enter the parking garage, cars enter the west side of the building, with an extra delivery access to the communal kitchen. To the east, another road allows for access to the restaurant kitchen/storage/waste for unloading and loading.

SITE PLAN
S 1:1000

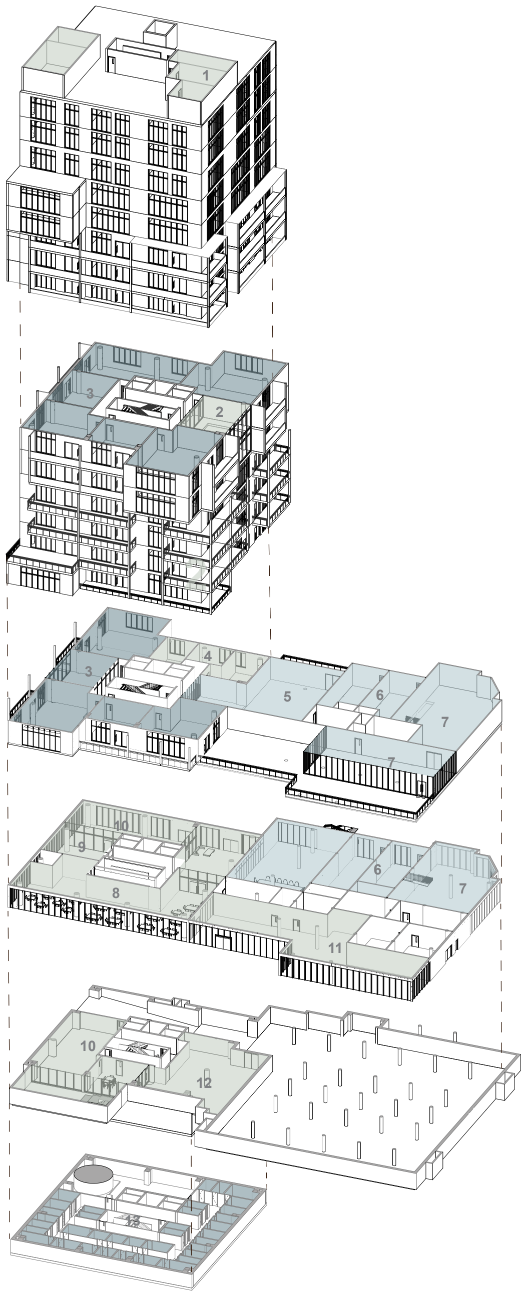


FUNCTIONS

OVERVIEW

The new functions of the tower are centered around communal living spaces, but also feau-ture different mixed public functions to revitalize the street and connect it to the local community.

Even though some of the communal functions are accessible to the public, they are grounded in the collaboration and organization between the inhabitants of the tower.



1 **ROOFTOP with COMMUNAL KITCHEN**
Rooftop for leisure, including communal kitchen, barbeque area, sauna and pool as well as some rooftop gardening.

2 **SEMI-PRIVATE COMMUNAL AREA**
Communal areas to foster stronger connections between neighbors. Also allows for natural light to enter circulation trakt.

3 **APARTMENT UNITS**
Depending on need and configuration, 60-102 units available. See Apartment Combinations for further details.

4 **GUEST APARTMENTS**
Three guest apartments located on 2nd floor for visiting family and friends.

5 **GYM**
Accessible to all residents and visiting guests. Operation organized by housing association.

6 **COMMERCIAL OFFICES**
Four commercial offices to rent out. Enhances the variety of uses within the building.

7 **RESTAURANT and GREENHOUSE**
Two-story restaurant with green house on the upper level. Includes outdoor terrace for guests and connects the building with the context.

8 **DINING HALL and COMMUNAL KITCHEN**
Main place for interaction and communal activi-ties. Can also be used as co-working space.

9 **HOBBY/-REPAIR ROOM**
Place for residents to fix bikes, household appli-ances, etc.

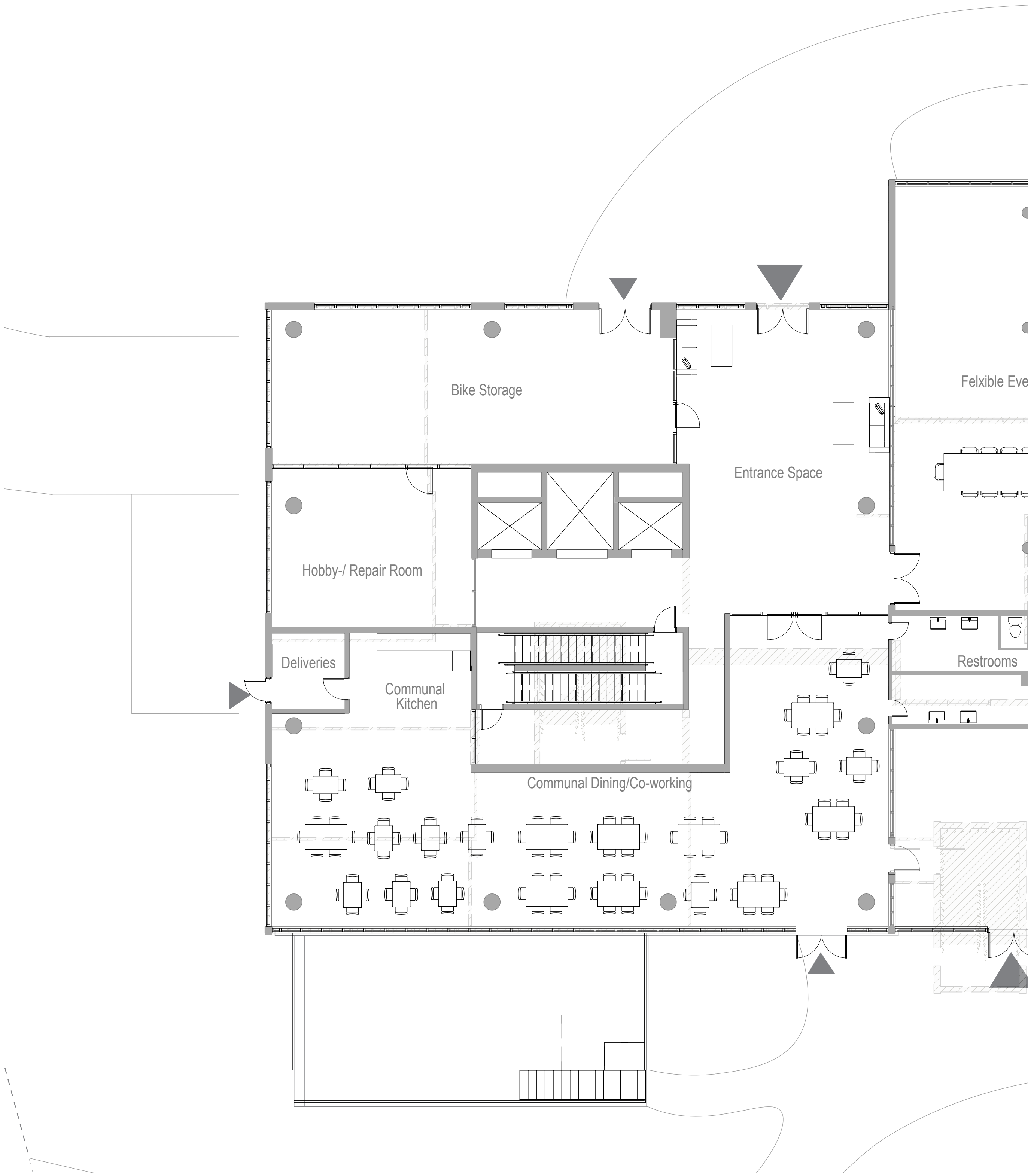
10 **BIKE STORAGE**
Total 112 spots for bikes. Underground storage for bikes which are not used on a daily basis.

11 **CHILD CARE**
Community-operated childcare, connected to communal kitchen in the communal area. Opera-tion organized by housing association.

12 **WOOD WORKSHOP**
For residents to use after completing safety train-ing. Offering classes orgnaized by housing asso-ciation.

13 **PRIVATE STORAGE**
36 Storage Units in basement ranging in size from 4 to 8 m2

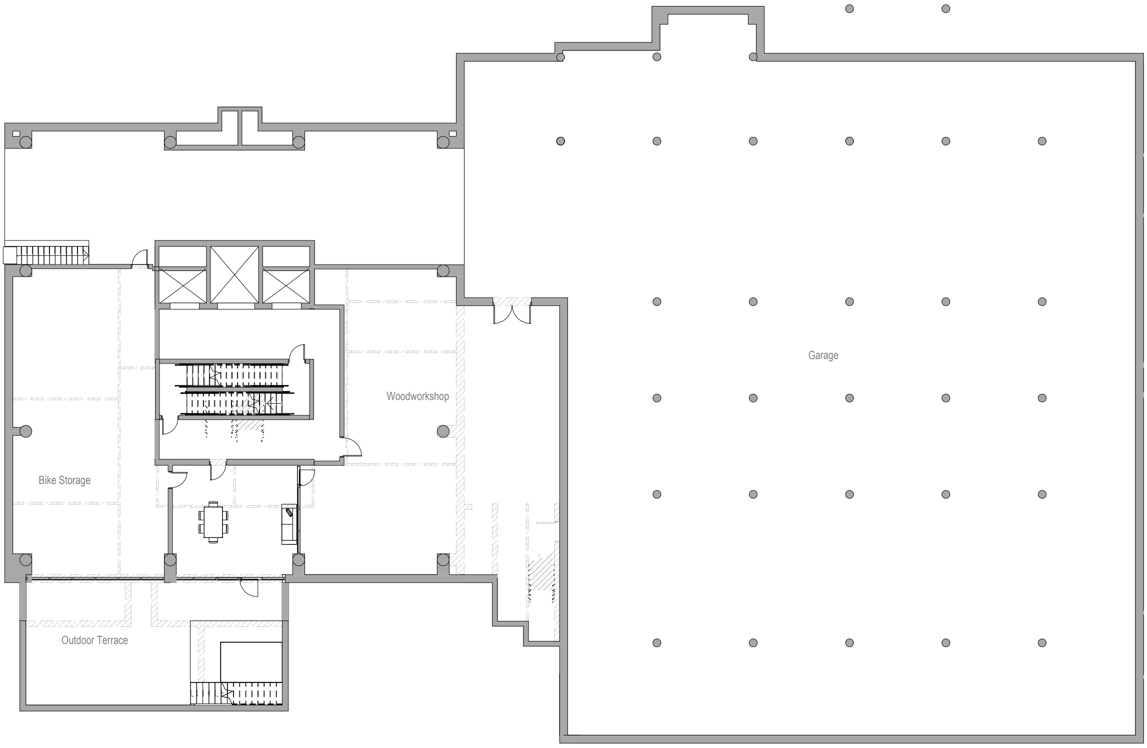
GROUND LEVEL 1:200



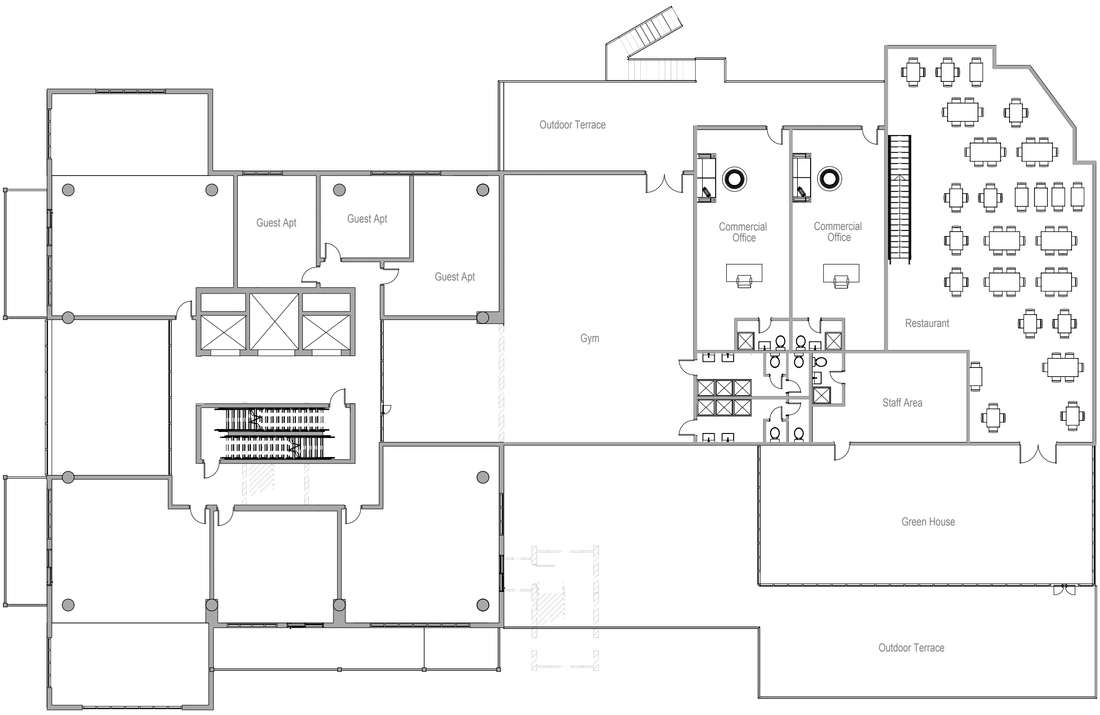
Commercial Office
Commercial Office
ntspace
Restrooms
Restaurant
Storage
Dishwashing
Kitchen
Storage
Restrooms
Storage/
Walk-in Fridge
Waste Containers
Child Care
PREVIOUS & NEW
DEMOLISHED

LEVEL -1
S 1:400

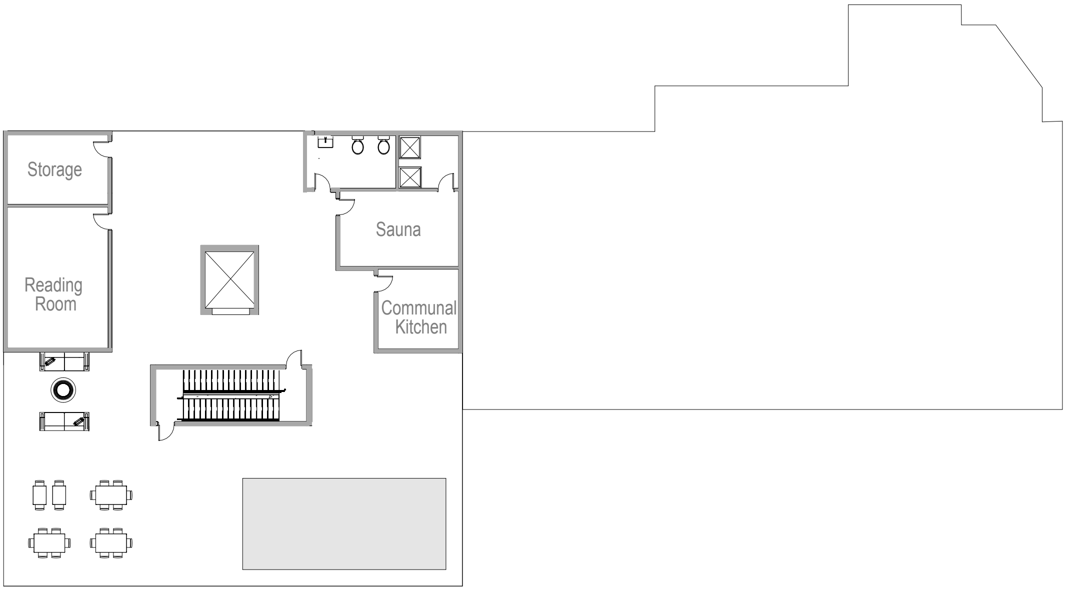
PREVIOUS & NEW
DEMOLISHED



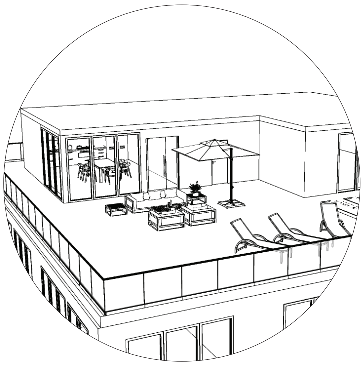
LEVEL 1
S 1:400



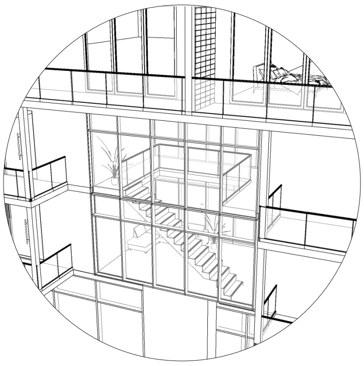
ROOFTOP
S 1:400



DESIGNING THE COMMUNAL

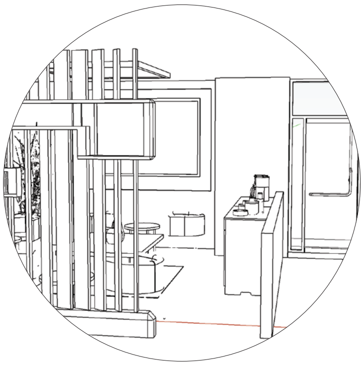


Rooftop

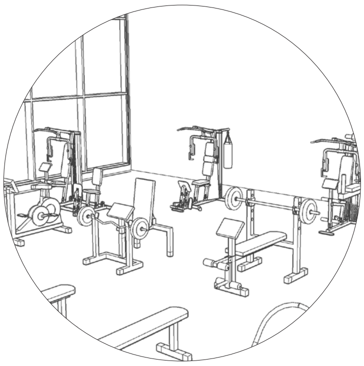


Communal Space

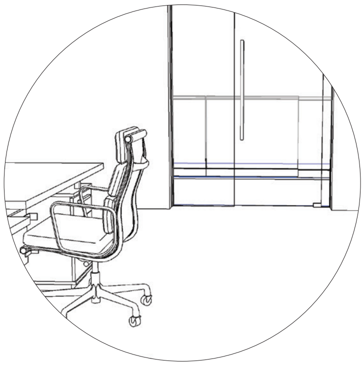
Event Space



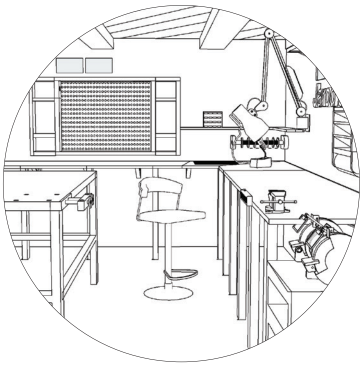
Entrance Lounge



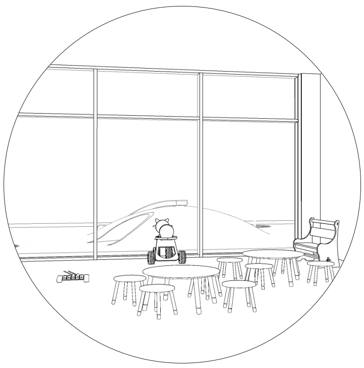
Gym



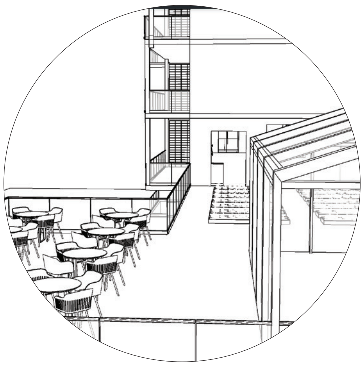
Commercial Space



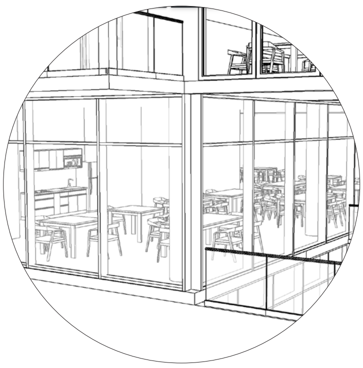
Wood Workshop



Child Care



Restaurant &
Green House



Dining Hall

SEMI-PRIVATE SPACES

SHARING ECONOMY - BENEFITS

The sharing economy within a residential building can manifest in various forms, fostering a sense of community and resource optimization among residents

Shared Amenities:
Instead of each unit having its own amenities, such as a washer/dryer or barbecue grill, residents can share these resources in designated communal spaces. This reduces the overall resource consumption and maintenance costs for individuals while promoting social interaction.

Task Sharing and Skill Exchange:
Residents can create a platform or utilize existing social networks to exchange skills and services, such as pet sitting, tutoring, or language practice. This allows individuals to benefit from each other's expertise without the need for monetary transactions.

Shared Storage Space:
Residents can collectively manage a storage area within the building where they can store seasonal items, luggage, or other belongings that are not frequently used. This optimizes space utilization within individual units and reduces clutter.

Community Events and Activities:
Regularly scheduled events such as potluck dinners, movie nights, or fitness classes can encourage residents to come together, build relationships, and share experiences.

Shared Transportation:
Residents may organize carpooling or establish a shared pool of bicycles or scooters within the building for commuting purposes. Some residential complexes even provide electric vehicle charging stations for shared use.

Shared Workspace:
Common areas such as a community room or lounge can be converted into shared workspaces equipped with amenities like Wi-Fi, printers, and comfortable seating. This allows residents to work or study outside of their apartments, fostering collaboration and networking among neighbors.

Tool Libraries:
A communal space within the building can house a collection of tools and equipment that residents can borrow on a short-term basis for DIY projects or repairs. This reduces the need for individual ownership of seldom-used tools and promotes sustainability.

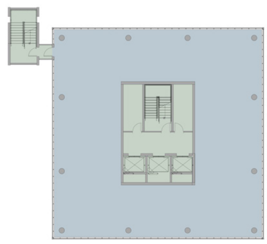
Community Garden:
Residents can come together to maintain a shared garden space within the building premises, where they can grow vegetables, herbs, or flowers. This not only promotes a sense of camaraderie but also encourages sustainable living and access to fresh produce.

APARTMENT FLOORS

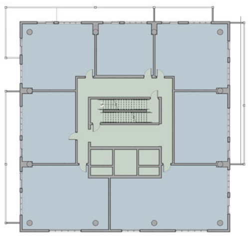
The floors within the tower are transformed from an open office floorplan with two seperate staircases into an apartment layout with both stairs within the central core.

In order to comply to the fire code, these were organized in wayto be accessible from each apartment. Therefore, two independent emergency pathways are created while the existing staircase on the southern corner of the building is demolished.

UPPER LEVEL
Existing



UPPER LEVEL
Transformed

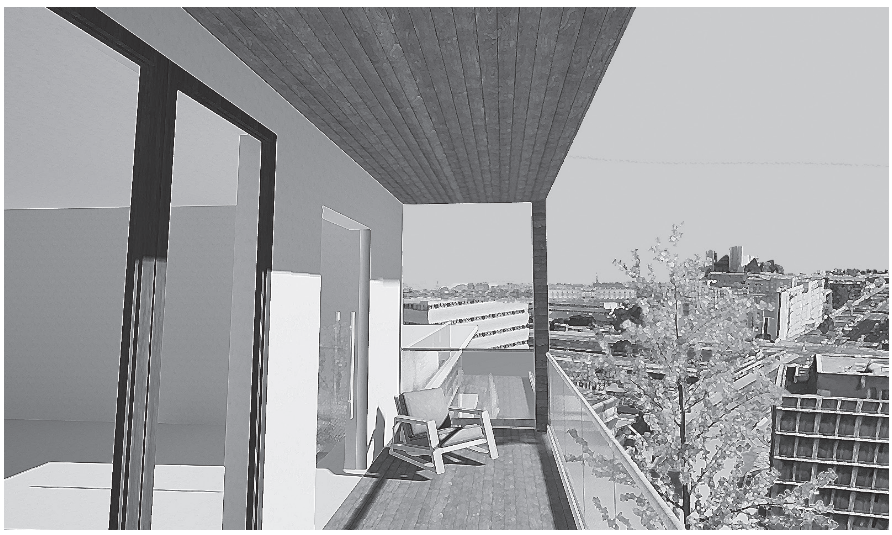


Number of Levels total: 19
Number of Levels (Apt): 14
Number of Communal Floors: 4
Ceiling Hight: 2.7 - 3.2 m
Room depth Apt: 5.6 m
Number of Apt (smallest configuration, see Combinations): 99

Useful Area Apartment Levels
Main useful area: 4796 m2
Secondary useful area: 418 m2
Circulation total: 1166 m2

After Transformation
Main useful area: 7341 m2
Secondary useful area: 421 m2
Circulation total: 1453 m2

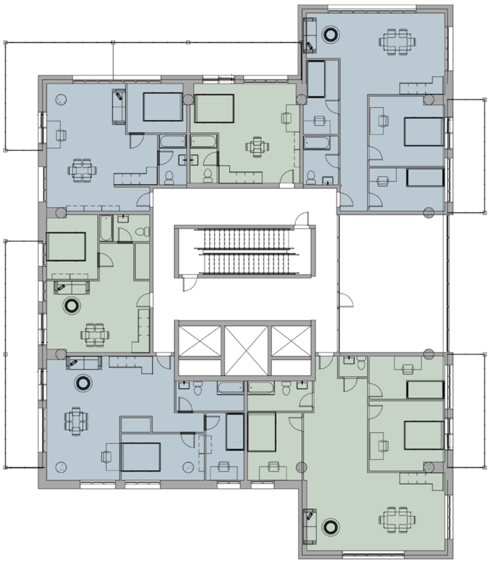
Useful Area
Circulation

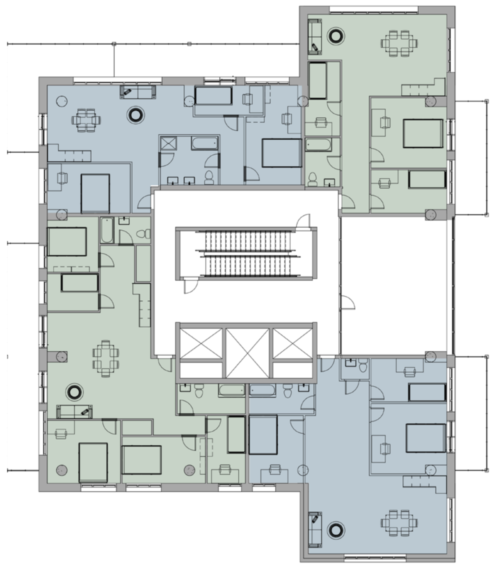


CONFIGURATIONS

Floorplan showing configuration with maximum amount of apartment units on a single level.

Floorplan showing configuration with combined units. Bathrooms are joined while the kitchen can be removed.





To meet future needs of residents, the apartments allow for alternations, either combining multiple units or seperating them through walls, which can be assembled or disassembled without any cause of demolition waste (see Chapter “Design for Disassembly”).

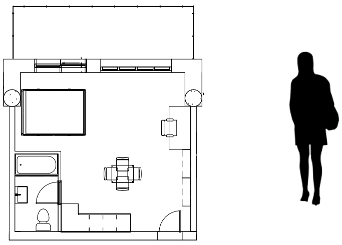
The bathrooms are placed to be combined if apartments are joined. Additionally, the kitchen can be removed without destruction and the space layout can be arranged according to the residents needs.

The placement and length of balconies is based on the apartment combinations. All apartments on Level 1 till 11 which can be combined, share a balcony. Two individual units can ensure for private outdoor space by placing a removable seperation wall in the middle.

PRIVATE SPACES

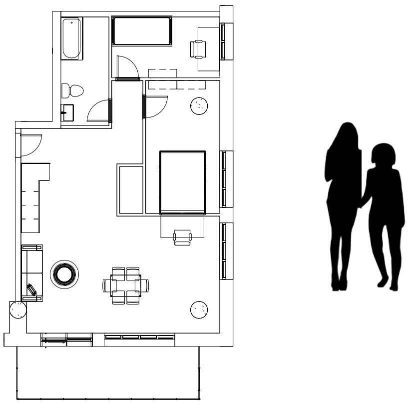
APARTMENT TYPES & USER PROFILES

Type A



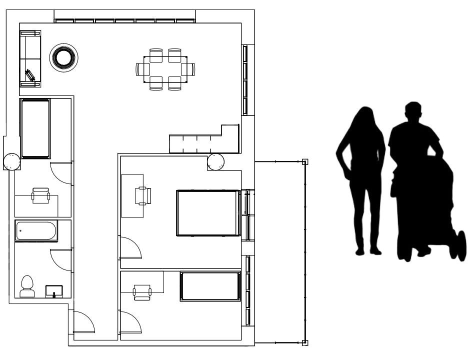
1 Room
max. 40m2 (min 30m2)

Type B



2 Rooms
max. 55 m2

Type C

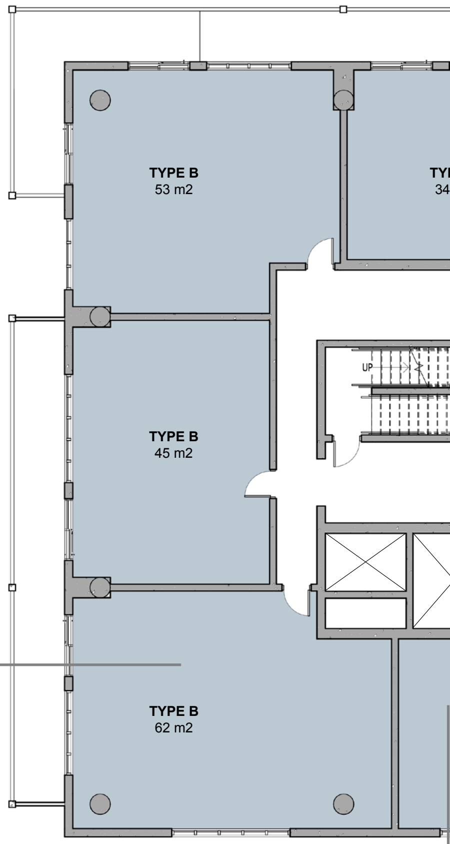


3 Room
max. 75m2

Markus, 62 & Jennifer, 59

“After growing up in the countryside, we were always struggeling with the busy and fast pace of Vienna. The private green areas on the rooftop as well as the protected garden seem to us like an oasis and let us forget the choatic city life.”

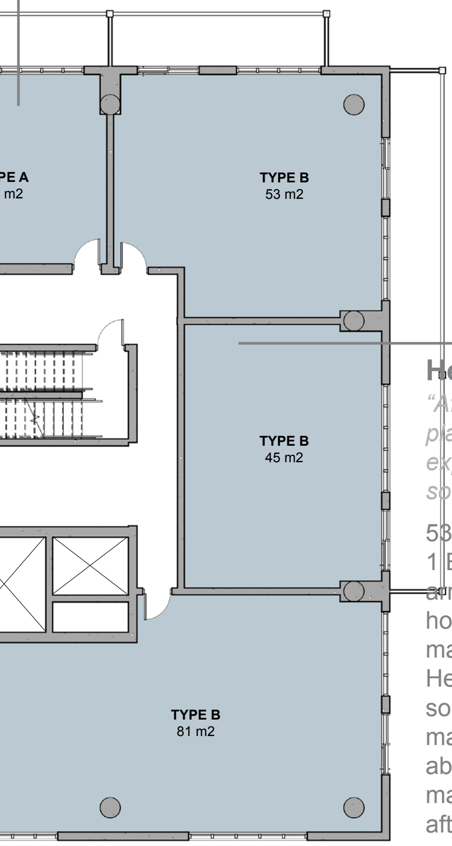
62m2 - later tansformed into 93,Type E
2 Bedroom Apartment, with flexible living arrangement over two floors. Markus loves taking care of the individual gardening area on the rooftop where he harvests vegeatables and herbs. Jennifer is a passionate cook and always looks forward to the fresh produce. They have a son living in England, with a granddaugther on its way. Whenever they visit during Christmas and the summer, they get to stay in the guest apartment on the rooftop.



Tobias, 19

“As a student, I wanted to find an apartment for myself but the communal aspect of the building helps with the transition from living with my family for all my life to being on my own. Feels like I moved to my extended family.”

34m2, Type A
Flexible living within a minimal area. Cheap rent while being exceptionally well connected to the city center made Tobias choose, this apartment. He was pleasantly surprise by the strong community within the housing project which helped him immensly with his homesickness.



Helmut, 41

“After my divorce, I was searching for a place to get used to the single lifestyle, while exploring new hobbies and finding a new social circle.”

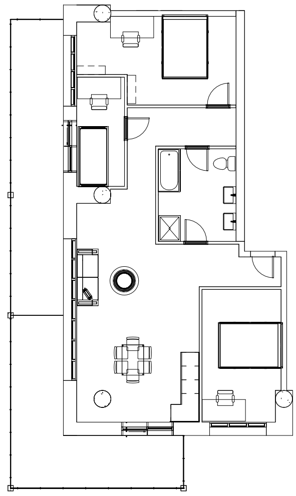
53m2, Type B
1 Bedroom Apartment, with flexible living arrangement. The opportunities of using the hobbyroom as well as the woodworkshop made Helmut choose, this apartment.
He also got involved with the housing association and is activily participating in the management. With this contribution, he was able to form stronger bonds with his house mates as well as regaining his confidence after his divorce.

Lena, 35 & Nika, 37

“With the stress of juggeling a fulltime job and two kids, it helps to have a preschool just downstairs as well as a elementary school less then a km away.”

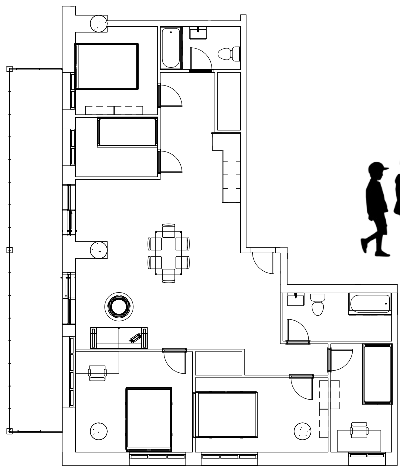
81m2, Smart-Apartment, Type D
2 Bedroom Apartment, with flexible living arrangement. The couple is thinking about expanding and adding 45m2 to their apartment once the kids get older so they can each have their own room.
Lena and Nika regularly attend the communal events within the building and Lena, as a professional designer hosts painting classes in the hobbyroom on thursday evenings.

Type D



4 Room
max. 85m2

Type E



5 Rooms
max. 100m2

DESIGN DEVELOPMENT

FORM EXPLORATION

CHARACTERISTICS

The transformation of the tower is based on the principle of reusing as many of the structural elements of the existing building while meeting the demads of the future functions. Overall, the building retains 95% of the original load-bearing structure (concrete columns, slabs, load-bearing walls) while also reusig parts of the exterior wall. In order to maximize the potential of the site, four extra levels, including the rooftop, are added to the tower as well as one extra level on the lower structure to the east. In order to create common spaces between apartments while avoiding limiting the overall useful area, specific levels are partly vertically extended. The final additions to the building include the outside areas, attached to the tower in form of balconies and loggias. The placement of these attachments is based on the possibility of combining or seperating individual apartments (see Chapter “Apartment Floors“).

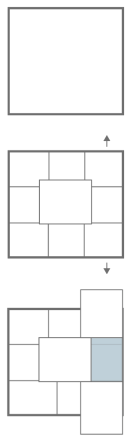
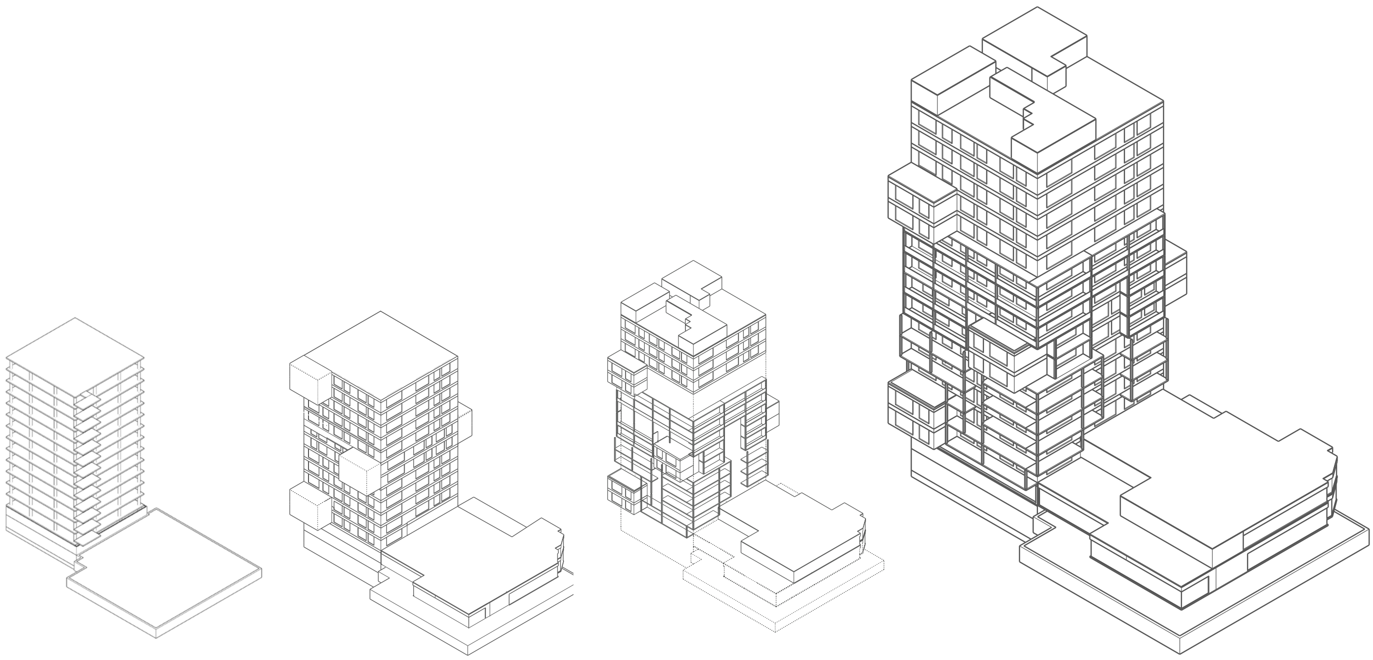


Diagram showing vertical extensions and common room.



Existing

Structure

The two lower levels as well as almost all of load-bearing structure (concrete skeleton frame type) is kept in place.

Additions

Vertical/Horizontal

4 levels, including the rooftop, are added to the tower as well as 1 level to the lower side structure. There are 3, double story horizontal extensions added to the apartments to the north and the south (see p. 67).

Additions

Balconies/Loggias

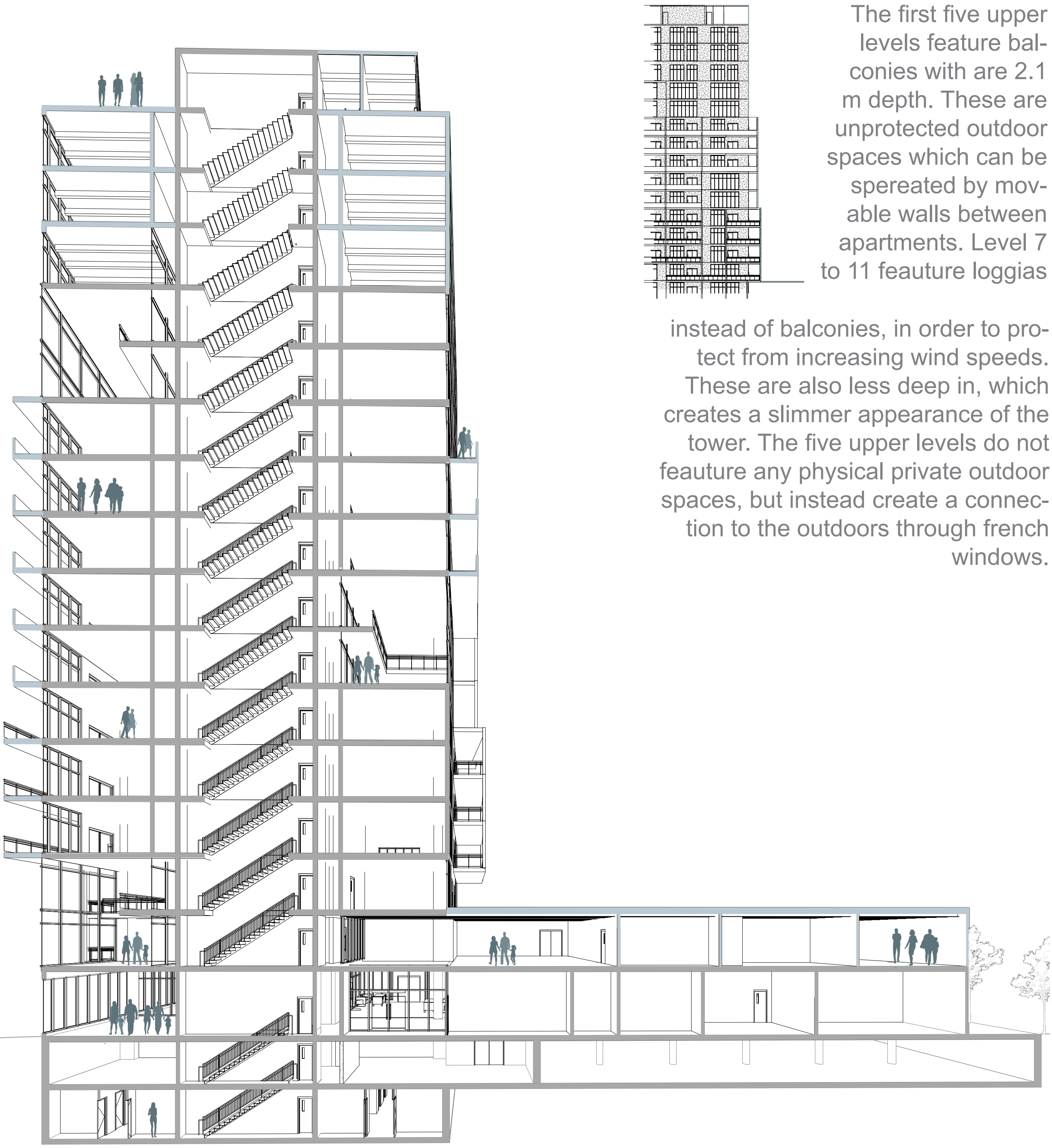
The first five stories feature outdoor space additions in form of balconies. In order to combate windspeeds, loggias are added to the next five stories while french windows are placed on the uppermost levels.

Transformed

The total transformation features additional floor area within the same footprint. The new shape of the tower not only adds to the density of the ubran fabric but also exhibits a new character. The various additions combined with the lively use of outdoorspaces, transforms the appearance of the building and adds value to its context.

BUILDING SECTION

1:200



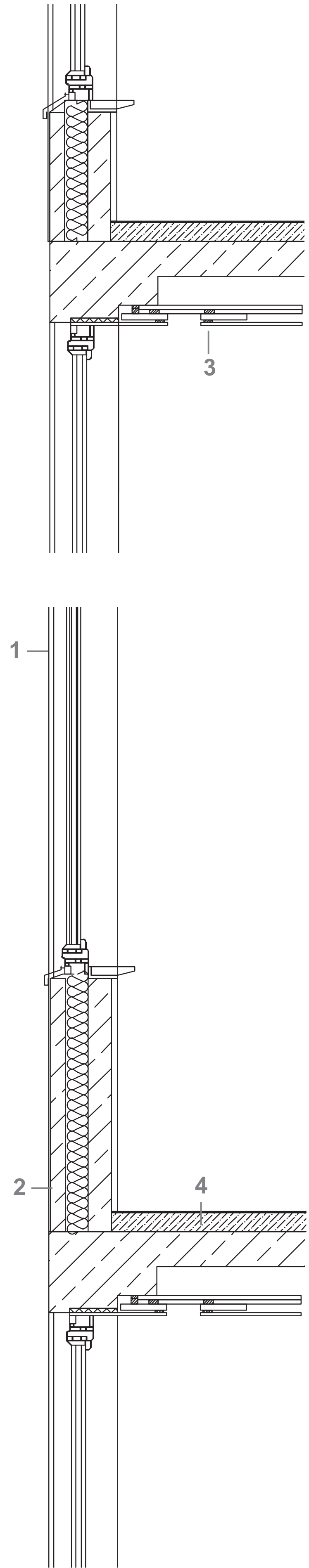
The first five upper levels feature balconies with are 2.1 m depth. These are unprotected outdoor spaces which can be spereated by movable walls between apartments. Level 7 to 11 feauture loggias instead of balconies, in order to protect from increasing wind speeds. These are also less deep in, which creates a slimmer appearance of the tower. The five upper levels do not feauture any physical private outdoor spaces, but instead create a connection to the outdoors through french windows.

CONCRETE
WOOD

CIRCULAR CONSTRUCTION

FACADE EXISTING

The existing stucture is a classic reinforced concrete frame building with an aluminum-glass facade, interior fittings with plasterboard, screed with impact sound insulation and suspended ceilings.
There are parquet, tiles and carpets available
The electrical and HVAC installations are standard installations.



DETAIL
S 1:20

1 Aluminium windows with two panels

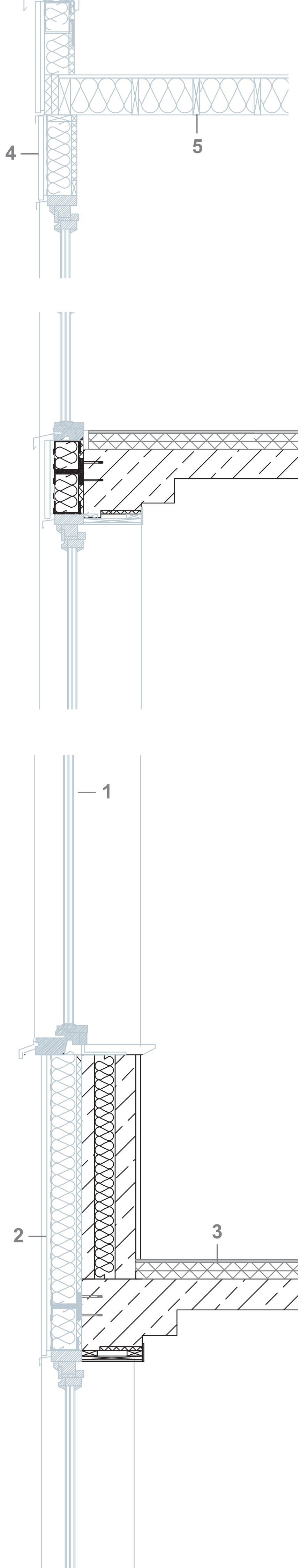
2 Concrete (attached to lintel) 80mm, Insulation 50mm, Reinforced Concrete 80mm, Plaster 20mm

3 Suspended ceiling plasterboard 10mm

4 Synthetic resin screed, natural stone, screed, reinforced concrete 400mm

FACADE TRANSFORMED

In order to improve the overall energy performance of the building, a layer of insulation and CLT boards is added to the outside of the existing walls. Additionally, all the windows are removed and retrofitted into triple glass elements with wooden frames. This allows for a significant improvement to prevent heatloss as well as a reduction in CO2 emissions since due to the use of wooden frames instead of aluminium components.



DETAIL
S 1:20

1 Triple glazed windows with sunprotection layer and wooden frame

2 Finishing layer 18mm, Ventilated air cavity 20mm,OSB board, Hemp Insulation 100mm, OSB-Board, Concrete (attached to lintel) 80mm, Insulation 50mm, Reinforced Concrete 80mm, Plaster 20mm

3 Floor screed, reinforced concrete 400mm

4 Corrucated metal sheeting, Wood battens 28mm, Wind proof board 18mm, Vertical wood studs 195mm, Hemp insulation, Wood batterns 45mm, Board 10mm

5 Wood flooring 22mm, Vertical wood studs 250mm, Wood battens 28, Wood cladding 13mm

RETROFITTING

NEW STRUCTURE

MATERIALS

FIRST - USE MATERIALS

The primary materials incorporated into this design for new building elements are organic. This choice has resulted in a notable decrease in the Global Warming Potential (GWP) associated with the new design proposal's life cycle stages A1 to A3.

To enhance the building's thermal envelope, a new layer of insulation along with a new finishing layer of high-quality wood is added to the existing facade. Additionally, structural enhancements such as the loggias and added levels will be built using glued laminated timber support and cross-laminated girders supplied by Hass, an Austrian company specializing in sustainable harvesting and production of building materials. These components are assembled with the aim of future reuse, as detailed in Chapter "Design for Disassembly."

For the additional structures like the top four levels as well as the vertical extension, CLT and glulam serve as structural elements. The choice for this material relies on the low GWP potential and over CO_2 emissions of the material.

Hemp is used as additional insulation material, in order to improve the thermal coat of the building. Hemp is recognized as a sustainable building material due to its renewable nature, low environmental impact, and ability to sequester carbon.

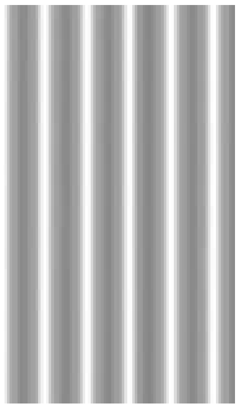
SECOND - USE MATERIALS

Windows

-all the glass planes are being retrofitted and reused. In order to improve the thermal coat of the building, an additional panel is added within the new frame. The aluminum frames are replaced by a new arrangement of wooden frames, based on the original sizes of the windows (70 x 180/70 x 255). Reusing the glass still saves 52% compared to producing new windows.

Facade

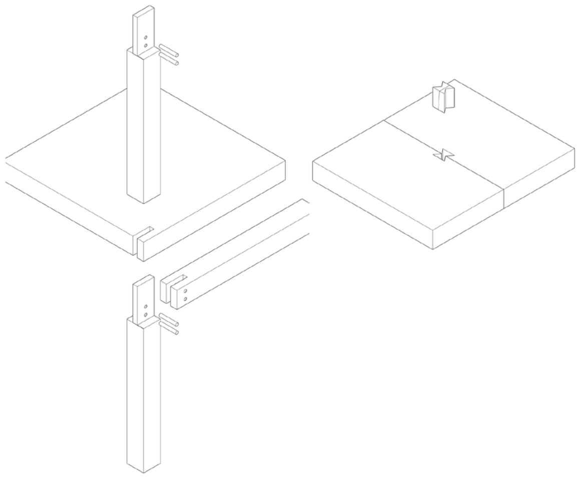
-for the finishing layer of the new climate shell, corrugated-metal sheeting with accent panels of perforated aluminium are reused to protect the exterior wall while creating a new character of the building.



DESIGN FOR DISASSEMBLY

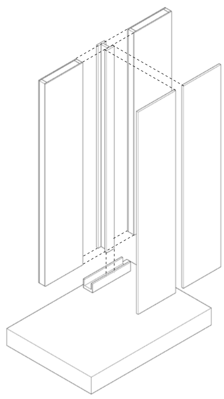
CONCEPT DIAGRAMS

This section visualizes some of the concepts of disassemblable design, integrated into the project. These are based on the core principles of flexible connections and material layering.



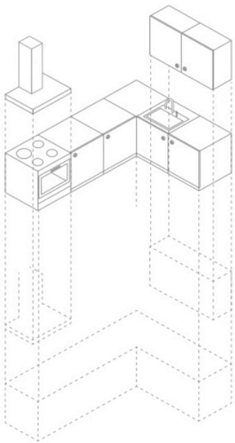
EXTERIOR ADDITIONS
Balconies/Loggias

The additional outdoor spaces in the form of balconies and loggias are based on a modular grid and are fully dismountable, allowing for alterations and reuse in the future. The additional structure is supplied from a local and sustainable construction company called “Haaslacher” (Haaslacher).



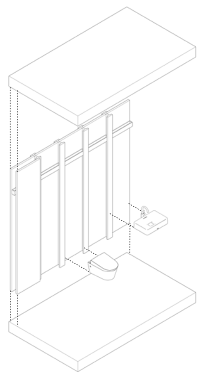
INTERIOR ADDITIONS
Wall System

The interior walls between apartments are fully disassemblable and thereby allow for flexible apartment configurations without the need for demolition of components. The concept is inspired by the ‘Circle house’ in Denmark from GXN (GXN, 2018) but adapted to the use of timber studs and OSB boards.



INTERIOR COMPONENT
Kitchen

The kitchen is an integral part when it comes to flexible apartment layouts. These are fully deconstructible, allowing the residents to either take the kitchen with them when they leave or resell it to the next tenant. The front and the top of the cabinets are easily changeable if needed and therefore allow for further personalization. This concept is inspired by the Circle House (GXN, 2018).



INTERIOR COMPONENT
Bathroom

The joining of bathrooms and therefore the possibility for moving or removing components without the need for demolition is another aspect emphasized in this project. The guide “BAAM Building Design for Disassembly” shows how the bathroom can be assembled to allow for flexible reconfigurations (Durmisevic, 2019).

ENVIRONMENTAL SAVINGS

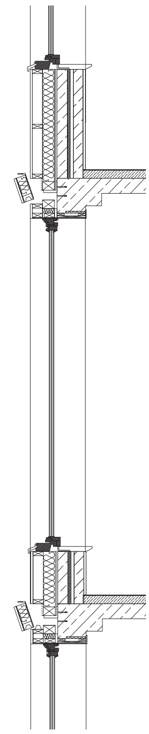
To be able to quantify the environmental savings of the transformation, a tool called CAALA was used to analyse four different stages of the life cycle. The program is a plug-in for BIM sofwares like SketchUp and Rhino, and creates environmental data visualizations of the impact of a specfic 3D model. The analyises include the overall existing structure, the additional layer, as wel as the additional structure. These do not take into account the interior additions or technical systems. The appendix features further information of the performed environmental analysis.

The initial climate analysis of the existing structure shows that the buildings total mass adds up to 5921 tons of buidling material and 2497 tons of embodied CO_2, which would have been released into the atmosphere if demolished.
Instead, a new climate shell is added to improve the thermal performance of the building and comply to the curretn energy standards.
The added facade layers and retrofitted windows improve the U-value of the windows from 2.5 to 0.7 W/(m2*K) and the wall from 0.98 to 0.21 W/(m2*K). These rather small design interventions contribute to a significantly lower energy demand.
In the third environmental analysis includes the additional levels, vertical extensions of specific levels as well as additional outdoor spaces. The new structure is based on renewable and reusable materials and therefore contain less embodied carbon.

The fouth analysis includes all the changes made to the climate shell as well as the additional structure.
It showed that the existing building contained 5921 tons of material and 2497 tons of embodied co2 which, if demolished, would have been wasted. Instead, the transformation only required 749 tons of co2 eq and 474 tons of material to be added, which is about ⅓ of the carbon and 1/13 of the materials already embodied in the existing building

With this analysis, the primary energy demand was also calculated and resulted in 53 kWh/(m2NFA*a) incl user energy and 18 excluding user energy after the transformation (for further details see appendix).

U-value Improvements



Roof: 0.52 > 0.25

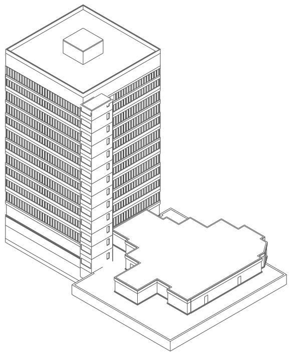
Windows: 2.5 > 0.7

Exterior Walls: 0.98 > 0.21

Floor: 0.75 > 0.32

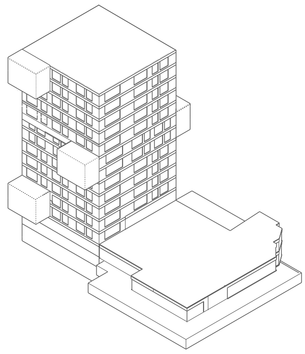
LIFE CYCLE ASSESSMENT

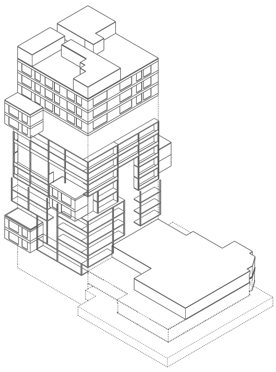
ENVIRONMENTAL SAVINGS



1 Existing Building:
Embodied CO_2: 244 kg CO_2-eq/(m2NFA)*
Total embodied CO_2: 2 497 ton CO_2-eq
Total mass: 5921 tons

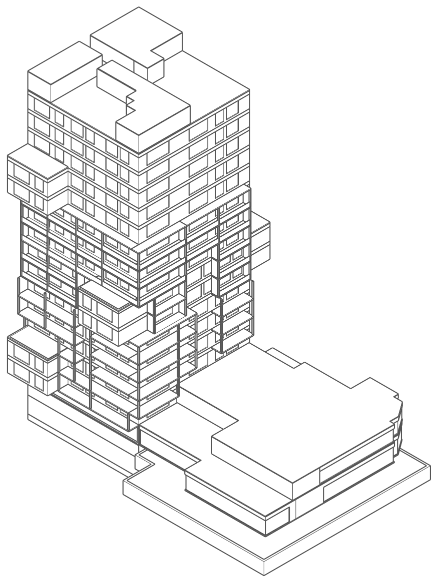
2 Additional Layer:
Embodied CO_2: 49 kg CO_2-eq/(m2NFA)*
Total embodied CO_2: 596 ton CO_2-eq
Total mass: 310 tons

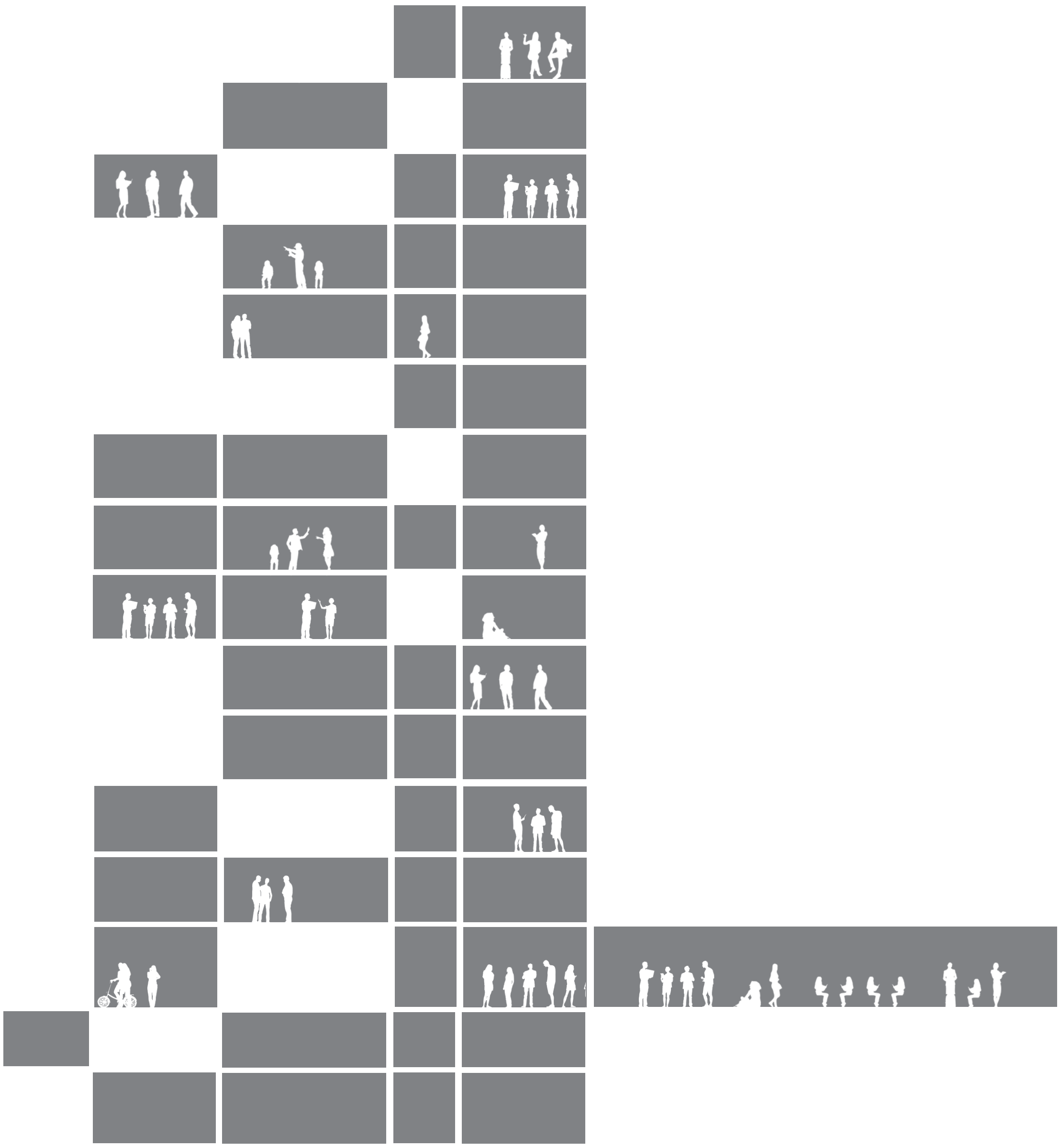




3 Additinal Structure:
Embodied CO_2: 60 kg CO_2-eq/(m2NFA)*
Total embodied CO_2: 153 ton CO_2-eq
Total mass: 164 tons

4 Total Transformation:
Embodied CO_2: 109 kg CO_2-eq/(m2NFA)*
Total embodied CO_2: 749 ton CO_2-eq
Total mass: 474 tons





PART 5

CONCLUSIONS

Summary
Reflections
Sources

CONNECTING TO A LARGER DISCOURSE

The complexity of architectural design does not allow for a one-size-fits-all solution when addressing specific topics such as reducing global emissions, minimizing the use of virgin materials, managing demolition and new construction, or tailoring programs to fit specific contexts. There are numerous examples of outstanding efforts that serve as case studies for this thesis. The diversity of approaches to transforming the construction industry demonstrates the progress and significance of shifting towards sustainable building practices, with the overarching goal of ensuring a healthy planet for future generations.

This thesis places particular emphasis on circular principles, including the reuse of an unused office tower in Vienna, Austria, transformed into social housing. With the city's rapid growth, there is an increasing demand for housing. Retrofitting the APA Tower not only provides new, well-connected living spaces but also revitalizes a neglected part of the 19th district, which was formerly overlooked by the public.

Viewed on a larger scale, Vienna has the potential to set an example of how specific structures can be repurposed rather than demolished and reconstructed, thereby reducing carbon emissions by at least tenfold. However, this process entails specific steps and numerous challenges, requiring multidisciplinary solution thinking that diverges significantly from traditional design and construction methods.

When it comes to shifting towards a more sustainable future, the construction industry alone cannot initiate necessary changes but rather a comprehensive societal transformation. Connecting circular principles to human behavior and the design of social housing involves considering how people interact with their living spaces and the materials within them. It requires understanding human habits, preferences, and needs to ensure that the design promotes sustainable practices such as recycling, reusing, and reducing waste.

This might involve designing multifunctional spaces that adapt to residents' changing needs, providing easy access to recycling facilities, and using durable, eco-friendly materials that can be repurposed or recycled at the end of their lifecycle.
Additionally, community engagement and education initiatives can help residents understand the importance of circularity and empower them to participate in sustainable practices within their homes and neighborhoods.

Nevertheless, the main challenges for integrating circular principles in the European context are less conntected to the program but more towards the construction industry. The biggest barriers are economic feasability, knowledge gaps, and labor and time intensity. These will be elaborated further (see Reflections on Circular Principles).

DESIGN FOR DISASSEMBLY

In order to allow for future alternation of the building without creating construction waste, designing for disassembly is integral. As mentioned in the Chapter `Circular Economy`, the continuous flow of materials throughout the buildings lifespan and beyond is based on principles of reversible building design, including adaptability, disassembly and reuse (Durmiservic, 2019).

Most building components and construction methods in the European context are still heavily based on one time use solutions and therefore suppliers, manufacturere and contracters all have to be committed to collaborate and explore new ways of designing. The configuration of virgin materials requires special connections without any permant fastening like glueing or welding, without compromising structural integrity, functionality, or aesthetic appeal. This adds complexity to the design and also efforts to coordinate all stakeholders in order to ensure the availability and compatibility of disassembly-friendly materials and components throughout the project lifecycle.

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Another aspect of designing for disassembly is the economic feasabilty. The initial investment to produce those components is cost, labor and time intesive. On the otherhand, developers should be aware that the upfront costs have longterm benefits including reduced resource consumption, waste generation, and lifecycle costs.

MATERIAL SALVATION

In order to strategecilly manage resources and move towards closing cycles and therefore minimizing envirironmental impacts, the sourceing of reusable, recyclable, and sustainable resources is integral. Additionally, these also have to comply to building codes, regulations, and standards while still achieving the project goals and performance requirements.

Additonally, there is no country specific platform which offers information about material availabilty, integrity and amount. Even though project like this are present in other countries like the Netherlands, there is no so-called material bank for Austria specifically. Even though there is a european initiative, to create a bank of materials, it might not be appliable since the materials should still be harvested from local sites to ensure for minimal transportation routes.

Furthermore, there is a lack in education and awareness of mateiral salvation and handeling. Even though guides like the Design for diasambly from ARUP or other academic institutions exist, there is no specific requriement for stakeholders within the construction industry to learn about htese pratices.

Addressing these challenges requires a holistic approach, interdisciplinary collaboration, and innovative solutions to transform the construction industry towards a more circular and sustainable future.

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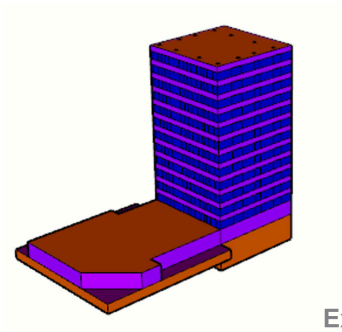
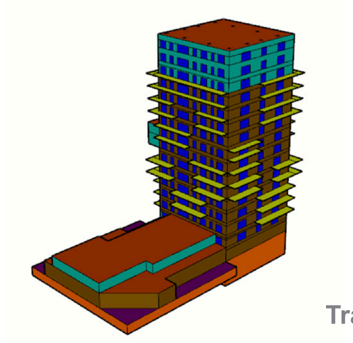
APPENDIX

LIFE CYCLE ANALYSIS

In order to analysis the environmnetal impact of the design intervention, a life analysis was performed with a software called CAALA. In combination with the sketchup model of the existing and transformed structure, specific parameters were outlined like the global warming potential, embodied carbon, energy demand, and much more. The tool integrates both embodied impact and operational impact, enabling the examination of modules A1-A3 (Production), B4 (Replacements), B6 (Operational energy usage), C3 (Waste processing), C4 (Disposal), and D (Recycling potential).


Existing


Transformed

Inputs:

For the Life Cycle Analysis specific parameters have to be selected which are stated below:

NFA
Existing:
New:
Total:

Life Cycle modules:
Analysis I-III: A1-3 Production, C3+C4 End-of-Life
Analysis IV: A1-3 Production, B6 Energy demand in use phase, C3+C4 End-of-life

Study period: 50 years
Thermal bridges: General 0.1W/m2K
Air tightness: new construction n50= 4h-1

Analysis IV (Entire Transformation) Inputs:
No technical systems included
Mechanical ventlation with heat recovery
Heating:
District Heating CHP
Energy sources heat: District heating - Biomass
Primary energy factor: heat 0.2
CO2-Intensity factor heating: 0.06

Electircity:
Energy sources: Windpower
Primary energy factor electricity: 1.3
CO2 intensity electricity: 0.1
User electricity: 0/30 kWh/(m2NFA*a)

LAYER DEFINITIONS

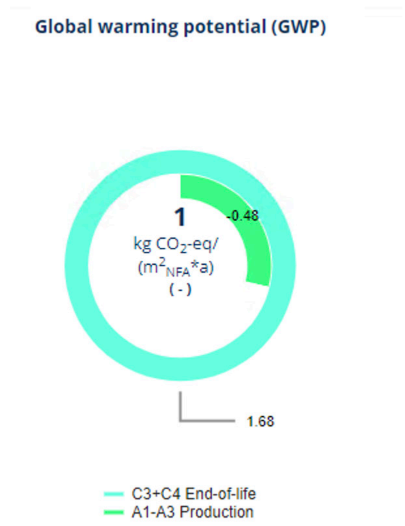
■ Existing ■ Added

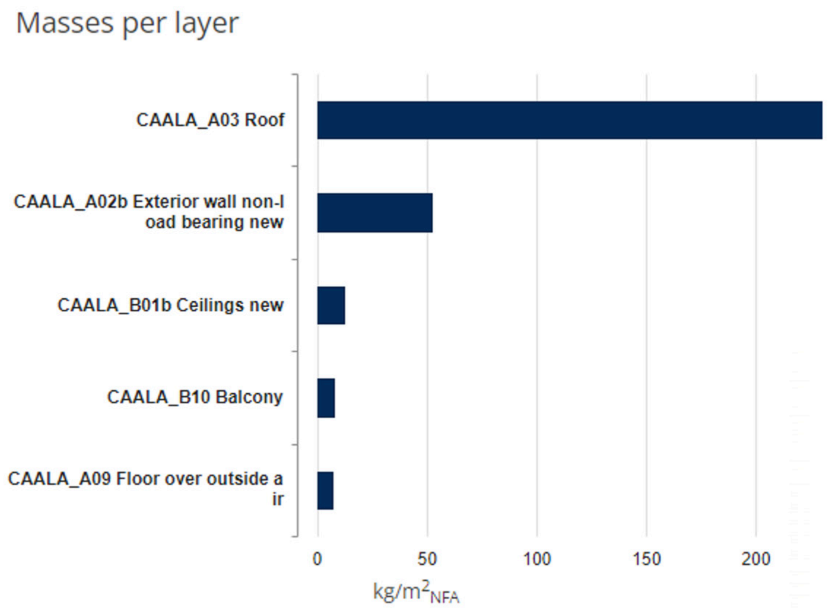
Category	CAALA Classification	Adapted Classification
Structure	CAALA_B02 Interior wall load-bearing	Walls, Columns
	CAALA_B07 Roof (un-heated rooms)	Roof
	CAALA_B11 Floor (un-heated rooms)	Floor Slab
Slabs	CAALA_A03 Roof	Roof, wooden stud
	CAALA_A03b Roof, terrace	Roof, wooden terrace
	CAALA_A04 Ceiling to unheated roof	Atrium Ceiling, concrete
	CAALA_A11 Floor to ground	Foundation, concrete
	CAALA_B01 Ceiling	Slabs, concrete
	CAALA_B01b Ceilings concrete and isolation	Extra isolated slabs, (Balco-nies, terraces)
	CAALA_B01c Ceilings new	Intermediate slab, wooden stud
Walls	CAALA_A01 Exterior wall load-bearing	Inner Core, concrete
	CAALA_A01b Support-ing outer wall new	Inner walls, wooden stud
	CAALA_A01c Support-ingn outer wall loadbering structure addition	Loadbearing structure, gluelam
	CAALA_A02 Exterior wall not loadbearing	Exterior walls, concrete
	CAALA_A02b External wall not loadbearing new	Non-loadbearing Walls, wooden stud
	CAALA_A08 Basement wall to soil	Basement walls, concrete

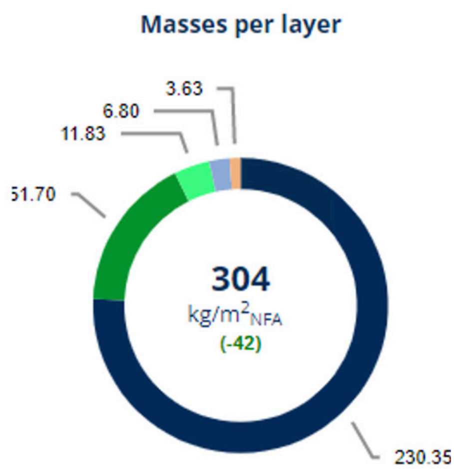
Category	CAALA Classification	Adapted Classification
Windows	CAALA_A12 Window (exterior wall)	Windows existing
	CAALA_A12b Window new	Windows, new
	CAALA_A14 Door	Doors
	CAALA_A14b Outer door new	Doors, new

NEW STRUCTURE

In this study, the impact of the newly added rooftop structure, hoizontal extensions as well as additions of outside spaces like balconies and loggias is examined. The analysis encompasses the exterior walls, load-bearing structure, intermediate floor slab, roof and windows. Any pre-existing impacts from the building are disregarded.

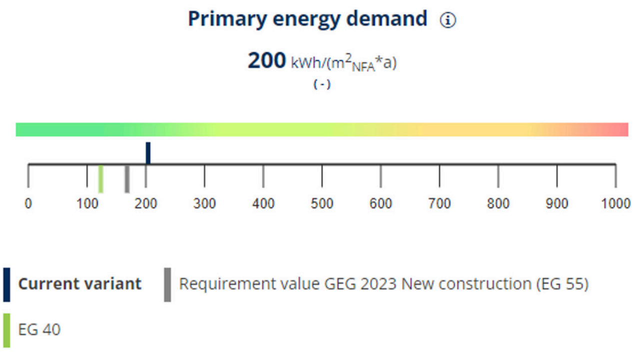


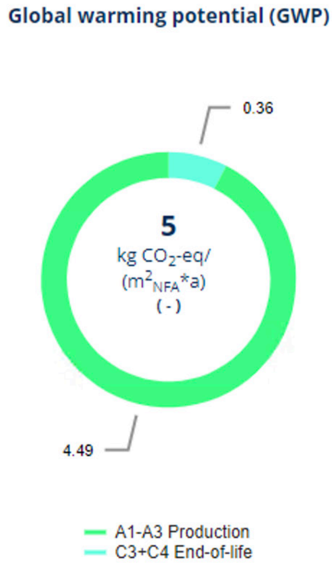


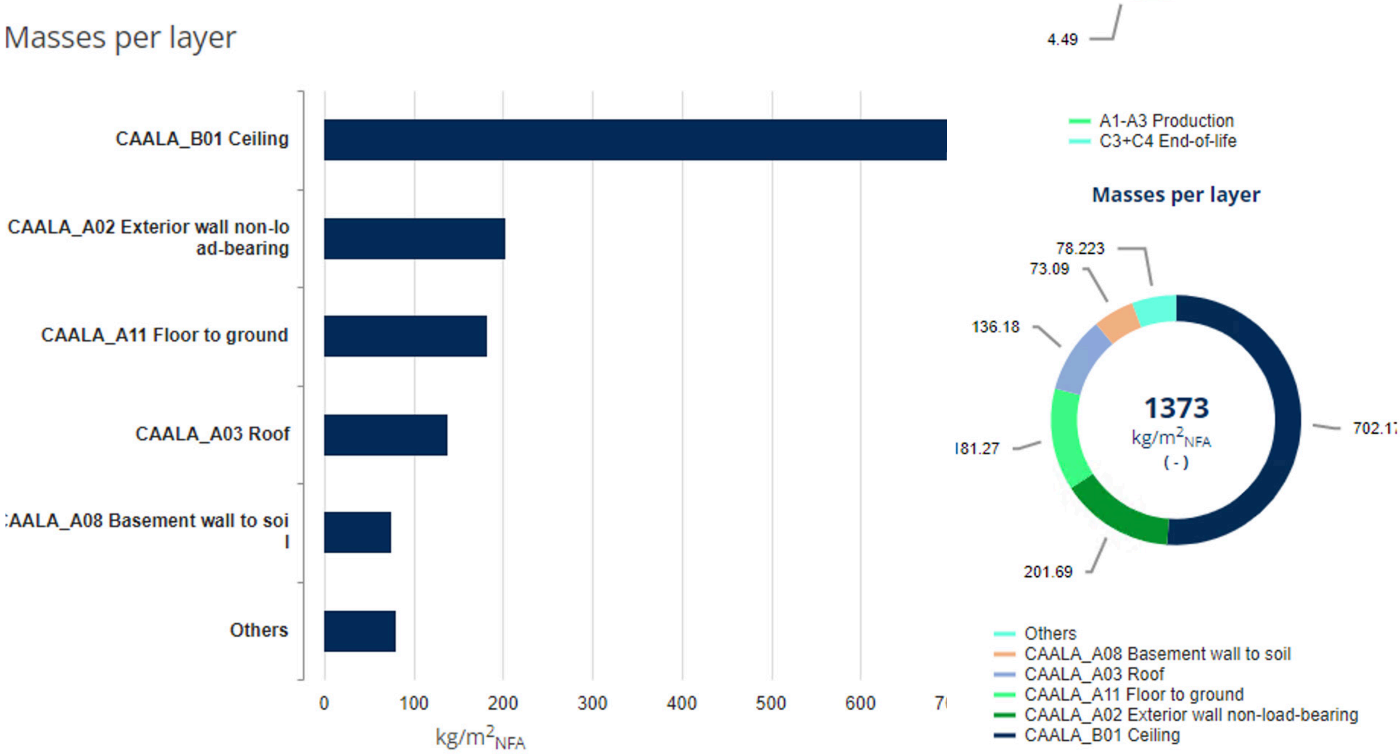


EXISTING BUILDING

This analysis is performed on the existing building and is including the entire building components ranging from the foundation, exterior walls, slabs, columns, roofs as well as windows.

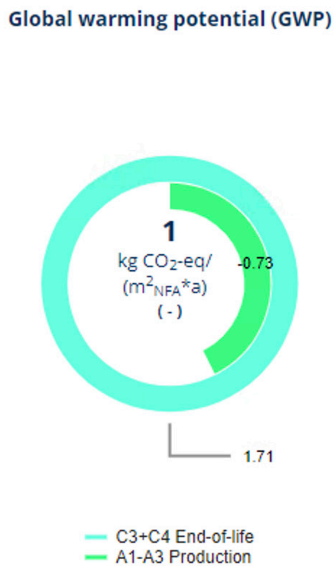


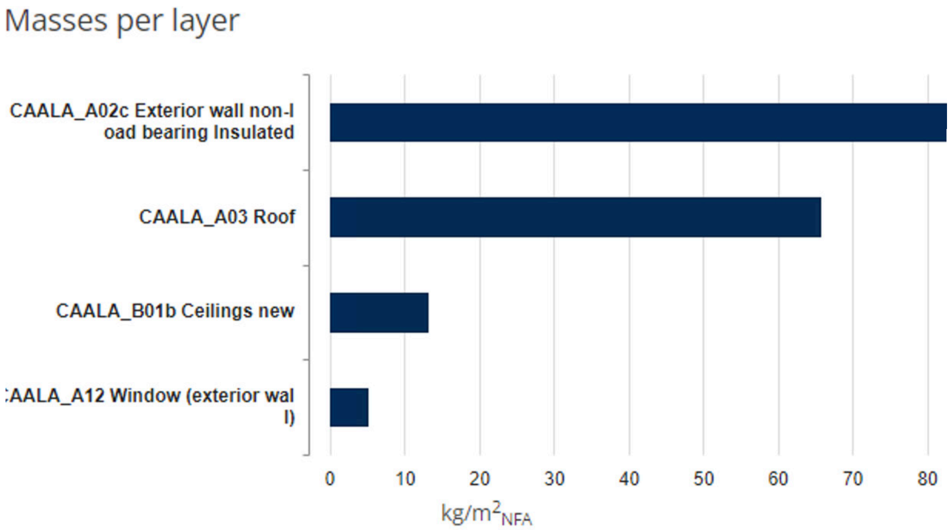


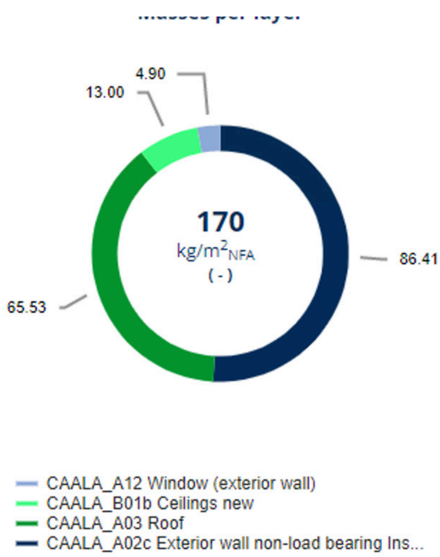


ADDITINAL LAYERS

This analysis looks at how changes to the climate shell of existing buildings, such as adding insulation and new windows, affect their performance. It also includes infills of the window opeinngs. It does not take into consideration any previous impacts from the building.

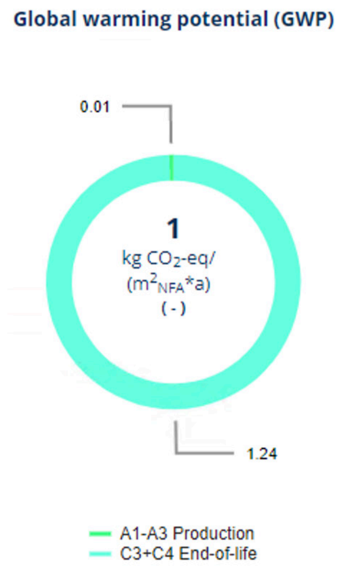


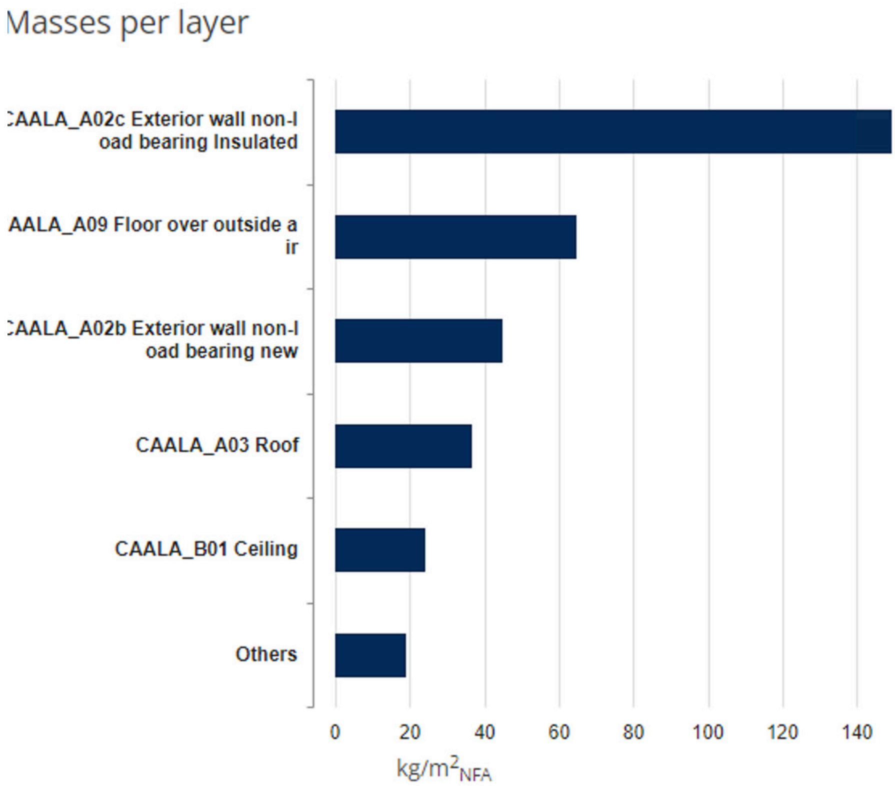


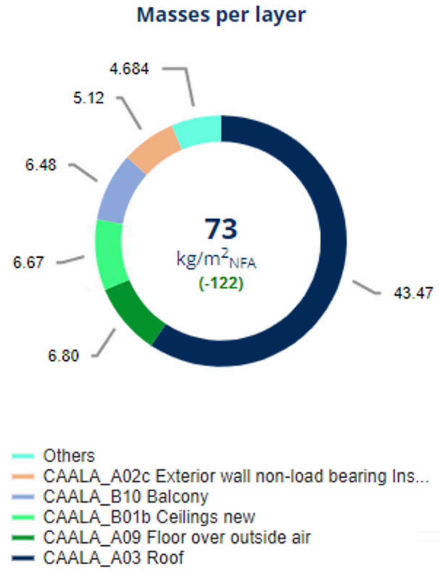


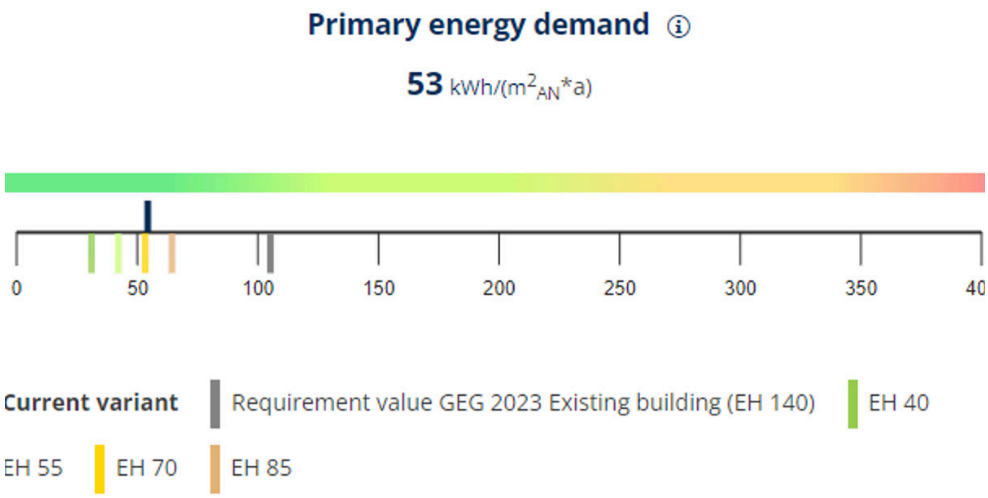
ENTIRE TRANSFORMATION

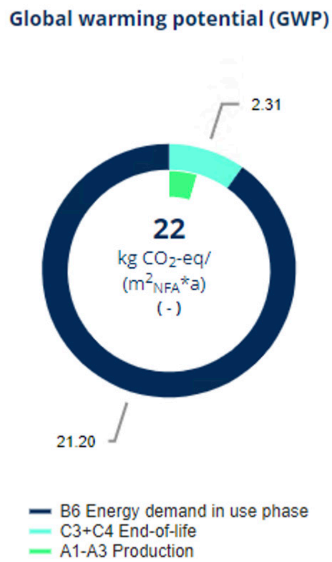
The ultimate analysis assesses the overall impact of all changes implemented during the transformation process. It calculates the effects of all additions, including extra layers and new rooftop structures. In this analysis, the impact of the existing structure and any reused materials is disregarded. It’s a comprehensive life cycle analysis covering production (modules A1-3), energy demand during use (module B6), and end-of-life considerations (modules C3+C4). C3 (Waste processing), C4 (Disposal), and D (Recycling potential).



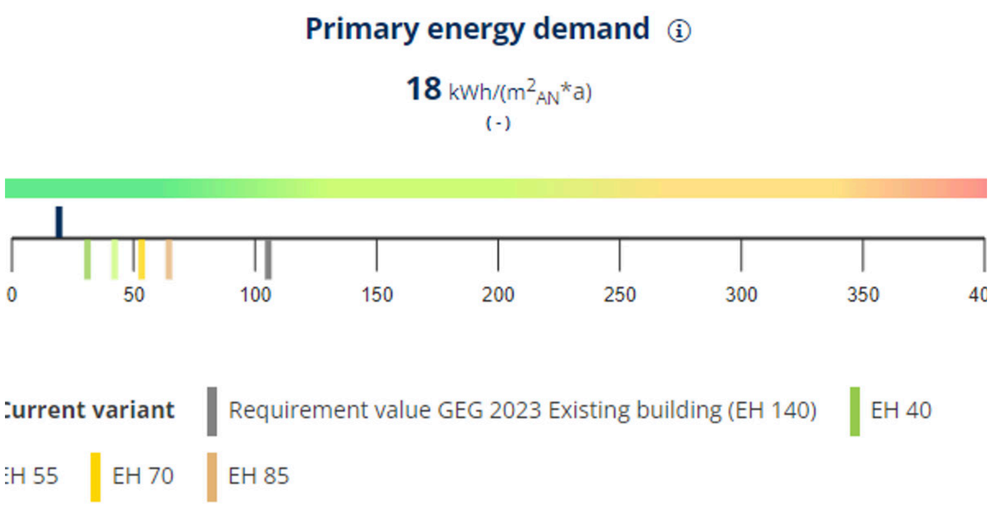


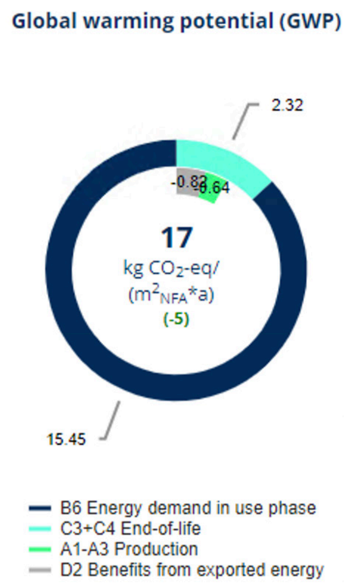






Including User Energy: 30 kWh/(m2NFA*a)





Excluding User Energy

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