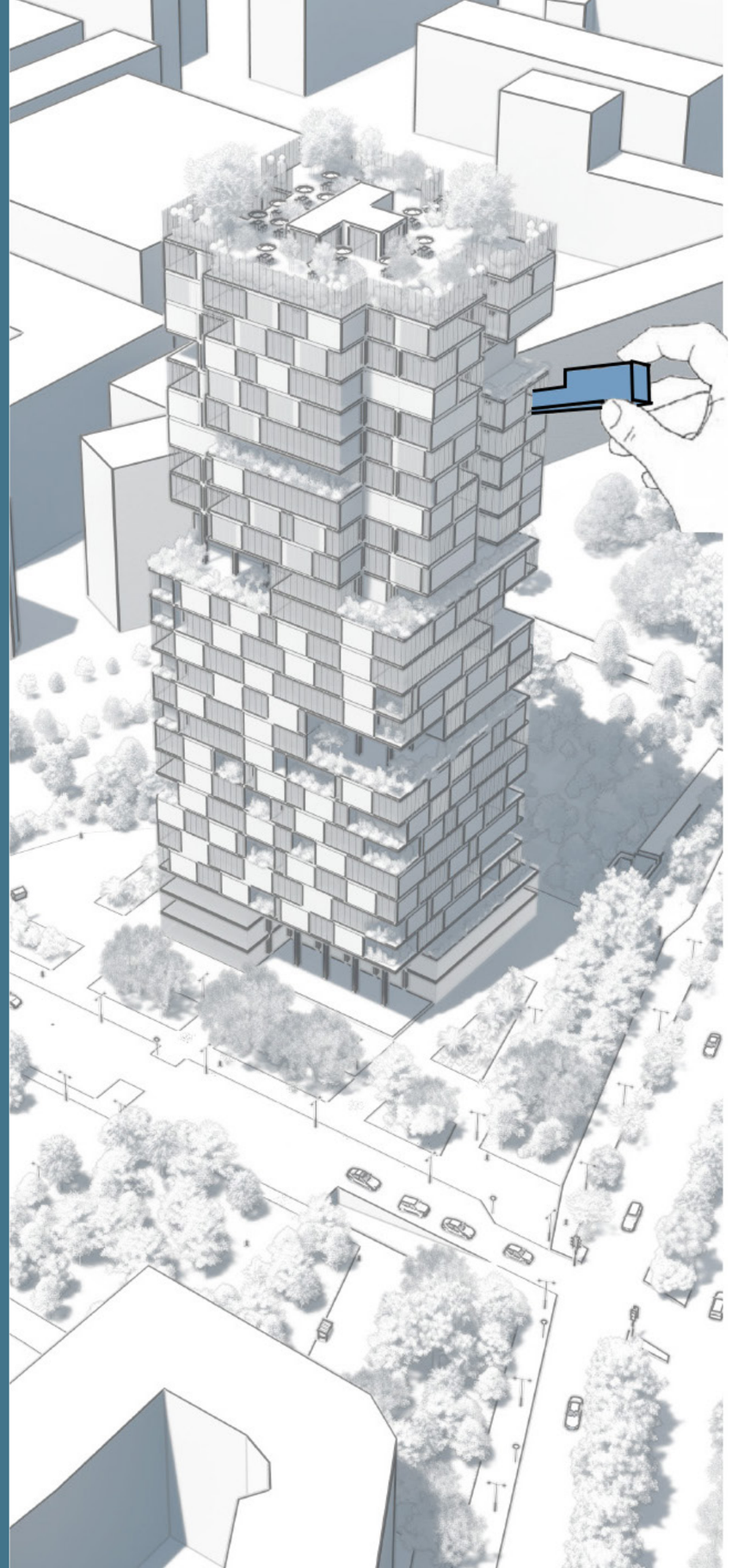
OPEN BUILDING SYSTEM IN VERTICAL URBANISM



POLITECNICO DI TORINO

Master of Science in
Architecture Construction City
Academic Year: 2023/2024

OPEN BUILDING SYSTEM IN VERTICAL URBANISM

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| ACKNOWLEDGEMENT

I would like to acknowledge my family for their unwavering support, patience, and understanding throughout the ups and downs of this journey. Without your love and belief in me, none of this would have been possible. What was initially an overwhelming hardship, to abandon the family surroundings, and the common grounds of my birth nation to study abroad for years, was only possible through their full endorsement along all of these years.

I would like to express my gratitude to the privilege of having Roberta Ingaramo as my thesis advisor and Negrello Miacol as co-advisor, whose dedication and expertise were essential to give me strength and confidence in the conclusion of each step towards the completion of the final thesis.

In the same way, I am also grateful for all the friends and colleagues with whom I've shared unforgettable experiences throughout this time at Politecnico.

ABSTRACT

Vertical urbanism is an emerging concept in urban design that seeks to address the challenges of rapid urbanization and limited land resources. It involves the creation of tall buildings and vertical infrastructure that maximize land use efficiency while providing solutions for sustainable urban living where as introducing Open building system into vertical Urbanism will help to achieve the growing need for **sustainable, efficient and adaptable built environment** this system is based on the idea that the user should be able to interact freely, independently and flexibly to support stability and resilience.**Combining this theory with the concept of vertical urbanism will give the ability to create a highly adaptable built environment that can better handle urbanization challenges**. This thesis explores the potential of incorporating open building system principles within vertical urbanism as a solution for affordable housing for young scholors and workers. Now a days many cities, faces challenges in providing affordable housing to its growing young population. By integrating the open building system concept, which emphasizes adaptability, flexibility, and user participation, this research proposes a sustainable and affordable responsive approach to meet the evolving needs of the young demographic.

To investigate the viability of integrating an open building system within Turin's vertical urbanism context, this research analyzes case studies from other cities that have successfully implemented similar approaches. These case studies provide valuable insights into the benefits of user participation, modularity, and flexibility in creating sustainable and socially inclusive housing environments. and by ,it will also focus on the potential to transform urban spaces, focusing on the advantages and challenges of this approach to create innovative, sustainable and affordable Building in the future.

Key words

Vertical Urbanism, Open Building system, Adaptable built environment, Sustainable, Affordability, Support ,Infill, Skin, Zoning and layering, Affordable housing, Growing population.

INTRODUCTION

Open building systems refer to an approach that takes into account the varying spatial requirements and changing lifestyle preferences of occupants throughout the lifespan of a building. It focuses on providing adaptable and future-proof spaces that can be modified easily to meet evolving needs. By incorporating this concept into vertical urbanism, it becomes possible to create living space that can be flexible enough to accommodate changes in living arrangements, technology advancements, and environmental considerations. Vertical urbanism, characterized by the construction of high-rise buildings, holds the potential to maximize land use efficiently while accommodating the ever-increasing urban population. However, traditional construction methods often hinder flexibility and adaptability, making it challenging to cater specifically to the dynamic needs of young population. This is where open building systems come to the foreground.The integration of open building systems in vertical urbanism offers several benefits for affordable social housing.

Firstly, it allows for a modular design, enabling flexible floor plans and room configurations that can be easily adjusted to cater to different student needs. This adaptability promotes efficient space utilization, as various housing options can be tailored to suit individual preferences, from shared apartments to single rooms or co-living spaces.Secondly, open building systems provide the opportunity for incremental development, allowing affordable housing to be constructed in stages or modules over time. This approach minimizes upfront costs while enabling continuous expansion and improvement as the student population grows or changes. It also offers the advantage of reducing disruptions from construction, as modifications can be made without disturbing the entire building structure.

Exploring the integration of open building systems in vertical urbanism offers a promising solution for the provision of affordable housing. **By embracing adaptability, flexibility, and sustainability, this approach can effectively address the dynamic and diverse needs of young user while optimizing the use of limited urban space.** Through further research and analysis, this thesis aims to shed light on the practical implementation of open building systems to create affordable housing that balances functionality, affordability, and sustainability in the vertical urban context.

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RESEARCH QUESTION

What is Vertical urbanism and Open building system, how it will full fill the demands of future generation ?

How flexible design and their composition can solve the spatial challenges of high rise ?

How Combining Vertical urbanism in Open building syatem is a better solution for Affordable housing and how it will improve the lives of the user and make if more flexible?

What is affordable housing and it's benifits and what are the challenges faced by the younger population?

METHODOLOGY

The methodology employed in this thesis entails a comprehensive approach that integrates research, case studies, and practical implementation. The thesis is divided into three main parts: Research on vertical urbanism and open building system, Case studies, and Implementation of open building system in vertical urbanism in the city of turin ,in order to build an affordable living space for students and young workers.
The methodology for each phase is outlined below:

The Research:

a. **Vertical Urbanism** - Litreature study on the brief history of vertical urbanism, followed by the study of the techonological development in the field.Development through time and the current scenario is also studied. in the end as a result of the conclusion the benifits of vertical urbanism is extracted.

b. **Open building system** - The research started from a question “Would you buy a car if the tires were moulded to the wheel rims, and the wheel rims welded to the chassis?”. To answer the question the theory of John Habraken was studies .Research on the theory of zoning and layering is done in order to understand the concept of open building system following with a conclusion.
The high rise of homes was studied in literature studies to support the concept of the thesis.

METHODOLOGY

c. **Affordable Housing** - A brief history of affordable housing is studied in ored to understand the problems following the current state in order to understand the problems faced by the people and how to solve them. a research is done on the affordable housing in italy along with turin to understand the situation better as the site for the proposed building is in turin italy.

Case studies: An in-depth study of 9 building projects releated to the open building system, vertical urbanism and affordable housing was done. the study was followed by summarising useful information after each building which can be used later to develop the design.

Implimentation: In order to impliment the theory of open building system and vertical urbanism a site was selected in the corso lyone region of turin italy.site study and the building study was conducted and designed priciples were formed on the basis of the research done through out the thesis.

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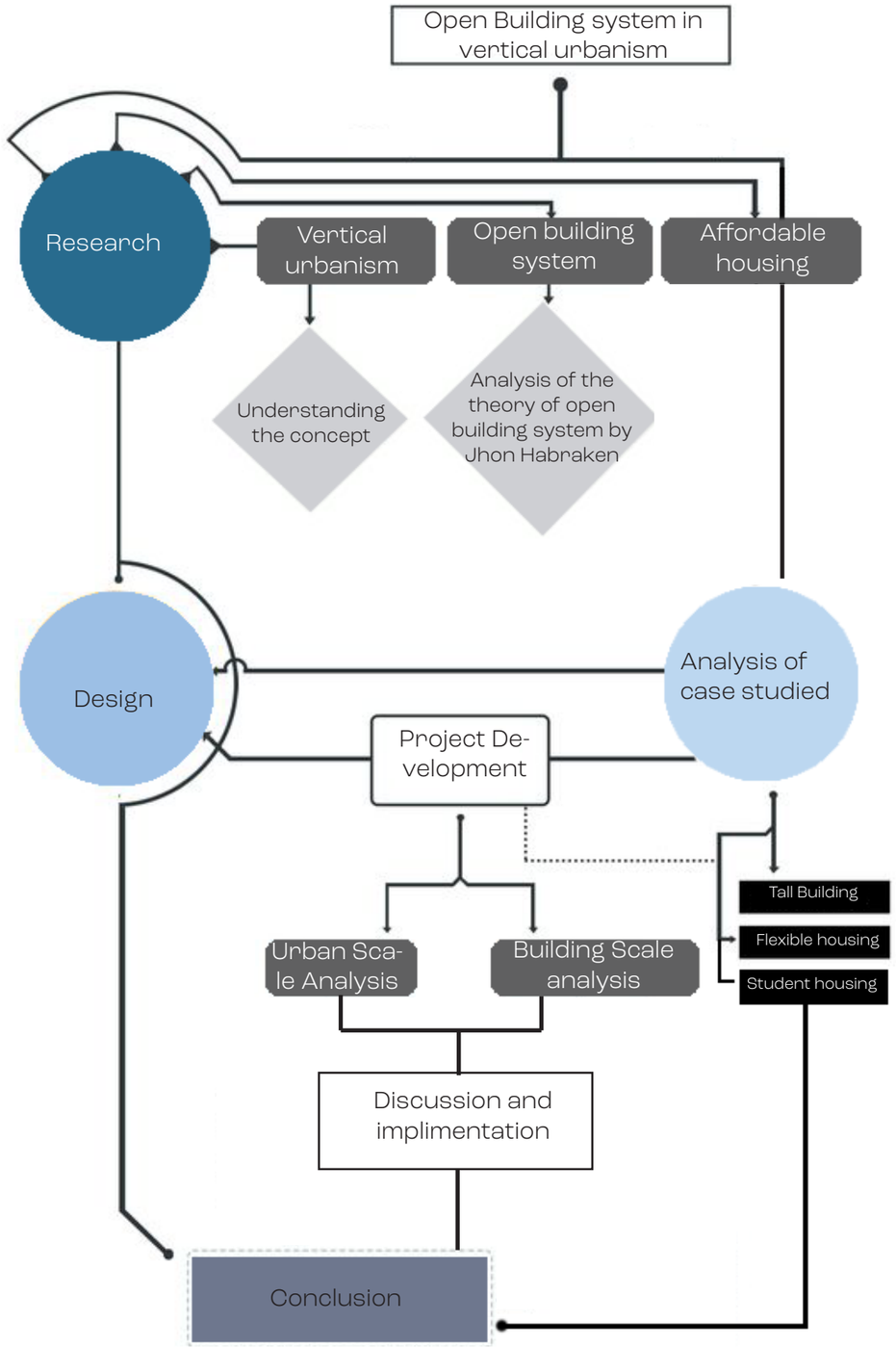

Fig. 01: Representation of Methodology

CHAPTER

1

Vertical Urbanism

01| VERTICAL URBANISM

Fig. 02: The Tower of Babel
Source: Pieter Bruegel the Elder (1563)

The significance of verticality to human notion goes back to early history. The Idea reaches back to the earliest civilization such as the **Tower of Babel**. Afterwards the builders started to fantasize vertical Buildings rather than horizontal. **Throughout history,other tall structures such as pyramids, cathedrals and towers were erected.**(Geoff Craighead, "High-Rise",pg.2,4.) However, Although cities have evolved for thousand of years, it is the past 150 years where we witness the birth and the rebirth of theVertical buildings. What was historically an anomaly of the urban experience has now become an integral part of the urban landscape In the **21st century, high-rises have been built like no other time, developing what is known now as the vertical city.**

01.1 Brief History

The construction of buildings that were considered tall dates to the Roman Empire. During the reign of Julius Cesar, the Roman Empire rapidly grew resulting in the city of Rome becoming the site of many hastily constructed apartment buildings.

Throughout history other tall structures were erected .However, it was not until the **end of the 19th century that the term 'skyscraper' was used.** According to the Oxford English Dictionary the word skyscraper got its architectural detonation in the early 1880s in several articles in journals and newspapers.(Gerard peet, Lecturer, 2011) The term 'skyscraper' was being used for buildings that would exceed six to seven stories and had a minimum height of 35 meters.

Although there already were structures that exceeded this height, such as cathedrals, the significance was that these buildings had multiple accessible and useable stories unlike cathedrals that reached these heights because of their high ceiling chapels and towers.Additionally, there were also other buildings that exceeded the height of 35 meters such as warehouses. However, these buildings were used to store goods and not accommodate people, this is how skyscrapers and tall buildings were different from each other.

Fig. 03: Home Insurance Building, Chicago, 1884.

Source: J.W. Taylor, IChi-00989; Chicago Historical Society)

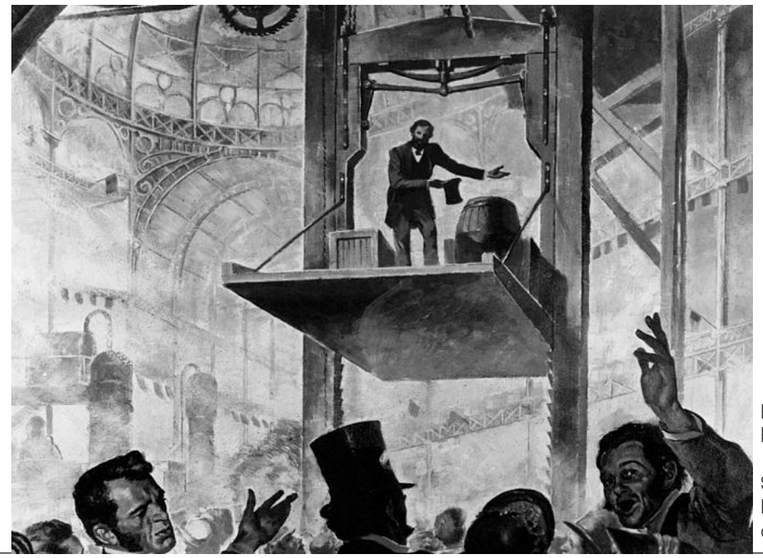

Fig. 04: . Invention of the elevator by Otis, 1853.

Source: Elevator. (2023, May 30). In Wikipedia. https://en.wikipedia.org/wiki/Elevator

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01.2 Technological development

What is noticeable is that the **first buildings** that were considered skyscrapers were all office buildings, **with the Home Insurance Building (1885)**, built in **Chicago** being the very first one. As a result of the economic growth after the Civil War (1861-1865), the financial organization of American businesses rapidly grew, demanding more office spaces. (Landau, Sarah Bradford,1996,pg.1). In combination with the increased land prices in the financial district the demand for tall office buildings rose resulting in skyscrapers that would function solely as office buildings.

It was not only the demand for tall office buildings that made the first skyscrapers emerge, but there were also two main developments that led to the existence of the skyscraper. The first being the invention of the **elevator, invented by Elisha Graves Otis in 1853.** (Geoff Craighead, "High-Rise",pg.2,4)

With the invention of the elevator people were able to travel upwards more safely, quicker and with less effort than walking up the stairs. **The second invention,** which was arguably even more important for skyscrapers was the process to **mass produce steel**.Around the 1870s builders started using steel because it's strong qualities and its cost efficiency. Before the introduction of the steel structure walls would function as the construction, which were made from cast iron and wood and in order to carry the weight of more floors the walls had to be stronger and thus thicker. (Geoff Craighead, "High-Rise",pg.2,4.) With the introduction of the steel frames the structure was able to carry the weight of the floors and walls simply became cladding for the purpose of aesthetics and insulation. The demand for these high-rise buildings was a response to the industrialization take took place in the late 1800s.

01.2.1 La Ville Radieuse' by Le Corbusier

Le Corbusier designed La Ville Radieuse, also referred to as "**The Contemporary City of Three Million Residents,**" for downtown Paris. It was first presented in November 1922 at Salon d'Automne in Paris. **It was intended to hold up to six times as many people as the center of Paris at the time.** Le Corbusier claimed that the layout of La Ville Radieuse is an unquestionable **example of personal freedom**. He thought that many early 20th-century cities were disorganized and ineffective, thus he proposed La Ville Radieuse, which had the following objectives: -

- Provide effective means of communications.
- Provide large amount of green area.
- Provide better access to the sun.
- Reduce urban traffic.

He soon understood that the best way to accomplish these goals and simultaneously make room for the **expanding urban population was to build tall.(**M. Montavon,2006)

La Ville Radieuse's plan is nearly symmetrical with respect to the city's center, which serves as the hub for all forms of public transportation. **24 skyscrapers, which are also the most contentious aspects of the entire plan, are set aside for the site's center.** These skyscrapers are primarily used for hotels and business. Five to eight hundred thousand people might live in each tower, which had proportions of **roughly 190 x 190 meters and a height of more than 200 meters.**

Le Corbusier first planned La Ville Radieuse for center of Paris; he also suggested adapting it for other locations, including Barcelona in Spain, Sao Paulo in Brazil ,Buenos Aires in Argentina and Algiers in Algeria. (M. Montavon,2006).

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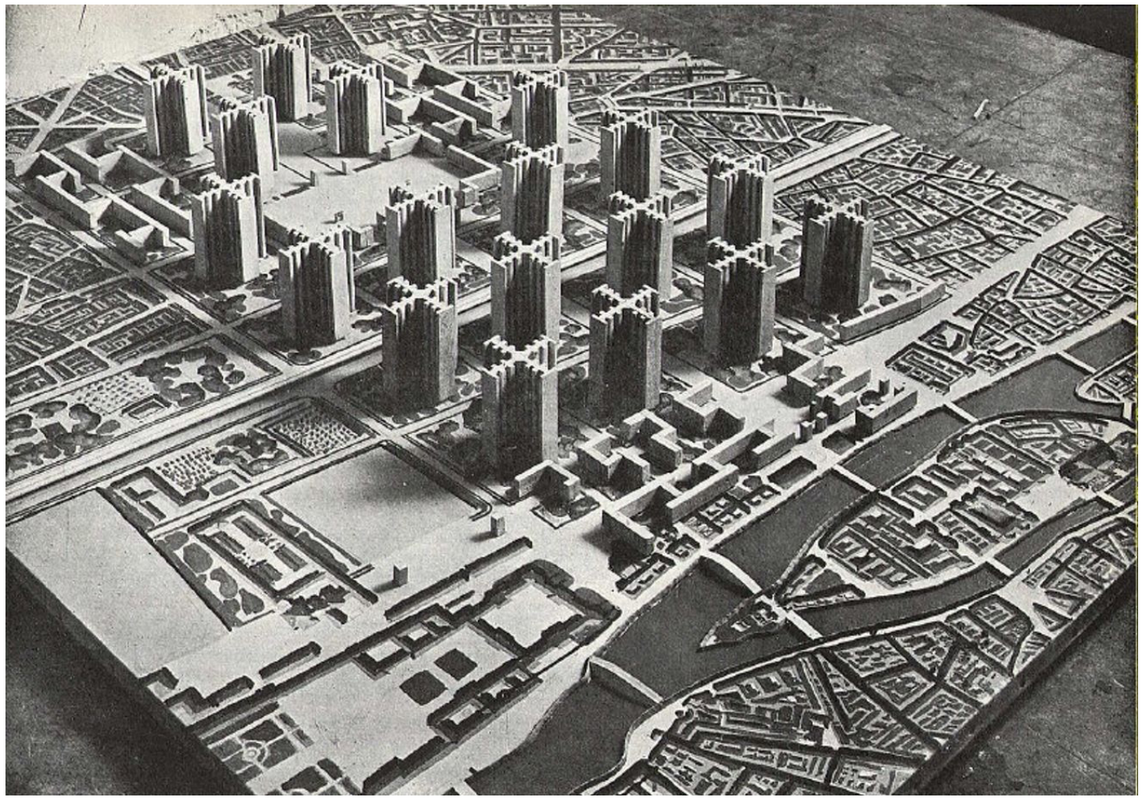

Fig. 05: The Radiant City model, Le Corbusier,1920s.
Source: Owner & developer, Structural Mat

Le Corbusier first planned La Ville Radieuse for center of Paris; he also suggested adapting it for other locations, including Barcelona in Spain, Sao Paulo in Brazil ,Buenos Aires in Argentina and Algiers in Algeria.

Mixed use building.

The Rockefeller Complex is one of the largest privately owned business projects. The Complex designed through many phases and minds. **Rockefeller is not just a skyscraper it is a Complex of 14 buildings where the three blocks only meet in the underground to preserve the rigid Grid of the city.** The underground is dedicated for shops, restaurants. The program is to create a theatre for the Metropolitan Opera Company, press building, the Elgin Botanic Garden, and business complex.(Mark Pimlott,2011)

Although it's the 1930s, nonetheless, the influence of the early tall buildings concept of a literal extrusion of the site remains feasible for the lower floors of the early 20th century's skyscrapers model. The unconscious architecture of the time followed the notion of supremacy which was applied through height and the mass of the skyscraper. It needs to be the largest the tallest, the biggest. **The building reaches a height of 259m (850 ft) and was open in 1939. The Center is considered to be the first mixed-use skyscraper.**

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Fig. 06: Rockefeller Center, 1939 is a
Source:photograph by Irving Underhill 28/11/2019

01.3 Development through Time.

By the end of the 1930s, the skyscraper boom came to an end. The **1940**s WWII affected everything; the **building industry went through a pause phase.** It later started again by the **1950s** the American invention of the skyscraper. **Skyscrapers became the symbol of the economic power** of a city and the capitalist age.Aesthetics, efficiency, and economy play the major factors of the skyscraper success. Skyscrapers of the 50's onward, tended to distinguish themselves from the pre-war period by being modern.

By the **1960s**, high-rise residential clusters vastly spread as a typology for **low-cost public housing** neighborhoods around the globe. St. James Town, located in Toronto, Canada, is a high-rise habitat that is considered one of the densest in Canada with more than 17,000 official inhabitants.

By the **1970s,** the skyscraper functions had been already formed, despite that. residential high-rises had significantly increased.(Kenoff, Jeffrey A., and Peter Gross,2022).

in this period, along with the **mixed-use typology**, the most remarkable high-rises of the period go for business functions The race now is once again focused on the highest, most technologically advanced structures, and unique modern aesthetics Chicago's Willis Tower (formerly Sears Tower) conquered the skyline of the city and the world upon its completion in 1974. With a height of 442.1m (1,451 ft), the skyscraper seized the title of the tallest building in the world and held it for over 20 years until it lost it in 1998 to the Petronas Towers in Kuala Lumpur.

By the end of the **20th century,** sustainability became a focal point for the construction industry, from material selection to building form.

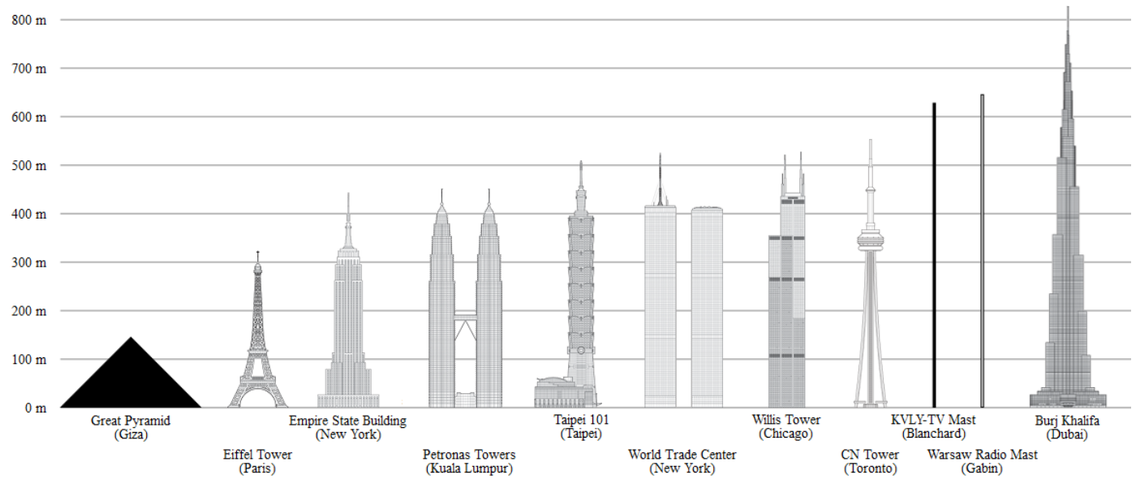

Fig. 07: Development of High rise building
Source: CTBUH, Height Article

In the **21st century,** tall building design is influenced by sustainability standards. Skyscrapers aim to become self-sufficient in energy production, the concept revolves around saving and generating energy and maximizing the benefits of natural resources

01.3.1 Why Tall Buildings in the 21st Century?

According to current UN projections, by the year 2050, the world population will increase from 7.5 billion to 9.7 billion and about **66% of this population will live in cities** . (Al-Kodmany, Kheir. 2018).The urbanization of the planet will grow by 1.5 million km2 by 2030, an area similar to the sum of Spain,France and Germany. If we look at these numbers and aware of an increasingly urbanized world, it seems that tall buildings will be the norm, rather than the exception.

According to statistics, skyscrapers have been built throughout the 21st century more than any time before. as the most active year in tall building history.

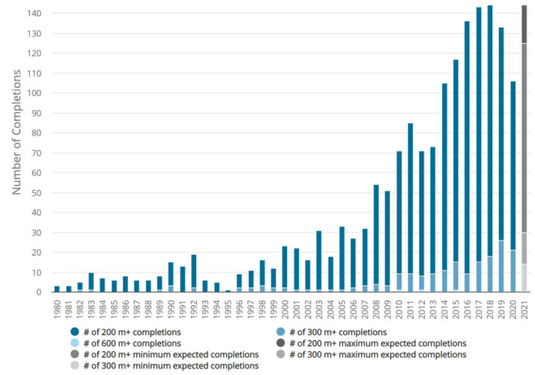

Fig. 08: Number of completed skyscrapers from the year 1980-2020. Source: 6.CTBUH Database, 2020 Year in Review report

In the 21st century, vertical structures are needed to save lands, suburbs, and energy, and reduce carbon emissions.

The global urban form is rapidly and intensively altering. Cities are exploding with inhabitants, and the migration from rural to urbancauses increased demand for space.

Sustainable developments render the high-riseurban sprawl results in a radical increase in travel time and congestion. (Hargrave, Josef, and Ralph Wilson , 2013).model and dense living more environmentally friendly than the horizontal expansion of the urban as they cut carbon emissions produced from travel time. Skyscrapers stand as an icon of the nation and the image of the city; therefore, they are viewed by many

Benefits of Tall Building:

I- Overpopulation

Tall buildings are a sustainable scheme to accommodate the increasing number of inhabitants in the city.

II- Urban Regeneration

The vertical expansion makes it possible to recreate the land in desirable locations in the city.

IV- Land Conservation

Tall buildings save open space and improve access to nature, which are primary objectives for sustainable living.

VI- Transportation and Infrastructure Models

Tall buildings are a compact type of development and thus create efficient infrastructures. They require fewer roads, energy lines, sewage systems, etc. relative to horizontal modules, as they allow dense infrastructure systems.

- High Land Prices

Skyscrapers are costly, but land prices in megacities are too pricy as well. Sometimes multiplying the lands vertically is more profitable.

Fig. 09:Benifits of Vertical Urbanism.

CHAPTER

2

Open Building System

02| OPEN BUILDING SYSTEM

Lets imagine that someone is trying to sell you a car but the car's tires were moulded to the wheel rims, and the wheel rims welded to the chassis. Would you buy it?

I expect that you will say no, because if your car needs a tire change, it would have to destroy the whole vehicle. But the building industry has always followed and still follows this exact approach.

Fig. 10: Spagitti Junction
Source: Google Image.

For example, cables are sometimes buried into concrete load-bearing ceilings. When you need to replace them after 20 years, you have to destroy the intact building fabric. This leads to considerable follow-up costs which are difficult to estimate. Perhaps someone would say that the cables could be disconnected, but then where would we find the space for the replacement installations?

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The answer is Open building System.

The origins of the concept of Open Building is best captured by one of John Habraken's finest quotes:

'We should not to forecast what will happen, but try to make provisions for the unforeseen' (Habraken, 1961).

He suggested adding three more levels of decision-making to the construction process: tissue, support, and infill, in order to account for unforeseeable future change. These levels correspond to the urban fabric, which include basic buildings and their fit-outs (Ype Cuperus,2001).

It provides the framework for a well-organized building process with clear interfaces. It enables us to move construction from buildings to manufacturing, at least in part. By planning measurements and locations rather than inventing on the spot and cutting to size, it is the secret to decreasing waste. (Ype Cuperus,2001) applying knowledge as opposed to effort.This is a crucial prerequisite for the reuse of building components, which will increase their lifespan without the waste of disposal and recycling, which also contributes to degradation and the usage of energy.

02.1 LEVELS OF DECISION MAKING

The exciting difficulty of Open Building is having to plan for an unknowable future, and the idea of levels points in the right way for solutions. There are three categories of decision-making: **tissue, support, and infill.** (Ype Cuperus,2001) Despite being apart, they work together. Buildings located within the town fabric are on a lower level than the town fabric itself. The structure of the town can remain the same while buildings can be changed or replaced. Base buildings (support level) and fit-outs (infill level) are two different categories for the buildings.

The lower level's requirements for the upper level (support) are established by the way the higher level accommodates and limits the lower level (infill). (Kendall, Stephen, and Jonathan Teicher,2000)There is a "**ultimate customer" on each leve**l: the consumer on the infill level,the housing corporation or developer on the support level, the municipality on the tissue level Decisions on building components are always included in the levels of decision-making.

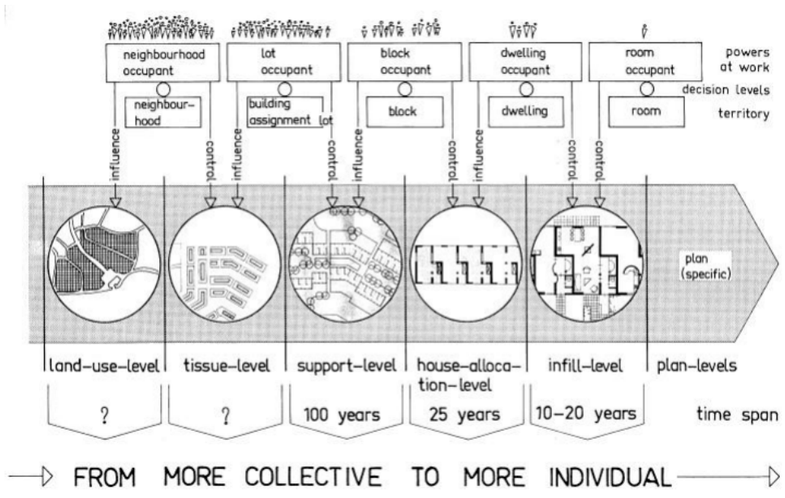

Fig. 11: levels of decision making.
Source: By J. Habraken

They link a decision-making entity to a thing that is being built or transformed. The various decision-making levels should be dispersed but coordinated. The building process is separated into numerous disciplines and trades in the construction and building sector in addition to decision-making levels. **This falls under the category of building management and contracting and requires a distinct form of cooperation.** Then there is the segmentation into technical subsystems, such as HVAC, the façade, the roof, the load bearing construction, and the interior dividing walls. Another subdivision might follow the same lines of financing, with a long-term mortgage on the foundation and a personal loan for the infill. If building parts with a different life cycle or a different environmental impact need to be separated, new subdivisions will be introduced. Any subdivision serves its own aim. A better understanding of these different subdivisions helps to synchronize their dividing lines, for a more efficient building process.

Nowadays, still many open buildings have involved user participation in the design process. However, the call for open buildings is increasing, because it advocates for a more adaptable building environment which has become extremely relevant in the last decades.

02.1.1 Zoning and layer types

The layout of the support is depending on the zoning and the types of other layers. Specially the place of the access elements and the vertical service elements have a lot of impact on the support.The location and dimensions of detachable layer components must clearly defined.The zoning of the access elements, service elements and the outdoor space relative to the support. The position of these three layers has the most impact on the structural layout.

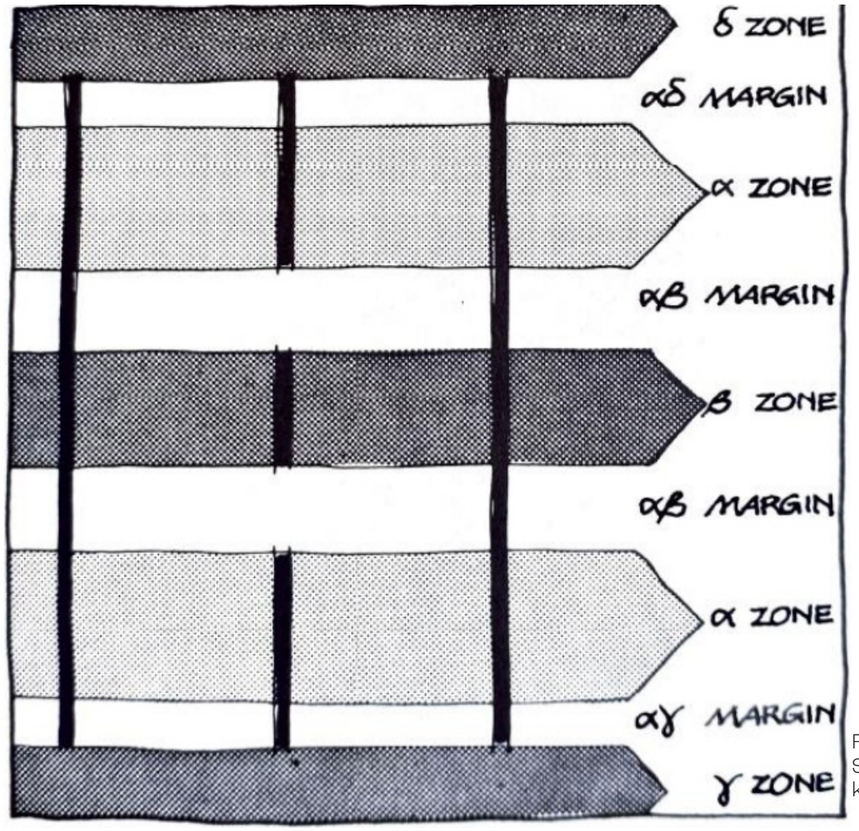

Fig. 12:Zoning supports. Source: defined by Habraken (Habraken, 1976)

Habraken (1976) defined several zones within the support. he α-zone is inside and adjacent to an external wall. The β-zone is inside as well, but not adjacent to an external wall. It is situated between two α-zones. The δ-zone is private outdoor space and the most outer zone.The γ-zone is intended for public use and can be both internal or external.(Guopeng Li, 2019).
Between each zone is a margin. Within each layer are many different types. The structure can consist of columns or walls and the access elements can consist of corridors or galleries.
zoning principles are combined into one generic floorplan and section. It shows the α-zones, βzone, γ-zone and the δ-zone and at the same time the defined typological building layers for a flexible support. The α-zones and the βzones are internal zones for private use. The β-zone, which is located in the middle of the structure, consist of a vide on every second floor. This makes it possible to place stairs in the center part of the structure and combine two different floors.

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Conclusion

The open building offers many possibilities for a flexible building environment.The **support** forms the frame which is the most permanent part of the building. The independent **infill** building layers can also be part of the permanent frame which forms a generic space in which change can occur. The circular infill layers have a **different lifespan** and can change independently from each other to accommodate an adaptable flow.

The building layers skin, access elements, service elements, scenery and outdoor space are all connected to the multifunctional support which forms a smart structure. The layer outdoor space has become more important in dense urban areas. Building volumes and outdoor space doesn't have to be opponents. An extension of outdoor space on building can have many social, access and climatic functions and besides it can offer more greenery and biodiversity in the city. Support, infill and the independency of layers also offers opportunities for more user participation and mass customization. Too what extend user participation is integrated is the decision of the architect or contractor.

The most flexible structures found in the analysis are bay structures with stabilizing shearing walls. The design of the support depends on flexible and adaptable zoning of building layers and layer types. The zoning scheme of Habraken and the mapping of different layer types and zones shows the most optimal layout of the support. It has a uniform section and ideal proportions between façade length and created surface area.

The zoning and dimensions which are based on a flexible infill, multifunctionality, climate performance, adaptability, daylight, façade length and materials offer a large variety of possibilities in terms of function, size and different user needs. The length and height of the total support configuration is variable and can be adjusted to the local situation.

Building Layers:

I-Structure

The structure is flexible and open for multiple types of layouts

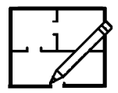
II- Skin

1.Openings in the skin can be changed due to its flexibility
2. The interference with outdoor spaces is minimalized

IV- Access elements

1.The vertical access is independent from the structure
2. The distance from a unit to a vertical access element is small

VI-Floor Layout



1. The floorplan of each level is flexible with minimal interference of other layers
2. A structural system gives form to the internal layout

VII-Outdoor space

1. Outdoor spaces can be divided in smaller outdoor spaces
2. Outdoor space are space efficient and profitable.

Fig. 13: Benifits of open Building System.

02.2 Highrise of Homes

The Highrise of Homes project was described as a "**vertical community**" by **James Wines, a founding member of the SITE** (Sculpture In The Environment) architectural group, to "accommodate people's conflicting desires to enjoy the cultural advantages of an urban center, without sacrificing the private home identity and garden space associated with suburbia."

The design calls for an eight to ten story, U-shaped building frame made of steel and concrete to be built in a heavily populated urban region. Within this time span, the developer would sell lots, each of which would be the location of a home and garden **designed in a manner specified by the buyer**. The end result would be a distinct **village-like community with inner streets on each floor. (**James Wines, Apartamento Magazine). These residences and gardens would be served by a central mechanical core, and the ground and middle floors would house the shops, offices, and other amenities that the people would require.

The Highrise of Homes would enable flexibility and individual choice in contrast to urban skyscrapers, which are typically constructed of similar, stacked, box-like flats. The detailed rendering's several house designs, gardens, hedges, and fences give a sense of the individuality and human connection that architectural formalism's stark and repetitive components typically obliterate. Wines creates a blend of suburb and city, a collage of buildings jointly formed by its people and by the art of chance. He does this by prioritizing the sociological and psychological demands of the dweller over the aesthetic sensibilities of the architect. **The project's potential location was Battery Park City in New York, but it was never completed.**

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Fig.14: INTERSECTION FIELDS IV: Highrise of Homes

New York, NY, United States. 1981

Architect: James Wines

Image by SITA.

Points of consideration

1. It can be collocated in rural areas or in very dense urban centers
2. It can be done for low or high-income neighborhood
3. It can be a reused abandoned structures, or newly built Structure either with steel and concrete.
4. IT can rise from 10 to 20 floors
5. It has High building configuration Either U-shape or rectangular accordind to the optimization of natural light.
6. It has floors which is a flexible platform housing streets and plots upon which individual homes or clustered into village-like communities can be built.
7. each house is unique, since follows owner preferences.

(Calamita Ilaria,highrise of homes...)

The project is Unbuilt because the material and design for each house would have been too expensive That's why remained an innovative but utopian vision .

CHAPTER

3

Affordable Housing

03| AFFORDABLE HOUSING

Fig. 15: A view of the Montreal docks in 1896 reveals working class housing tucked in among the factories and works yards. Note the laundry on the line in the lower foreground.

Source: Houses for Mr. Meredith, Montreal, QC, 1903 by McCord.

Fig. 16: Early Peabody housing: Southwark Street SE1, originally consisting of 12 blocks of 22 flats each, opened in 1876: intended to "ameliorate the conditions of the poor and needy" (Photo: © Peabody, c.1960s)

Source: Photo by Peabody, c.1960s)

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Home is one of the most essential and fundamental aspects of everyone's life. It have a physical, cultural, phenomenological or psychological dimension (Moore, 2000). As Appleyard (1979) claims, a home provides not only psychological comfort, but also social and the most basic physiological needs. Affordable housing is a broad and complex subject intertwined with many disciplines including finance, economics, politics, and social services, to name a few.

The origins of affordable housing can be traced back to the early. **As the demand for housing increased, landlords capitalized on the situation by charging exorbitant rents, leaving low-income individuals and families struggling to find suitable places to live**. The dire living conditions and exploitative practices prompted the need for affordable housing measures.

However, it was during the Industrial Revolution in the 18th and 19th centuries that the need for affordable housing became increasingly urgent due to rapid urbanization and overcrowding. Governments and philanthropic organizations began constructing public housing and tenements to address housing shortages, such as **London's Peabody Trust in the mid-19th century.** George Peabody 1795-1869 was an American business man and philanthropist. As mention in the london news from 1869 he set up the Peabody Donation Fund in 1862 and built the first homes for the labouring poor in Commercial Street in Spitalfields in 1864. (Peabody Housing. London News, 1869)These blocks housed 93 low-rent flats with separate wash houses, baths and laundries. There was also a playground for children. These blocks altogether contain ninety-three dwellings, or 225 rooms, and a boardroom for the meeting of the trustees. There are forty dwellings of three rooms, fifty-two dwellings of two rooms, and one dwelling of a single room.

In response to the housing crisis, governments began introducing policies and initiatives to tackle the issue of affordability. One notable example is the United States' New Deal era in the 1930s, during which the Federal Housing Administration (FHA) was established. The FHA promoted affordable housing by introducing mortgage insurance programs, making homeownership more accessible to low-income individuals.(Tom Hanchett,2000)

Furthermore, several countries, including the United Kingdom, Canada, and Singapore, enacted legislation to ensure the availability of affordable housing for their citizens. Governments began constructing public housing projects and subsidizing rents to assist marginalized communities. These efforts aimed to mitigate economic disparities and improve living conditions.

In addition to government intervention, nonprofit organizations have played a significant role in promoting affordable housing. Organizations such as Habitat for Humanity, Mercy Housing, and many others have dedicated their efforts to providing affordable housing options for those in need. These organizations work through various means, including constructing low-cost homes, providing rental assistance, and advocating for fair housing policies.

Affordable housing initiatives are also influenced by economic factors and social imperative. Urbanization, population growth, and gentrification exert pressure on housing markets, often leading to soaring prices. **Access to safe and affordable housing promotes stability, health, and well-being among individuals and families. It fosters community cohesion, offers educational opportunities for children, and reduces the risk of homelessness. Affordable housing allows individuals to allocate their resources to other essential needs, stimulating overall economic development**.

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Fig. 17: The new report documents decades of the city's rent control policy, including the introduction of a rent stabilization ordinance in the 1970s.

Source: Pictured: A 1978 rent control march on City Hall.

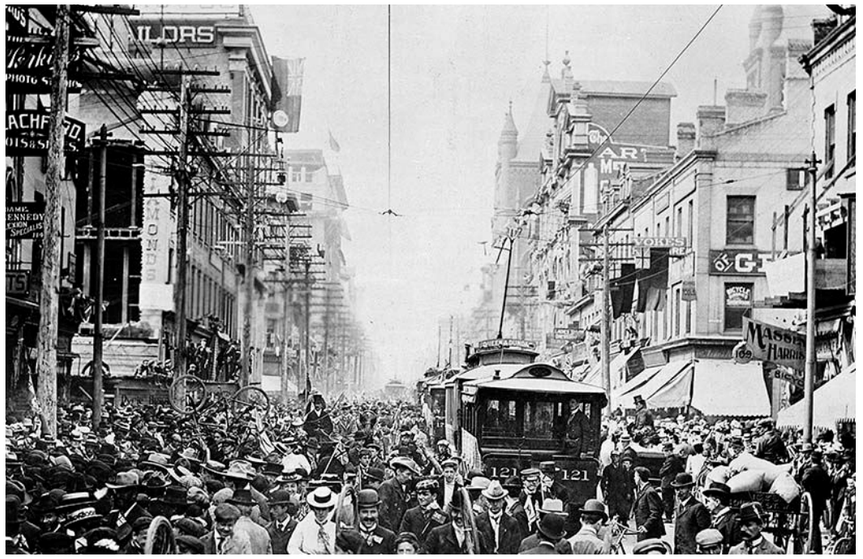

Fig. 18: The largest city in English Canada, Toronto covered a relatively small area. Public celebrations – like this one for the Boer War in 1901 – brought thousands into the streets. Notice how pedestrians, cyclists, streetcars, and horse-drawn wagons compete for space.

Source: Pretoria Day 1901 by James Salmon is in the public domain.

https://pressbooks.bccampus.ca/lwiener/chapter/3-4-urbanization-and-industry/

03.2. Affordable Housing in italy.

Nowadays “affordable housing” has different meanings in Italy.Today the Italian affordable housing definition became “blurry” in a mix of public and private practices, proposing either rental housing or home ownership,using complex financial tools.(Caruso, N.,2017,pg.23)

The traditional concept,born in the post-World War II scenario, is associated with the words‘residential public building’ (edilizia residenziale pubblica, ERP), which have been used with various meanings in everyday practices, in recent years, to promote housing initiatives that draw attention to social attributes and try to cope with different housing needs. (Caruso, N.,2017,pg.23) An official definition of social housing in Italy was provided in 2008 by the national State (D.M. 22/04/2008), precisely, “mainly dwellings rented on a permanent basis; also to be considered as social housing are dwellings built or rehabilitated through public and private contribution or with the use of public funding,rented for at least eight years and also sold at affordable price, with the goal of achieving a social mix.”

In the most populated Italian cities, the issue of housing for lower classes was first addressed by private associations around 1870. This kind of private initiatives took place in cities like Florence, Milan and Turin during 1862–1868, where houses for specific beneficiaries, the workers, were built. (Caruso, N.,2017,pg.27) The goal was to meet few requirements by building economical dwellings.The first Italian law on social housing was declared in the early twentieth century (Law 251/1903). Proposed by MP Luzzati, it was called the “Luzzati Law.” It creates intermediate entities, financial companies and cooperatives, which build dwellings to be rented or sold to people in housing need.

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Fig. 19: People marching with Housing for All banner.

Source: Credit: Cathy Crowe
Credit: Cathy Crowe

The resources of banks and mutual aid societies can finance these entities. (Caruso, N.,2017,pg.23) IACP (Istituto Autonomo per le Case Popolari, Independent Institution for Tenement Building) was established in 1908 in almost all Italian cities. For many decades these entities have been the main actors on the scene of social housing. The aim of the IACP was to provide housingto lower classes of the population. Luzzati’s idea was to give a house to families who could pay mortgages to financial companies and cooperatives; hence to the working class.

Table 2.2 Growth of housing in Italy during the twentieth century

Years	Dwellings/houses	Rooms	Average number c
1931	9,700,770	31,690,631	3.3
1951	11,410,685	37,342,217	3.3
1961	14,213,667	47,527,666	3.3
1971	17,433,972	63,833,741	3.7
1981	21,937,223	88,617,874	4.0
1991	25,028,522	104,152,467	4.2
2001	27,291,993	111,197,834	4.1

Fig. 20: Growth of housing in italy

Source: https://esploradati.istat.it/databrowser/#/en/dw/categories

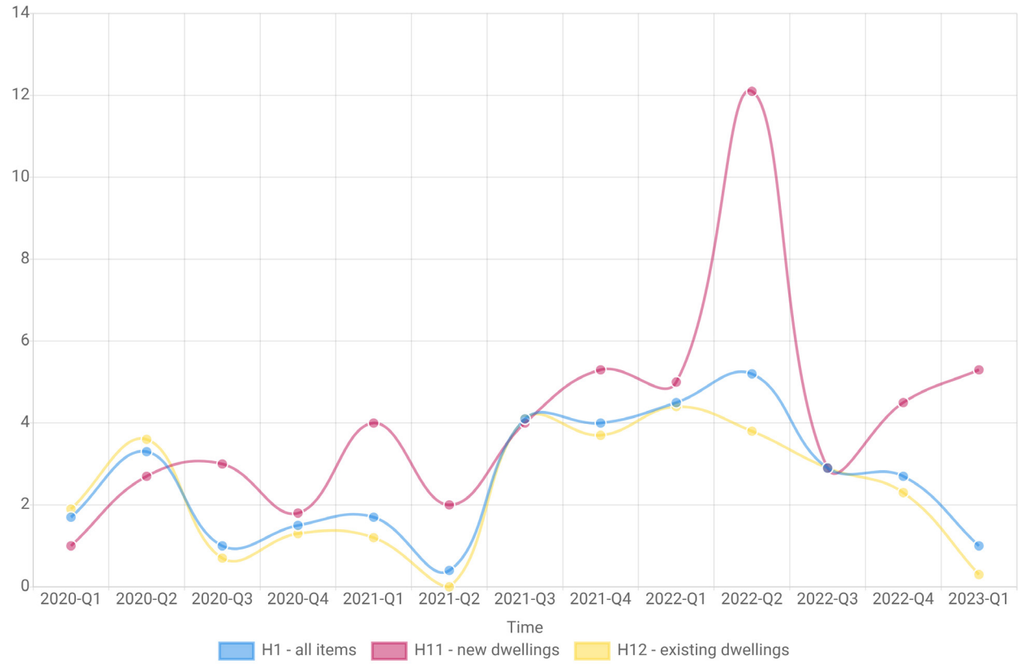

Fig. 21: House price - Quarterly data from 2010 onwards(base 2015) chart.
Source: https://esploradati.istat.it/databrowser/#/en/dw/categories

Purchases of dwellings	H1 - all items	H11 - new dwellings
Time		
2022-Q4	107	116
2022-Q3	107	113
2022-Q2	108	119
2022-Q1	106	112
2021-Q4	104	111
2021-Q3	104	110
2021-Q2	103	107
2021-Q1	101	107
2020-Q4	100	105
2020-Q3	100	106
2020-Q2	102	104
2020-Q1	99	102
2019-Q4	99	104

Fig. 22: Quarterly data from 2010 onwards (base 2015)

Source: https://esploradati.istat.it/databrowser/#/en/dw/categories

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Recent Years and the Financial Crisis (2000–Today)

The new millennium began with such a difficult situation in the housing scenario.The rental sector constitutes a limited share of the market, with high prices compared to the level of salaries and pensions. The continuing rise in land revenue is causing an increase in prices for home ownership and rents (the rise of land and real estate value started in 1997, and kept a steady pace until 2007). The disproportion between the demanded financial capacity and the percentage of owners creates rigidity in the market. These factors, along with precarious forms of labour, cause housing exclusion to the population who would access the housing market for the first time. The small percentage of social rent (5.5 % according to Housing Europe data 2015) shows its residual role and its ineffectiveness in answering social needs. (Caruso, N.,2017,pg.38) The lack of financial resources poses the main challenge of finding a way to finance housing policies in order to improve the sector.

The main features of the Italian housing issue can be summarised as specified below:

· increasing prices of dwellings (to buy and to rent) and housing trade until the financial crisis 2007–2008, when the real estate market entered a phase of crisis;

· the real estate market was growing until the financial crisis, which caused a rise in interest rates on mortgages and the debt load of the families started to worsen;

· complex housing demand due to changes in the social structure;

· territorial imbalance between Northern and Southern Italy: demographic data are showing a scenario in which the central and northern parts of the country attract migrants from abroad and young people from the south;

· unsuitability of the rental supply (small market share and high incidence on family income and subsidised and agreed housing (conditions and numbers);

CHAPTER

4

Case studies

04.1| CASE STUDIES **Luoghi Comuni Porta Palazzo, Torino.**

Fig. 23: Map of Turin.
Source: Google maps.

Project name: Luoghi Comuni Porta Palazzo

Location: via Clemente Priocca 3, Torino

Program: Residential Building.

Architect: : Pier Matteo Fagnoni per Fagnoni & Associati, Gpa Ingegneria srl, Galliano Habitat

Year:.2013

The Temporary Residence project represents an experimental intervention both from a technical and a social point of view. Through the recovery of the existing building, it has been decided to transform the degraded building into a new model of Social Housing, which can benefit not only the tenants, but also the entire community.(Luoghi Comuni Porta Palazzo,2013).

The complex object of intervention (about 2,200 square meters) was in a state of advanced decay and had remained sealed since the late nineties.

it consisted of an historical building of four floors above ground and a basement of cellars, as well as a more recent building, of little aesthetic value of three floors, and a courtyard closed by a boundary wall, altered by additions.

27 dwellings have been created for users defined by the Client (single and couples under residential stress) and the small commercial units existing on Piazza Repubblica have been recovered, ad a common areas for residents and the district has been provided. (Luoghi Comuni Porta Palazzo,2013).

Fig. 24: Luoghi Comuni Porta Palazzo.

Source: https://www.guiding-architects.net/social-housing-turin-satisfying-new-needs-rehabilitating-historical-buildings/

Function

Mixed-used Residential building.

Facade

use of wooden panels which makes a screening that allows diffused lighting.

Accessibility

the building can be accessable by a **staircase** and **a lift.**

Layout

the apartment is a mix of uses having commercial spaces on the ground floor and apartments on the upper ones

Outdoor elements

The balconies function as lifted streets. Besides their function of accessability they can be used to sit outside

For the purposes of sustainability and comfort of the inhabitants, the application of some of the most used environmental and energy assessment tools was simulated. These tools have also proven useful in the choice of materials and plant technologies. Among the various technologies used are: coat insulation with eco-sustainable materials (pressed wood fiber panels), radiant panels for air conditioning, photovoltaic system and solar thermal. For the coverings were used: the parquet in bamboo, eco porcelain stoneware, some existing recycled materials such as iron from gates and balconies and cladding stones. In addition, the strips were used for the Porta Palazzo sunscreen, made with wooden materials.

Skin

The facade consist of a wooden panales which makes a screening that allows diffused lighting.glass blocks were also used which allows greater lighting of the basement floor.thermal roof insulation were used withe help of green roof.

Urban, building and social regeneration, temporary residence, sustainability of the intervention, participation, public and semi-public spaces: these are some of the key words that guided the design. (Luoghi Comuni Porta Palazzo,2013).

Fig. 25: floor plan showing the outdoor spaces.

Source: https://portapalazzo.luoghicomuni.org/Social_Housing_e_Riqualificazione_La_Residenza_Temporanea_di_Porta_Palazzo.pdf

Access

The building levels are accessable by a staircase and a lifts which are situated intraction of the two wings. A corridor along the front facade providesthe connection to the units. eight openings can be used as an entrance, which results in a maximum of eight units per floor.

Outdoor space

The balconies function as lifted streets. Besides their function of accessability they can be used to sit outside. There is also a front courtyard which can be used by the tennents.

Flexible Layout

The layout of the building is flexible and modular and adopt innovative technologies with sustainable solutions that involve social and economic criteria.It manages a mix of uses having commercial spaces on the ground

Fig. 26: outdoor spaces.

Source: https://datalabaa.blogspot.com/2015/04/luoghi-comuni-porta-palazzo-fagnoni.html

04.2| CASE STUDIES **Sharing, Torino.**

Fig. 27: Map of turin
Source: Google maps.

Project information

Location: Via Ribordone, 12, 10156 Torino

Program: Residential Building.

Architect: : : Studio Costa & Partners - Roma Studio Costa & Partners - Roma

year: 2011

Sharing Torino is the first temporary social housing project carried out by the DOC cooperative with the contribution of the CRT Development and Growth Foundation, and provides for the offer of 122 apartments at limited rates and 58 3-star hotel rooms.(Sharing torino,n.d.)
Sharing Turin, is a project with a high social impact for the competent part its apartments which are aimed at the gray band of society: students, young couples, precarious workers, city users, who temporarily have no ability to access the " normal rental market "

and who can use our services. Born from the public request of the City of Turin which, through a public call, required the design and management of the first Social Hotel of the City, Sharing Torino concretizes the collaboration with the Toriense administration in the hospitality of families in conditions of housing emergency and with other public and private bodies with which the project has started collaborations on solidarity projects also internationally.

Fig. 28: Sharing Torino.

Source: Arianna Forcella, courtesy of Urban Center Metropolitano Torino.

Function

Mixed-used Residential building.

Facade

use of vibrant color on the facade and glass windows.

Accessibility

the building can be accessable by a **staircase** and **a lifts.**

Layout

the apartment is a mix of uses having commercial spaces and apartments.

Outdoor elements

the building have private balcony to the apartments.

The complex is located in an area of about 10,000 sqm and consists of two buildings of 9 floors each. The scope can be further broken down to the architectural design of 180 residential units including 122 units with kitchenette, for a total of about 480 beds.

The complex is reserved to persons with temporary housing problems such as young couples, single mothers with children, students, people waiting for public housing, posted workers, immigrants. Support services will also be offered which includes a mediation center, legal services, medical clinics at controlled prices, gathering places for cultural activities and events, as well as a grocery store, laundry, bar and restaurant. The redevelopment project as proposed by SCA, is a rethinking of the existing building through the use of color that will give a new vibrancy to the facades which will in turn use de-polluting and photocatalytic self-cleaning materials Environmentally friendly materials will be used throughout the project; a solar PV system is proposed for the production of electricity and a solar thermal plant will produce hot water intended to satisfy more than 60% of the resident needs.(Sharing Torino, Studio Costa Architecture,n.d.)

> The passive solar systems used aims to maximize the radiation of the sun in winter and at the same time ensure interior comfort in summer. The system of insulation will ensure a high degree of thermal comfort; the fixtures will be replaced with more efficient windows and doors from a functional point of view and energy needs. These solutions will lead to an overall decrease heating cost. (Sharing Torino, Studio Costa Architecture,n.d.)

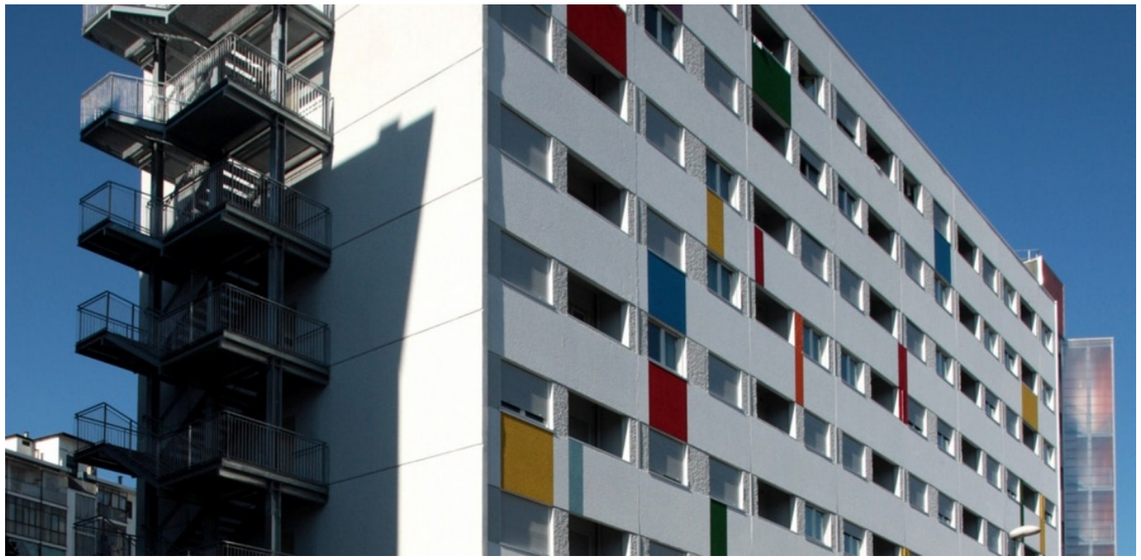


Fig. 29: building facade.
Source: https://sh-sharing.it/en/sharing-torino/

Fig. 30: living space.
Source: https://sh-sharing.it/en/sharing-torino/

04.3| CASE STUDIES **Buena vista, Torino.**

Fig. 31: Map of turin
Source: Google maps.

Project Information

Location: via Giordano Bruno 191-195

Program: Residential Building.

Architect: TRA – Architettura Condivisa

Year: :2012

Buena Vista has a mix of functions and of different living solutions, with the objective of favouring the building of solidarity and neighbourhood networks and of experimenting shared management solutions.

The common spaces are distributed throughout the building and are different from each other: large terraces, green roofings and common halls offer spaces of socialisation and meeting between neighbours.

Social housing seeks new solutions. For some time now, the Buena Vista experiment has animated a central place in the city debate: the buildings of the MOI, a former Olympic village.(Buena Vista,Homers,n.d).
The dedicated colorful legacy buildings of 2006 thus offer forty apartments with reduced rentals, aimed at non-profit operators (single, cohabitants, with the family), people in housing emergency, off-site students.With a mix of functions, the goal is to foster solidarity and neighborhood networks and experience shared management of spaces and times.

Fig. 32:3d view of buena vista

Source: https://tra.to.it/works/buena-vista-homers/

Function

Mixed-used Residential building.

Facade

glass windows.

Accessibility

the building can be accessable by a **staircase** and **a lifts from both the corner.**

Layout

the apartment is a mix of different size of apartments.

Outdoor elements

rooftop garden for the users.

The structure of the property subject to the intervention allowed one remarkable flexibility in the distribution of housing and the provision of large common areas that can be transformed into places of social relationship have given it a great deal potential for its transformation into social housing, where precisely, the common spaces they constitute a central element and become the ideal environment for the interaction between the inhabitants.

Buena Vista houses a mix of functions and always experiment with different housing solutions with the aim of creating solidarity networks and strengthening the spirit of community and good neighborly practices. It provides 40 housing units and multiple common spaces, located throughout the building, which include large shared terraces.(Buena Vista,2022)

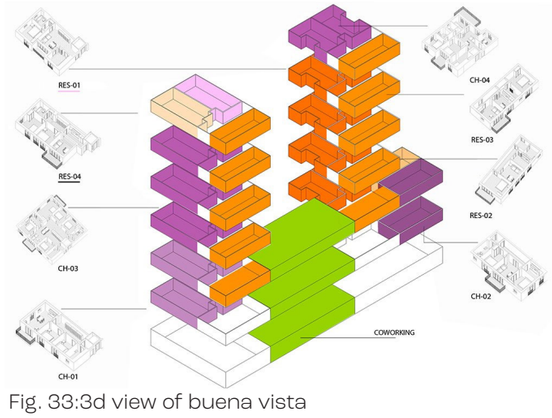


Fig. 33:3d view of buena vista

Source: https://tra.to.it/works/buena-vista-homers/

Buena vista is an example where the two models coexist . It is a social housing as the idea was born to respond to the housing needs of third sector workers, who due to precarious conditions or low income are unable to access the private market, but at the same time it is a form of cohousing as it includes independent housing units together with shared spaces.(Buena Vista,2022).

Fig. 34: Buena Vista

Source: Photography by Varvara Iliaki

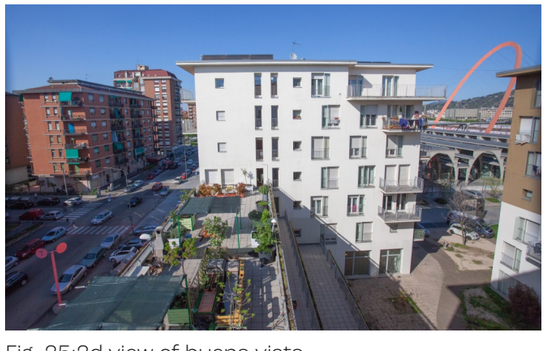
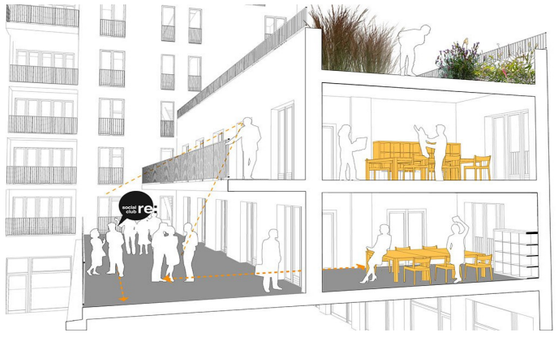


Fig. 35:3d view of buena vista

Source: https://tra.to.it/works/buena-vista-homers/



04.4| CASE STUDIES CX, Torino.

Fig. 36: Map of Turin
Source: Google maps.

Project information

Priject name: CX Torino

Location: Via Belfiore, 23, 10125 Torino TO

Program: Hospitality Building.

Architect: : CampusX, RIZOMA ARCHITETTURE

Year: 2021

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Fig. 37: Common space of CX Torino.
Source: https://www.cx-place.com/it/cxturin-marconi-campus.html

All the energy of CampusX mixed with the urban vitality of the San Salvario district in Turin. (CX Torino,n.d.)The new CX Turin Belfiore is one of the seven urban resorts in Italy of the student housing company CX. The explosive blend of **dynamism, sustainability and social interaction** has been orchestrated and translated into design by the Bologna-based studio Rizoma Architetture, which starting with a functional and layout restyling of the building has generated a new hospitality format: **a double long-stay and short-stay** offering for variable experiences aimed at different generations (**not just students, then, but also digital nomads, locals and tourists**).

Function

Mixed-used Residential building.

Facade

use of large openable windows for better light and ventilation.

Accessibility

the building can be accessable by two **staircase** along with **lifts.**

Layout

the building is a mix of uses having commercial spaces on the ground floor and apartments on the upper ones.

Outdoor elements

Open rooftop at 8th floor for various activity.

Access

The building levels are accessable by two staircase on each corner along with lifts. The building is well connected by corridors and a courtyard in the center of the building.The building has a main entrance and a private entrance.

Outdoor space

The building have a open terrace for common activity. Besides their function of accessability they can be used to sit outside. There is also a courtyard which can be used by the tennents.

Skin

The facade consist of large openable windows for better light and ventilation of the building.double glass door were used in the ground floor for the entrance of the building.

Floor Layout

The layout of the building is flexible and modular and adopt innovative technologies with sustainable solutions that involve social and economic criteria.It manages a mix of uses having commercial spaces on the ground floor and apartments on the upper ones (CX Torino,n.d.).

Fig. 38: floor plan showing the outdoor spaces.
Source: https://www.rizoma.me/en/progetto/cx-turin-belfiore/

Fig. 39: Outdoor space.
Source:https://archello.com/project/cx-turin-regina

Fig. 40: Common space.
Source: https://archello.com/project/cx-turin-regina

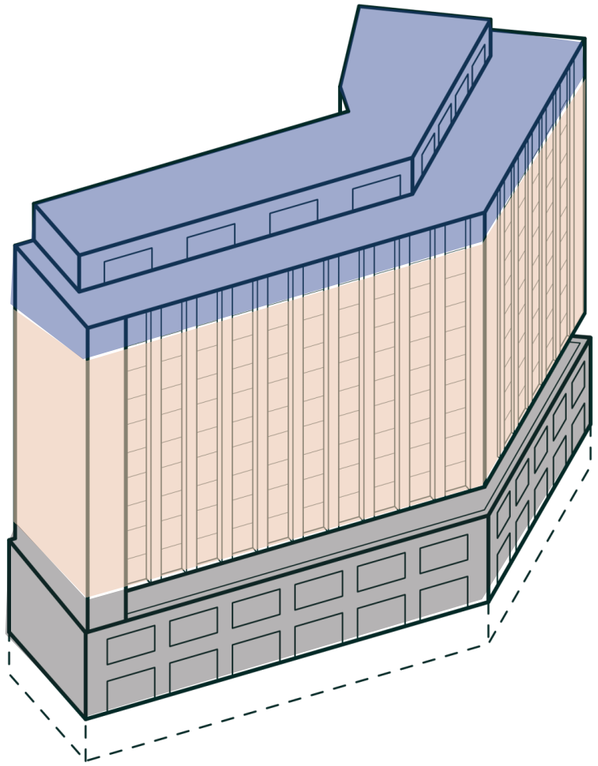

Fig. 41: 3d View of CX Torino.

Source: https://www.cx-place.com/it/cxturin-marconi-campus.html

The structure has 246 rooms, study rooms and coworking areas, in addition to various social and relaxation spaces, including a large terrace on the dome and the neo-medieval spires of the church on via Morgari. (CX Torino,n.d.). The aim of CX is to have a space for common activities on the ground floor, connected to the city; the large glass walls of the cafeteria and the gym are completely open and visible from outside, drawing attention to the activities and the program that comes to life inside. (CX Torino, Archello,n.d.).

04.5| CASE STUDIES **Stories, Amsterdam.**

Fig. 42: Map of amsterdam
Source: Google maps.

Project information

Location: Buiksloterham, Amsterdam, The Netherland.

Program: 29 apartments, 6 commercial units, parking

Architect: Olaf Gipser Architects

Year: 2021

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'Stories' addresses the challenge of high-density, communal, sustainable, and healthy urban living. As a housing co-operative project, it combines human and non-human habitat, is built largely from renewable, bio-based resources, and deploys 'open building' principles to ensure accommodation of future needs. (Stories,n.d).

In its current configuration, **Stories contains 29 apartments ranging from 43–185 m2 size**, many combined with working spaces facilitating living/ working combinations, forming ten different apartment types and consisting of single and double-height units. **Ceiling height is 2,87 m respectively 6,12 m.** (Stories,n.d).

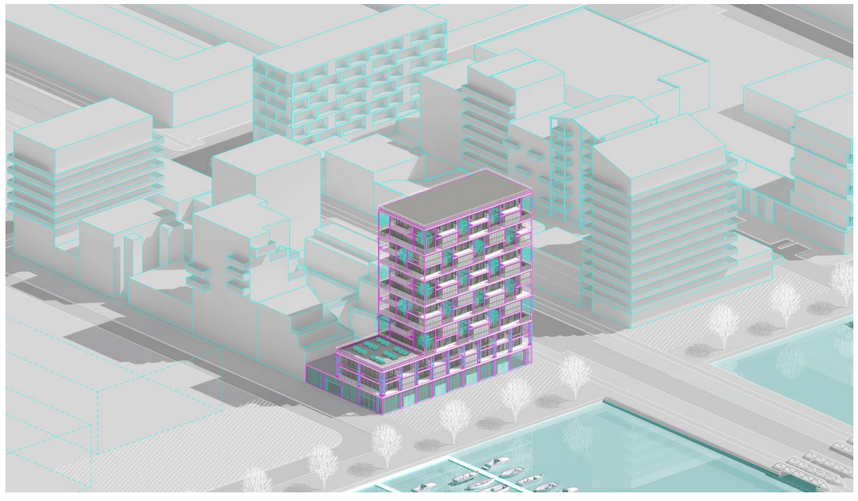


Fig. 43: 3d model of the building Stories.
Source: https://olafgipser.com/projects/residential-building-bsh/#6

The building is a **mixed-use residential tower** in post-industrial Amsterdam Buiksloterham with 35 housing and commercial units and an on-**ground parking garage**. Located in a former industrial harbor area, it occupies an exposed lot marking the intersection of a main street and a former industrial harbor basin. Stories is the result of close collaboration between its future residents, architect, contractor, and advisors. (Stories,n.d).

Access
The building levels are accessable by a staircase and two lifts which are situated in the concrete building core. A corridor around the lifts and staircase provide acces to the units. Six openings can be used as an entrance, which results in a maximum of six units per floor.

Outdoor space
The balconies function as lifted streets. Besides their function of accessability they can be used to sit outside. For all residents is a collective roofgarden on the parking garage. The green roofgarden functions also as a waterbuffer.

Skin
The facade consist of a variation between glass fronts and a closed finishing of sheet pil profiles of Azobé. The glass fronts allow a lot of daylight in the building. The facade is completely made of flexible components which makes it easy adaptable for future use

Flexible Layout
Partitionwalls can be installed to create the floorplan conform the requirements of the tennants. Appartments can be made biger and smaller which is provided by the flexible structural layout. Also interior doors, floors and ceiling can be adjusted. Howver, the flexibility of the interior space is limited by location of the wett cells and the relavely small single floorheights.

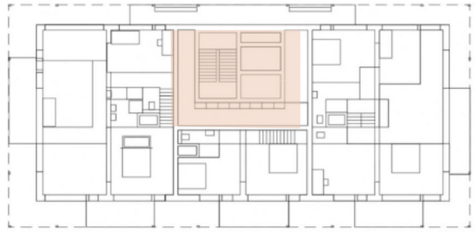


Fig. 44: floor plan showing the access of the building.
Source: https://olafgipser.com/projects/residential-building-bsh/#4

Fig. 45: floor plan showing the outdoor spaces.
Source: https://olafgipser.com/projects/residential-building-bsh/#4

Fig. 46: Building Facade.
Source: https://olafgipser.com/projects/residential-building-bsh/#2

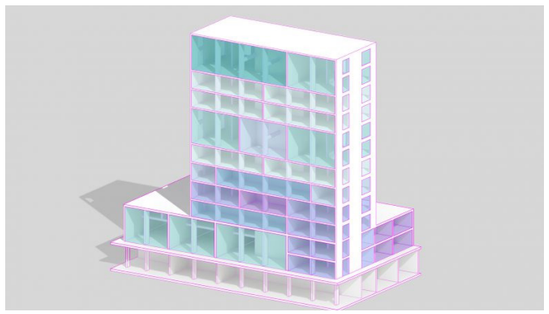


Fig. 47: Building Facade.
Source: https://olafgipser.com/projects/residential-building-bsh/#2

Fig. 58: Stories, Amsterdsm,under construction.
Source: https://olafgipser.com/projects/residential-building-bsh/

Stories does not only provide private space but addresses collective urban living. An enveloping steel structure contains extensive outdoor spaces in the form of **private balconies and winter gardens which are simultaneously architectural shading elements, a communal roof for urban farming that is connected to a shared, multifunctional indoor space, and 57 double-height vegetation units**. (Stories,n.d). The larger ones of these are niches for trees, bushes, grasses, and related animal life. They act as privacy screens between individual units, operate as infrastructure providing a healthy environment and microclimate.

Function

Mixed-used Residential Tower.

Facade

variation between **glass** fronts and a closed finishing of sheet pil profiles of Azobé

Accessibility

the building can be accessable by a **staircase** and **two lifts.**

Layout

Appartments can be made **biger and smaller** by moving the Partition wall.

Outdoor elements

The green roofgarden functions also as a **waterbuffer.**

Stories provides habitat for an expanded collective of humans and non-humans.

04.6| CASE STUDIES **Het Schetsblok, Amsterdam.**

Fig. 49: Map of amsterdam
Source: Google maps.

Vertical Urbanism

Project information

Location: Poeldijkstraat 319-367, Amsterdam, The Netherlands

Program: 25 apartments, basement with 16 parking spaces and 25 storage boxes.

Architect: ANA Architecten

Year:2018

This building is **designed as a flexible three dimensional housing structure with a maximum freedom of the individual layout**. The buyers of the apartments in The SketchBlock were able to **fill in the dwellings freely in size, position, layout and finishing.** The Sketchblock has been chosen as Best Building of the Year 2019 in the category 'private living experience'. The building is part of an ensemble of three new residential all-sided buildings in a park-like car-free setting. (The Sketchblock,n.d.) Access to the three buildings is from a central green space. The residents of the three buildings determined the layout of the park in a special collaboration with the municipality. The residents of the three buildings are collectively responsible for the maintenance of the park.

Fig. 50: Het Schetsblok, Amsterdam.
Source: https://www.openbuilding.co/schetsblok-ana

The sub grid is used to accommodate different apartment layouts. Residents could make their own choices from a catalogue of different colors and choose the place and size for the balcony.The SketchBlock was designed together with and for the future residents. In many cases, Cohousing is a difficult procedure with lengthy processes and aesthetic mediocrity. Here the best components of Cohousing have been applied and all negative effects are circumvented through smart design and efficient process management. After an investigation of the buildings preconditions and an inventory of the residents wishes, ANA designed a flexible construction that formed the basis for a modular layout. The residents chose the position and size of their apartment. Rules have been drawn up to ensure consistency. (The Sketchblock,n.d.)

Access

The building levels are accessable by two staircase and a lifts which are situated in the center core of the building. A corridor around the lifts and staircase provide acces to the units.

Outdoor space

The building Layout Provides the to modifie the outer space such as flexible balcony.

Facade

The façade grid is formed by slanted concrete composite elements. The chamfer aims to give the façade more depth and to make it less heavy. The infill of the closed parts in the concrete grid is materialized in anodized expanded aluminum panels. (The Sketchblock,n.d.) Three different shades are used in the overall façade, giving each apartment its own accent. The play of chamfered concrete façade-elements and expanded aluminum give the building a whiff and makes it tactile.

Flexible Layout

The layout of the building is made flexible for the user.The smallest apartment in the building is 46 m2, the largest 150 m2. The floorplans can also be adapted for future use. If the personal needs of the residents changes over time, The SketchBlock can easily be arranged differently. (The Sketchblock,n.d.)

Fig. 51: Floor plan showing the access of the building.
Source: https://architectenweb.nl/nieuws/artikel.aspx?ID=46023

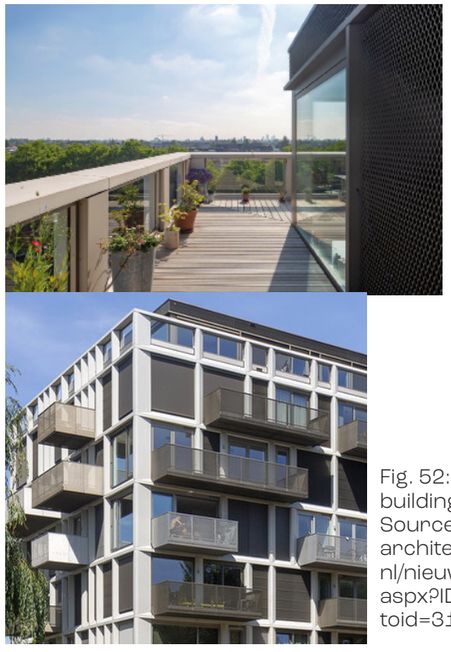


Fig. 52: Facade of the building.
Source: https://architectenweb.nl/nieuws/artikel.aspx?ID=46023#photoid=315607

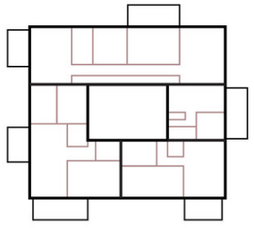


Fig. 53: Flexible layout.
Source: https://architectenweb.nl/nieuws/artikel.aspx?ID=46023#photoid=315629

Function

Residential Apartment.

Facade

The façade grid is formed by slanted concrete composite elements.

Accessibility

the building can be accessable by **two staircase** and a **lifts**

Layout

The layout of the building is made flexible for the user.

Outdoor elements

can be modified according to the user.

The typologies in the building are maisonettes on the ground floor with apartments above that are oriented one-sided, two-sided or even three-sided. The concept for The Sketchblock is based on the principles of 'Open Building'.'which implies a separation of the different layers of the building: construction, installations, façade, layout and finishing. (The Sketchblock,n.d.)

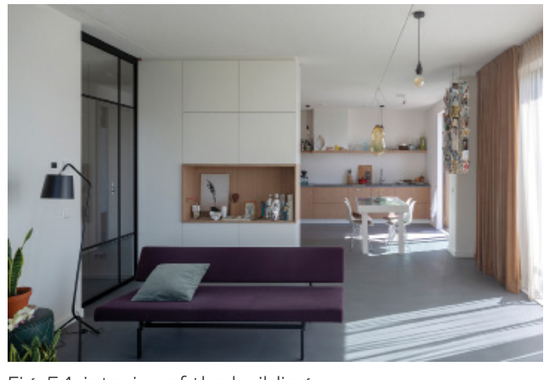


Fig. 54: interior of the building.
Source: https://architectenweb.nl/nieuws/artikel.aspx?ID=46023#photoid=315610

04.7| CASE STUDIES **Insel Hospital, Bern, Switzerland.**

Fig. 55: Map of Switzerland.
Source: Google maps.

Vertical Urbanism

Project information

Location: Freiburgstrasse 18, 3010 Bern, Switzerland

Program: 1,000 beds Hospital,Restaurents, a post office, a bank and a chaple.

Architect: HWP Planungsgesellschaft

Year: 2012

The Insel hospital - which is referred to locally as the **“Insel”** (island) – **was founded in 1354**. In the founding papers, Anna Seiler demanded that her hospital must “always and for ever” be kept open for thirteen sick persons - who should be cared for by three “honourable people”. Today the University Hospital of the Canton of Bern, **with its 1,000 beds and some 5,000 employees, is one of the largest and most efficient hospitals in Switzerland**.(Stefan Geiser,2005) The Insel has several buildings, **restaurants, a post office, a bank and chapels** - in fact, it could be called a “city within the city” . The hospital’s physical facilities are managed by the Canton Bern Building Department.

The west surgery wing , which was completed in 1971, **no longer meets modern standards of building services and safety**. To overcome the technical and operational deficiencies and meet the requirements for a university hospital, the existing surgery wing must be completely renovated. The existing west surgery wing was not planned for variable use. It was tailor-made for the use concept envisaged at the time of its construction. It has highly differing installation and load-bearing structures, and it is neither suitable for use nor adaptable. **A decision was made in 1995 that it must be completely renovated**. The INO renovation project embraces in particular the Intensive care, Emergency and Surgery Centre. The Building Department of the Canton of Bern, which is responsible for overseeing construction work on the Insel hospital. (Stefan Geiser,2005)

They are pursuing an **open building method** for the INO project to **ensure that the “serviced structure” of the building (with main utility infrastructure) will continue to be highly adaptable, and that the components of the building are interchangeable and reusable.**Building sections with differing service lives and des gnated purposes are therefore kept consistently separate in the planning and execution phases. The use of separate (discrete) systems anticipates the long-term life cycle of the building, and thus safeguards its value in terms of future use.(Stefan Geiser,2005) Work is divided into discrete system levels: the primary system (building shell) is designed for a service life of 50 to 100 years, the secondary system (fitout) for 15 to 50 years and the tertiary system (hospital equipment) for 5 to 15 years.

Fig. 56: Insel Hospital, Bern.
Source: https://www.ibra.net/Head/$/University-Hospital-of-Bern-Inselspital/11

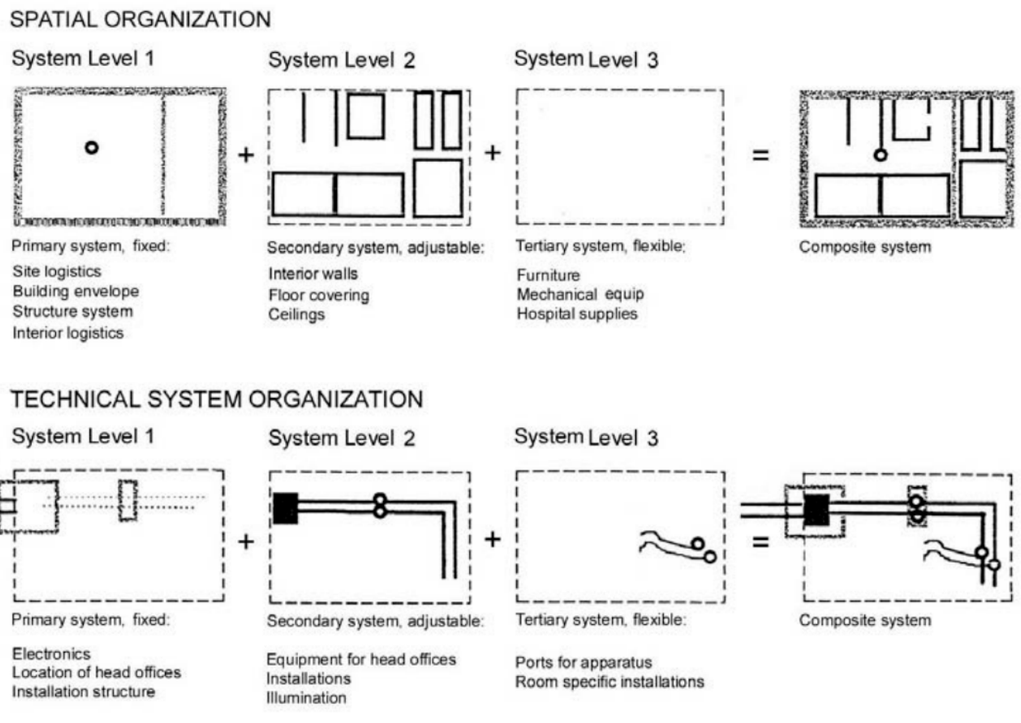


Fig. 57: organisation of design in level.
Source: file:///E:/thesis/Stephen-Kendall-WCDH-2005.pdf

the project was split into three systems organized and conceived according to their expected life spans:
Primary system (nearly 100 years)
Secondary system and (nearly 20 years)
Tertiary system (nearly 5 -10 years)

The primary system - is a long-term investment and unchangeable. The primary system must be as open as possible for the different (and unforeseeable) activities in the secondary system, so the scope for adaptation must be as wide as possible. It must be assumed that the primary system will accommodate various secondary systems in different cycles during its service life.

The primary system mainly comprises the following elements:

- External site conditions (site access, public utilities)

- Load-bearing structures (vertical and horizontal support structures)

- Outer building structure (facade, roofs)

- Building services structure (installatio structure: concept of the technical access and location of the central control rooms)

The secondary system - is a medium-term investment and adaptable . Subsequent installability, disassembly and reassembly are the key focal points for this system level. The secondary system mainly comprises the following elements:

- Finishing work (interior walls, finish floors, ceilings)

- Building services installations (central control rooms and technical access)

- Internal personnel, patient and materials movement (vertical and horizontal access, transport systems)

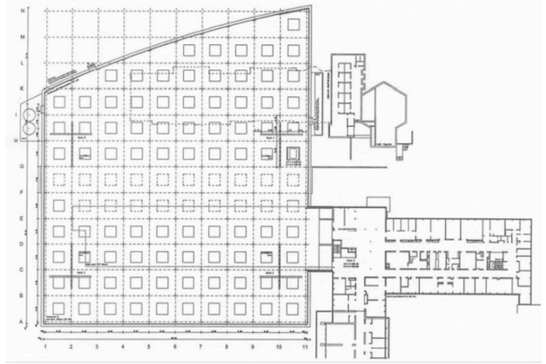


Fig. 58: Typical floor plan of the building.
Source: file:///E:/thesis/Stephen-Kendall-WCDH-2005.pdf

The tertiary system - is a short-term investment that can be changed without any major structural work. It is subject to rapid change and is least predictable.

The tertiary system mainly comprises the following elements:

- Medical equipment

- Fittings, furniture

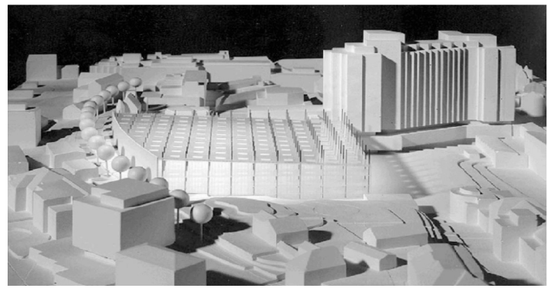


Fig. 59: 3d model of Insel Hospital, Bern.
Source: file:///E:/thesis/Stephen-Kendall-WCDH-2005.pdf

Conclusion.

The idea of dividing a large project into these autonomous levels differs from conventional project delivery methods used for medical facilities and presents challenges, not all of which were for-seen, concerning coordination between the separate firms responsible for each level. It is worth noting that large shopping centers and office buildings are routinely managed in this way, but for some reason the principle has only now migrated into health care architecture in an explicit, structured way.An open building strategy organizes the project in terms of the anticipated duration of value of a cluster of subsystems. (Kendall, Stephen, n.d).It does so to avoid waste, to optimize boundary conditions, to prepare the facility for long-term manageability in concert with anticipated changes, and to reduce costs of future adaptation.

This particular example of distributed design management is one way of organizing an “open building strategy” for the design, construction and long-term management. (Kendall, Stephen, n.d). It is not necessary for different designers to be assigned to each level. But the “partitioning” of design management in this way is a strategy particularly well suited to institutional clients whose interests are long term. In principle, then, this management strategy is not fundamentally different from the way large and complex medical facilities behave “in fact” (if not in the theories of “integrated whole buildings” now in currency).

04.8| CASE STUDIES **Bosco Verticale Milan, italy**

Fig. 60: Map of Milan.
Source: Google maps.

Vertical Urbanism

Project information

Location: Torre De Castillia: via De Castillia

Program: Residential Apartment.

Architect: Boeri Studio

Year: 2014

The first example of a '**Vertical Forest**' (il Bosco Verticale) was inaugurated in October 2014 in Milan in the Porta Nuova Isola area, as part of a wider renovation project led by Hines Italia. (Bartesaghi Koc C, Osmond P, Peters A ,2017). Milan's Vertical Forest consists of **two towers of 80 and 112 metres, hosting 480 large and medium trees, 300 small trees, 11,000 perennial and covering plants and 5,000 shrubs**. (Vertical Forest,n.d.)The equivalent - over an urban surface of 1,500 m2 – of 20,000 m2 of forest and undergrowth. The Vertical Forest is an architectural concept which replaces traditional materials on urban surfaces using the changing polychromy of leaves for its walls. The biological architect relies on a screen of vegetation, needing to create a suitable microclimate and filter sunlight, and rejecting the narrow technological and mechanical approach to environmental sustainability.

Fig. 61: Bosco Verticale Milan.
Source: https://tourismmedia.italia.it/is/image/mitur/20220407111621-il-bosco-verticale-milano-poi-shutterstock-1440165473-1?wid=1240&hei=500&fit=constrain,1&fmt=webp

Biological Habitats:

The Vertical Forest increases biodiversity. It promotes the formation of an urban ecosystem where various plant types create a separate vertical environment, but which works within the existing network, able to be inhabited by birds and insects (with an initial estimate of 1,600 specimens of birds and butterflies). In this way, it constitutes a spontaneous factor for repopulating the city's flora and fauna. (Bartesaghi Koc C, Osmond P, Peters A ,2017)

Mitigation:

The Vertical Forest helps to build a microclimate and to filter fine particles contained in the urban environment. The diversity of plants helps to develop the microclimate which produces humidity, absorbs CO2 and particles, produces oxygen, and protects against radiation and noise pollution. (Vertical Forest,n.d.)

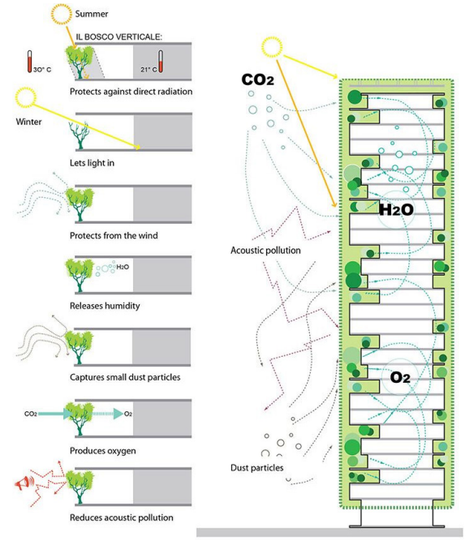


Fig. 62: Benefits brought by the plant screen.
Source: Bosco Verticale. (2023, May 6). In Wikipedia. https://it.wikipedia.org/wiki/Bosco_Verticale

Function

It has two Residential Tower.

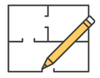
Facade

The building facade is made up of vertical forest.

Accessibility

the building can be accessable by a **staircases** and **lifts**

Layout



The building have different layout for user needs.

Outdoor elements

the building outdoor is filled with different trees and plants.

Anti-sprawl:

The Vertical Forest is an anti-sprawl method which helps to control and reduce urban expansion. In terms of urban density, each tower constitutes the equivalent of a peripheral area of single family houses and buildings of around 50,000 m2. (Vertical Forest,n.d.)

Changing façades:

The Vertical Forest is an ever-evolving landmark of the city, whose colours change depending on the season and the different natures of the plants used. This offers Milan's population an ev- er-changing view of the city. (Vertical Forest,n.d.)

Fig. 63: Typical floor plan
Source: Boeri Studio

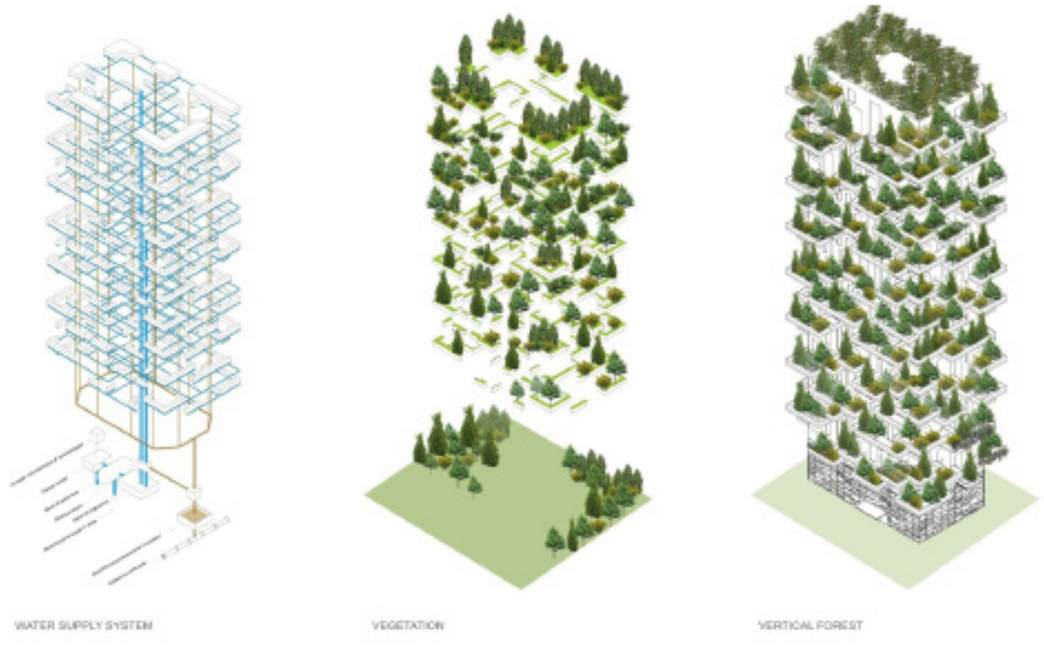


Fig. 64: Details of the building.
Source: https://www.archdaily.com/777498/bosco-verticale-stefano-boeri-architetti/564e7c88e58ece4d730003a5-bosco-verticale-stefano-boeri-architetti-detail

Hydration and irrigation system:

Following micro-meteorological studies, the calculation of irrigation requirements was carried out by examining climatic characteristics and was diversified depending on the exposure of each façade and the distribution of vegetation on each floor. (Bartesaghi Koc C, Osmond P, Peters A ,2017)

Management:

The management of the basins where the plants grow is the responsibility of the condominium, as is the maintenance and replacement of all vegetation and the number of plants established for each basin. (Bartesaghi Koc C, Osmond P, Peters A ,2017)

Fig. 65: installation of plants.
Source: marco garofalo.

The concept behind the Vertical Forest, that of being a "home for trees that also houses humans and birds", defines not only the urban and technological characteristics of the project but also the architectural language and its expressive qualities.

04.9| CASE STUDIES

Intesa Sanpaolo Office Building, Turin, Italy

Fig. 66: Map of Turin , Italy.
Source: Google maps.

Vertical Urbanism

Project information

Location: Intesa Sanpaolo S.p.A., Via Stradella, 34, 10147 Torino TO

Program: Mixed used office building.

Architect: Architect Renzo Piano

Year: 2015

The project for the new Intesa Sanpaolo head office is both an **environmental and social laboratory and an urban project**, (Intesa Sanpaolo ,2015).with a discreet urbanity that unites it with the city's inhabitants. The building is **located on the edge of the historic town center, near Porta Susa Station, at the N/E intersection of Corso Inghilterra with Corso Vittorio Emanuele II**, and is set at the center of an exceptional concentration of public services and facilities on the metropolitan scale in a zone of strategic importance for the city. The adjoining garden, Giardino Nicola Grosa, has been **upgraded and transformed into a playful space,** with trees of different heights, lawns and neighborhood functions.(Intesa Sanpaolo,Architizer,n.d.)

Fig. 67: Intesa Sanpaolo Office Building,Turin.
Source: https://www.designboom.com/architecture/renzo-piano-intesa-sanpaolo-office-building-turin-italy-05-21-2015/

Access to the garden from Corso Inghilterra is provided by a public gallery that traverses the entrance hall on the ground floor.

The tower, **166 meters high. is divided by infrastructure into 3 levels of parking garages, one of utility rooms and a low garden** around which are laid out the company restaurant and kindergarten, while above ground it consists of **26 floors of offices and a floor for training** which includes spaces and services open to the public. Two volumes in particular reveal the tower's public vocation. The lower is the **multi-purpose, flexible conference room**. (Intesa Sanpaolo,archdaily,n.d.)

It can be transformed into an exhibition hall, with concerts or performances as required thanks to movable loft and variable acoustics. It can accommodate 364 people. Higher up, thebioclimatic greenhouse, naturally ventilated, welcomes the public on three levels: the restaurant with the garden, the exhibition hall and the roof terrace. (Intesa Sanpaolo ,2015). The building is the result of advanced research intended to take advantage of the surrounding natural sources of energy (water, air, sunlight) and limit overall consumption. Ground water is used for cooling the offices. Solar energy is captured by the photovoltaic panels coveringthe tower's whole south façade.

Function

The building is mixed used office tower

Facade

The building has double-skin glass façade

Accessibility

the building can be accessable by **staircases** and **lifts**

Layout

The layout of the building consist of multiple offices a flexible auditorium and restaurent

Outdoor elements

the building has a roof top garden.

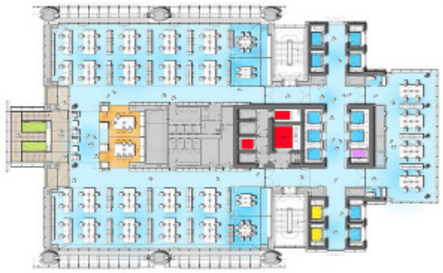


Fig. 68: Typical Floor plan.
Source: https://www.archdaily.com

Access

To the **east and west the building's spine consists of elevators and stairs**, contributing to the vital and varied effect of the design. To the south the staircase connecting the floors incorporates a vertical winter garden.(Intesa Sanpaolo,Architizer,n.d.)

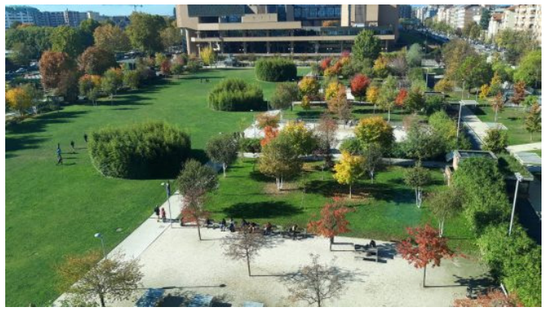


Fig. 69: Park beside the building.
Source: https://group.intesasanpaolo.com/content/dam/portalgroup/nuove-immagini/grattacielo-intesa-sanpaolo/06-grattacielo-renzo-piano/Giardino%20Grosa_1920x1080.jpg.transform/resize-540/img.jpg

Outdoor spaces

The building consist of a roof grden and Vertical winter garden which is connected with the staircase and corridors.

Facade

Fig. 70: Facede of the building.
Source: https://group.intesasanpaolo.com/content/dam/portalgroup/nuove-immagini/grattacielo-intesa-sanpaolo/06-grattacielo-renzo-piano/11img-min.png.transform/resize-540/img.jpg

The building has double-skin glass façade which makes it possible to limit heat loss in winter and is controlled in relation to the heat input through a system of apertures and solar screens with motorized louvers, which control irradiation and lighting in the work areas.

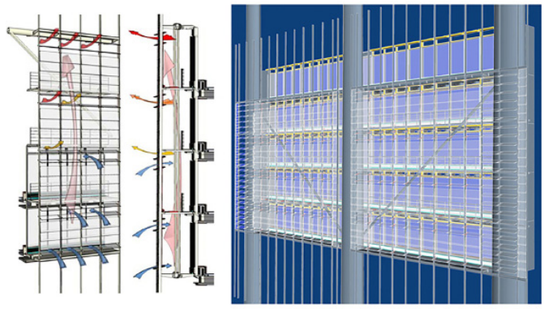


Fig. 71: Diagram.
Source: https://group.intesasanpaolo.com/content/dam/portalgroup/nuove-immagini/grattacielo-intesa-sanpaolo/06-grattacielo-renzo-piano/11img-min.png.transform/resize-540/img.jpg

In summer, the cool night air is channeled inside through the double concrete floor slabs, absorbing its coolness and giving it out in the offices by day with the help of radiant panels. (Intesa Sanpaolo ,2015). The whole is controlled by probes linked to a technologically advanced BMS (Building Management System).

Fig. 72: Diagram.
Source: https://group.intesasanpaolo.com/content/dam/portalgroup/nuove-immagini/grattacielo-intesa-sanpaolo/06-grattacielo-renzo-piano/12img-min.png.transform/resize-540/img.jpg

The skyscraper is powered by electricity produced from renewable sources and by 1,600 square meters of photovoltaic panels. It is illuminated for ' 80% by LED lamps, the east and west facades are covered with « double leather » of steel and crystal with mobile slats that create a thermal bearing. A centralized system, guided by sensors, regulates its opening and closing, in order to optimize the temperature and brightness of the indoor environments. The air conditioning system uses geothermal energy, with the withdrawal and return of groundwater without harmful emissions into the atmosphere. In normal operating conditions the skyscraper has no polluting emissions.(Renzo Piano,n.d.) Rainwater, collected in special tanks, feeds both the irrigation network of the green areas and the hunting boxes of the bathrooms.The internal lighting system regulates the intensity of the sources according to the amount of natural light and the presence of people. The terminal systems with radiant panels suspended from the ceiling and microphones, used for air conditioning, allow to obtain an excellent environmental comfort.

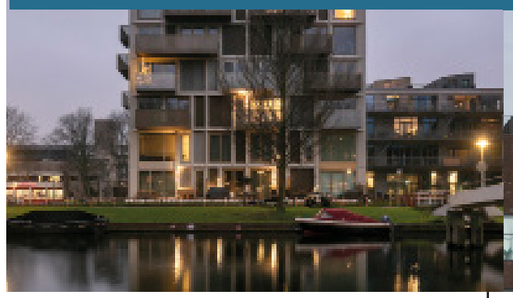
Benifits of case studies.

Nine case studies are conducted to get a better understanding of supports and infill of open buildings. The building layers structure, skin, access elements, servant elements, scenery and outdoor space are analyzed of each open building. In the analysis special attention is on the type of structure, the dimensioning of the structure, the facade type and its flexibility, the locations of the vertical servant and access elements, the flexibility of the scenery and the type and function of the outdoor space.

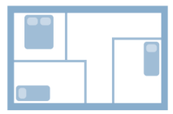
Ino Beren Hospital, Switzerland

Open building case studies helped to understand better the concept of support, infill and skin.

HET SCHETSBLOK - Amsterdam



Stories - Amsterdam



TYPOLOGY

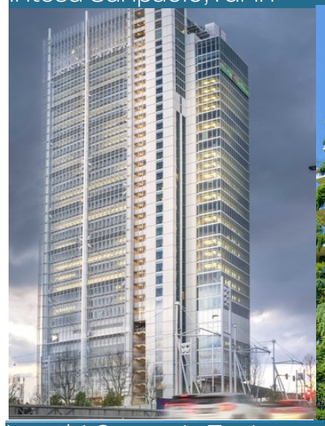
ADAPTABLE & FLEXIBLE

VARIETY IN FLOOR PLANS

Thesis
OPEN BUILDING SYSTEM IN VERTICAL URBANISM

The case studies of tall building and the affordable housing solution helped to better understand the multipurpose use of the space. It also helped to understand the connection between the different space and their function.

Intesa Sanpaolo,Turin



The Bosco Verticale - Milan

Buena vista - Turin

CX Torino - Turin

Luoghi Comuni - Turin

Sharing Torino - Turin

HIGH DENSITY

MULTIFUNCTIONALITY

OUTDOOR SPACE

CHAPTER

5

Project Development

05| PROJECT DEVELOPMENT

The integration of open building systems and vertical urbanism presents a promising approach to urban design and development.

By combining these two concepts, cities can benefit from the dynamic and responsive nature of open building systems, while also taking advantage of the efficiencies and environmental benefits of vertical urbanism. This can result in more affordable, sustainable, and livable urban environments that foster community, innovation, and creativity. We can create spaces that are both highly functional and adaptable to changing needs over time.

One of the advantages of this approach is its ability to promote sustainability. By designing buildings with a focus on flexibility and longevity, we can reduce waste and minimize the need for costly renovations or demolitions down the line.

However, the implementation of this approach requires careful planning, coordination, and collaboration among architects, engineers, developers, and local authorities. It also demands the adoption of new technologies and materials, as well as new social and cultural practices that support the maintenance and evolution of open building systems within vertical urban contexts.

Thesis
OPEN BUILDING SYSTEM IN VERTICAL URBANISM

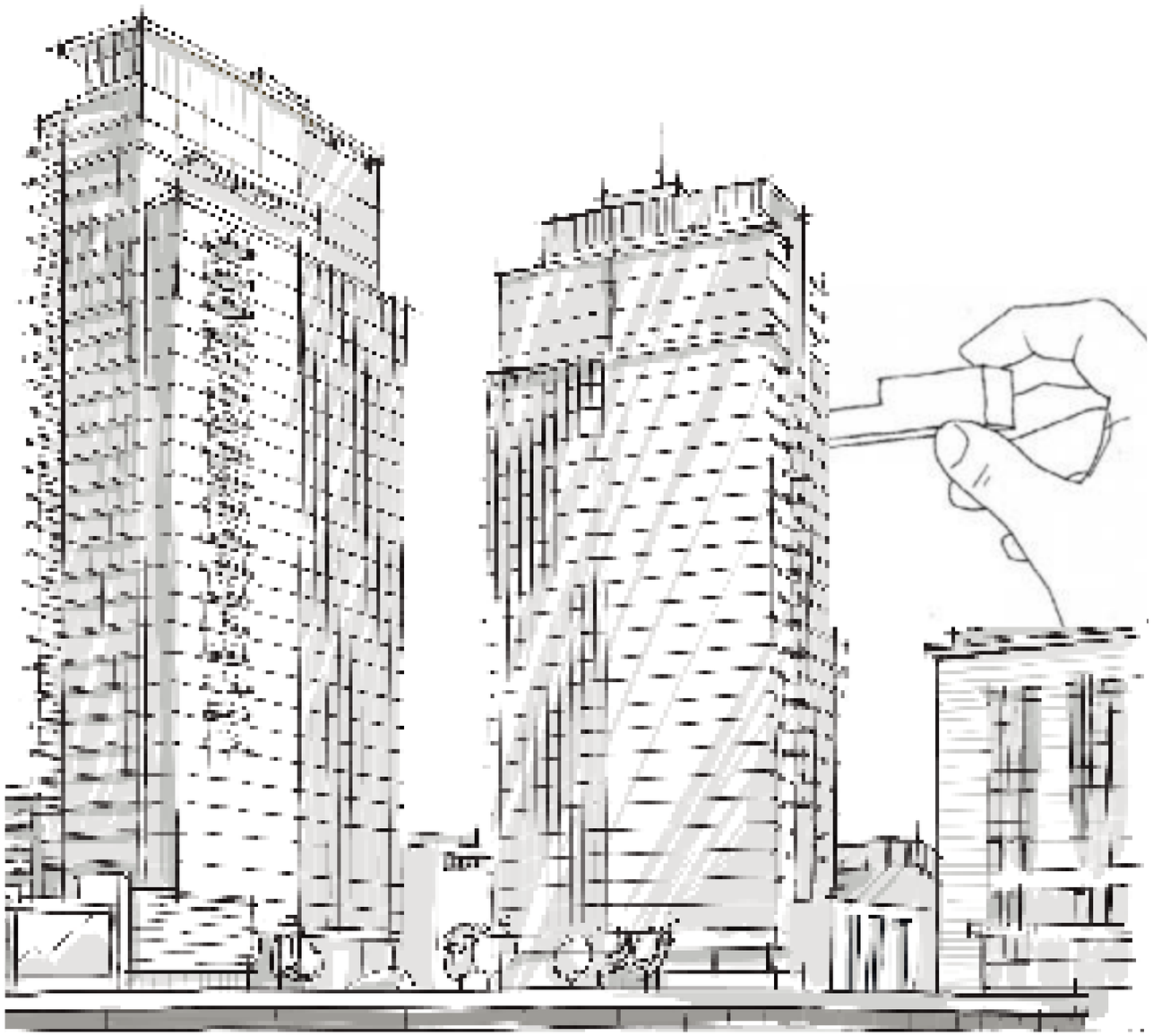
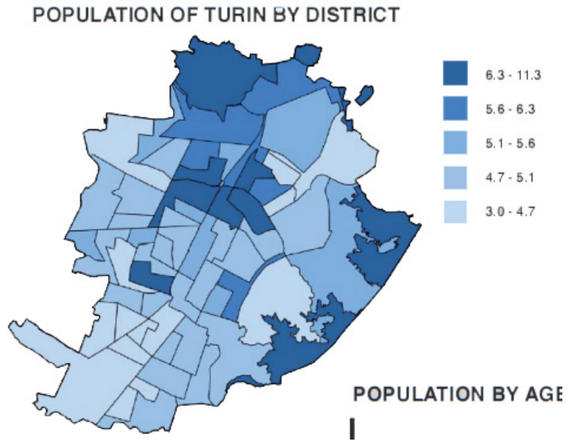


Fig. 73: Demonstration of open building system in Vertical urbanism.
Source: Picture by pngwing.com and edited by the author.

Turin

Fig. 74: City view of turin.
Source: Getty image.

The project site is located in the city of Turin in Italy. Turin Being the former capital city from 1861 to 1865, it has been among the leading European political centers. Later in the 20th century, Turin became one of the important Italian industrial poles, flourishing during the Italian economic boom, and becoming the "Automobile Capital", while hosting some of the major Italian automotive industries, such as FIAT. Today Turin is recognized for its **technological, engineering, higher-education, design and manufacturing vocations, a strong legacy of social activism, a progressive political and intellectual tradition and a significant artistic and cultural heritage driving more people to live in the city.** In the fierce competition between European cities to attract investment, it seems to be witnessing a new common urban rationale. (Fair Housing Programs,n.d.)



Population 848,885 density of inhabitants/km sq. 6527

42.8%

51.2%

Number of students for 2021 ca.110,911 graduated in 2021 ca.22,618

Unemployment rate 7.4%

Apparently, the long term population decline was then followed by a slight increase in the beginning of the 21st century reaching 900,000, while the city was brought back to attention, becoming a destination for thousands of students, tourists and various international events such as the 2006 Winter Olympic Games and the 2022 Eurovision song contest.In recent times, being integrated into the general character and the contemporary shape of the city, these industrial infrastructures are often reinvented and regenerated, hosting new functions or becoming large public spaces.

Fig. 75: Poulation of turin by Distric

Source: Torino Atalas

Thesis
OPEN BUILDING SYSTEM IN VERTICAL URBANISM

The issue

Turin, Italy, a bustling city known for its rich cultural heritage, renowned universities, and thriving job market, attracts a significant number of young workers and students seeking opportunities. However, while Turin offers fantastic prospects, it also presents various housing challenges for its young population.

One of the most pressing problems in Turin is the **scarcity of affordable housing options for young workers and students. Rental prices** in desirable neighborhoods are often prohibitively high, making it difficult for individuals on limited budgets to secure adequate accommodation. As a result, many are forced to settle for smaller apartments or shared housing arrangements, often compromising their privacy and quality of life.

High Rent Prices

Limited Budget

Cost of Living

High demand of affordable housing

Limited place to study or work

High construction cost

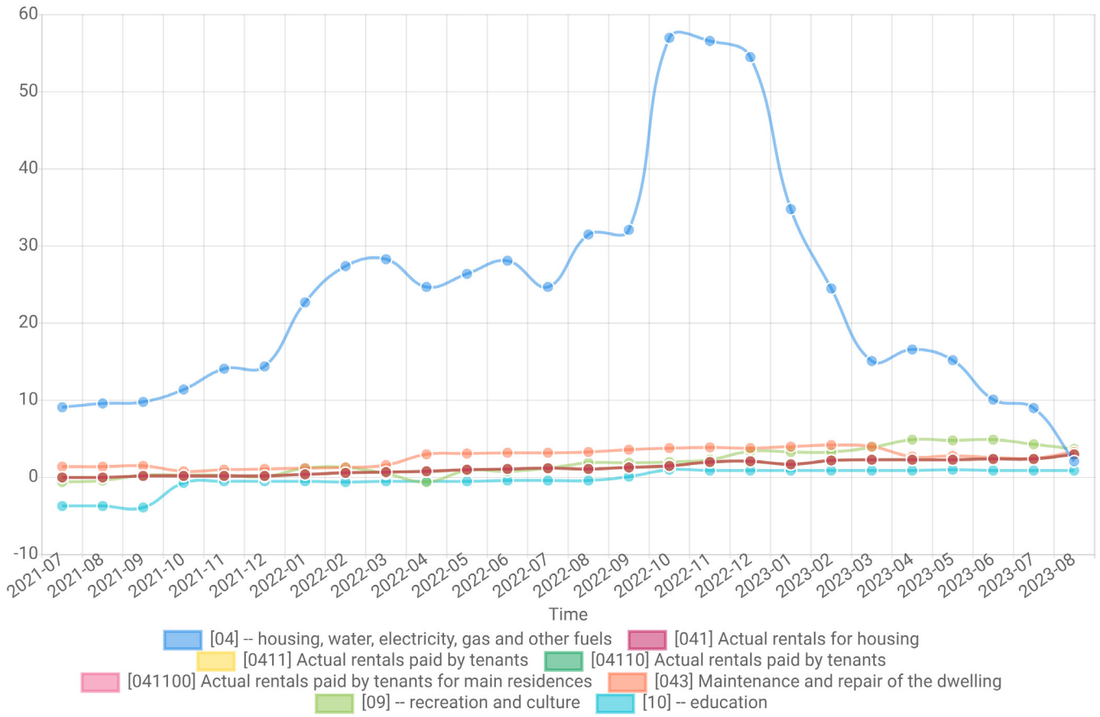


Fig. 76: Consumer price index.

Source: https://esploradati.istat.it/databrowser/#/en/dw/categories

As we can see in the fig. the most of the money goes into the housing sector and it's increasing very rapidly it is very difficult for the students and the young working class to cope up with the change.

These demographic, social and economic changes are impacting the residential market; the standard sale agreement is evolving towards alternative forms of investment and new sectors are emerging: micro-living, co-living, senior living and multi-family and, in the broader sense, student housing and RSA (care homes).

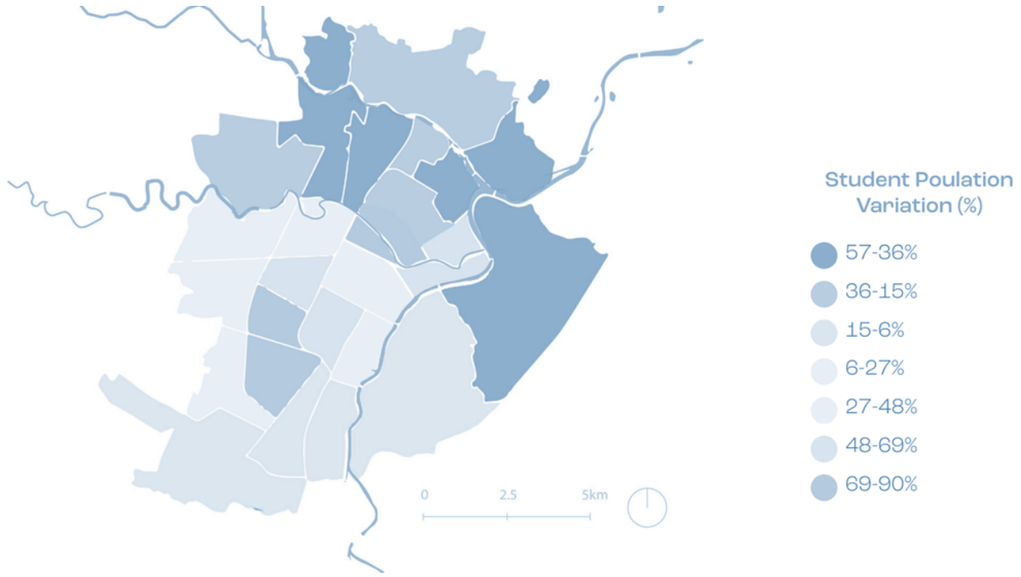


Fig. 77: Variation of students' concentration between 2010/11 and 2017/18.

Source: Cenere, Mangione, Santangelo, Servillo 2023

During the last 10 years, the total number of students enrolled at both major universities reached 115,000, with almost 40,000 people coming to Turin from either other Italian regions or from abroad. (Samantha Cenere,2023) Spatial transformations came along, differently impacting parts of the city.The **increased need to accommodate non-local students has fuelled the dedicated housing supply.**In the span of two decades, the two universities have shifted from being important assets of the city to crucial partners in implementing urban strategic plans and programmes of urban regeneration.

Torino's new housing plans encompass many types of policies:

-policies addressed to specific groups of the population.

-measures trying to limit the spread of housing hardship.

-rent subsidies to offset, at least in part, the almost total disengagement of the State from public housing.

-search for greater efficiency in the provision and management of social housing, aimed at overcoming the risks of segregation.

Site Overview.

Fig.78. Map of turin.

Source: geoportale comune torino.

The site is located in **Corso Lyon Torino**.The approximately triangular area at the intersection of the Lyon and Mediterranean courses, already home to the Materferro factories, was destined, since the Prg in 1995, to house a tall building, which was configured as a visual and symbolic term of the alignment of Thorn 1.

The site is located in these highly attractive spaces, interesting areas offer a special quality with northward views towards the Alpine region and across the city centre.

Fig.79. Map of turin in the year 2005.

Source: Google earth

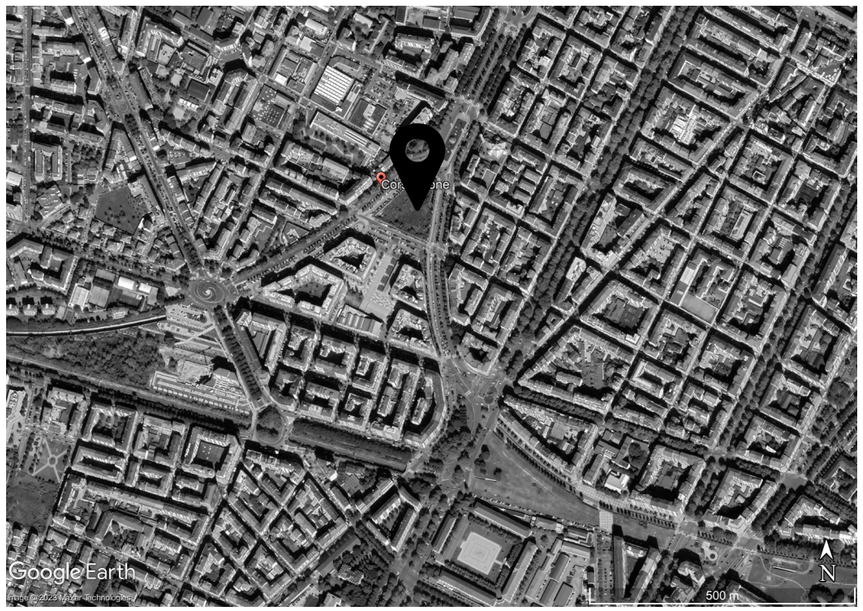


Fig.80. Map of Turin in the year 2017.

Source: Google earth.

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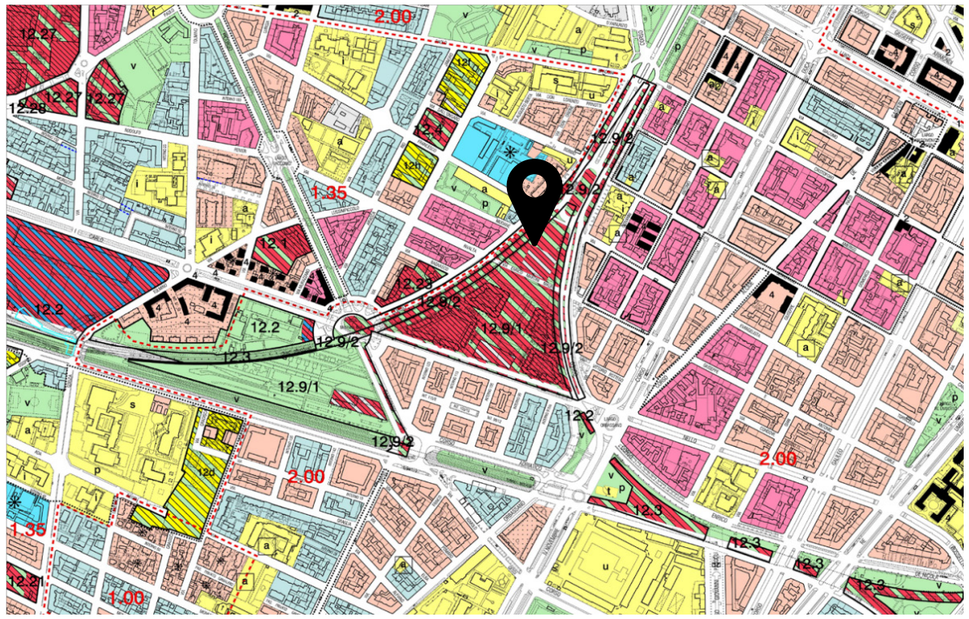

Fig.81. PRG Map of Turin.

Source: geoportale comune torino.

Zone normative

- **Zona urbana centrale storica**
- **Zone urbane storiche ambientali**
- **Zone urbane consolidate residenziali miste:**
  - 2.00 — 2,00 mq SLP/mq SF
  - 1.35 — 1,35 mq SLP/mq SF
  - 1.00 — 1,00 mq SLP/mq SF
  - 0.60 — 0,60 mq SLP/mq SF
  - 0.40 — 0,40 mq SLP/mq SF
- **Zone a verde privato con preesistenze edilizie**
  - TE a — Attivita' terziarie; Servizi (lettera corrispondente alla classificazione)
- **Zone urbane consolidate per attivita' produttive**
- **Zone consolidate collinari:**
  - 0,07 mq SLP/mq SF
  - TE AR — Attivita' terziarie; Attivita' ricettive
  - R1 — Area normativa R1
  - 0,20 mq SLP/mq SF
  - R2 M1 — Area normativa R2; Area normativa M1
  - AR — Attivita' ricettive; Servizi (lettera corrispondente alla classificazione)
  - 0,60 mq SLP/mq SF
  - TE — Attivita' terziarie
- **Zone boscate**
- 1.1 — **Zone urbane di trasformazione:** (denominazione ambito)
  - Viabilita'
  - Servizi
  - Impianti Sportivi
  - Continassa - Ambito di riqualificazione

Concentrazione dell'edificato, destinazione d'uso prevalente:

- Residenza
- Attivita' terziarie e attrezzature di servizio alle persone e alle imprese
- Residenza - Attivita' terziarie
- Attivita' produttive
- Attrezzature di interesse generale (Universita', Casa della Musica, ecc.)
- Attivita' ricettive
- Commercio: grande distribuzione
- Eurotorino - Parco tecnologico
- Lingotto - Centro polifunzionale

11.1

Accessibilità all'area metropolitana

DATI 2018 | FONTE: ELABORAZIONE RAPPORTO ROTA SU DATI CITTÀ METROPOLITANA E CITTÀ DI TORINO

Fig.82. Nearby transportation Systems

Source: Torino Atlas 2018

> Being among the abandoned industrial areas of Turin and consequently having a low population density statistics, the area is however perfectly connected with the main spots of the city and even better connectivity is projected according to the public transportation development strategies

Connectivity

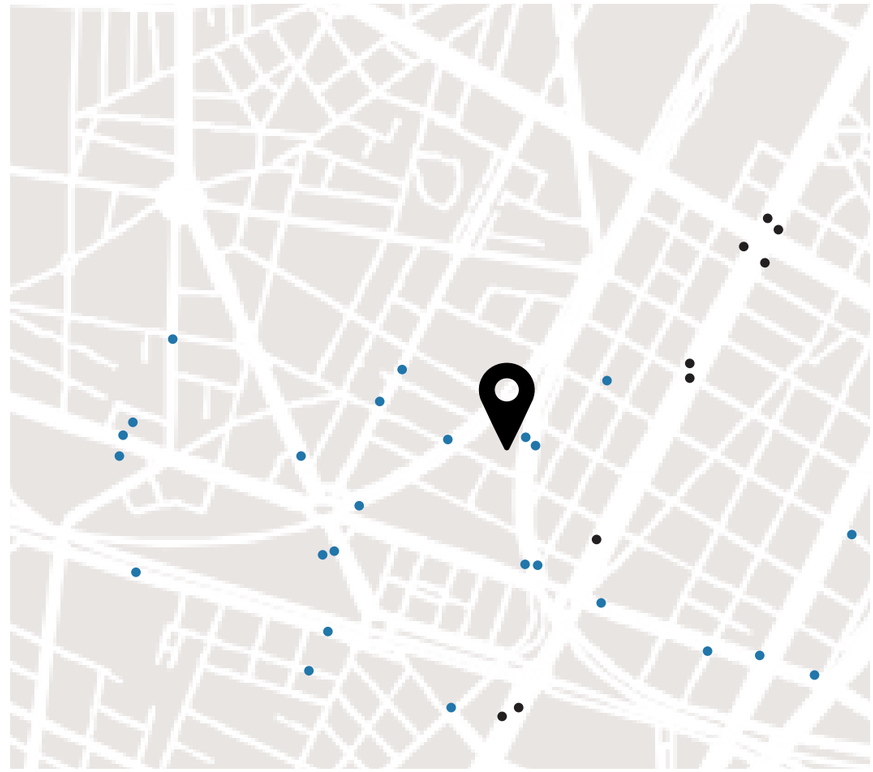

Fig.83. Connectivity of the site.

Source: Torino Atlas 2018

Bus stop

Tram stop

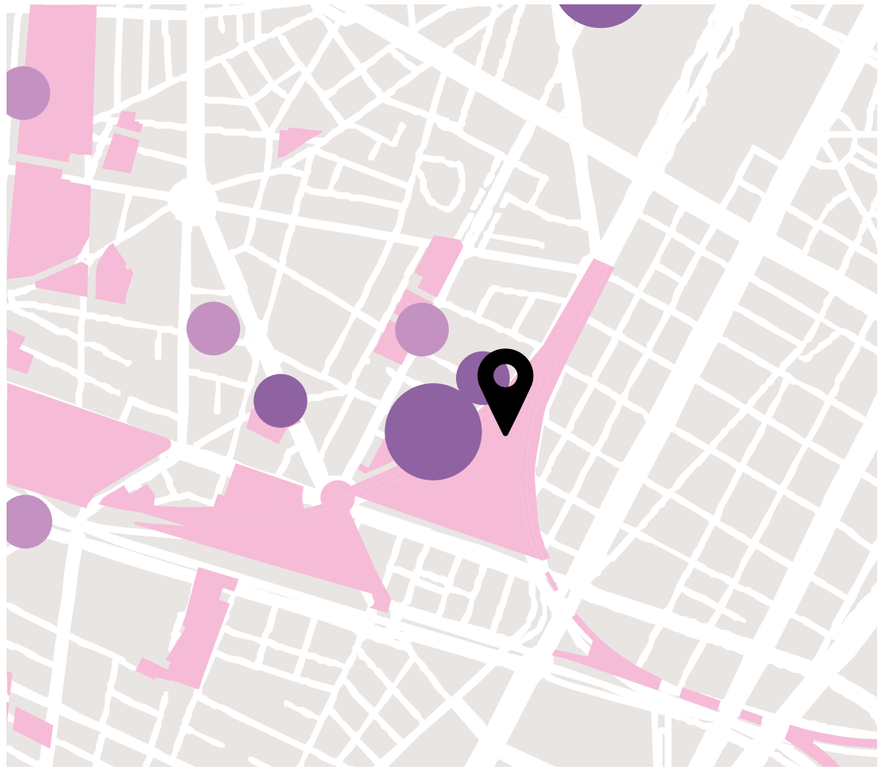

Fig.84. Abandoned Industrial areas of Turin

Source:Torino Atlas 2018

Area abandoned in 1989 and reused before 1997

Area still abandoned in 1997 and reused before 2001

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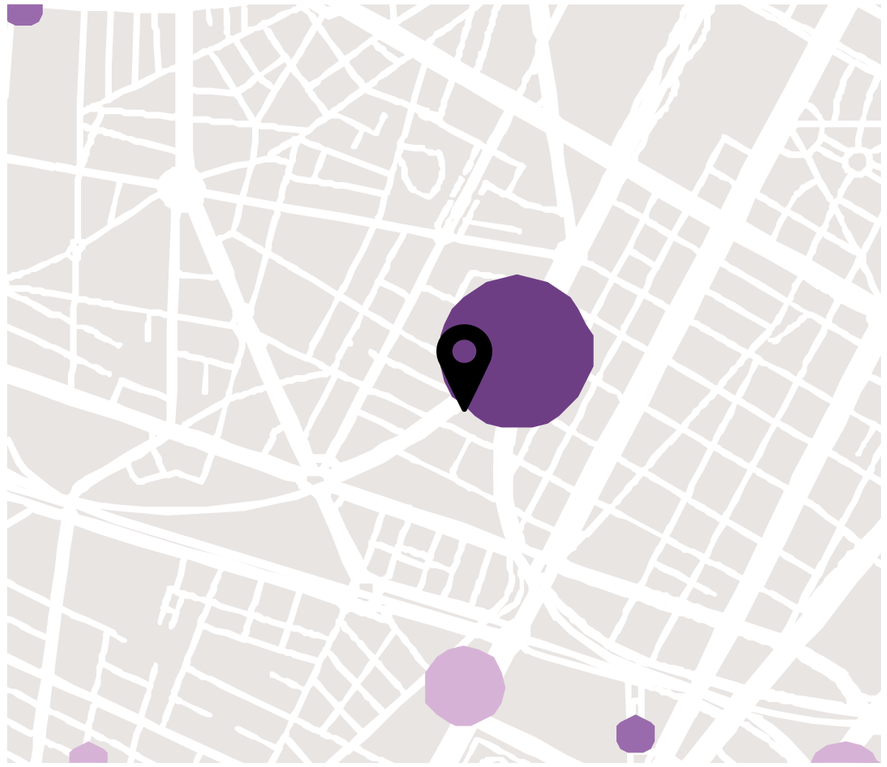

Fig.85.Economic houses.

Source: Torino Atlas 2018

Years of Construction

1980 - 2000

1900 - 1920

Existing Condition

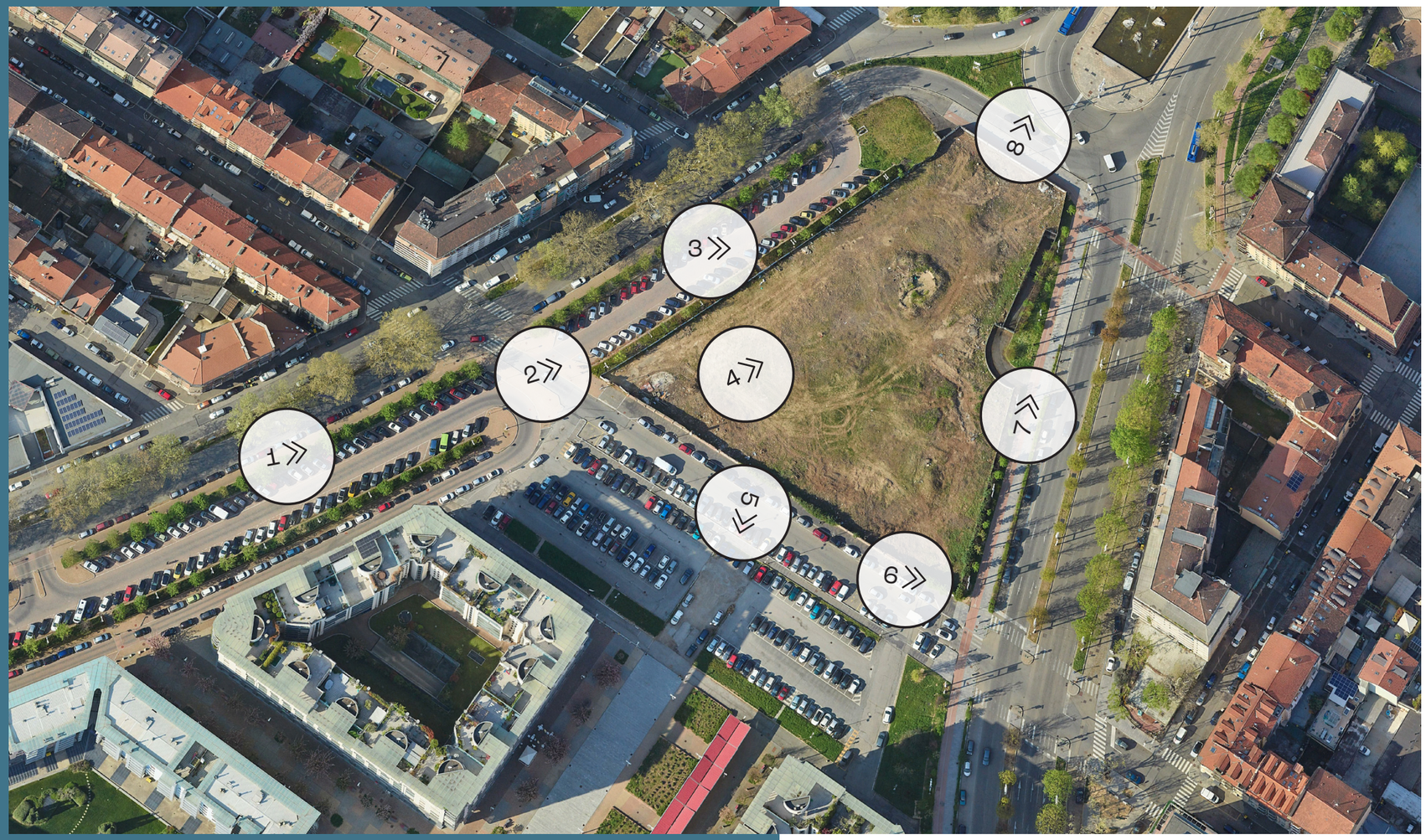

Fig.86. Map of the site.
Source: Google earth.

The site is lcated in these highly attractive spaces, interesting areas offer a special quality with northward views towards the Alpine region and across the city centre.

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1.

Pedestrian road connection to the site and corso lione

2.

Interaction between corso Lione and via Enrico Martini Mauri

3.

Parking along side corso Lione

4.

Existing Condition of the site

5.

Parking in front of the site on Via Enrico Martini Mauri.

6.

Interaction between Corso Mediterraneo and Via Enrico Martini Mauri

7.

Pedestrian road along corso Mediterraneo

8.

View of corso Mediterraneo

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Project development Goals

Fig88:The17Goalsareassociatedwiththe169 Targets,tobemeasuredbythe232Indicators.

3 GOOD HEALTH AND WELL-BEING

Ensure healthy lives and promote well-being for all at all ages

Most people spend the majority of their life indoors, making indoor climate an influential factor of health.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Build resilient infrastructure, promote inclusive and sustainable industrialization

The building industry is producing massive amounts of waste and is consuming large amounts of natural resources and energy.

11 SUSTAINABLE CITIES AND COMMUNITIES

Make cities and human settl ments inclusive, safe, resilient and sustainable

The built environment is crucial to the development of sustainable cities and communities

In order to connect the building with the site many points were taken into concendration to achive the sustainable goals. Open building system was integrated in a tall structure which creats more flexible and systainable building.By allowing modifications without significant structural changes, open building systems reduce the waste and cost associated with traditional demolition and reconstruction, thereby fostering economic and environmental sustainability.

Rather then moving the landscape horizontally it is moved vertically creatinf many flexible green space throughout the building including the rooftop garden. **In many urban locations around the world today, the integration of buildings into vegetation has become essential.** The benefits of plants in buildings are comparable to those of typical city greenery. **As it helps in increasing the livability and sustainability of modern structures, both inside and out**, and it has become a crucial new construction philosophy.It can have a positive impact on the climate.The purification, humidification, and psychological calming effects of indoor plants can be used to create a comfortable environment, and indoor greening technology, such as indoor vertical green walls, has shown to be an effective technique to enhance indoor air quality.

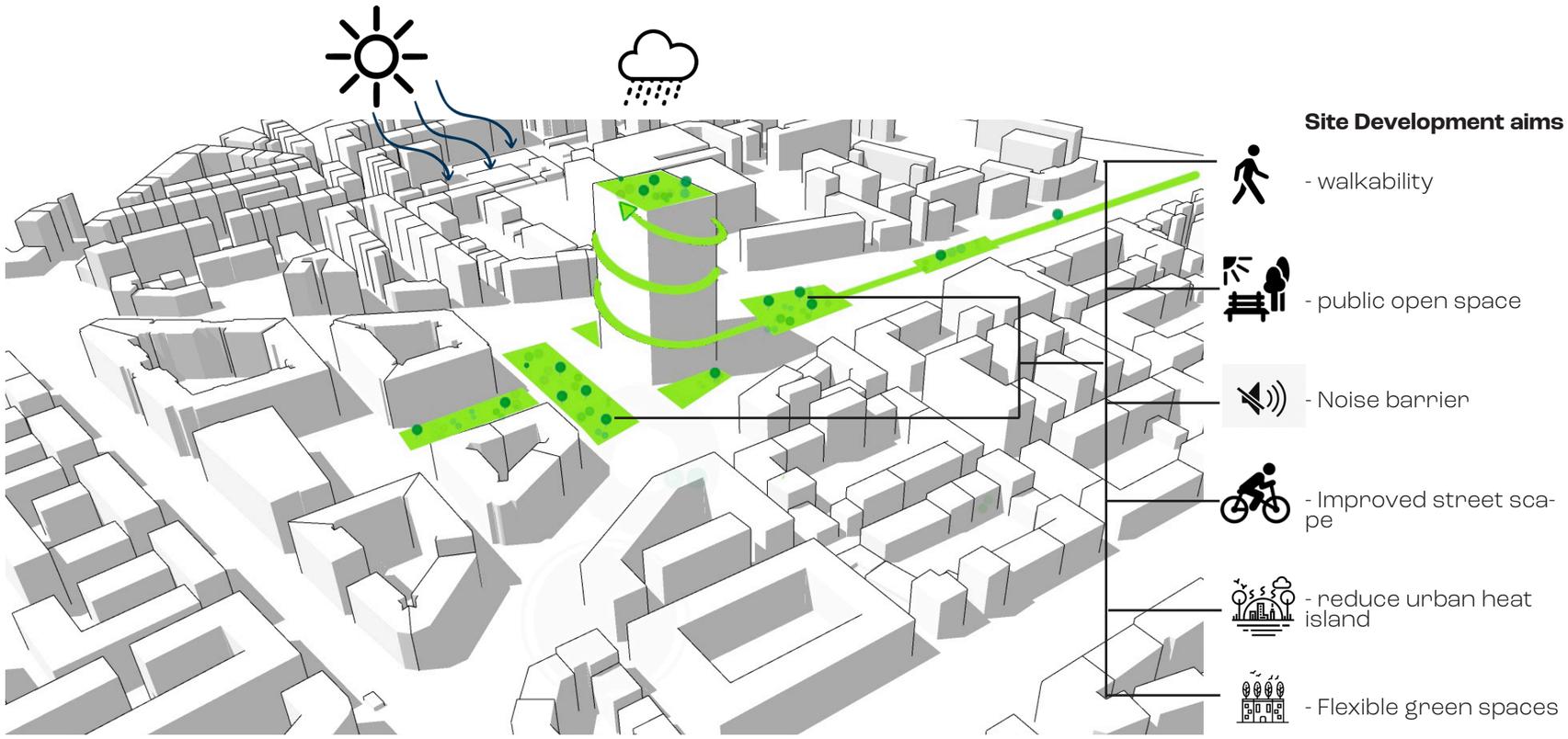
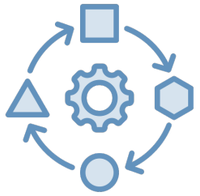


Fig.87 connecting the building with its surrounding landscape

Design stratigies.

Vertical Urbanism

Open building system



Design solution for affordable housing.

As housing costs continue to rise steadily in the city, one of the significant challenges faced by the young group of people is the lack of affordable housing options and it becomes imperative to explore innovative solutions.. To address this issue, implementing an open building system in high-rise buildings can provide a viable solution. Open building systems allow for flexibility, customization, and incremental construction, making them the ideal approach to cater to the evolving needs of young workers and students.Flexibility and Customization:

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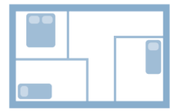
Design stratigies

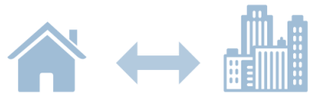
HIGH DENSITY



TYPOLOGY

MULTIFUNCTIONALITY

ADAPTABLE & FLEXIBLE



CONNECTION TO CITY

VARIETY IN FLOOR PLANS

OUTDOOR SPACE

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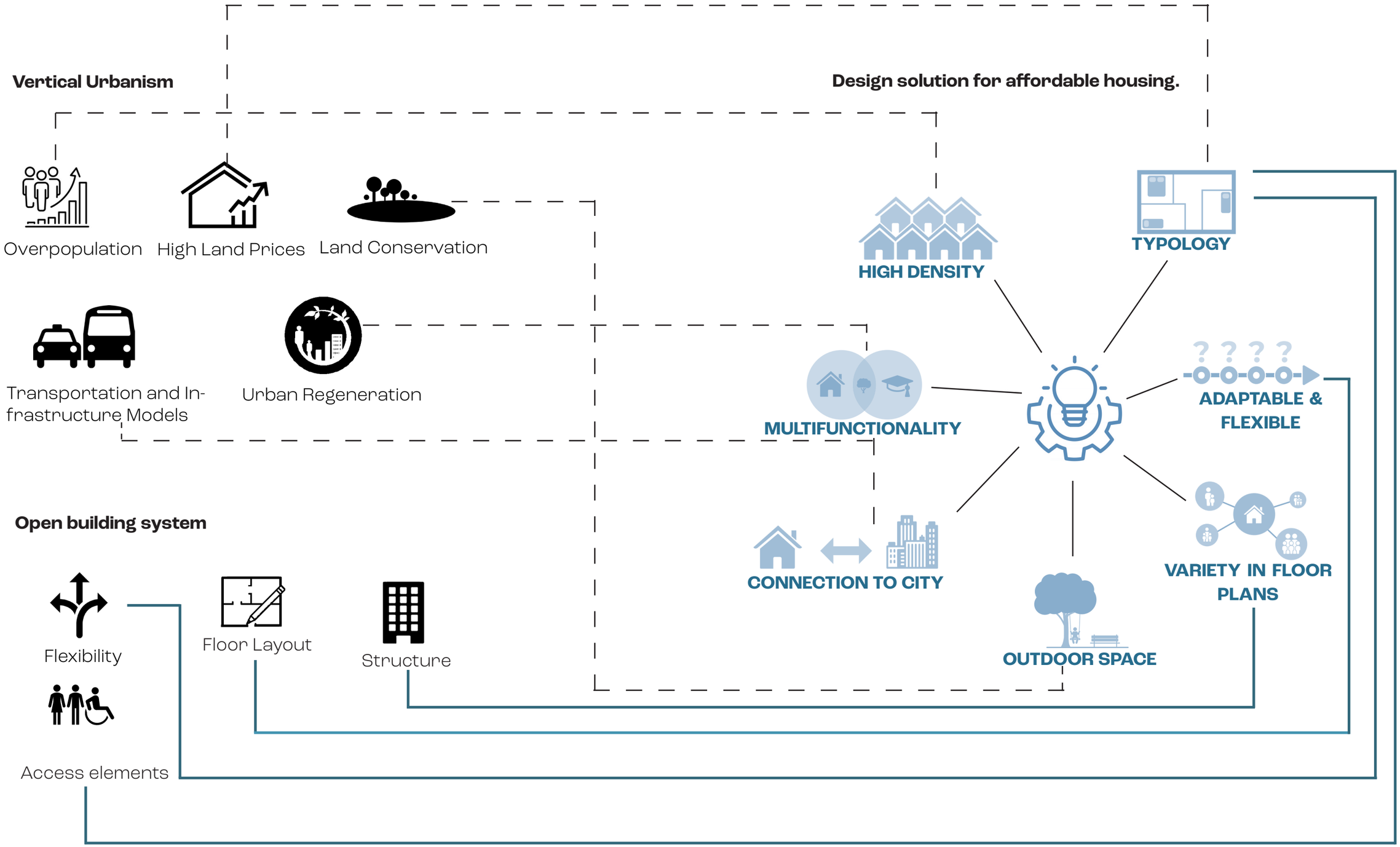
Design stratigies.



HIGH DENSITY

In the design a balance should be found between quantity (the amount of dwellings) and quality (views, sunlight, privacy etc.).

TYPOLOGY

Optimal floor plans should be designed to find a balance between affordability and desired sizes of spaces.

MULTIFUNCTIONALITY

The space is scarce and valuable in this part of the city. If possible, spaces should be transformable or multifunctional. Different functions could share a space according to the time of the day or week. This applies to the dwelling, as well as for public space in the building block.

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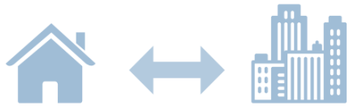
ADAPTABLE & FLEXIBLE

The future of the city is unknown, therefore the building should be able to adapt to an unknown future. Especially commercial spaces should be able to accommodate diverse functions



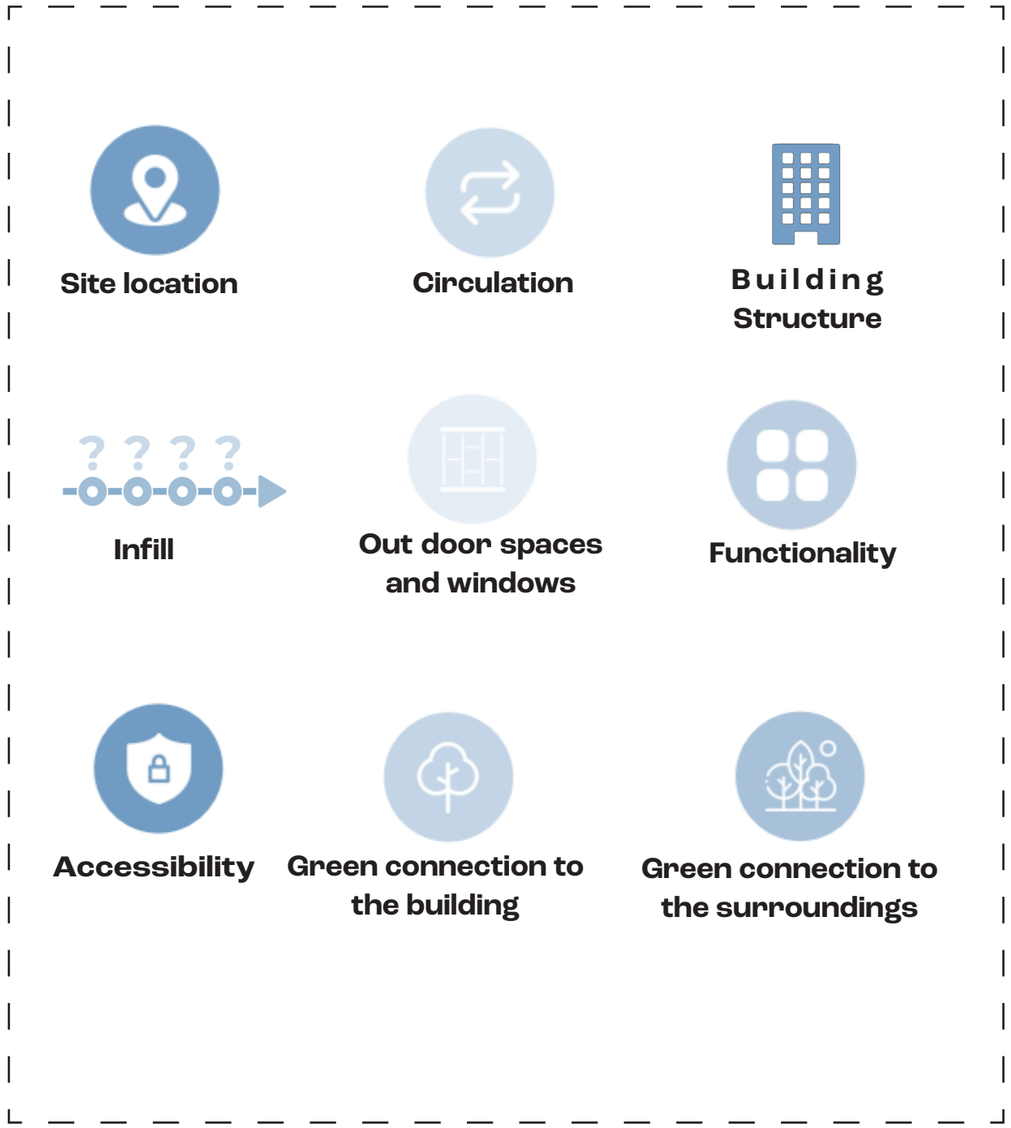
CONNECTION TO CITY

In most high rise buildings the transition between the private dwelling and the public city is relatively abrupt. To create a building suitable for People, the connection from the dwelling and the city should be more gradual, with Public spaces

VARIETY IN FLOOR PLANS

To cater for different household sizes and income groups, a range of floor plans should be offered, varying in size. These should be mixed to subsequently create mixed smaller “neighbourhoods” inside the building block..

Design direction



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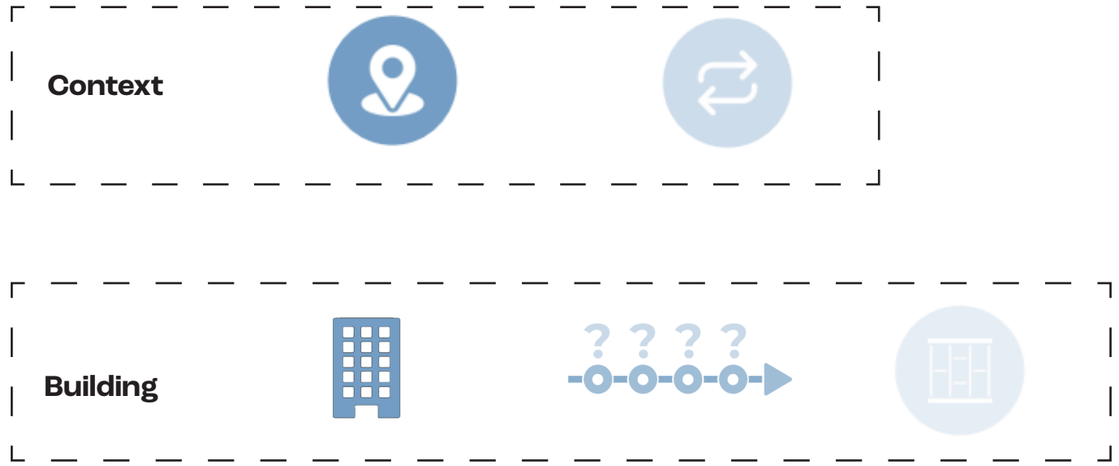

Context

The site is located in **Corso Lyon Torino**. The approximately triangular area at the intersection of the Lyon and Mediterranean courses.

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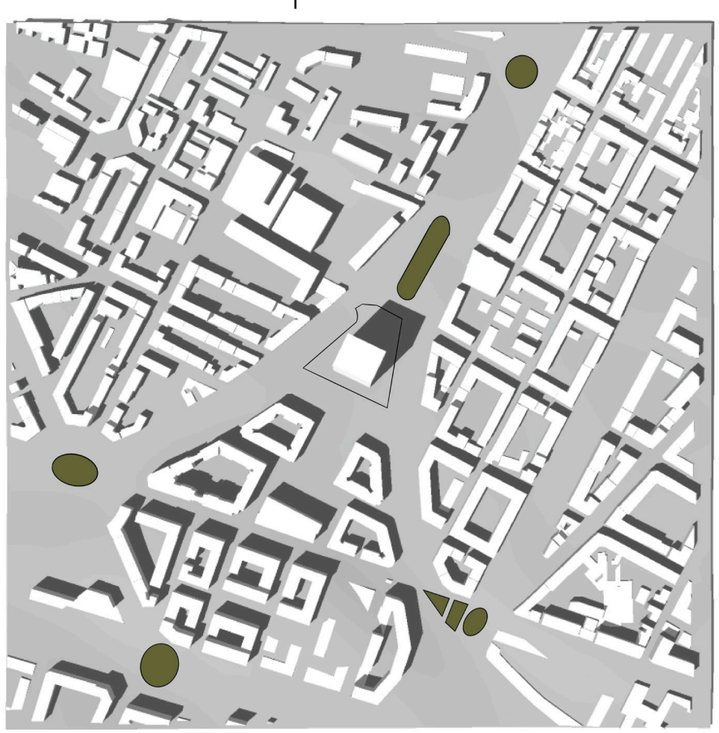
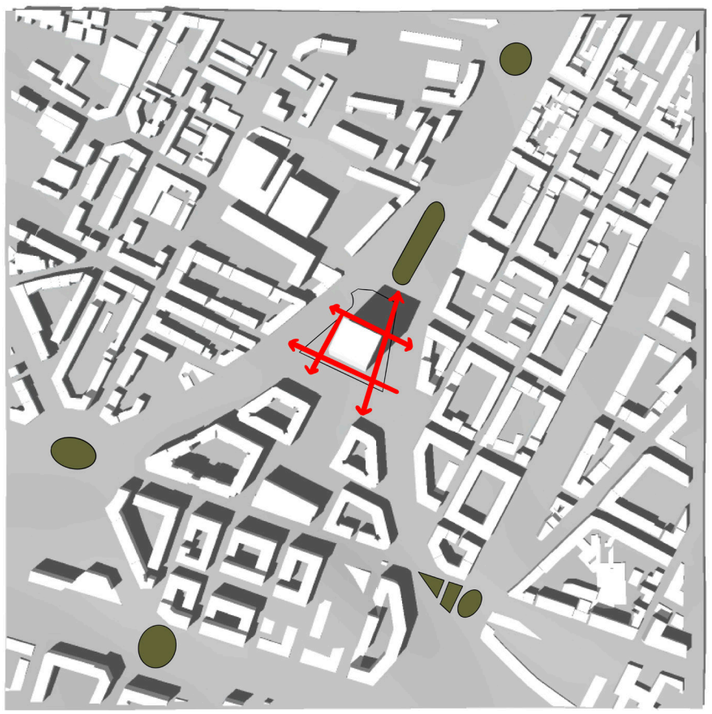
Fig.88. Existing site showing the connectivity.

Context



Nearest public transport services.



Possible circulation of the site.

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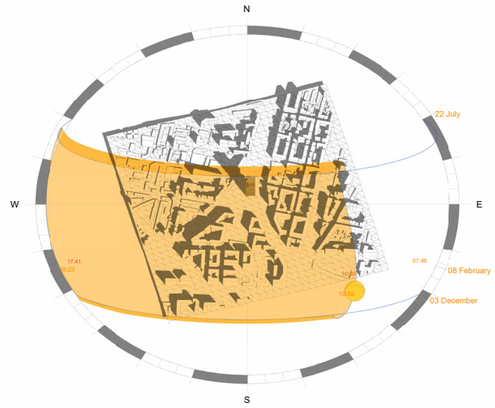
Solar Study



The solar study shows the data one year from 10:30 am and 12:30 pm.It show the shodwe of the building on its surrounding which helps in the better positioning of the building block.

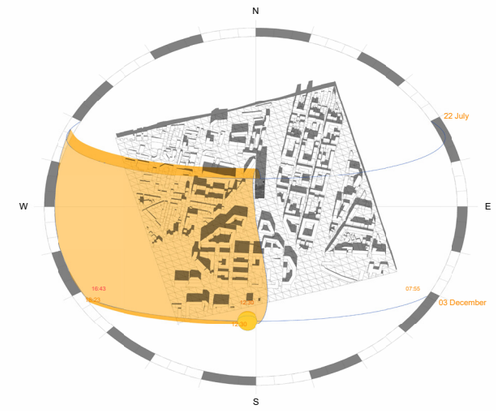


Fig.91.. Sunpath digram drawn on the existing site.

Site development

In the development of the site 4 steps were followed the site is first divided into two parts in which the bigger part of the site is kept for the placement of the building block the other is for the recreational activities.

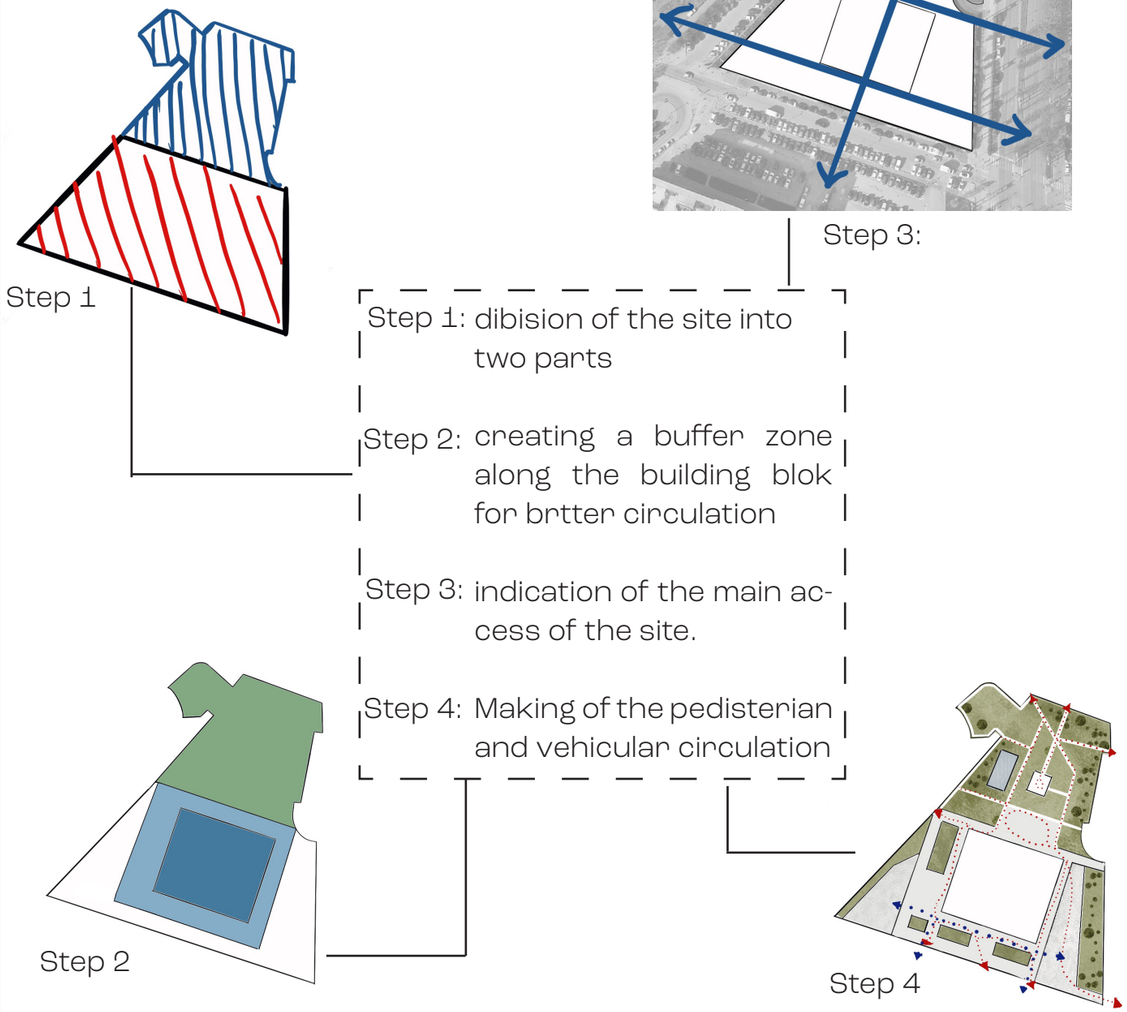


Fig.89 Development of the site

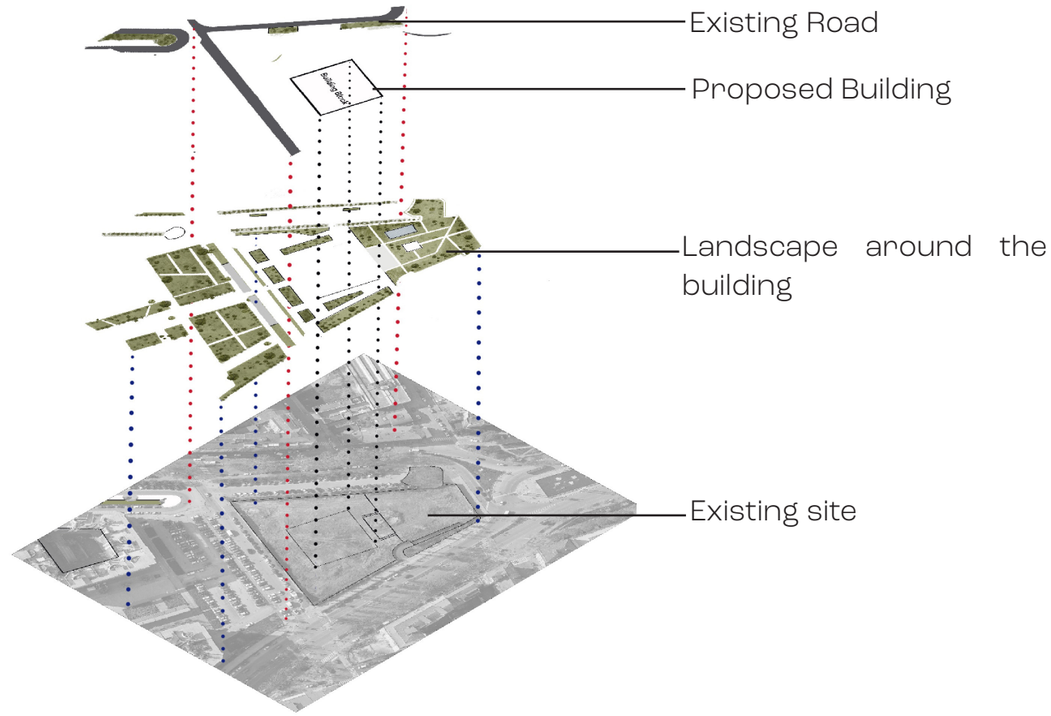


Fig.90 Isometric view of the building

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Site development

nteraction between Corso Lione and via enrico Martini Mauri

Interaction space beside the building

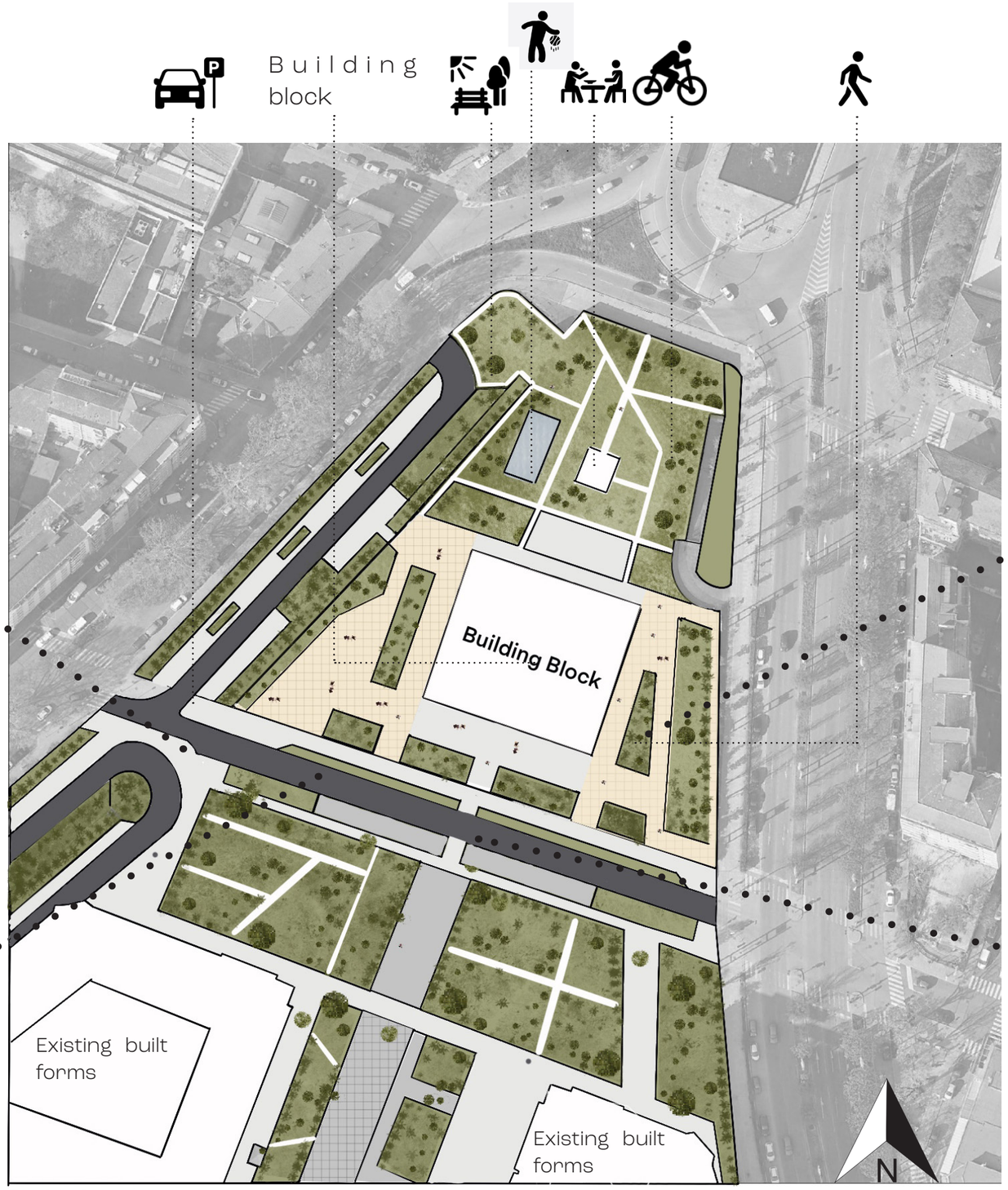
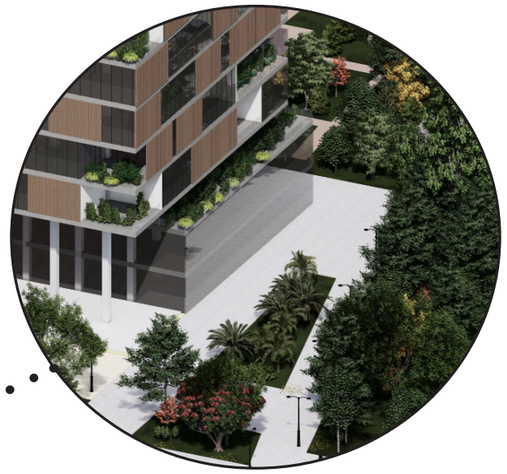
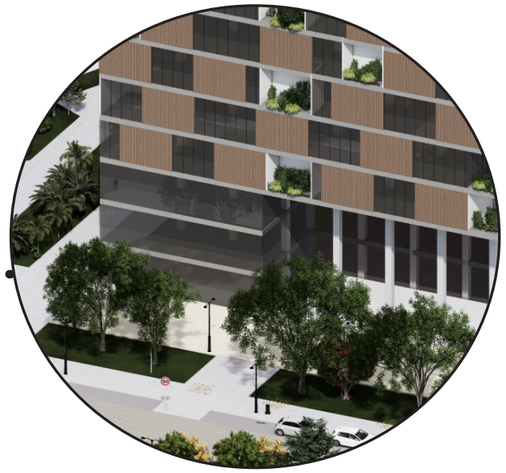


Fig.91. Site plan



Interaction space beside the building



Main entrance of the building

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Adding the proposed building to the skyline of Turin. With the height of 100 meters it is smaller the the intesa san paolo, which is an office building in porta susa with the height of 166 meters.

Proposed building
The height of the building is 100 meters

Intesa san paolo.
the height of the building is 166 meters

Torre littoria torino
The height of the building is 87 meters

Mole antonelliana
The height of the building is 167.5 meters.

Fig.92. Picture edited by the author
Source: https://www.alamy.it/fotos-immagini/skyline-di-torino.html?cutout=1&imgt=8&sortBy=relevant

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Fig.93 elevation from via enrico Martini Mauri

Fig.94 Elevation from corso Mediterraneo

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Fig.95.Isometric view if the site.

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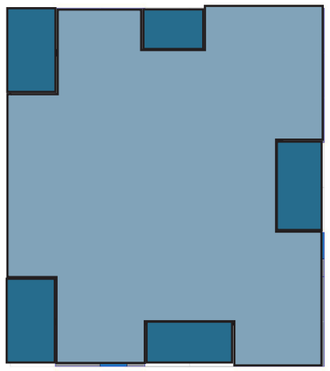
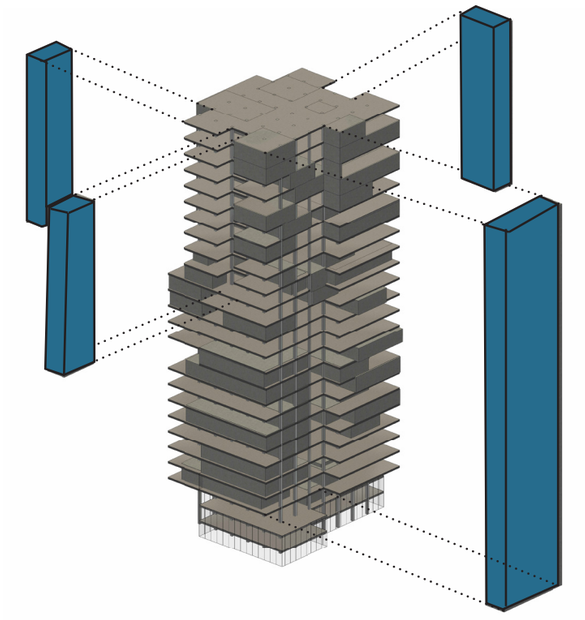
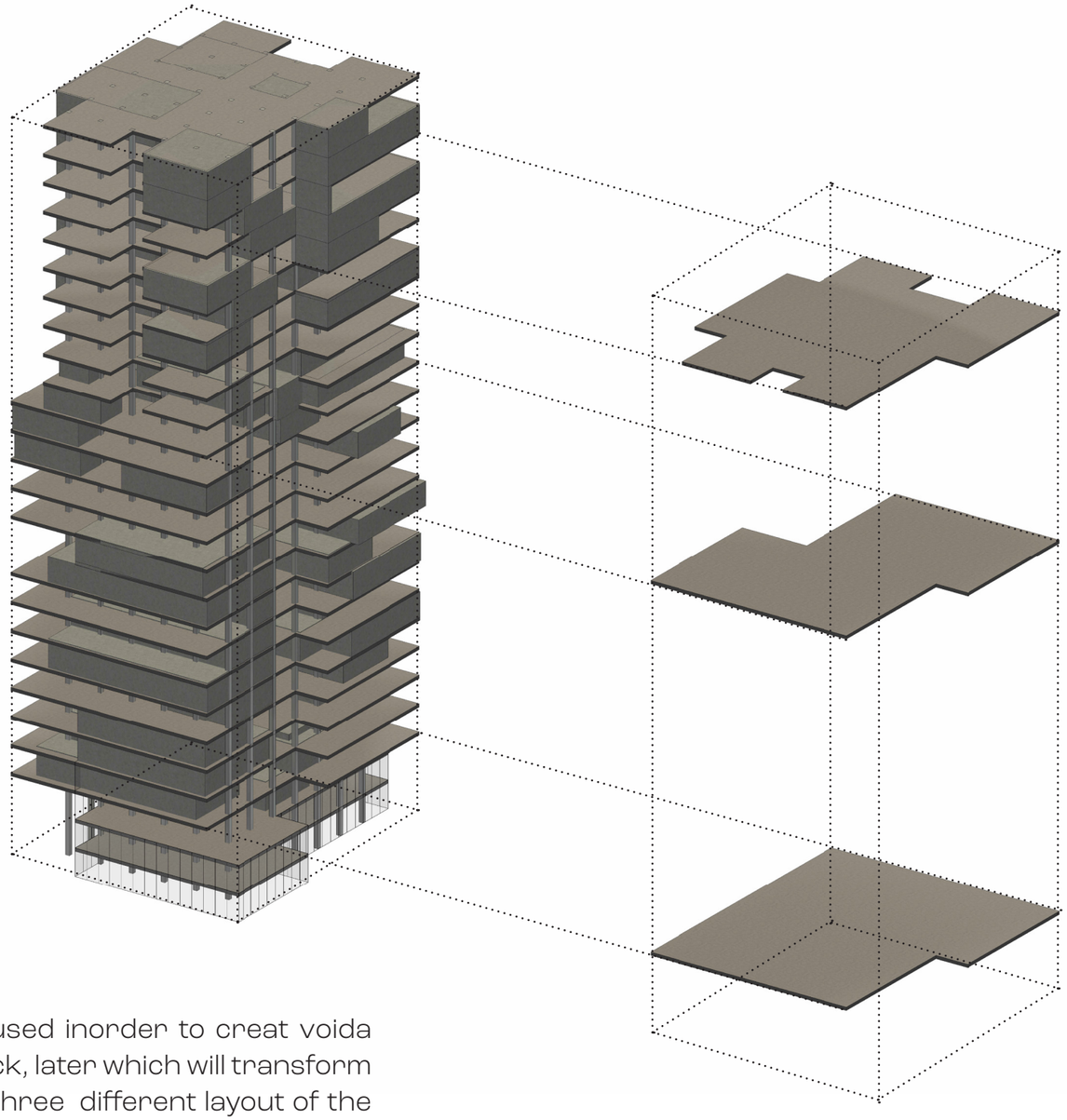
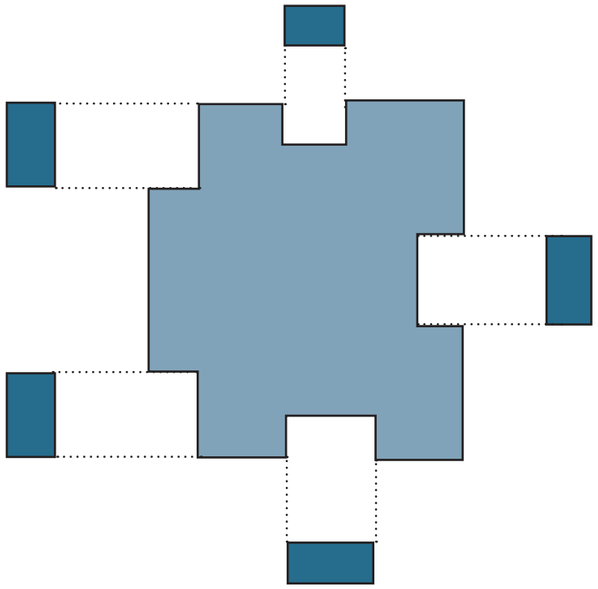
Building Block









The method of substraction is used inorder to creat voida and open spae in the building block, later which will transform as a gree space in the building. Three different layout of the floor plans were created inorder to better the needs of the function of the building and creat more flexibility in the plans.

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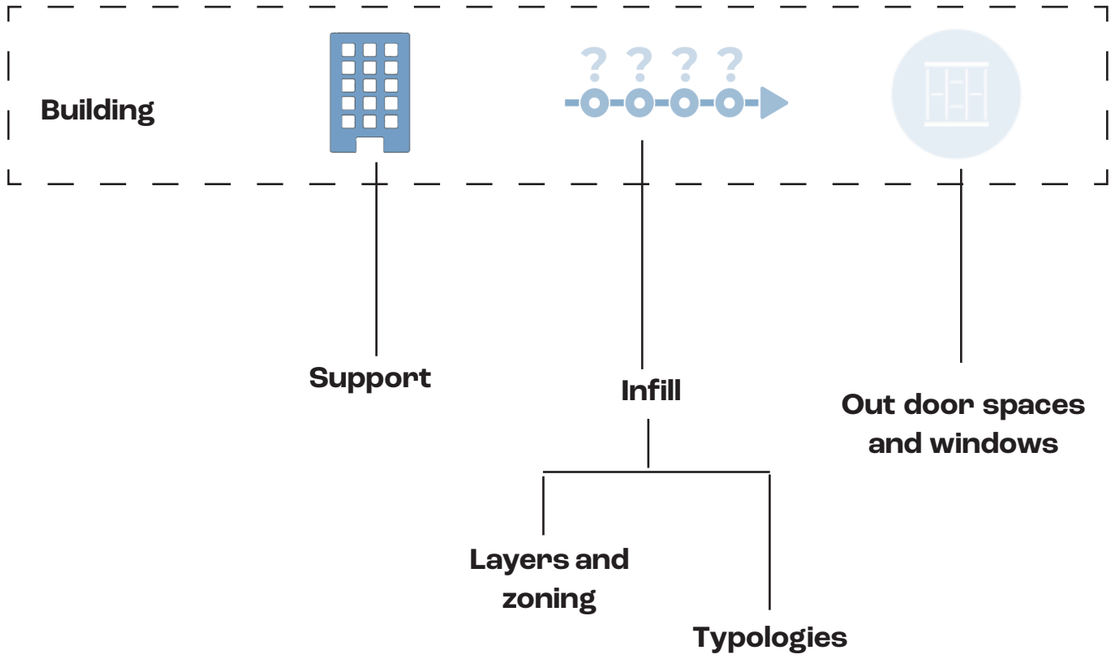


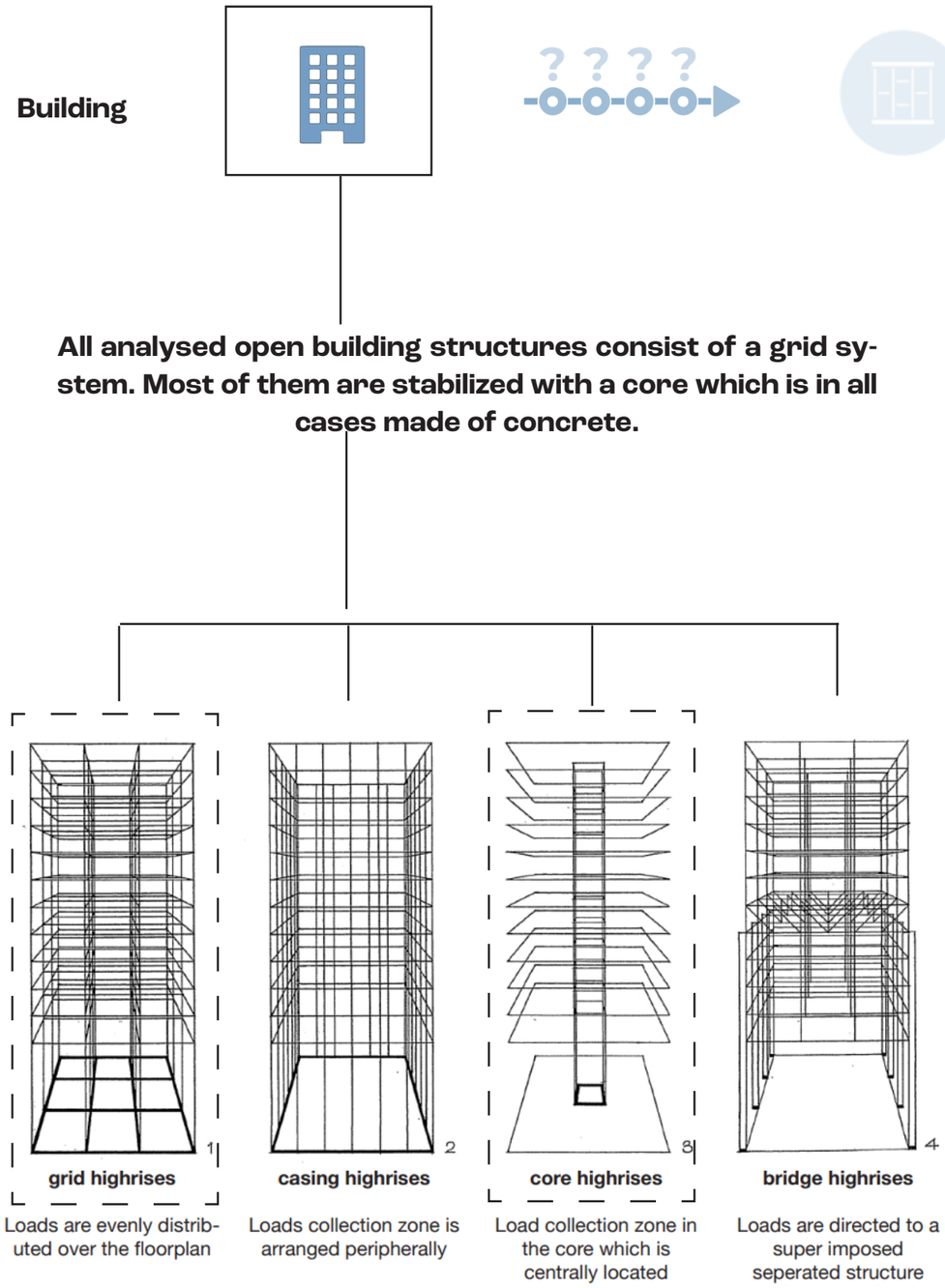


Fig.98. Four major families of high-rise structure
Source: englel and hatge, 1997

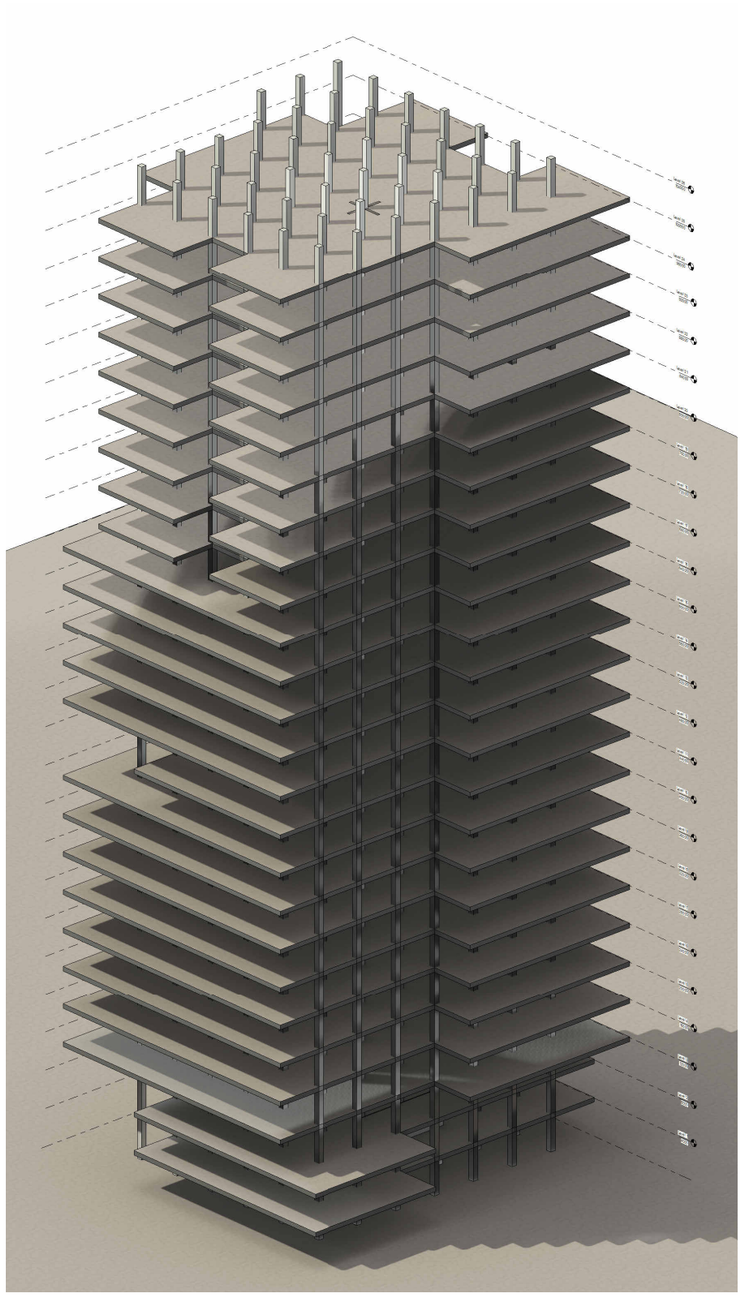
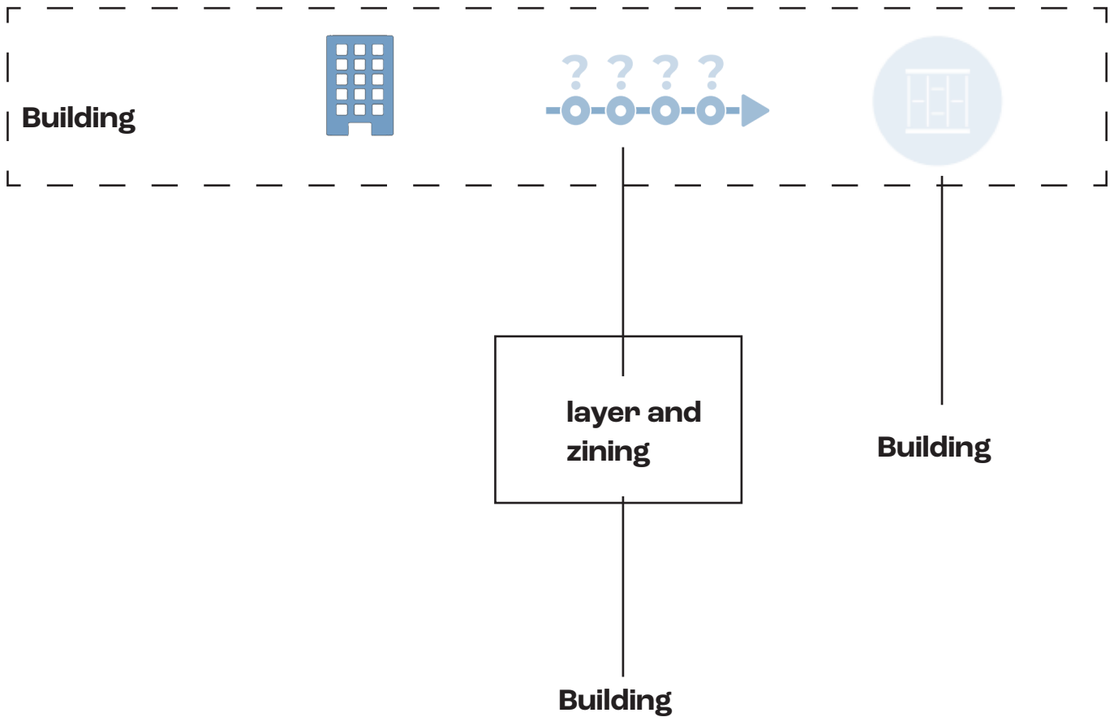


Fig.96. Structure of the building.

The structure consist of a grid system with two stabilization cores. The vertical columns, the two cores and the floors are made of concrete. The floor heigts differ and make it possible to make one or two storey units. The columns offer a lot of flexbility and many possibilities for the interior arangement.

Layers and Zoning



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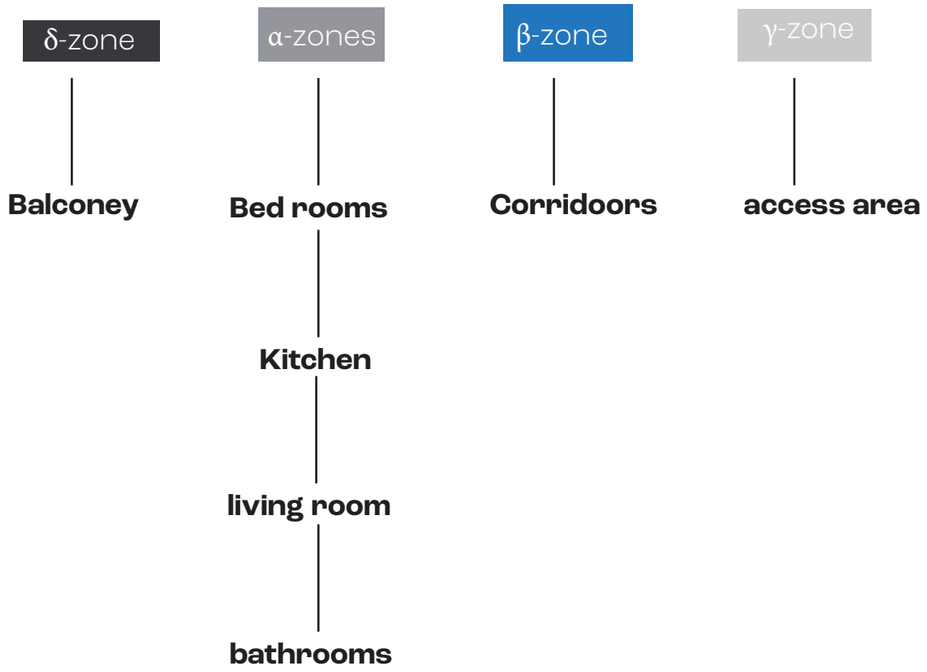
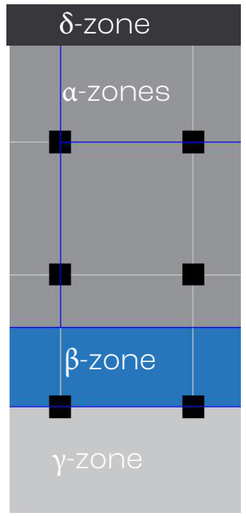
Van der Werf (1993) describes three space types: the parcelable space (α-zones - and β-zone), the
access space (γ-zone) and the private outdoorspace (δ-zone).



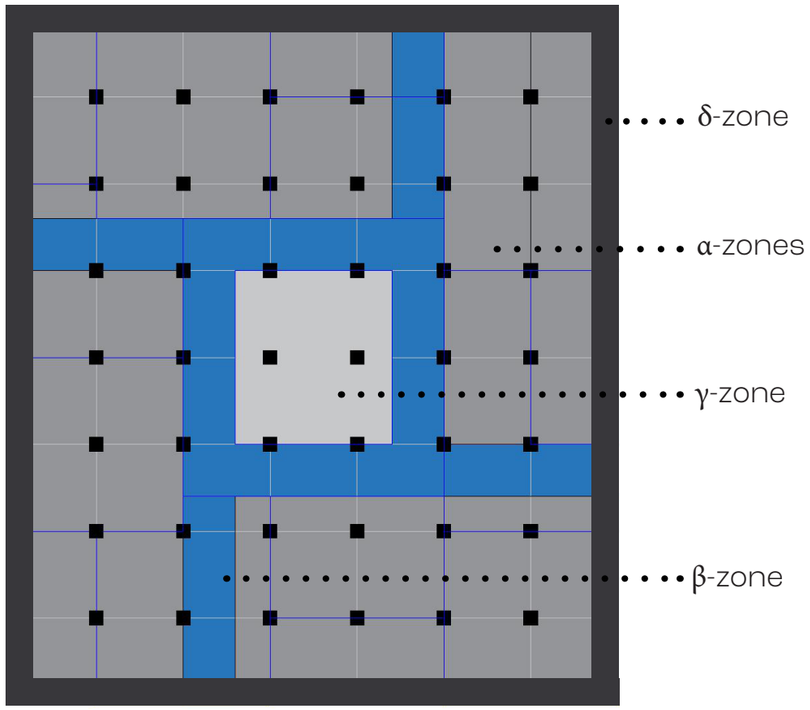
Within each layer are many different types. The structure can consist of columns or walls and the access elements can consist of corridors or galleries.

Layers and Zoning



The infill has to change many times throughout the life cycle of the support. Interference and conflict between layers should be avoided and parties controlling them. (Kendall & Teicher, 2002) The layers skin, access elements, servant elements, scenery and outdoor space form together the infill.

the most important aspect is that the infill is flexible and circular whichmeans it is designed for disassembly.



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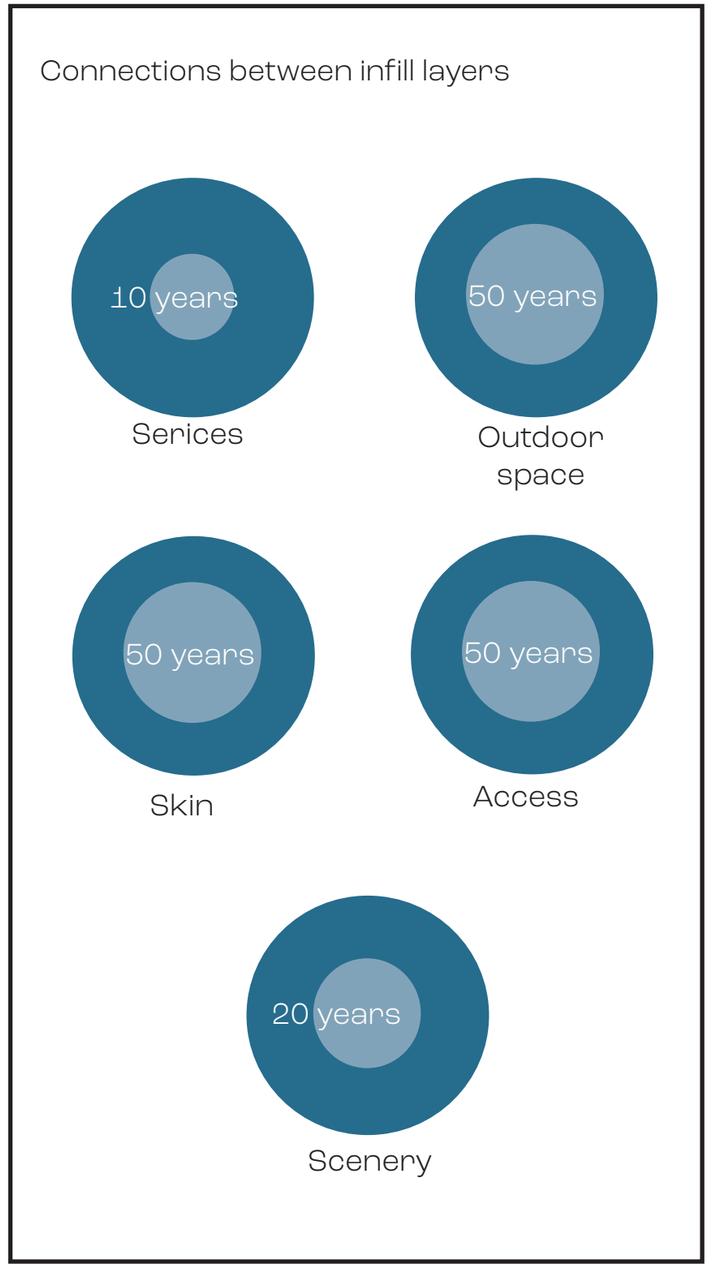

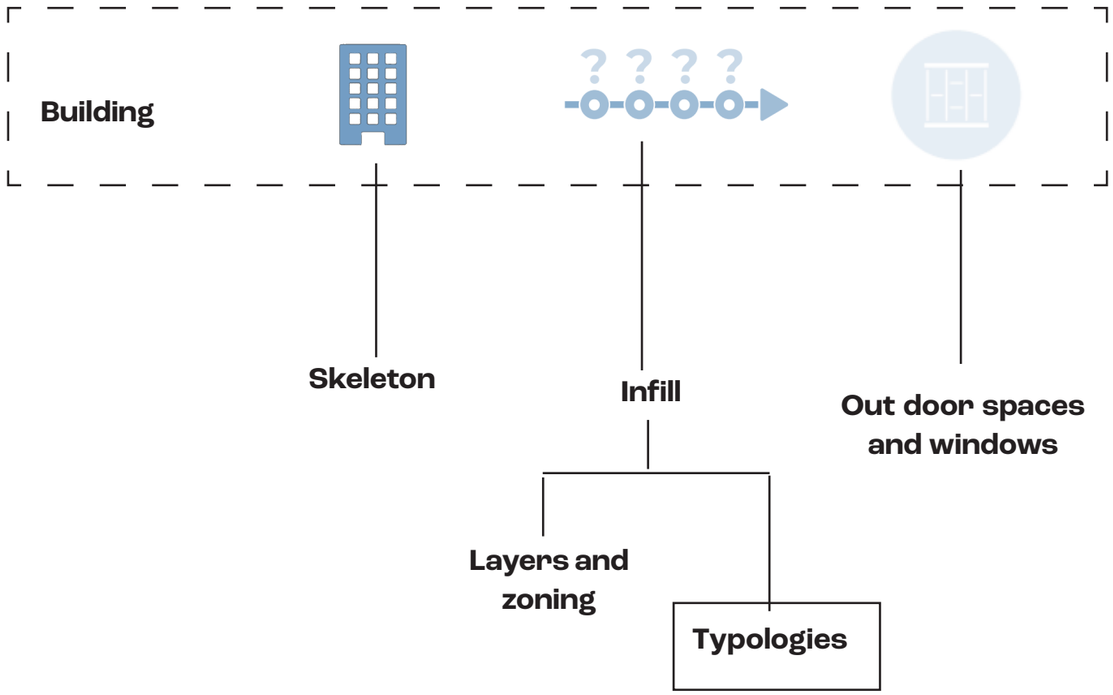

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Typologies

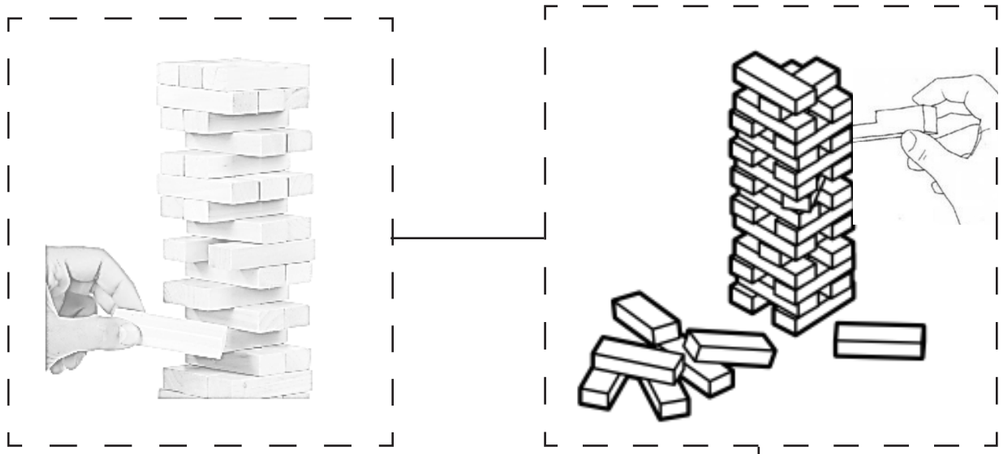

Fig.97. The concept behind the typologies.

Source: picture by the noune-project.com and edited by the author

The concept of the typologies was derived from Jenga. like in jenga each block can be moved from its position without disturbing the stability of the structure. Each unity in the building can be moved from its postion without distrubing the main structure.each unit can be combined or seperted from each other to form a new unit.

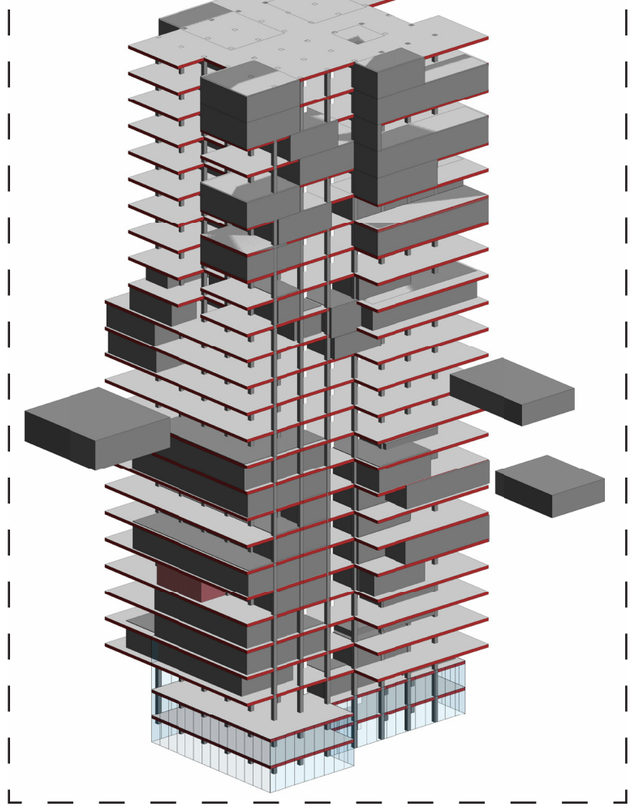

Fig.98 The formation of diffirent units

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Typologies

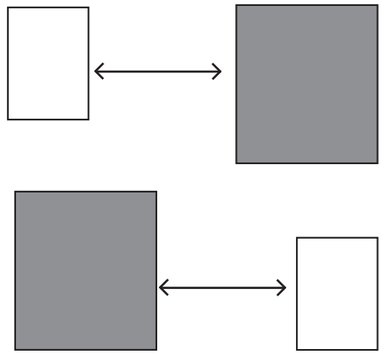
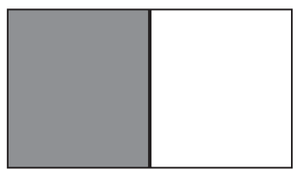
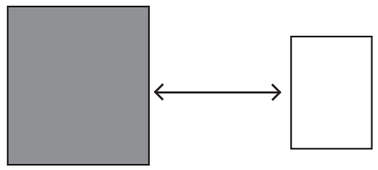
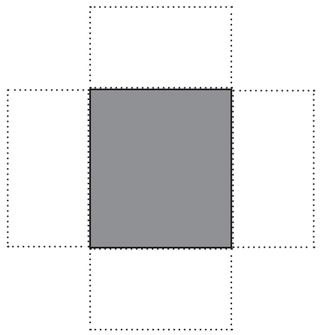
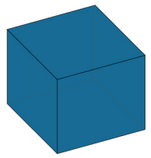
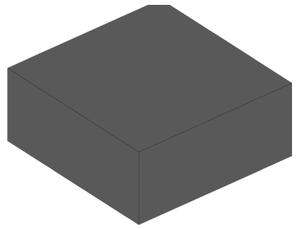
	The ability to reposition different functional units within one building structure. This means that buildings function remains the same but its sub functions can be moved from one location to another.
	The ability to reconfigure one space from one function to another. That means that the space changes the function within the same structural constrains. Multifunctionallity.
	Free internal partitioning of one functional zone into sub-zones.For example, partitioning of the apartments.The main function is not changed, only the size of sub- zones
	The ability to extend the building Horizontally or vertically.

Fig.99The formation of diffirent units

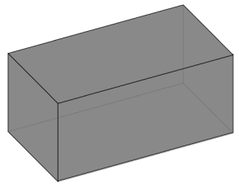
Typologies



Unit 1

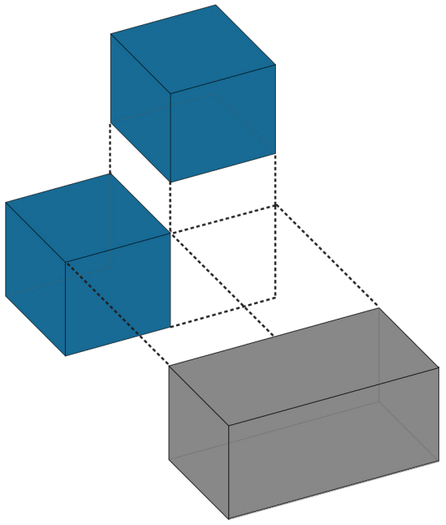


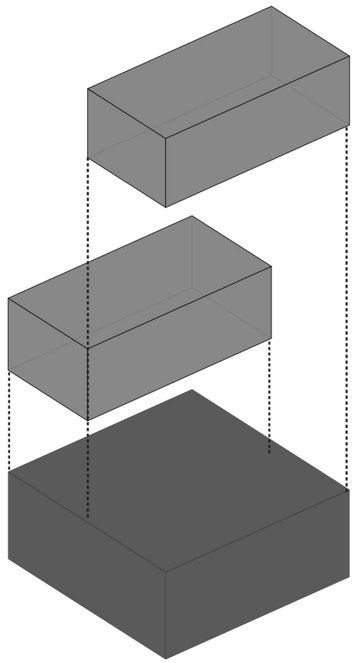
Unit 2



Unit 3

Three aprtment units were created which is unit 1, unit 2, unit 3 inorder to increse the flexibility of the layout.All three units and be combined together to form different size of the appartment according to the need of the user. like two of the unit 1 can be combined to form unit 2 and the combined withe unit 2 to form unit 3 and multiple layout can be created by the combinition of these units.





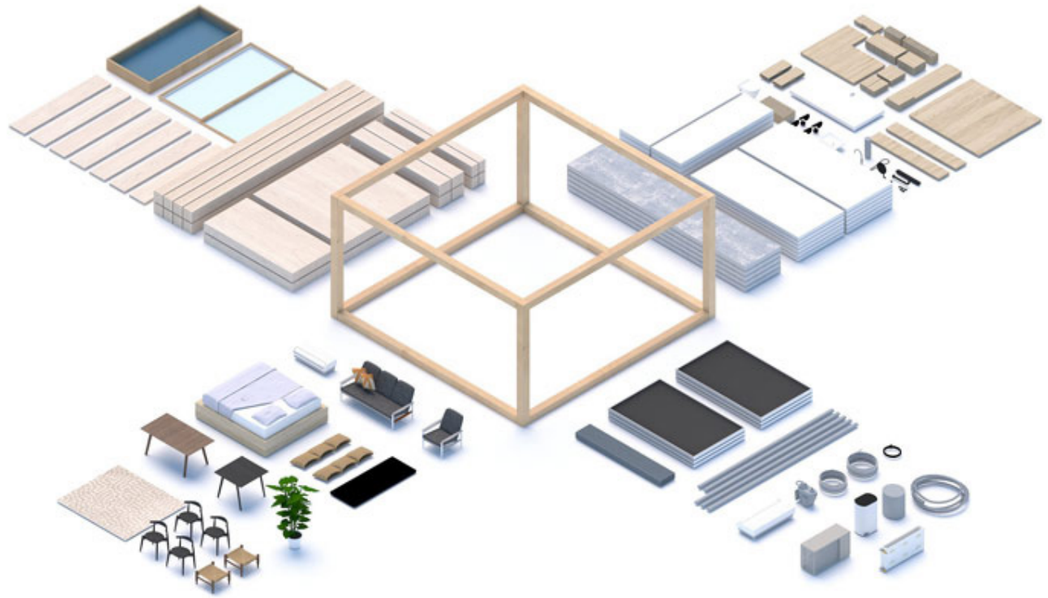
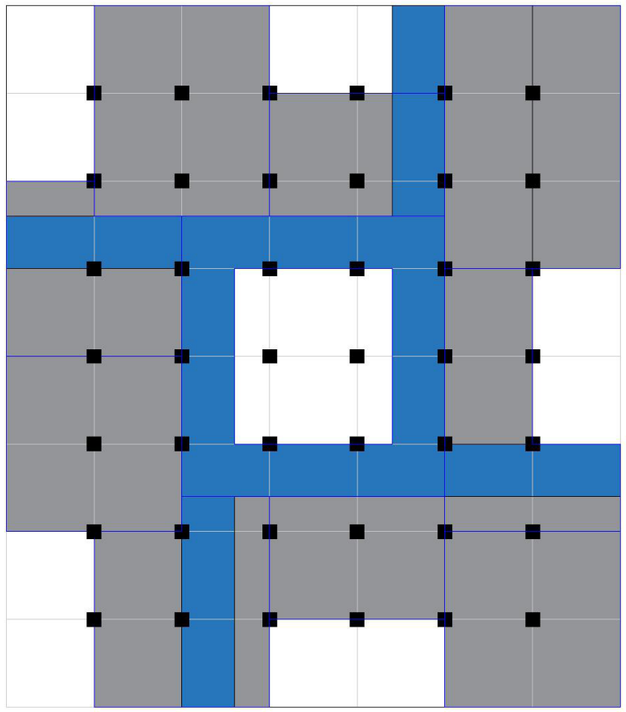


Fig.100.Concept of disassembly.

Source: https://builtoffsite.com.au/news/designed-for-disassembly/



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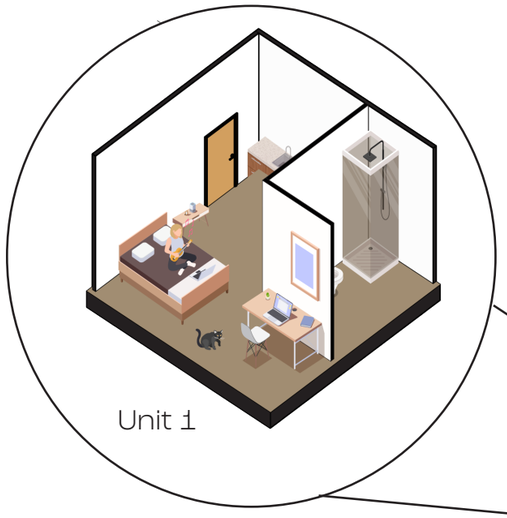
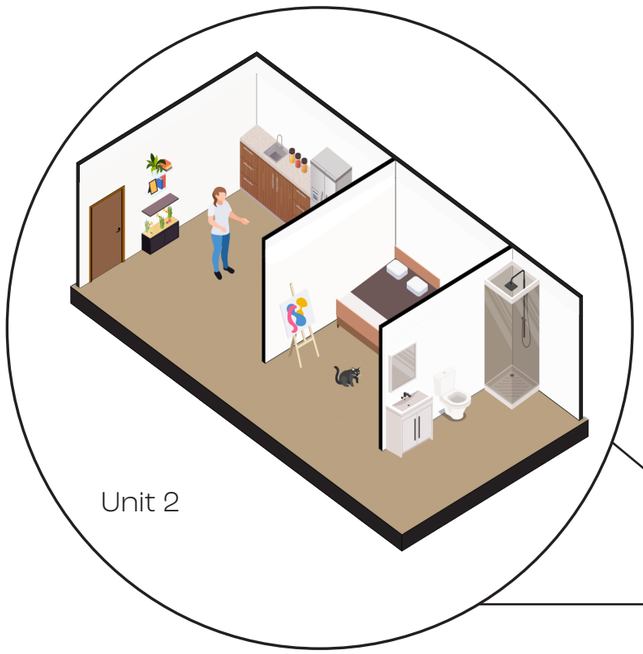
Typologies





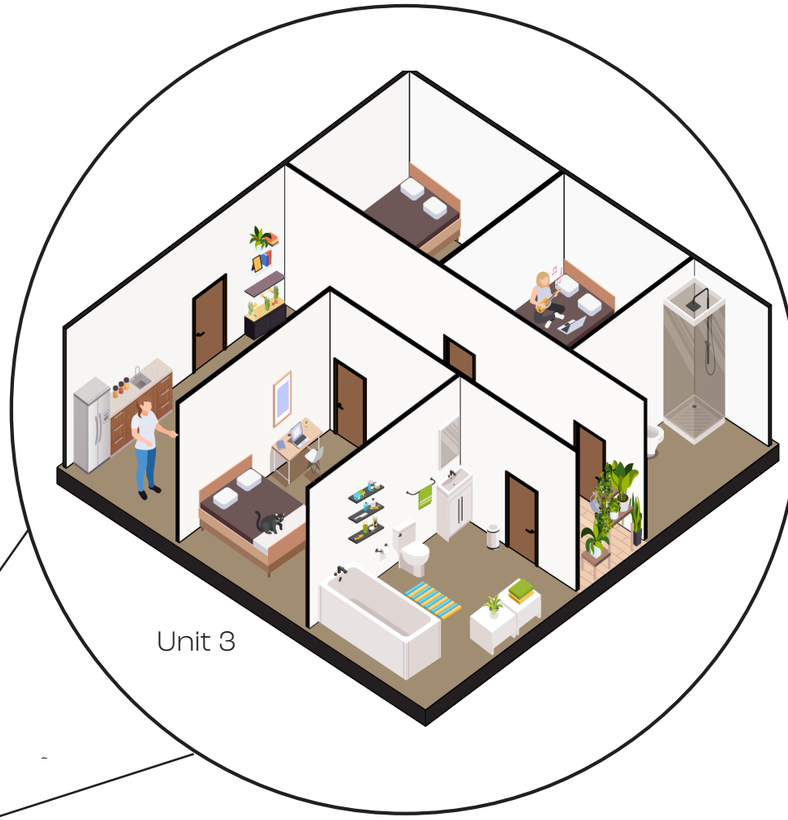
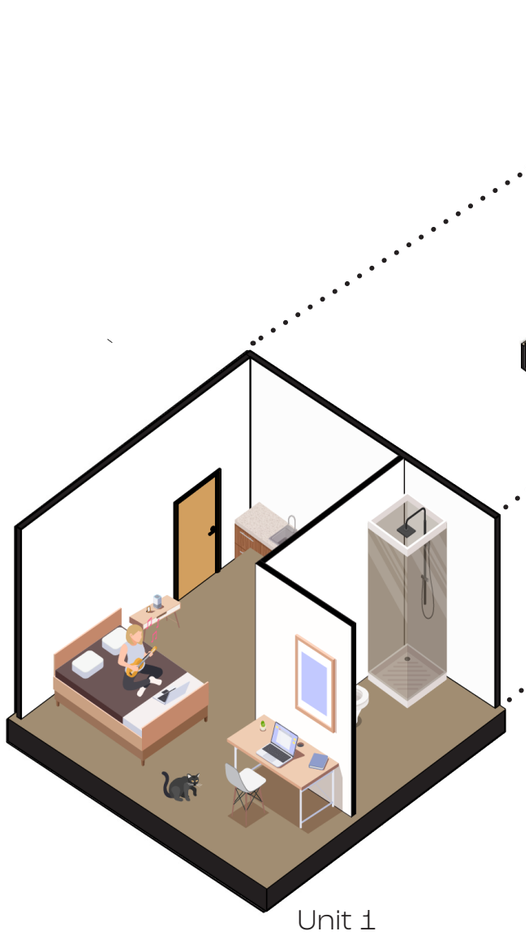


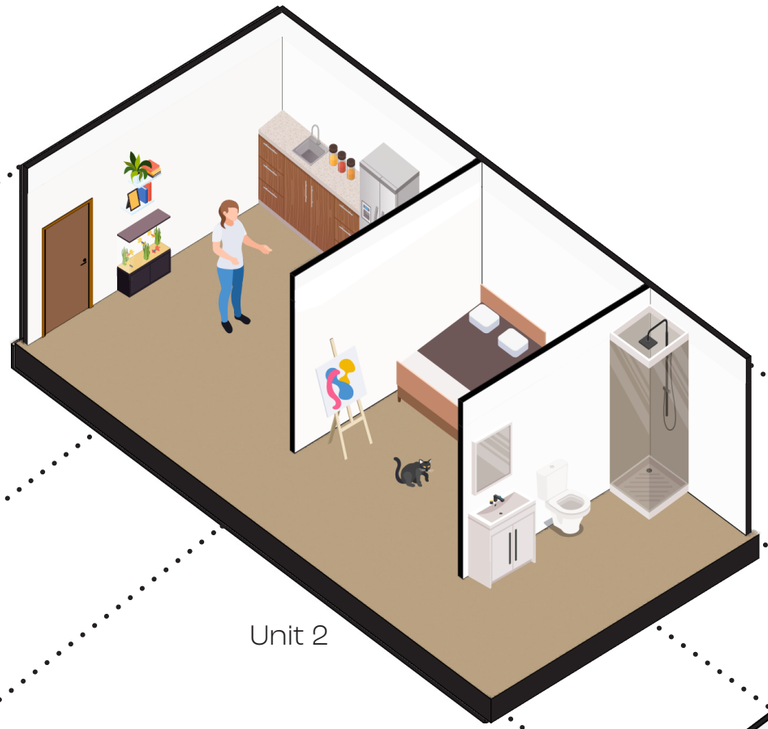
Fig.101.Concept of disassembly.

Thesis
OPEN BUILDING SYSTEM IN VERTICAL URBANISM

Typologies



Unit 1

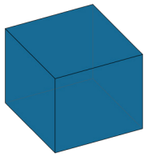


Unit 2

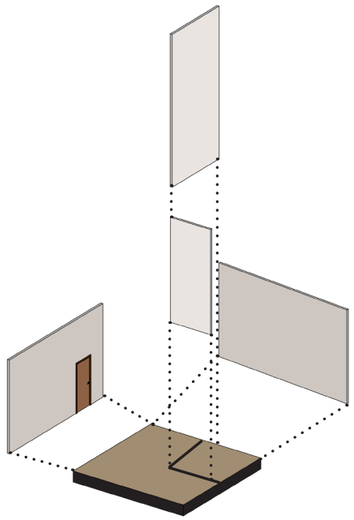
Unit 3

the unit is formed using the prefebricated elements like the the movable walls, Demountable walls and Sliding walls so that is can easly be transformed into a new unit according to the use of the occupants.

Unit 1



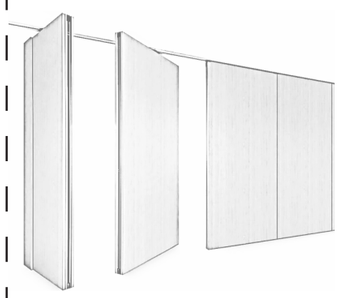
Unit 1



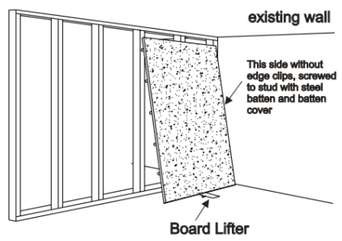
the unit is formed using the prefebricated elements like the the movable walls, De-mountable walls and Sliding walls so that is can easly be transformed into a new unit according to the use of the occupants.

Tools

Movable walls



Demountable walls



Sliding walls

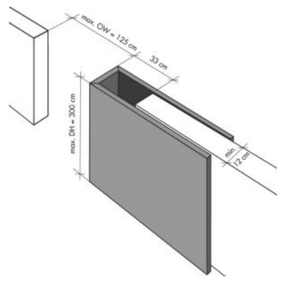


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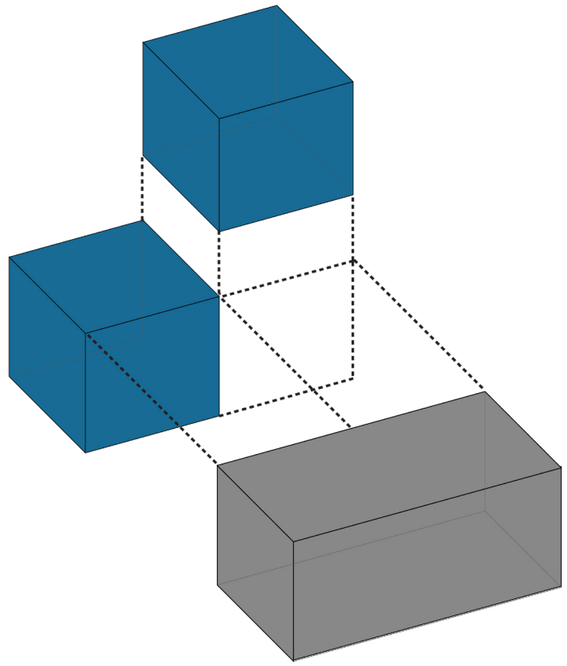
Fig.102 Conceptual view of a studio apartment.

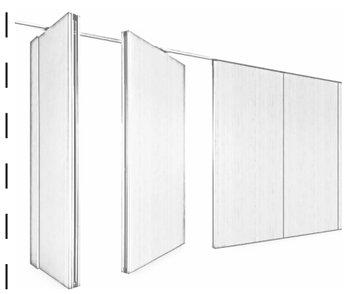
Unit 2



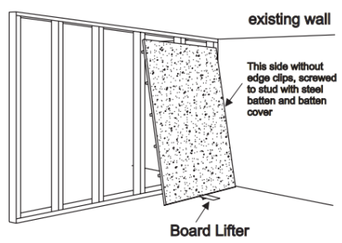
The unity can easly be divided into two smaller unit by simply dessembling into which increaes the flexiblility in the layout. two room appartment can be converted into two studio appartment.

Tools

Movable walls



Demountable walls



Sliding walls

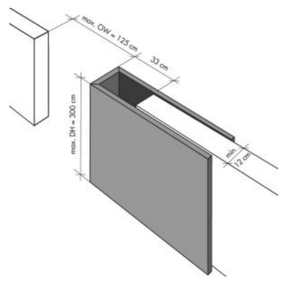


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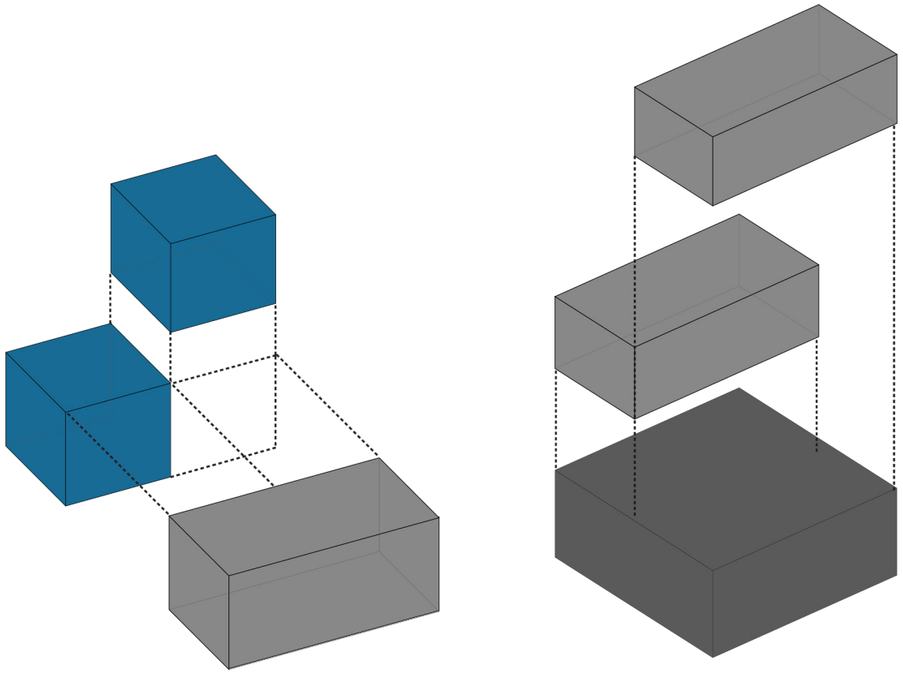
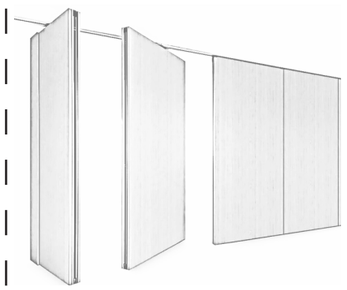
Fig.103. Conceptual view of a two room apartment.

Unit 3

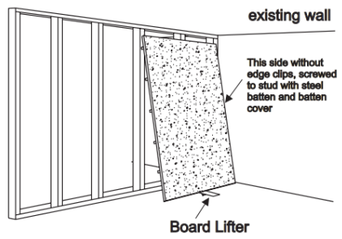


Tools

Movable walls



Demountable walls



Sliding walls

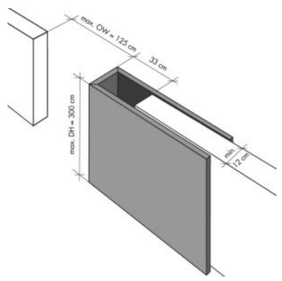


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Fig.104. Conceptual view of a three bedroom room apartment.

Fig.105. floor Plan of the apartments.

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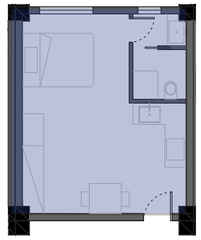
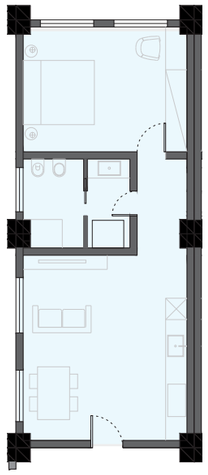
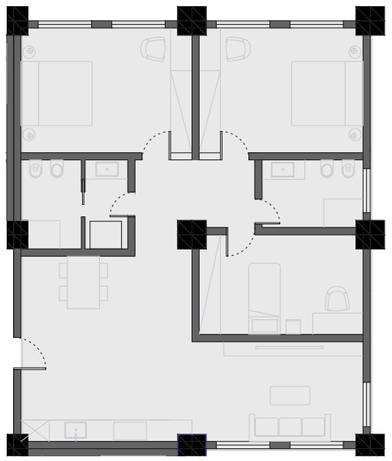


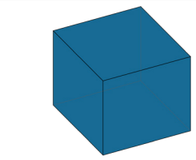
Unit 1
it is a studio apartment consisting of bathroom living space with a kitchen and bedroom. the size of the apartment is 30 sq.m



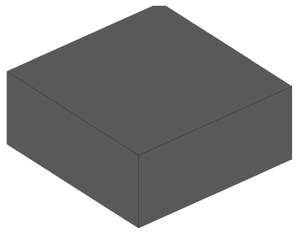
Unit 2
it is one bedroom apartment consist of a bathroom, a kitchen, living and a bedroom. the size of the bedroom is 14 sq.m



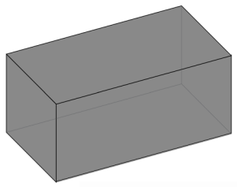
Unit 3
The apartment consist of 3 bedroom, 2 bathroom , a kitchen and living space. the size of each bedroom is between 14 sq.m to 16 sq.m



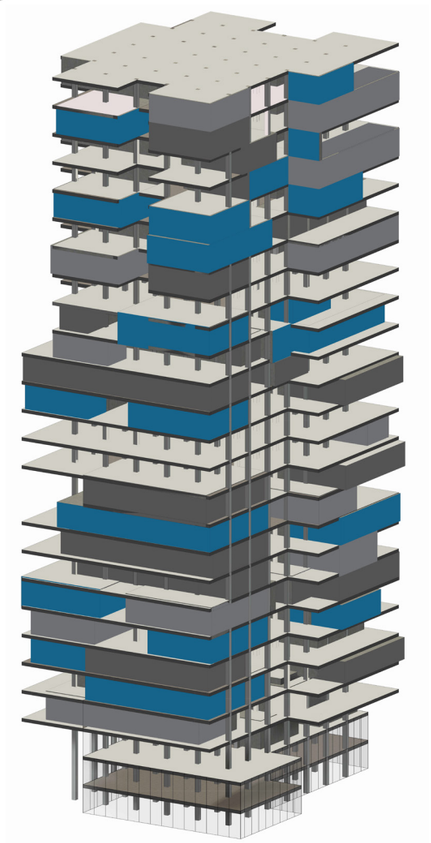
Unit 1



Unit 2



Unit 3



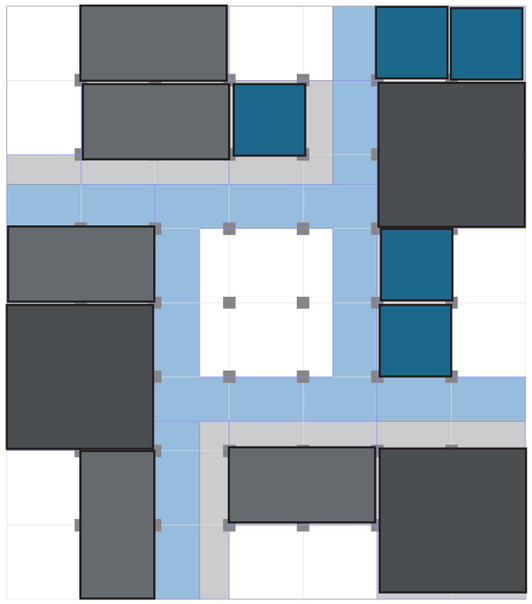


Fig.106. different arrangements of the units. -**Type A**

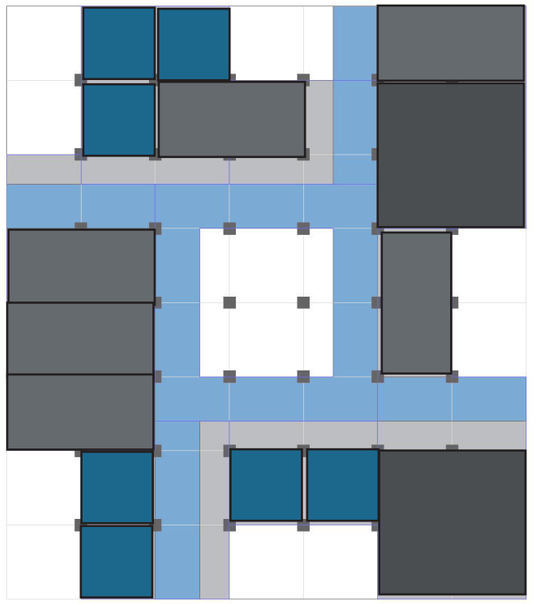


Fig.107. different arrangements of the units. -**Type B**

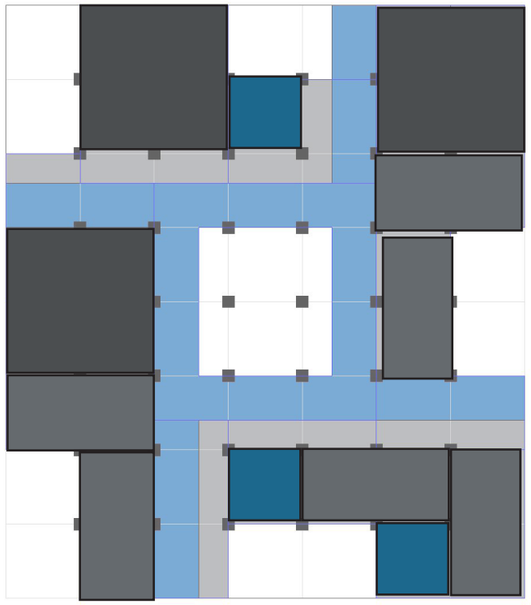


Fig.108. different arrangements of the units. -**Type C**

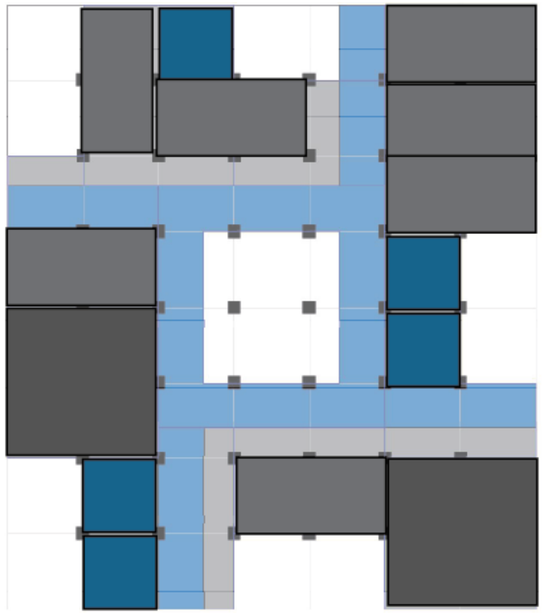
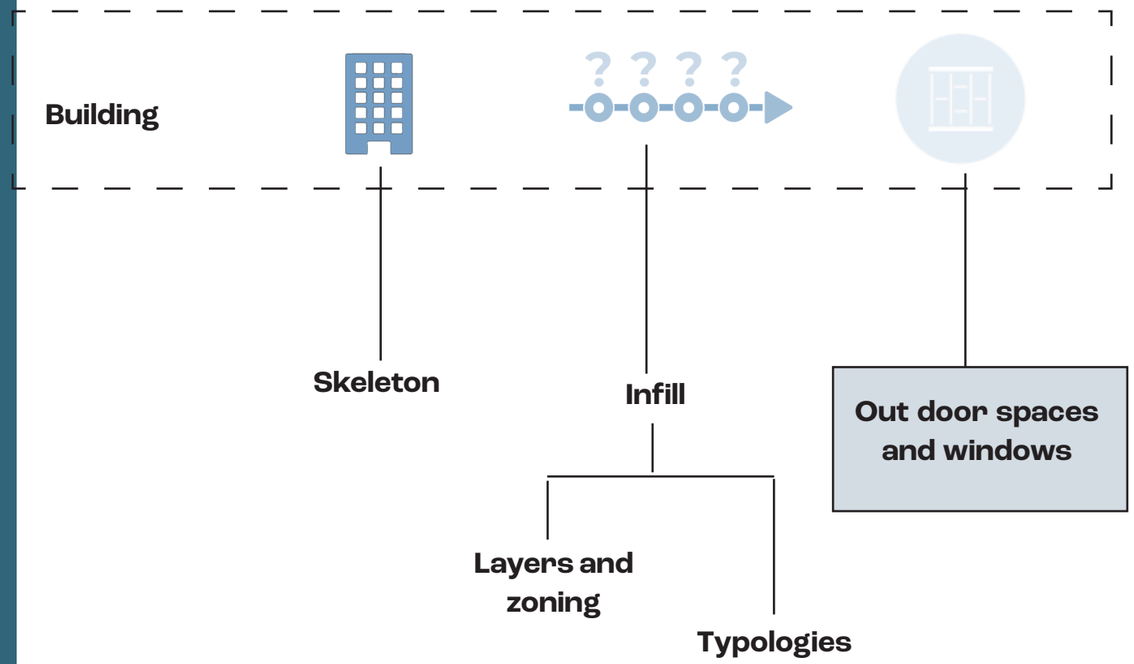


Fig.109. different arrangements of the units. -**Type D**



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Skin

The independency of building layers makes it easier to implement user participation in the design process. Too what extend this is implemented is the decision of the architect or the contractor. This can be limited to vertical elements in the scenery layer like partition walls, but it could also include the skin like individual customized façade elements.

Facade Openings:

Small openings which can accomodate more room adjacent to the facade.

Medium opening can accomodate less room possibilities adjacent to the facade.

Large opening can accomodate just one room adjacent to the facade.

Facade material color

Wood light

Triple glazes glass pannel

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Out door spaces and windows

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Connections

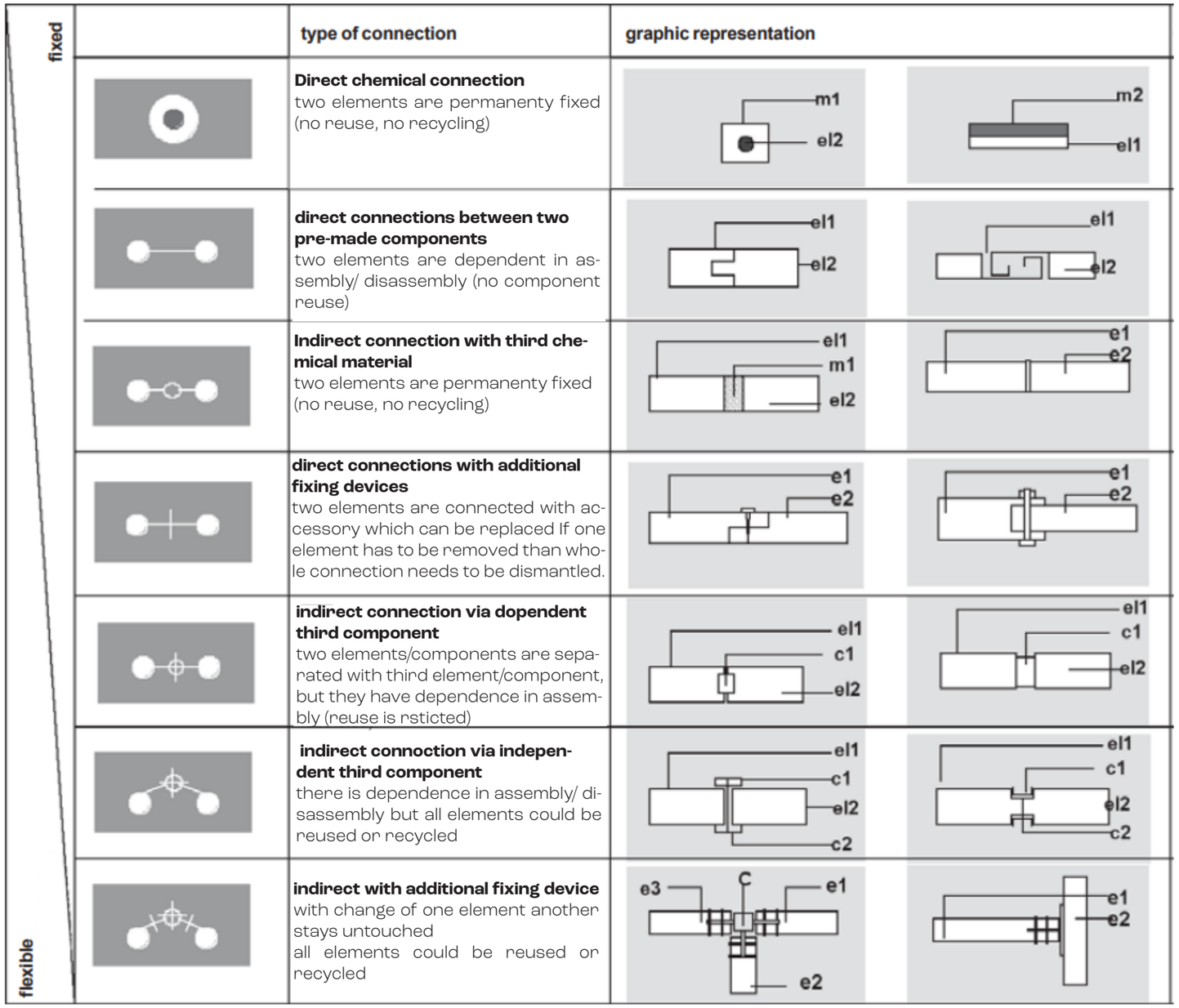


Fig.110. Connection principles

Source: Durmisevic, 2006, p. 183.

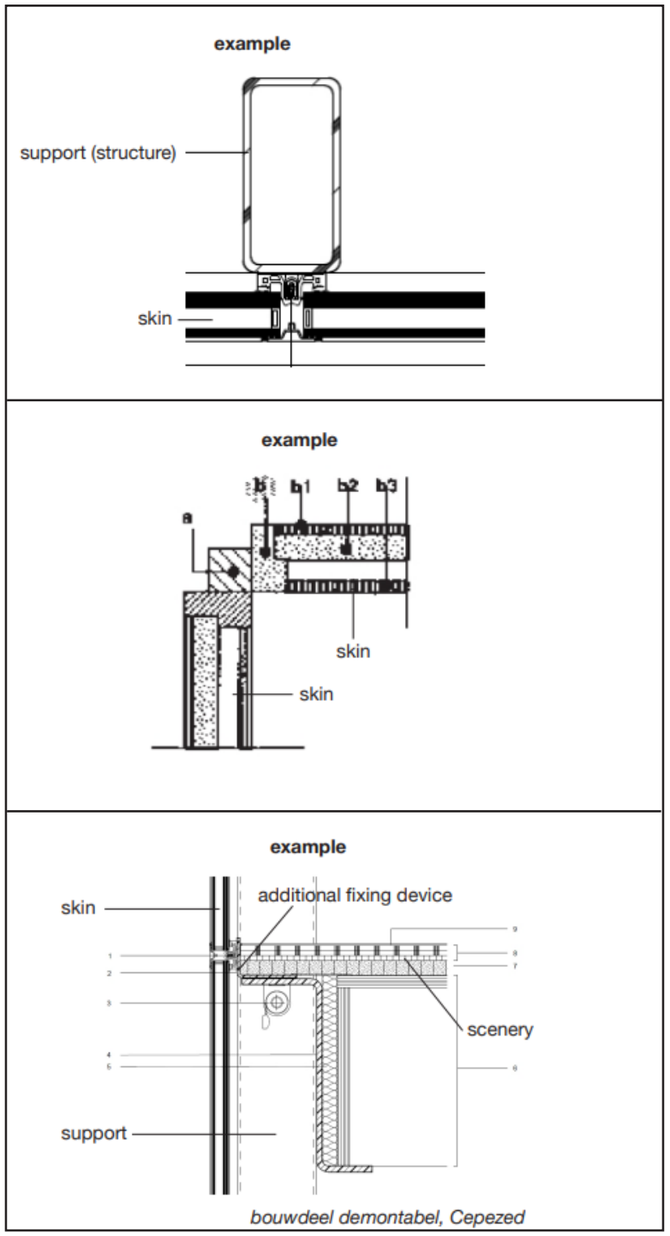
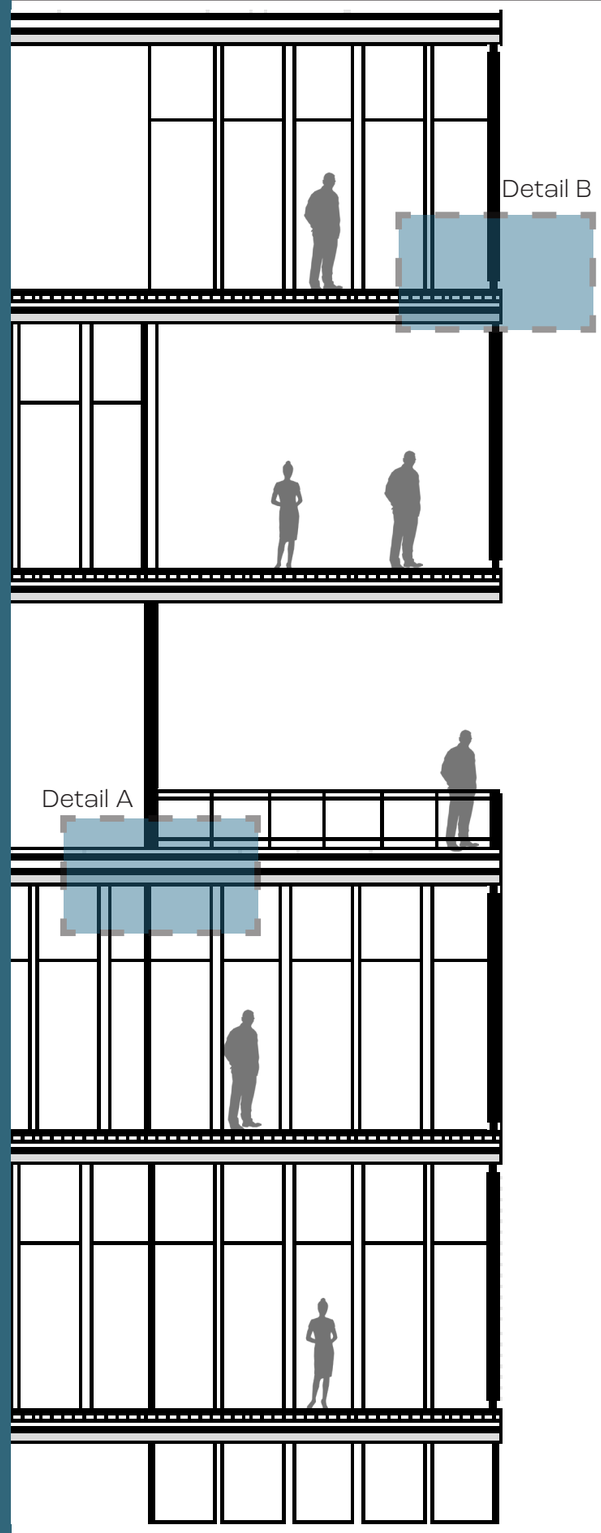


Fig.111. – independent assembly of two independent functions.

Source : Durmisevic, 2006, p. 176



Representation of the connection between the support , infill and the skin.

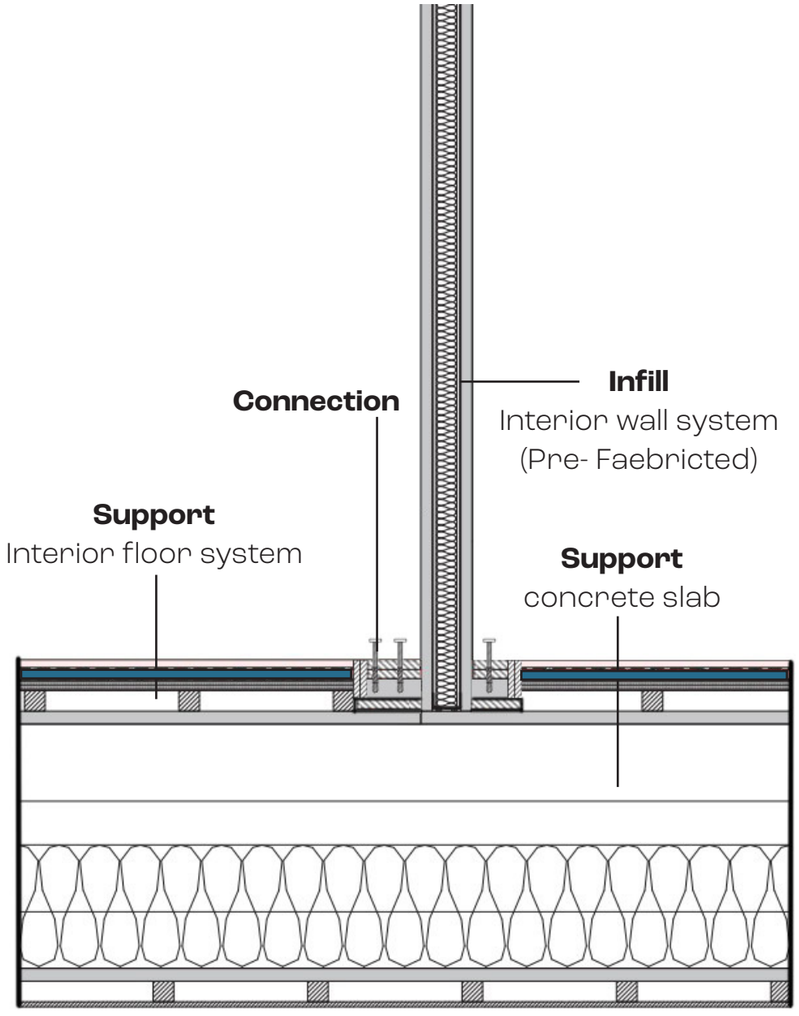


Fig.112 Detail A - Deatail of the partitation wall.

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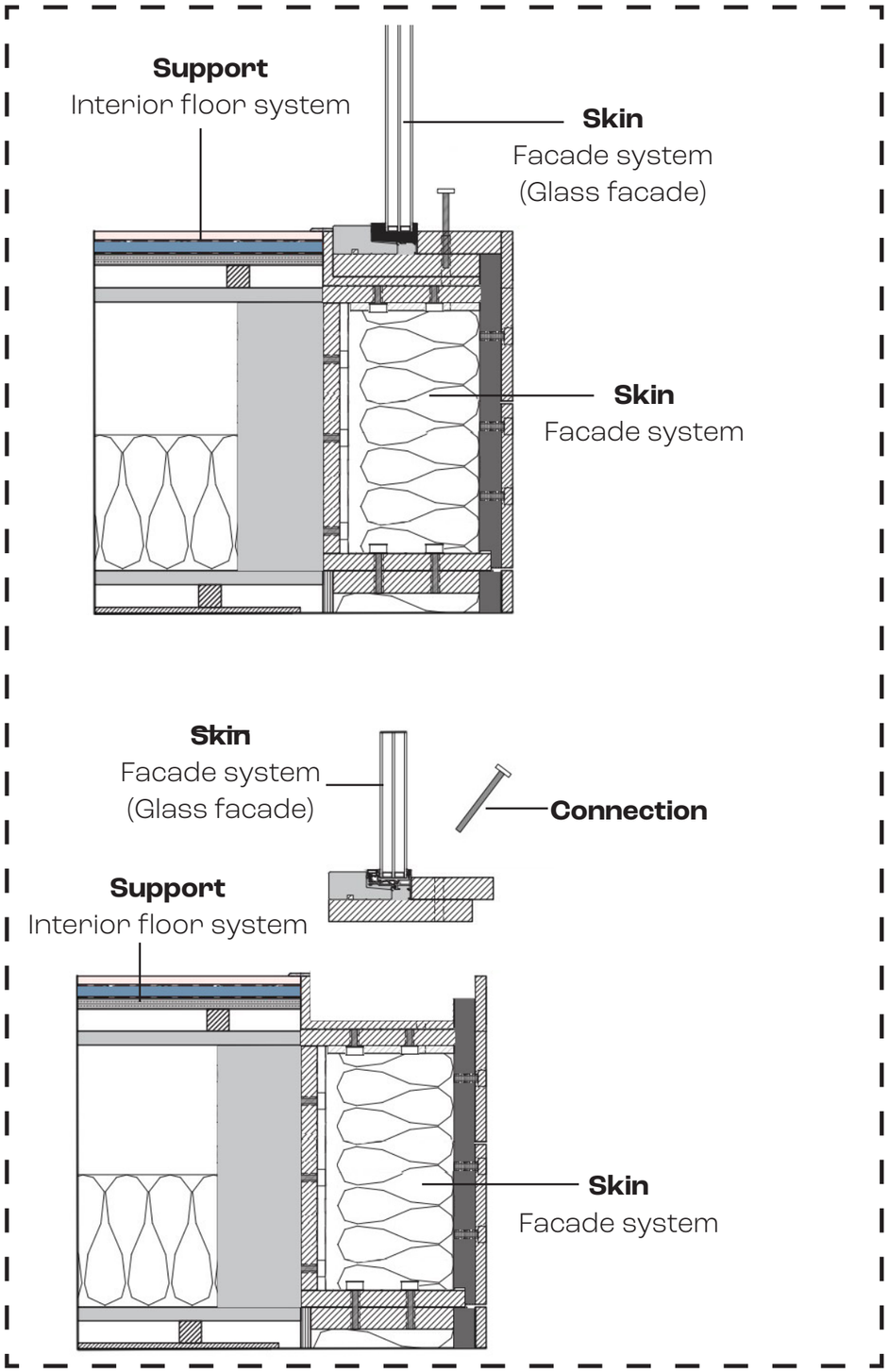

Fig.113 Detail B - Detail of the Facade.

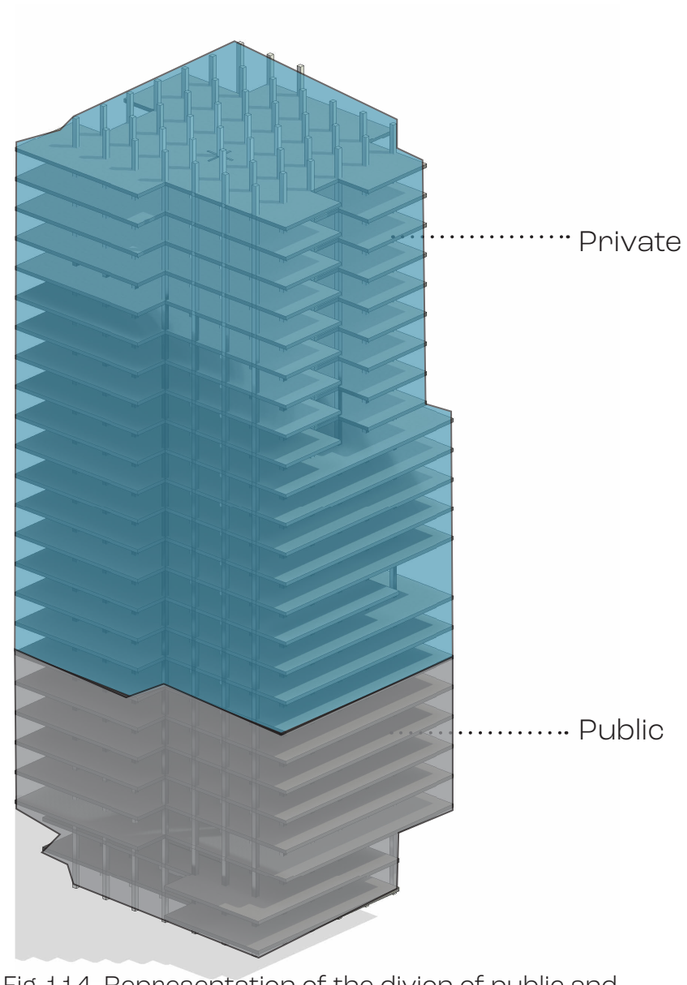

Fig.114. Representation of the divion of public and private space in the building.

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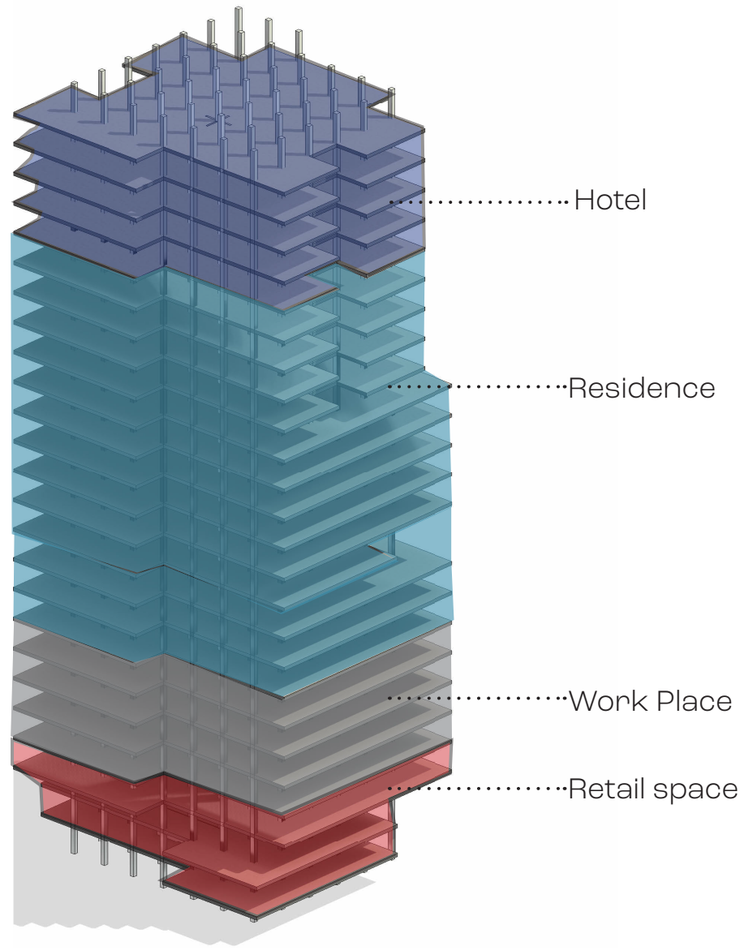

Fig.115. Representation of the different function of the building.

Green Connection

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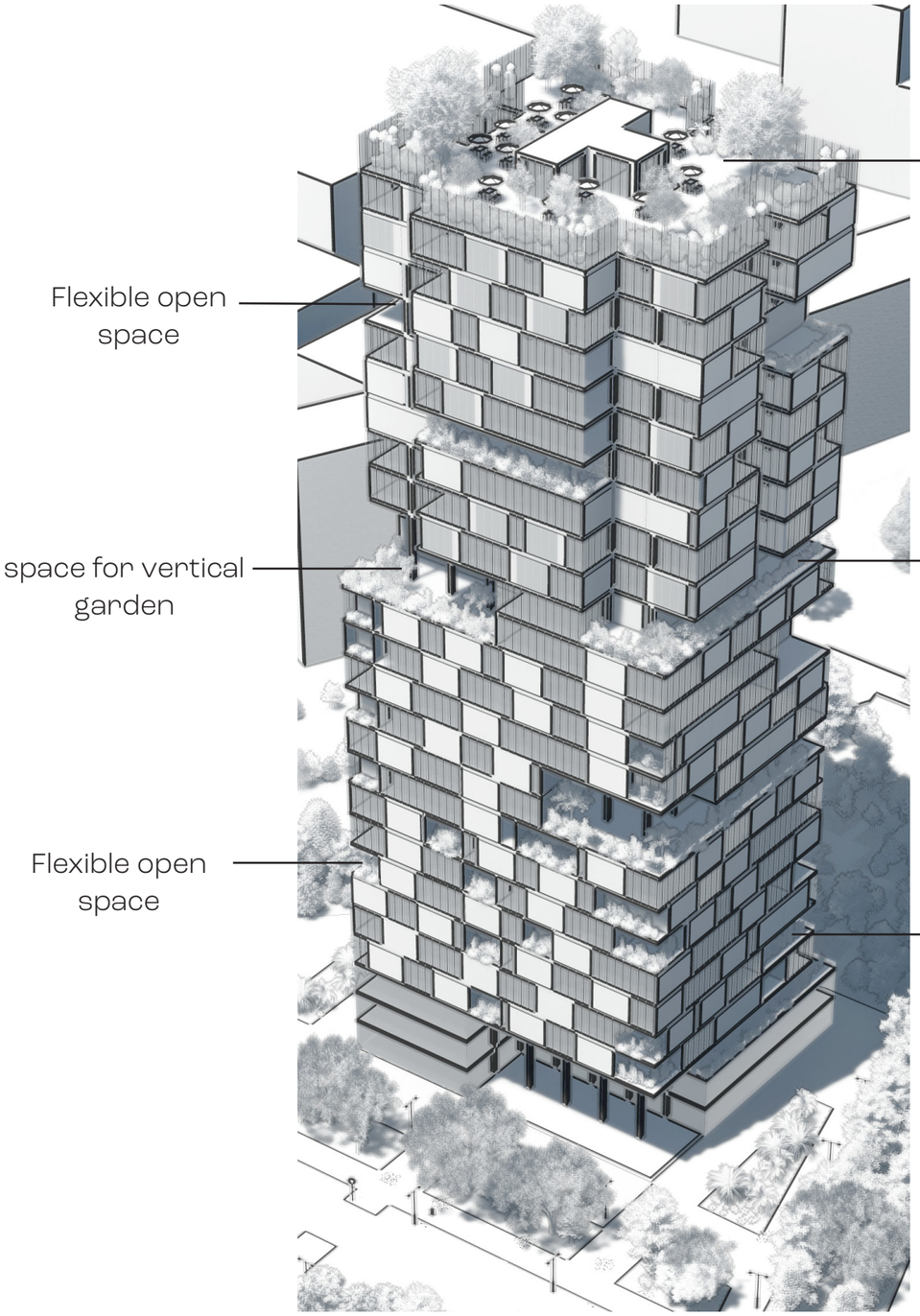

Fig.116 Connecting the building to the surrounding by creating green spaces.

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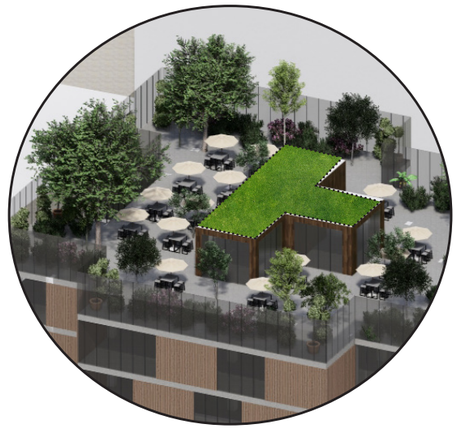
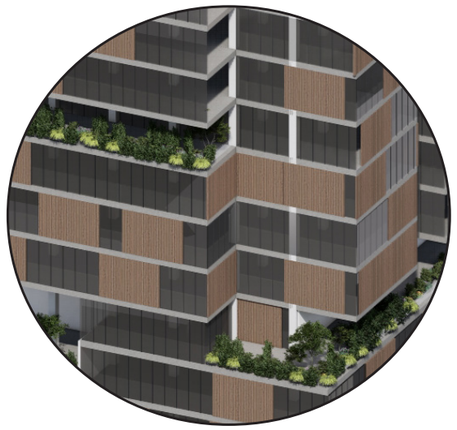
Site development

In the development of the concept of the building multiple empty space were created which can be filled with the green spaces later according to the user.



A Rooftop Garden was created on the top of the building.



Muiltipal green spaces were created throughout the building which can be used according to the user.

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Fig.117 Isometric View

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Fig.118 Lateral View

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Fig.119View of the rooftop Garden.

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Fig.120 Front elevation

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Fig.121 View from the corso Mediterraneo

Conclusion

The thesis concluded on implimenting the **open building system in vertical urbanism** to offer an insight on the design principles for a space which provide maximum flexibility in function, size,affordibility and appearance, by giving a design solution for a tall building in the in the corso lyon region of turin.

combining open building system and vertical building it open a whole new world of opportinitues and level of flexibility and sustanibility.This requires planning for change **– not predicting the future but making provisions for what cannot yet be foreseen.** This is one of the most important things which was consider throughout the research and we can do for future generations and for the resilience of our built environment. the concept of vertical urbanism and the theories of Jhon Habraken were studied from the perspective of flexibility and has given a definition of the relation between flexible supports and the infill building layers.

Vertical urbanism

The vertical expansion inherent in this approach maximizes the efficient use of limited urban land. By building upwards, cities can accommodate more residents within a smaller footprint, preserving green spaces and reducing urban sprawl. This not only mitigates the environmental impact associated with extensive land use but also enhances the quality of urban life by maintaining open, communal spaces.

Open building system

Open building systems, characterized by their flexibility and modularity, enable the construction of high-density residential structures that can evolve over time to meet changing needs.

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The theory suggests that **The design of the support depends on flexible and adaptable zoning of building layers and layer types.** The zoning scheme of Habraken and the mapping of different layer types and zones shows the most optimal layout of the support.the proposed building was designed by following the theories and was divided into zones according to there need to provide more flexibility. By allowing modifications without significant structural changes, open building systems reduce the waste and cost associated with traditional demolition and reconstruction, thereby fostering economic and environmental sustainability.

Through case studies and litrature study, this thesis has demonstrated the potential of Open Building to revolutionize vertical urbanism by creating dynamic, adaptable, and affordable housing solutions. As cities continue to grow and face new challenges, adopting such innovative frameworks will be crucial in ensuring that urban development remains equitable, sustainable, and responsive to the needs of all residents.the flexibility is crucial in accommodating young people, changes in financial situations, or alterations in lifestyle preferences. **By incorporating modular designs and flexible floor plans, residents can easily reconfigure their living spaces, adding or removing rooms according to their requirements**. This adaptability ensures efficient utilization of available space, reducing the need for frequent relocations and ultimately aiding in affordable housing for young workers and students in Turin.

Therefore, the Open Building System stands as a promising paradigm for the future of urban housing, offering a scalable and adaptable model that can be replicated across diverse urban contexts to meet the global demand for affordable housing.

Future direction

Future research on the open building system in vertical urbanism can delve into several promising directions to enhance its application and impact. such as:

Technological Advancements and Integration:

Smart Building Technologies: Investigate the integration of AI (Artificial Intelligence) in open building systems to enhance the efficiency, safety, and comfort of living spaces. This could include automated energy management systems, smart appliances, and predictive maintenance technologies.

Advanced Construction Techniques: Explore the use of innovative construction methods such as 3D printing, prefabrication, and robotic construction to reduce costs and improve the speed and precision of building projects.

Environmental Sustainability:

Lifecycle Analysis: Perform comprehensive lifecycle assessments of open building systems to quantify their environmental impacts compared to traditional building methods. This should include energy consumption, material use, and waste generation throughout the building's lifecycle.

Cost-Benefit Analysis: Conduct detailed economic analyses to compare the initial and long-term costs of open building systems with conventional housing solutions. This should consider factors such as construction costs, maintenance, and energy savings.

By focusing on these future directions, research on open building systems in vertical urbanism can contribute significantly to creating more adaptable, sustainable, and inclusive urban environments. This will not only address current housing challenges but also ensure that urban development is resilient and responsive to future needs.

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05| APPENDICES

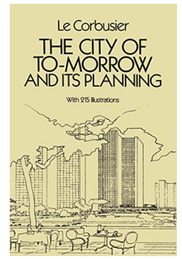

Fig. 126: Le carvusier and his book The cities of tomorrow and it's planning.
Source:https://99percentinvisible.org/article/ville-radieuse-le-corbusiers-functionalist-plan-utopian-radiant-city/

Le Corbusier presents two imposing schemes for urban reconstruction — the "Voisin" scheme for the center of Paris, and his more developed plans for the "City of Three Million Inhabitants," which envisioned, among other things, 60-story skyscrapers, set well apart, to house commercial activities, and residential housing grouped in great blocks of "villas."For those who live in cities as well as anyone interested in their planning, This book is a probing survey of the problems of modern urban life and a master architect's stimulating vision of how they might be solved.

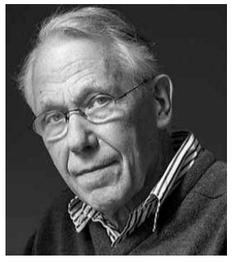

Fig. 127: john habraken and the book the support.
Source:https://www.openbuilding.co/legacy

this book has inspired practitioners for generations. It's proposal to distinguish the infill from the support - what users can individually decide in a housing process from what users share - has turned out to be feasible in practice. The Natural Relation - the interaction of people with their immediate environment and the central concept of the book - is the result of that distinction. It is essential to the well-being of everyday environment regardless of function or available resources.

Fun Palace

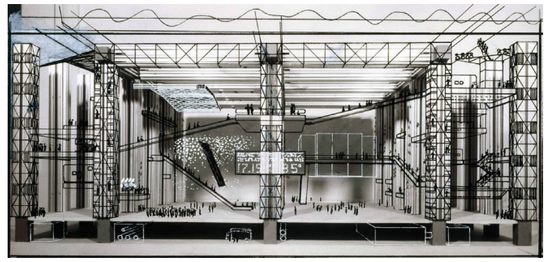

Fig. 128:Fun Palace.
Source:https://www.ianvisits.co.uk/articles/unbuilt-london-the-1960s-fun-palace-15581/

Architect Cedric Price came up with the notion of an improvisational architecture, which would be in a constant state of construction, dismantling, and reassembly. He thought of the building as a skeletal framework, within which enclosures such as theatres, cinemas, restaurants, workshops, rally areas, can be assembled, moved, re-arranged and scrapped continuously.

Structural engineer Frank Newby assisted on the design, which ended up with fourteen towers, forming two 60 feet wide aisles which flanked a 120-feet wide central bay.
The towers were for services, leaving the central voids empty to be filled with the temporary walls and floors they envisioned.

the Fun Palace remained nothing more than a high ideal.Eventually, in 1975, Price declared the project dead.

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