POLITECNICO DI MILANO

FACULTY OF ARCHITECTURE, URBAN PLANNING & CONSTRUCTION
MSC PROGRAMME - BUILDING ARCHITECTURE

ARCHITECTURE MASTERS THESIS

LIFE ON HIGH

HIGH RISE PROJECT IN SHANGHAI

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ABSTRACT

Chinese urban realities, and in particular Shanghai, reveal a model of complex urbanity that exaggerates the timing and consequences of socio-economic change in cities. Shanghai, like the rest of China, is characterized by a high density of housing. The motivation of the study is to find a way to design a mix functioned high rise building to meet the very current need of housing, due to high population density in the city; while taking the user profile, habits, urban realities and conflicts into consideration to suggest a new way of living in verticality in the context through the synthesis of the needs of the context, users, and the city.

The choice of the place for the project, Pudong district, was consciously made after understanding of the urban development of the city, drastic demographic changes which it has been through, the effects on modernisation, globalisation, as well as keeping the cultural background with the history of the city.

Being a newly developing district transformed partially from industrial zone of the city, has its own characteristics and challenges to be considered with the suggested design proposal.

With the awareness of all the analysis that has been made, to get a better understanding of the chosen context for the project, formed the concept naturally: a proposal to introduce a new way on living in the 'high rise'.

As the relation the building will have with the context surroundings are carefully considered, the challenges of design of mix used buildings are also noticed and carefully considered, as underlined before importance given to the analysis of the user habits and cultural solutions through time; not only to physical aspects of a courtyard, square or a house, but also to consider the aspects and relations that they are forming; within the role they play in the context for placemaking, needed for creating a better and sustainable way of living on vertical.

INDEX

THEME & PLACE

Many Asian cities are experiencing a population explosion and economic expansion, the unprecedentedly rapid rise of the urban scale in the early 21stcentury is leading to the creation of megacities with populations exceeding 20 million.

With an exploding population migrating from rural areas and small towns to large cities, particularly in Asia, residential and commercial/mercantile accommodation problems continue to magnify. The future of these cities lies in the inevitable construction of high-rises unless an alternate solution is found for creating architectural spaces, and efficient infrastructures.

On this point, to analyse the conflicts that are being faced on the existing design of high rise for housing, understanding the needs of the context and the residents becomes a crucial point for the study of new ways of living vertical.

THEME:
TALL BUILDING

Tall buildings through years:

From tall to supertall, supertall to megatall, adaptation of definition of tall building:

The definition of 'tall', however, has changed over time. According to the definition given by CTBUH, a 200 m+ building is 'tall', 300 m+ is 'supertall' and 600 m+ is 'mega tall'. Advanced technology in building construction and elevator systems, among others, pave the way for skyscrapers to grow taller and taller.

Today's super-tall buildings are no longer single-purpose skyscrapers, rather they are considered mixed-use vertical cities with many facilities and functions available to occupants & users. Structures such as the Burj Khalifa, Shanghai Tower, and Kingdom Tower, as cases in point, take the typology in unprecedented directions.

The more it becomes this tall building typology gets into people life, hosting and serving the living, working / service spaces, the more challenges it brings with itself; social sustainability, energy aspects, architectural quality, humanistic approaches based on the users...
As well as these key points highlight the quality of the architecture of tallness; it is undeniable that they have significant visual impact on skylines of the cities.

It is important to notice not only how it is perceived from distance yet also to consider the close context relationships that they are forming; within the role they play in the context for placemaking. needed for creating a better and sustainable urban fabric.

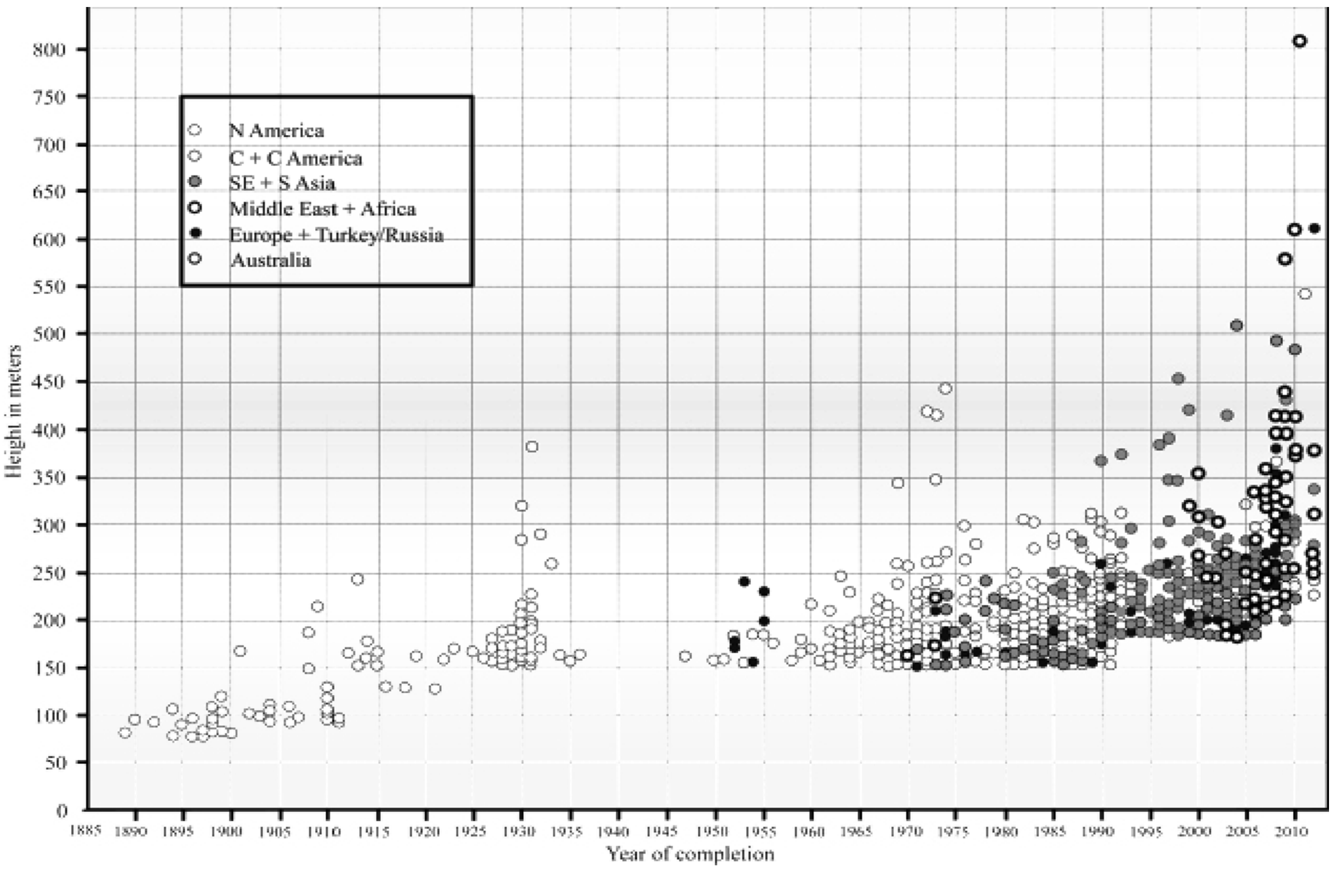


Figure 2: Tall buildings in 2000 and 2020, In recent years it has been built more tall buildings with greater height.

Building Height (m)	2000 Completed	2000-2020 Completed	2000-2020 Under Construction	2000-2020 Proposed	2000-2020 Visionary
50+	7513	8827	2816	3043	2112
100+	3649	5117	1623	1266	1730
150+	1139	2715	1111	809	1643
200+	261	924	627	469	1108
250+	68	255	302	285	749
300+	24	144	150	174	527
350+	10	29	58	87	361
400+	4	16	32	51	259
450+	2	9	20	27	195
500+	0	6	13	19	156
550+	0	3	6	14	114
600+	0	3	2	8	93

Figure 3: Tall buildings in 2000 and 2020, In recent years it has been built more tall buildings with greater height.

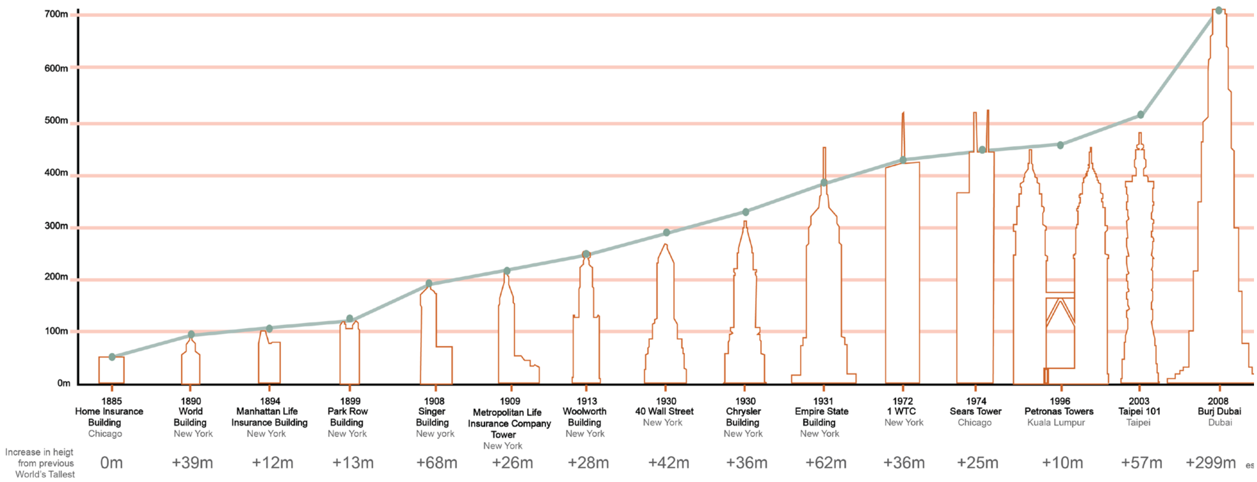


Figure 4: Tall Buildings in 2000 and 2020. In recent years , wehave been building more tall buildings with greater heights. In addition, buildings ''under construction,'' '' proposed,'' or ''visionary'' categories feature greater heights. Shaded rows highlight the supertall and megatall categories.

Tall building reasonings:

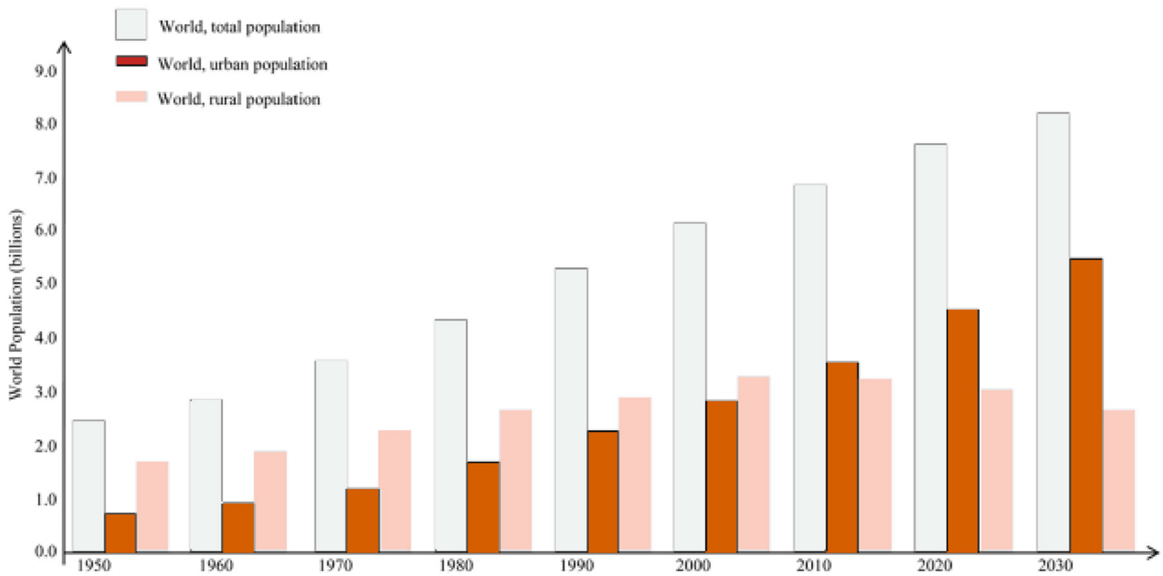


Figure 5: World Population Data and dispersion in between rural and urban- Reality and prevision for future based on pattern

Population Increase and Migration:

Among the major problems that have prodded tall structure advancement, and will probably proceed, is the outstanding expansion in metropolitan populace worldwide related to abundance collection. Right now, the greater part of the world is metropolitan when 20 years prior it was only 33%. By 2030, it is normal that around 60% of the total populace will be metropolitan.

Demographic Change:

Segment shifts exhibit that a large number of the twenty to thirty year olds incline toward living in metropolitan communities that offer social conveniences, energetic public activity, and mass travel.

Global Competition and Globalization:

The continuous pattern for developing tall structures all over the planet reflects the expanding sway of worldwide rivalry on the improvement of the world's significant urban areas.

These urban areas contend on the worldwide stage to have the title of the tallest structure where to declare the confidence and worldwide height of their developing economies. A notorious tall structure improves the worldwide picture of the city. It is probably going to put the city on the world guide and flag or advance its significant monetary advancement and progression.

THEME:
TALL BUILDING

City	Population	City	Population	City	Population	City	Population
1 New York	12.5	1 Tokyo	19.8	1 Tokyo	26.4	1 Tokyo	25.4
		2 New York	15.9	1 Mexico City	18.1	2 Bombay	25.1
		3 Shanghai	11.4	3 Bombay	18.1	3 Lagos	23.1
		4 Mexico City	11.2	4 Sao Paulo	17.8	4 Dhaka	21.1
		5 Sao Paulo	10.0	5 New York	16.6	5 Sao Paulo	20.4
				6 Lagos	13.4	6 Karachi	19.2
				7 Los Angeles	13.1	7 Mexico City	19.2
				8 Calcutta	12.9	8 New York	17.4
				9 Shanghai	12.9	9 Jakarta	17.3
				10 Buenos Aires	12.6	10 Calcutta	17.3
				11 Dhaka	12.1	11 Delhi	15.8
				12 Karachi	11.8	12 Metro Manila	14.8
				13 Delhi	11.7	13 Shanghai	14.6
				14 Jakarta	11.0	14 Los Angeles	14.1
				15 Osaka	11.0	15 Buenos Aires	14.1
				16 Metro Manila	10.9	16 Cairo	13.8
				17 Beijing	10.8	17 Istanbul	12.5
				18 Rio De Janeiro	10.6	18 Beijing	12.3
				18 Cairo	10.6	19 Rio De Janerio	11.9
						20 Osaka	11.0
						21 Tianjin	10.7
						22 Hyderabad	10.5
						23 Bangkok	10.1

Figure 6: Population of Cities with 10 Million Inhabitants or More, 1950, 1975, 2000, and 2015 (in millions)

Urban Regeneration:

As mentioned before, downtown areas in created nations that experienced the relocation of their populace to suburbia in the 1970–1990s have seen a significant re-visitation of their focuses as of late. In this manner, urban communities are seeing a metropolitan renaissance and a craving to get back to skyscraper living in the metropolitan centers.

Tall structures are seen as apparatuses to support focal living and working.

Infrastructure and Transportation

The high cost of maintaining expansive infrastructure hurts taxpayers and contributes to the fiscal crisis that local governments face. Largely, vertically configured buildings facilitate more efficient infrastructure.

Simply put, a 500-unit single-family subdivision requires many more roads, sidewalks, sewers, hydro lines, power and gas lines, light standards, and fire hydrantsthan that of a tall building, which allows integrating these systems efficiently in a dense manner.

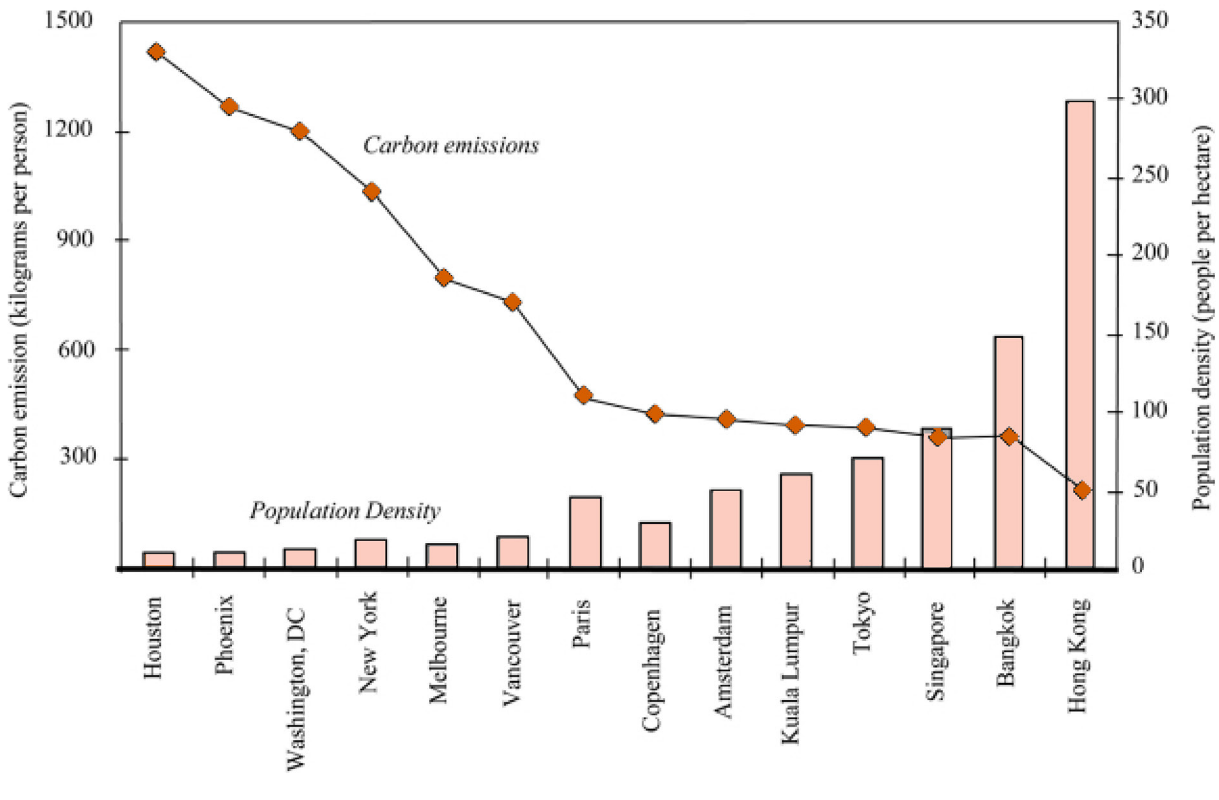


Figure 7:Tall buildings in 2000 and 2020, In recent years it has been built more tall buildings with greater height.

THEME:
TALL BUILDING

Climate Change and Energy Conservation

In this context, tall structures have thepotential to burn-through less energy than low-ascent buildings since they have a few energy-effectiveattributes, for example, agglomeration, reserve funds in auto fuel and travel time, and a decrease in misfortunes inpower lines. The rooftop is an excellent wellspring of energy misfortune in a structure notwithstanding the façade.

All things considered, a 50-story working of 10 lofts for every floor has one rooftop and 500 single-family homes with each having the equivalent floor space of a condo with 500 rooftops. Energy misfortune from 500 rooftops is more noteworthy than that from one rooftop .

Generally speaking, vertical advancement diminishesfossil fuel byproducts as well as alsoprovides freedoms to establish reduced conditions that highlight efficient portability and openness while offering a more excellent of life.

“Minimized, blended use, walkable, travel arranged spots offer significant ecological, financial, and social benefits”

Land Prices:

Land prices have been a prime driver for constructing tall buildings. A phrase for skyscraperscame from Cass Gilbert in 1900, “A skyscraper is a machine that makes the land pay”.

Land Preservation

Sustainability promotes compact urban living and vertical density is viewed as a tool to create a more sustainable city.
The availability of open space provides significant environmental quality and health benefits that include improving air pollution, attenuating noise, controlling the wind, providing erosion control, and moderating temperatures

Agglomeration

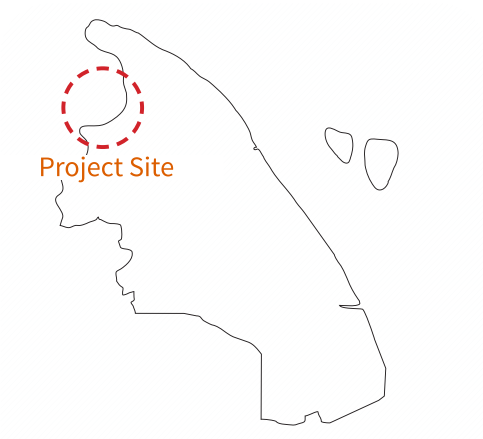
The height of structures is additionally an issue of agglomeration in business district.Urban agglomeration hinges on the proximity of activities and tall buildings do just that. Clustering tall buildings fosters urban synergy for diverse activities and specialized services.

PLACE: SHANGHAI

The world map

China

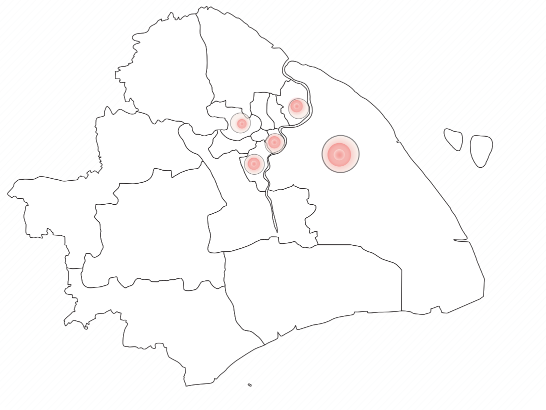
Shanghai

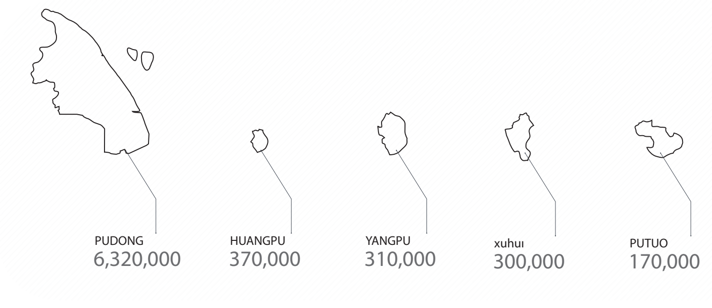


Pudong

The coastal city of Shanghai, is located at the mouth of the Yangtze River, and through years of even world has changed in many ways, the city kept its place in one of the major important cities overall the world. From the times that it was just a fisherman town to nowadays; faced many urban transformations, evolving and growing; currently holding the largest urban population in China and one of the most active cities in the world in constructing tall buildings.


SHENYANG
4,720,000
TIANJIN
7,040,000
Beijing
10,717,000
Beijing
10,717,000
Shanghai
17,730,000
Chongqing
6,363,000
Guangzhou
8,425,000
HONG KONG
7,233,000
Dongguan
4,320,000
Shenzhen
4,320,000




PUDONG
6,320,000
HUANGPU
370,000
YANGPU
310,000
xuhui
300,000
PUTUO
170,000

PLACE: SHANGHAI

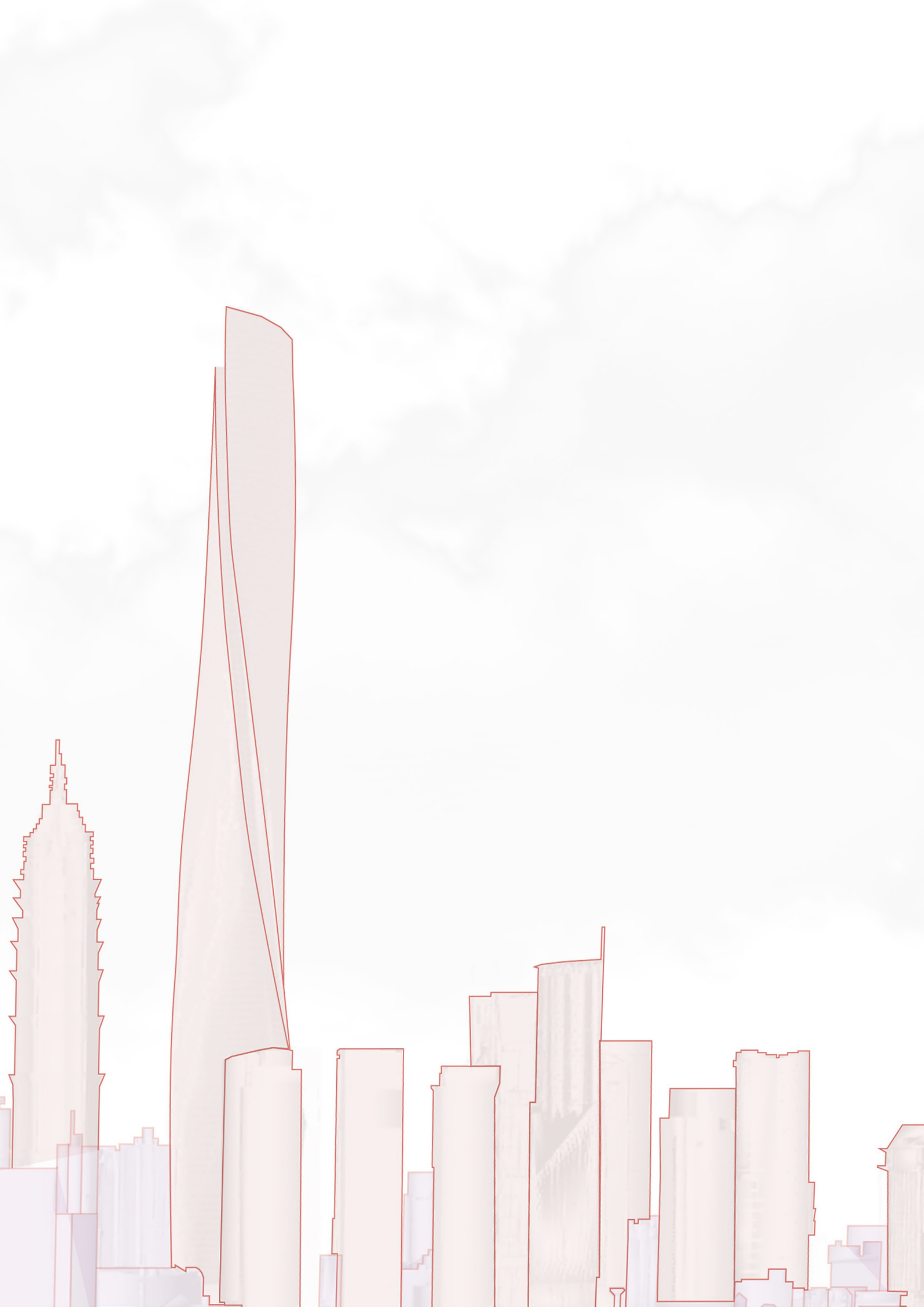
Locating onThe southern estuary of the Yangtze River, with the Huangpu River flowing through it, the city has always been having a great importance, even in the back of times when it was just aa fisherman town.

Today with the population of 24.89 million as of 2021, keeps its place in of the world's is the most populous urban area in China and the most populous city proper in the world, one of the world's major centers for finance, business and economics, research, education, science and technology, manufacturing, tourism, culture, dining, art, fashion, sports, and transportation.

As many of the major standing cities with great numbers of population, Shanghai was deeply invested on high rise buildings. Overall, in the first two decades of the 21st Century, Shanghai will add 156 skyscrapers to the 69 skyscrapers it built previously.

As indicated previously the trend for living high rise can be supported by many different objectives; environmental aspects, population, prestige, appearence, land prices... On the other hand it is also true that with the urgent need of growth on cities can give birth to some quick unconsiderate solutions which as can be seen from some newly built cities in China have already turned into ghost cities as people do not want to move there even though the residential high-risebuilding units have been bought by speculative investors.

These are ominous indications that theconstruction glut has resulted in a housing bubble that will likely burst in the near future. Taking into consideration the transformation Shanghai has been through in recent years, the rapid population increasements, rapid change on city silhuet and people's lives; it is crucial to have a second look towards the life on vertical.



ANALYSIS

Many Asian cities are experiencing a population explosion and economic expansion, the unprecedentedly rapid rise of the urban scale in the early 21stcentury is leading to the creation of megacities with populations exceeding 20 million.

With an exploding population migrating from rural areas and small towns to large cities, particularly in Asia, residential and commercial/mercantile accommodation problems continue to magnify. The future of these cities lies in the inevitable construction of high-rises unless an alternate solution is found for creating architectural spaces, and efficient infrastructures.

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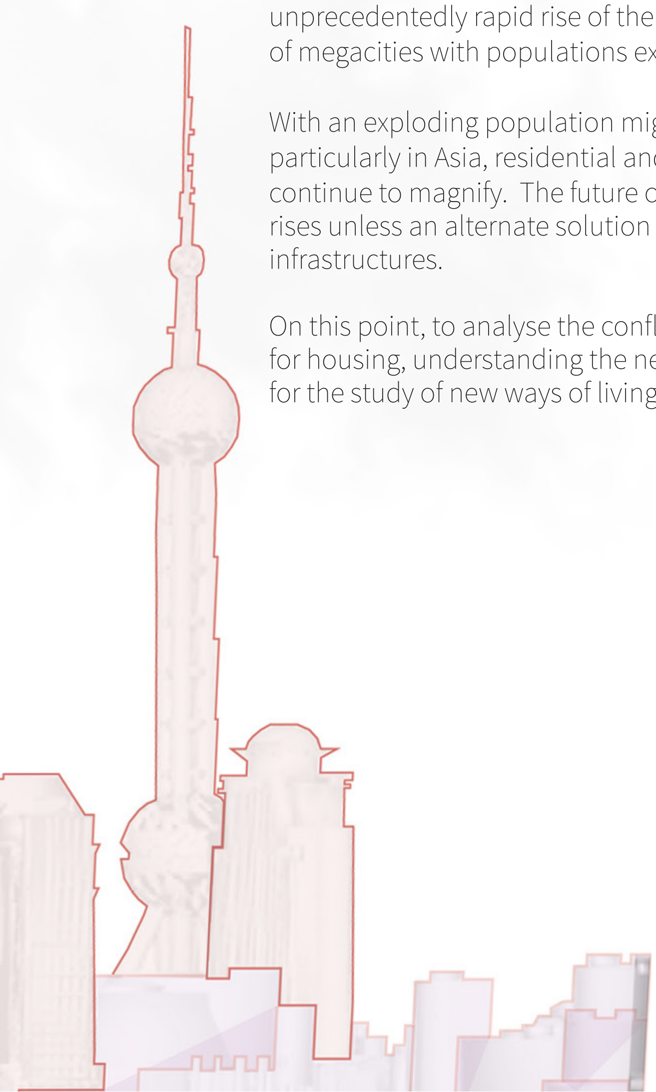


Ming Period,
Walled City of Shanghai (1368 to 1644)

the typical structure of Chinese city features

low-rise traditional courtyard houses

market & street relations

Figure 8: A view inside Shanghai walled city before the treat port time showing the typical structure of Chinese city with low-rise traditional courtyard houses, market, and street. Outside the wall were trading ports of this market

Shanghai is strategically positioned at the T-shaped junction of two major economic belts in China: the Eastern coast and the Yangtze River Valley. This advantageous location spurred the formation and growth of Shanghai, which quickly developed into a major fi nancial centre within a century after the early 1840s when it was a small town.
Since the walled city of Shanghai, to date, the city has already experienced three eras of urbanisation, each stage exhibiting distinct characteristics in terms of population, industry, role in national and regional fi nancial systems, urban expansion and so on. These complex and rich historical processes have left their mark on the city; each one morphing and transforming the urban fabric of Shanghai.

SHANGHAI
THROUGH HISTORY

The traditional planning of a Chinese city:

The north-south orientation for maximum exposure to sunlight

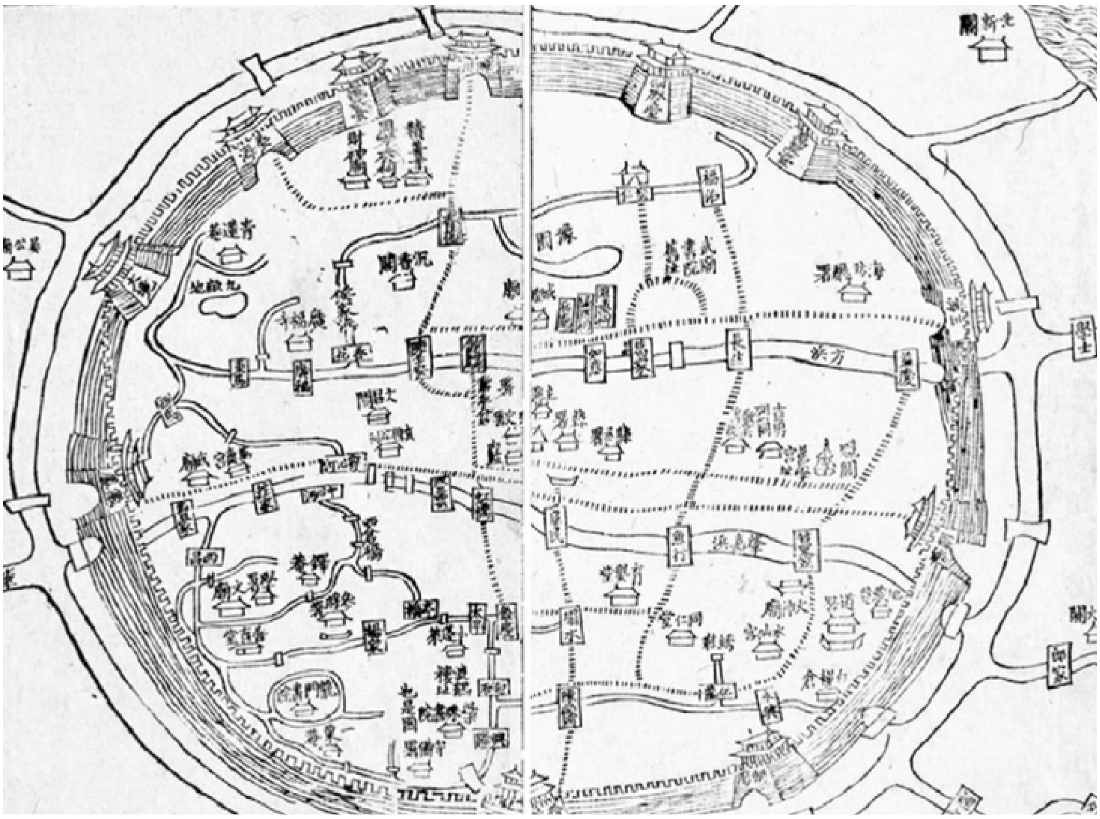


Figure 9: A plan of Shanghai walled city showing the basic traditional planning of a Chinese city.

includes the north-south orientation for maximum exposure to sunlight, organic structure of houses and neighborhoods, which had been built and added to the sides of two main east-west spines over time constituting organic city's morphology.

Small Town to a Metropolis 1843–1949

Shanghai's first era of urbanisation in modern times began in the 1840s with the forced establishment of the British Settlement and the French Concession in the area.

By the 1920s–1930s (the so-called Golden Era of modern Shanghai), the city developed into the fi nancial centre of the Far East.

When Shanghai opened up for development in 1843, the small town's territory was mainly made up of the area enclosed by its city walls and the wharf area along the Huangpu River.

The town existing at that time is today's Lao-Cheng-Xiang or the traditional town, nearly 2 km 2 in size.

The first foreign settlements were planned north of this town along the river, with the intention to separate foreign settlements from Chinese areas. Project area which is defined in today's Shanghai City is on the Pudong region; which is a horn on Huangpu river and under transformation & development in recent years.

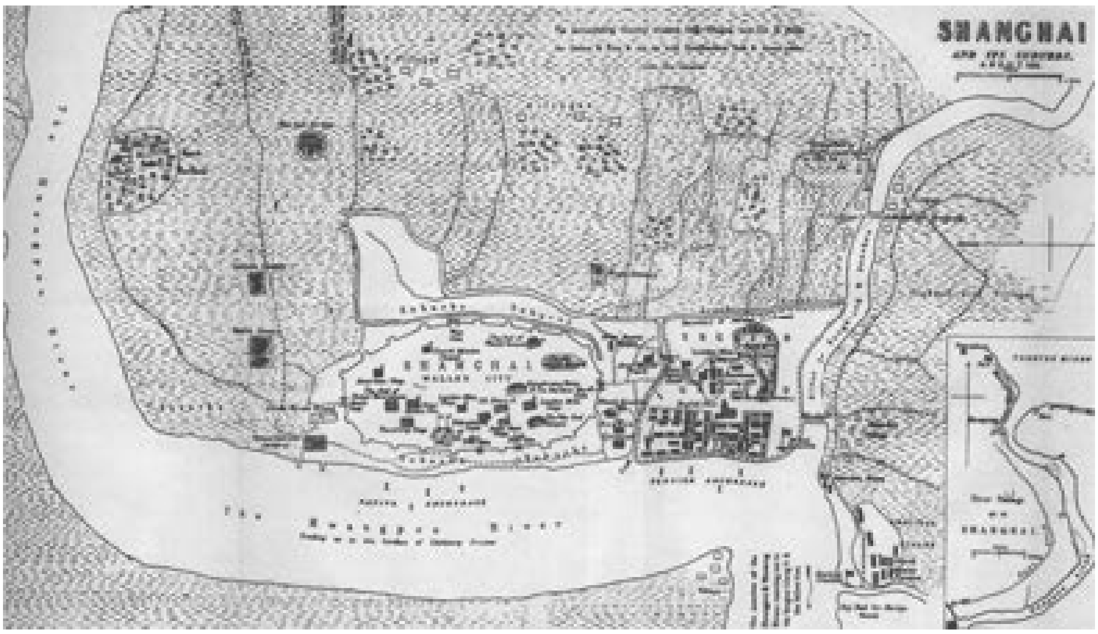
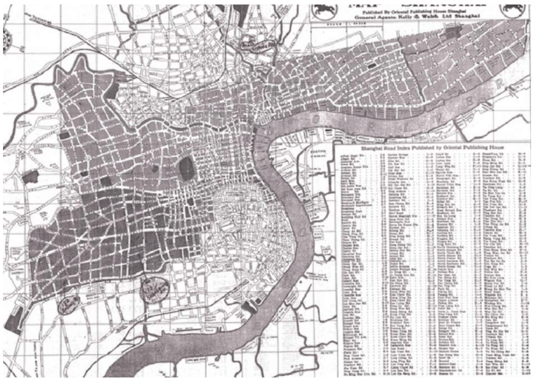


Figure 10: The first foreign settlements were planned north of this town along the river, with the intention to separate foreign settlements from Chinese areas. This separation formed the twin town structure of Shanghai half a century later.

SHANGHAI THROUGH HISTORY

Figure 11: A map of Shanghai showing the spatial relationship between the Shanghai walled city and the British settlement where the Land Regulation was implemented



An official map of Shanghai by the Oriental Publishing House Press showing the occupation

Views of Pudong from the Bund before the massive development took place.

A Primary Socialist Industrial City 1949-1990

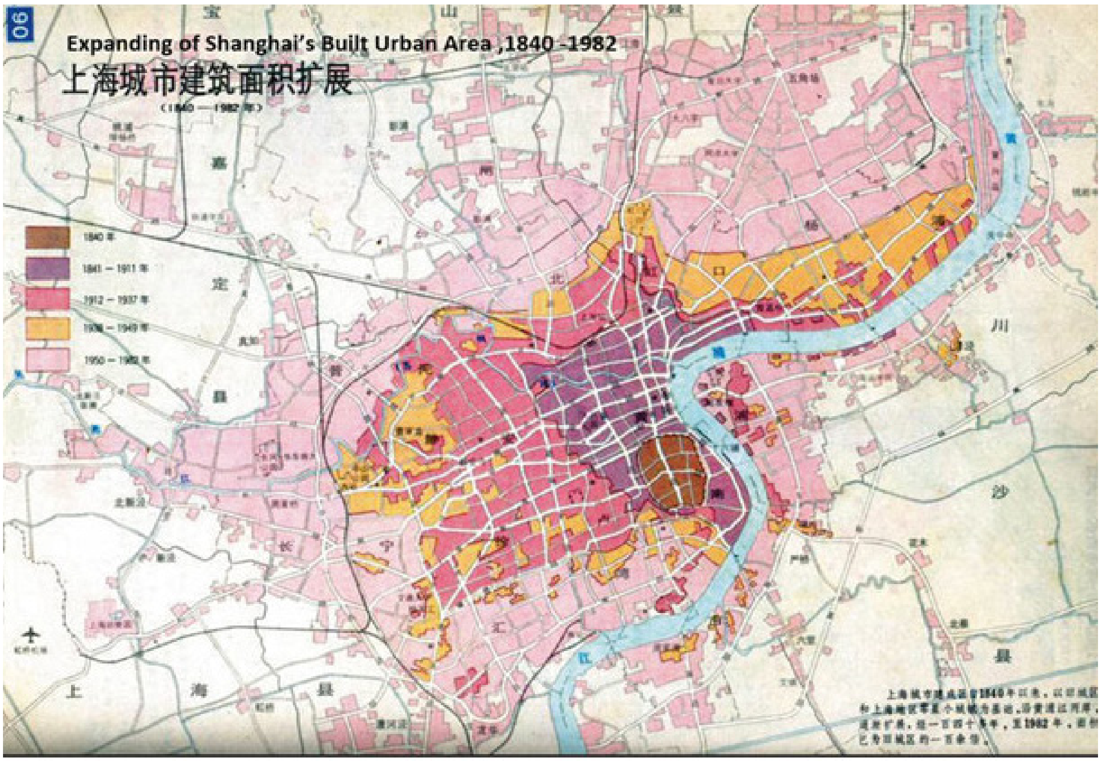


Figure 12 : Expanding of Shanghai's built urban area from 1840 to 1982

The second era of urbanisation happened after New China (the People's Republic of China) was founded in 1949. rebuilding the country's economy, developing the manufacturing and industrial sectors was highly prioritised. In response, Shanghai swiftly transformed from a financial centre into a comprehensive manufacturing hub.

SHANGHAI THROUGH HISTORY

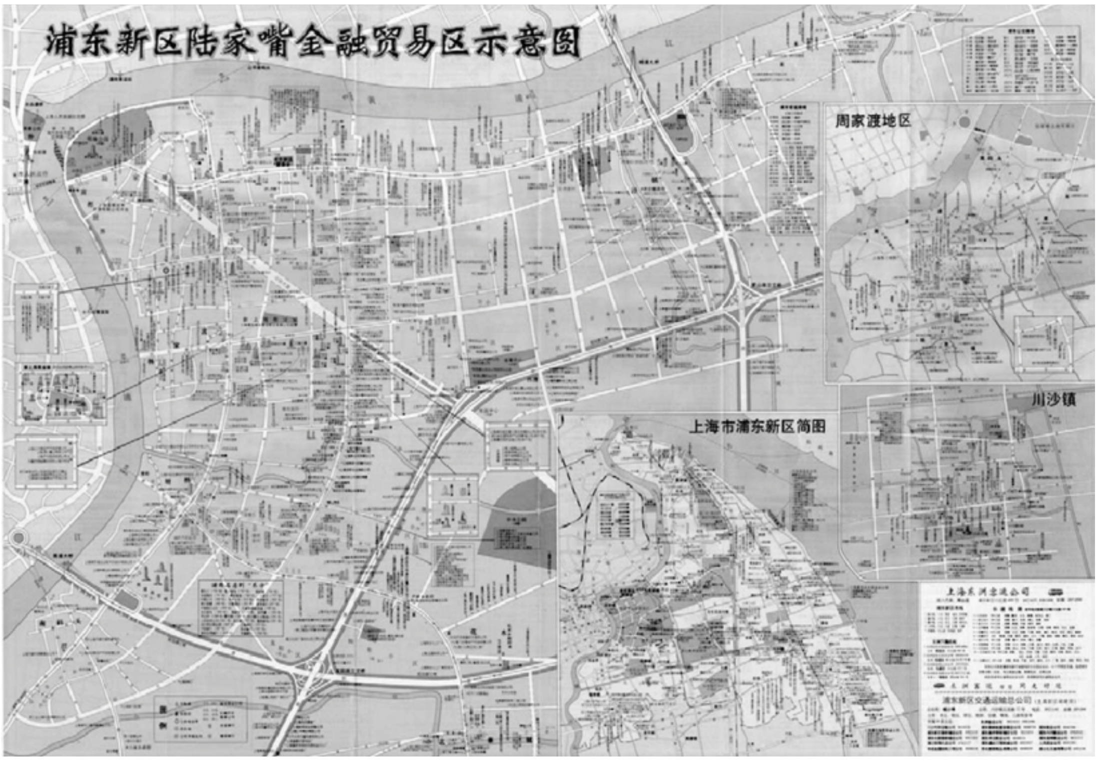


Figure 13: A map of Shanghai in 1994 after the first phrase of massive road and underground infrastructure

From 1949 to the late 1970s when the Cultural Revolution ended, Shanghai's population doubled from 6 million (in the early 1950s) to about 12 million (in 1982).

Shanghai in 1994 after the first phrase of massive road and underground infrastructure investment was put in place for the developers to build buildings according to the master plan.

Urban Transformation after China Reform & Opening General Overview

Strictly speaking, these manufacturing districts could not be considered urban areas – they were just large plots of factories with workers' living quarters built beside.

They had a strong socialist character, but did not truly form city-like urban areas. As the living quarters included amenities such as kindergartens, primary schools and healthcare facilities that were all provided by state-owned work units.

At the early stage of the China Reform and Opening, from 1978 to 1990, development in the Pearl River Delta region centred on the new city of Shenzhen, which became the test-bed for the nation's reform and opening ideas, while Shanghai took the back seat in China's economic reform plan at that period.
At Shanghai during the ten some years, since new economic sectors had taken over the old manufacturing sectors, the new and old economic systems experienced much friction.

Although Shanghai's economic growth had always been strong, its rate of growth was lagging behind that of the Pearl River region at that time, so Shanghai's economic importance in the country fell. Consequently, during this period, there was no significant change in the urban framework of Shanghai.

As for physical urban development, contrary to Shanghai's contribution to the country, the Shanghainese quality of life kept falling. Up till the early 1990s, Shanghai's average living space per capita, green space per capita, public transport situation and other key indexes of living conditions ranked among the country's worst. It was also during this prolonged period of declining living conditions that Linong areas and other historical areas became extremely densely populated, giving such places a slum image.

The years between 1991–2010 China's open door policy forms the backdrop of Shanghai's third era of urbanisation, which took place in line with the larger context of China's urbanisation in this period. In 1991, Shanghai's urban development entered an era of great change. This is according to the Chinese central government's strategy and policy that 'with the development and opening of Shanghai Pudong as the spur, the cities along the Yangtze River will be further opened up, in order to shape Shanghai as one of the international economic, fi nance, and trade centres and thus bring along new leaps of regional economy in the Yangtze River Delta and the whole Yangtze River Valley', 4 which led to the development and opening of Shanghai Pudong and its offi cial launch in 1991. Shanghai's population has risen to 23 million in 2011, almost doubling in the past 30 years, while the built area of the city increased from 1,000 to 2,860 km 2.

Shanghai thus underwent a fundamental change within the 10-year span of the 1990s. The rapid momentum of Shanghai's growth since Pudong Development began in 1991 has continued into the twenty-fi rst century, with the Shanghai World EXPO in 2010, continuing to attract global attention

SHANGHAI THROUGH HISTORY

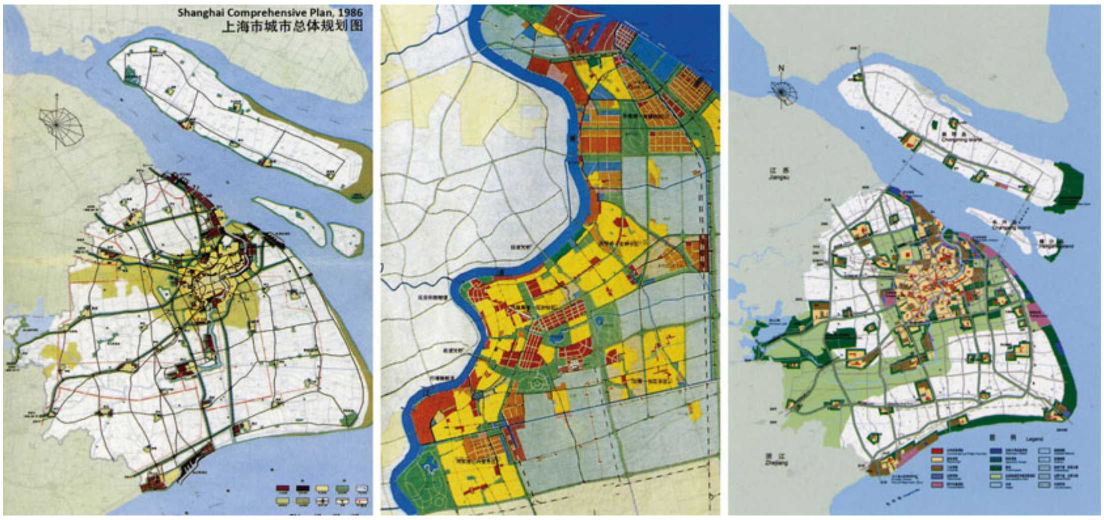


Figure 14: Left to right: Shanghai Comprehensive Plan, 1986; The Comprehensive Plan of Pudong New District, 1991, Shanghai Comprehensive Plan 1999–2020, 1999

On the one hand, this change brought about a rapid improvement in basic urban infrastructure and a substantial improvement in the living conditions of the public. Shanghai's living space per capita rose from 6.9 m 2 in 1992 to 13.1 m 2 in 2002. On the other hand, such rapid development has also raised questions and criticism of various aspects of the city's history, culture and social problems.

The Comprehensive Plan of Pudong New District published in 1991 expanded and almost doubled Shanghai's urban territory across the Huangpu River. Crossing the river with several bridges and tunnels and plans for Lujiazui Central Business District (CBD), Huamu Civic Centre, manufacturing and industrial zones, Century Avenue, major iconic public buildings and a series of building initiatives signalled Pudong Development in full force. A new Pudong presented itself before everyone at the turn of the century, after 10 years of rapid development under the slogan 'A new look every year, an astonishing change every three years'. This was also the most evident symbol of Shanghai's success in the 1990s.

Urban Transformation of the City Through Years

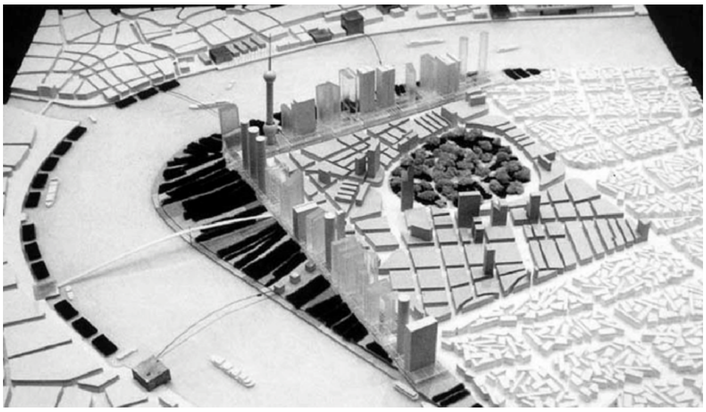


Figure 15: Richard Rogers and Partner's plan for Pudong, 1993. Source: The Shanghai Urban

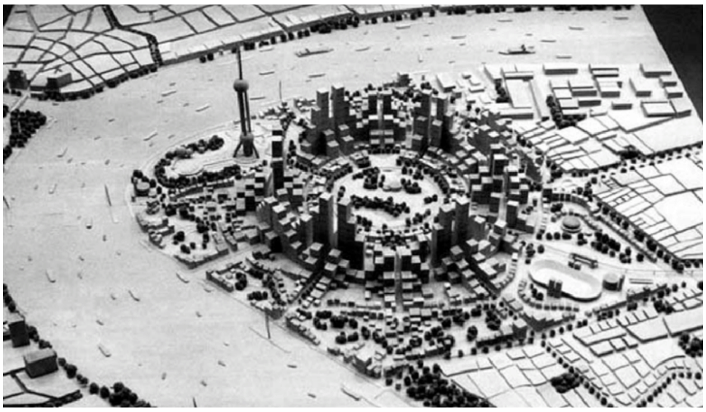


Figure 16: Dominique Perrault's Plan for Lujiazui, 1993. Source: The Shanghai Urban Planning Exhibition Center, Shanghai, P.R.China.

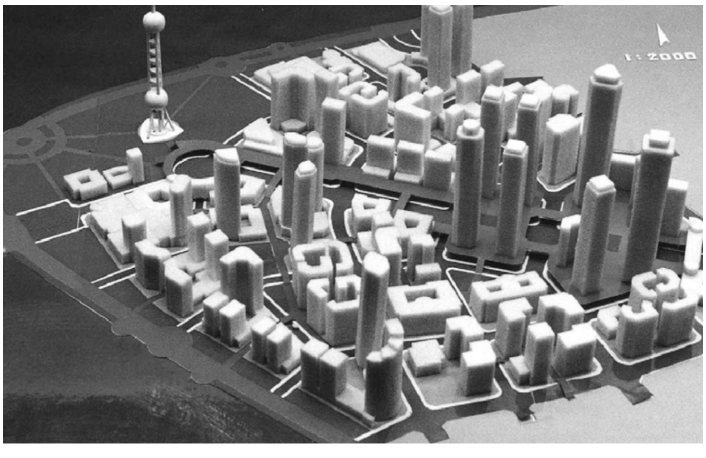


Figure 17: The proposal by Shanghai Urban Planning Institute. Source: The Shanghai Urban Planning

SHANGHAI THROUGH HISTORY

A large proportion of Pudong New Area has relatively low urban vitality, apart from the Lujiazui and its surrounding areas. Pudong New Area is affected by modern zoning plan, which forms a monotonous built environment.

Since Pudong was approved as a national-level new area in 1990s, it was divided into five zones for specialized industries.In 2000s, Sanlin and Chuansha were added as two additional specialized zones aiming to develop World Expo and logistic industry, respectively.

Zoning plan allows these specialized zones to preferentially supply large-scale industrial land in suburb, which facilitates to accommodate enterprises and factories.

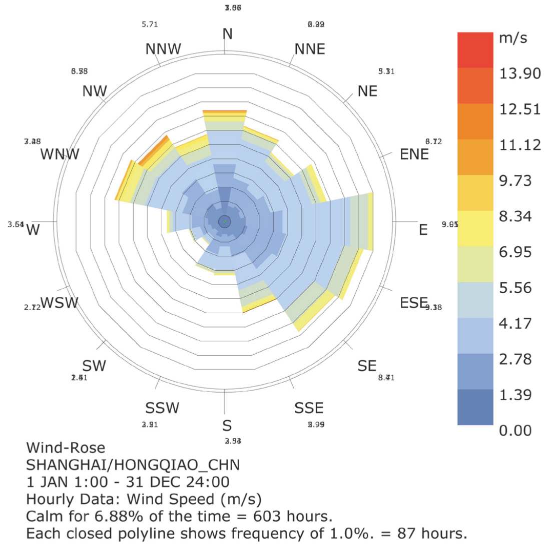
Stimulated by this industry-oriented land development strategy, local authorities make efforts to establish industrial parks and transport network.

Meanwhile, zoning plan tends to feature grid-pattern road network composed of dense urban expressways, with sparse outspread paths. Under the circumstance, many industrial parks and neighboring residential communities are divided into large number of independent large-scale closed blocks with an enterprise or a residential community, forming regular layouts The plan is similar to American's Euclidean zoning that is featured by the segregation of urban land into independent spatial units.

It therefore results in absent road junctions and 'human touch', leading to severe road vacuums.

Consequently, monotype land use, regular large-scale blocks, and road vacuums render many sub-districts of Pudong as hardest-hit areas for low urban vitality.

ANALYSIS
CURRENT SCENARIOS



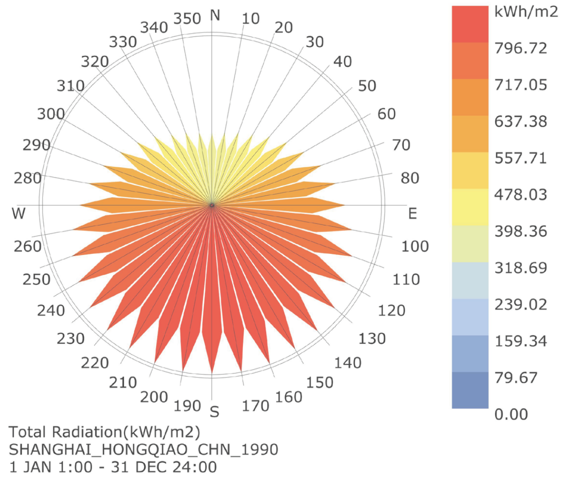
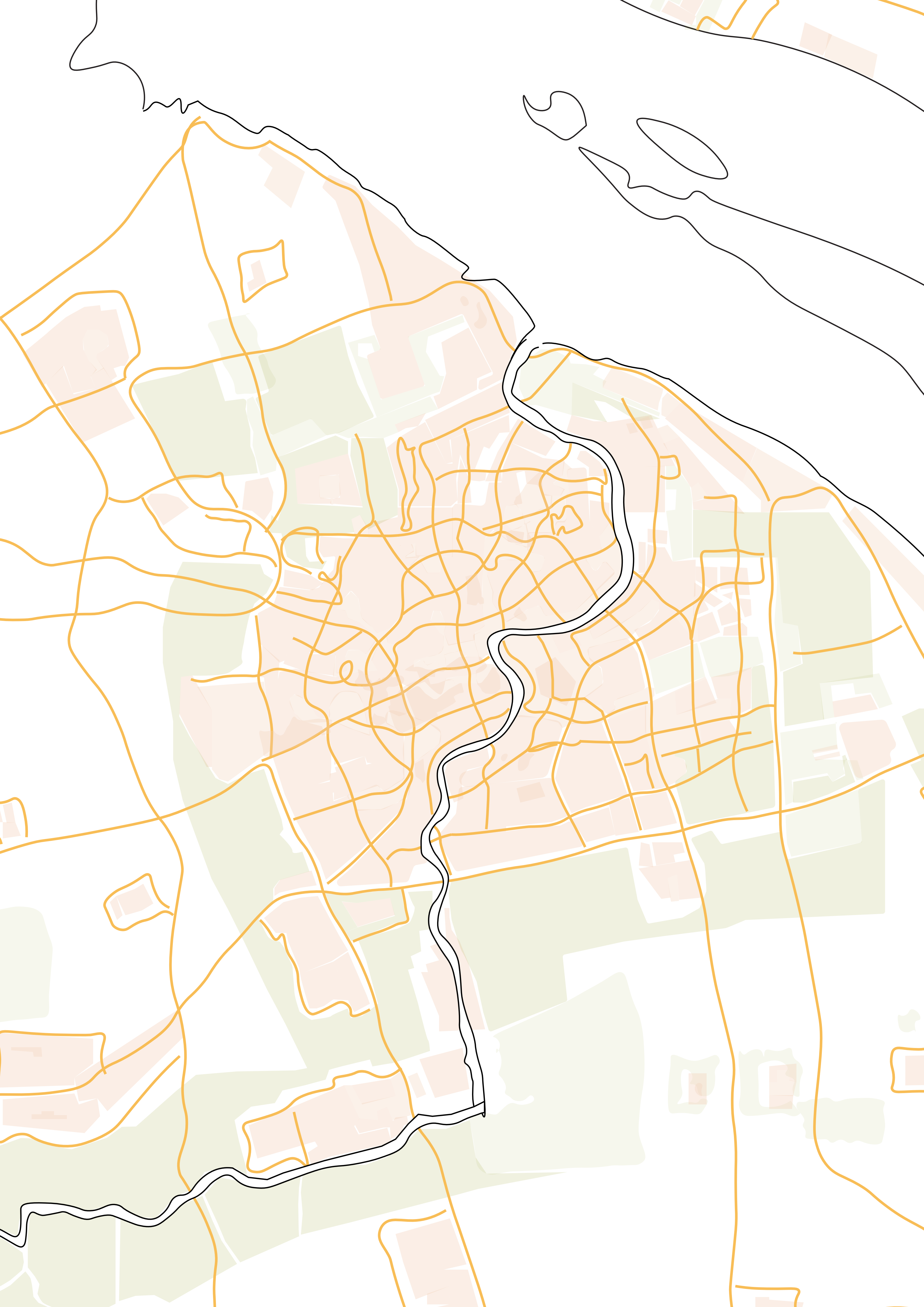


Figure: Green Network on the City   Figure: Wind Rose of Shanghai   Figure : Raditation Analysis



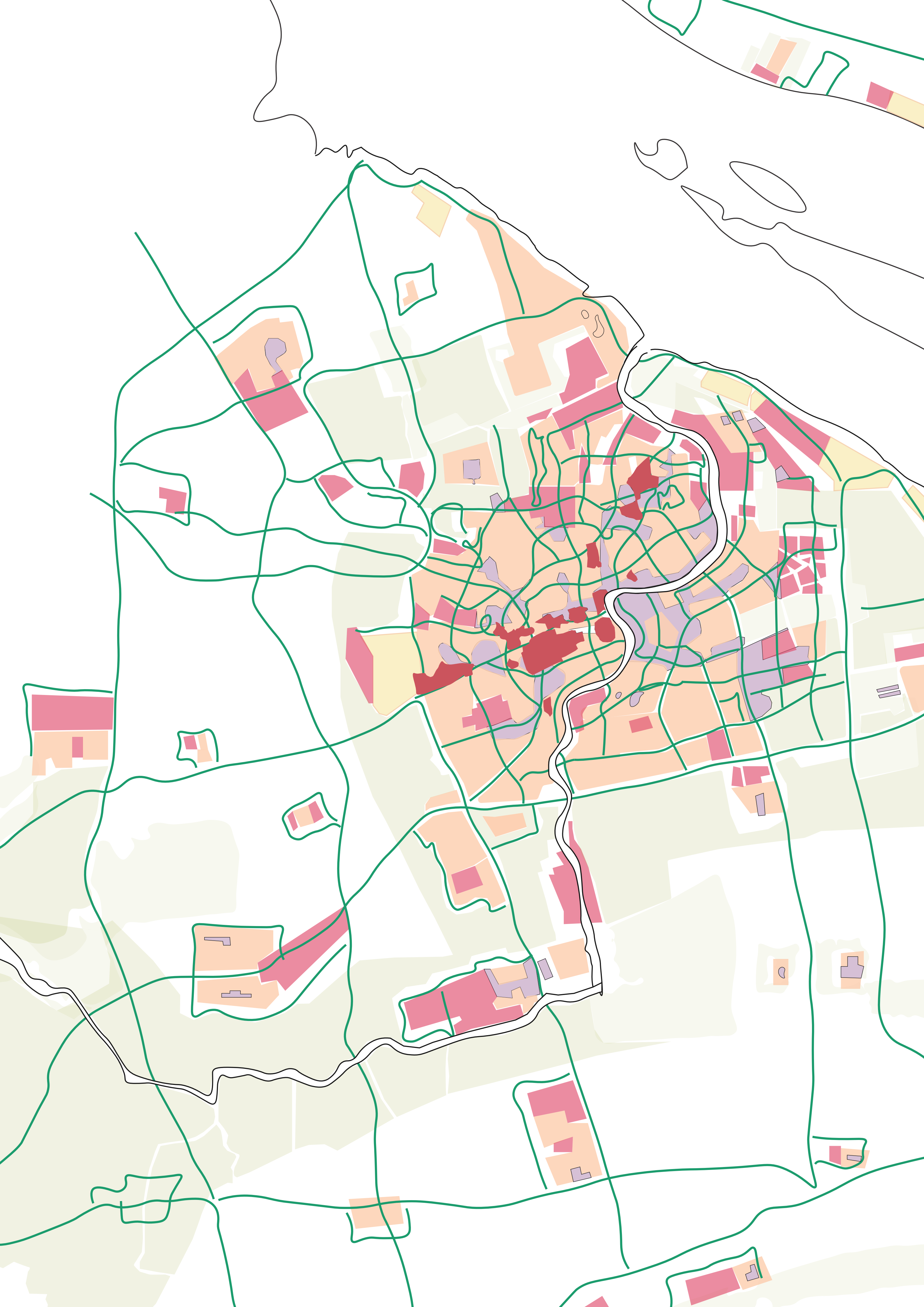
ANALYSIS
CURRENT SCENARIOS

Build Areas
Road
Green Structures

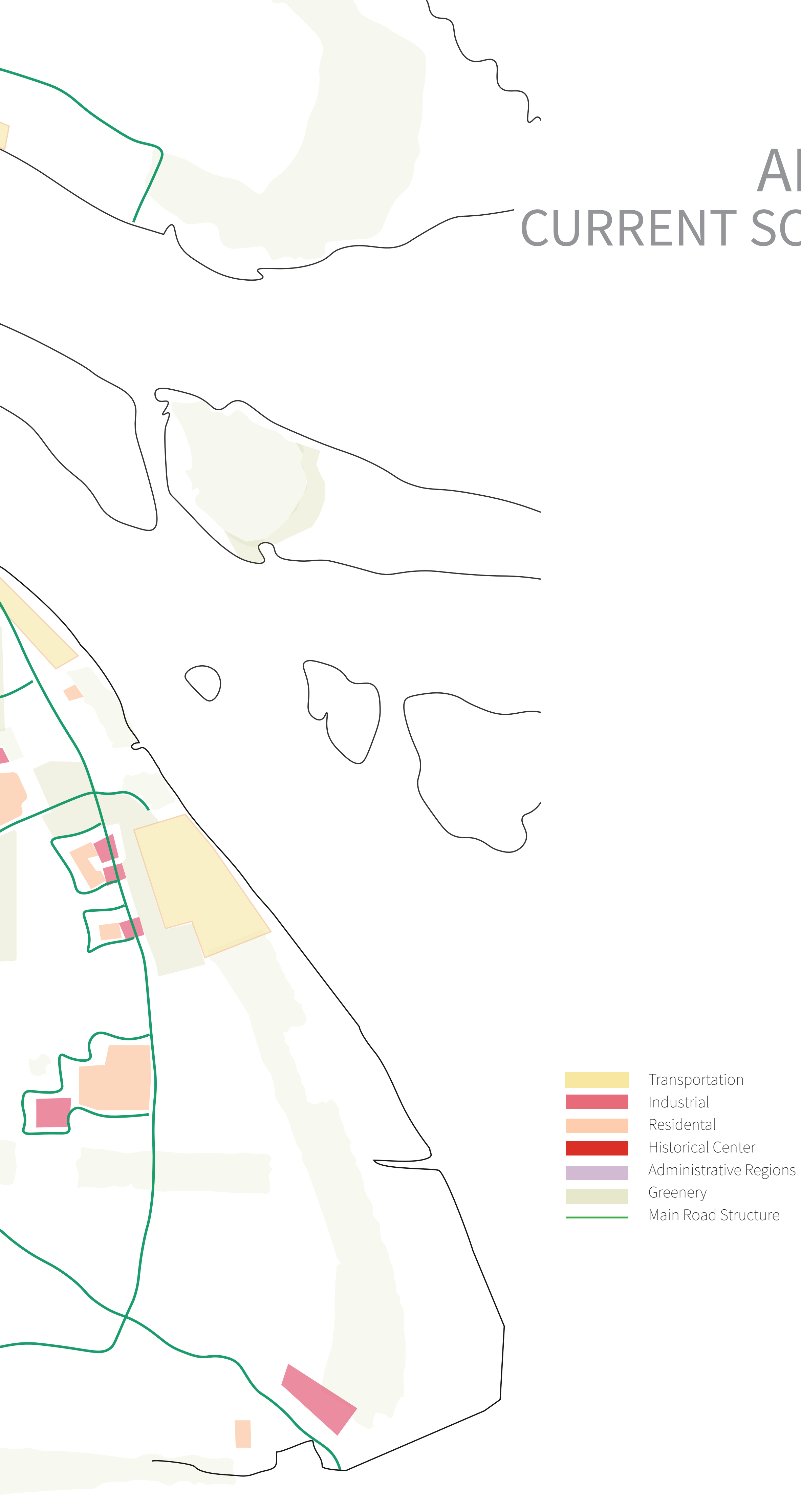

East China Sea
Jiangsu
Baoshan
Jiading
Yangpu
Hongkou
Zhabei
Putuo
Jing'an
Huangpu
Changning
Qingpu
Pudong
Xuhui
Minhang
Songjiang
Fengxian
Jinshan

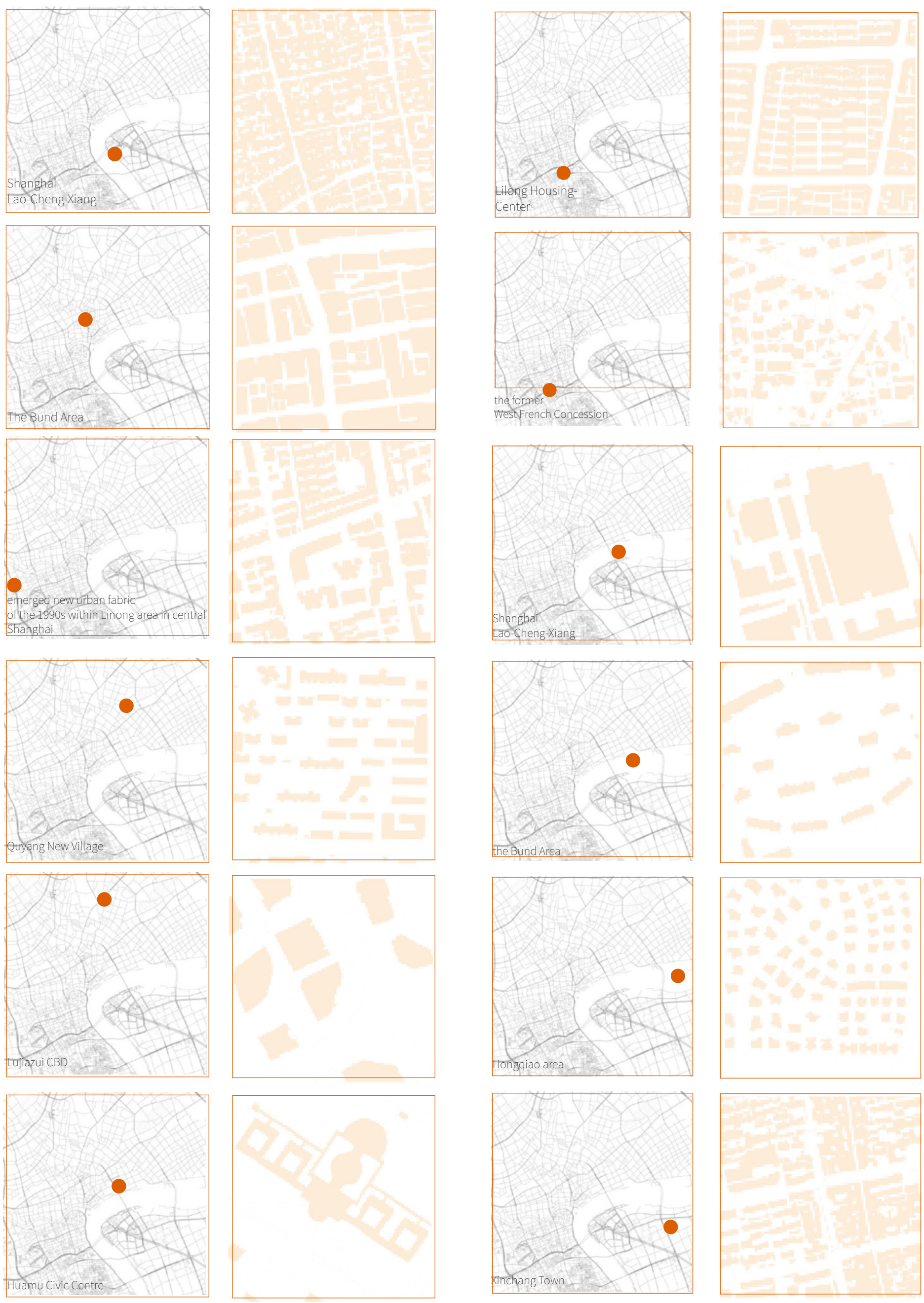
ANALYSIS
CURRENT SCENARIOS

Urbanised Areas
Administrative Regions
Main Road Structure
Project Site

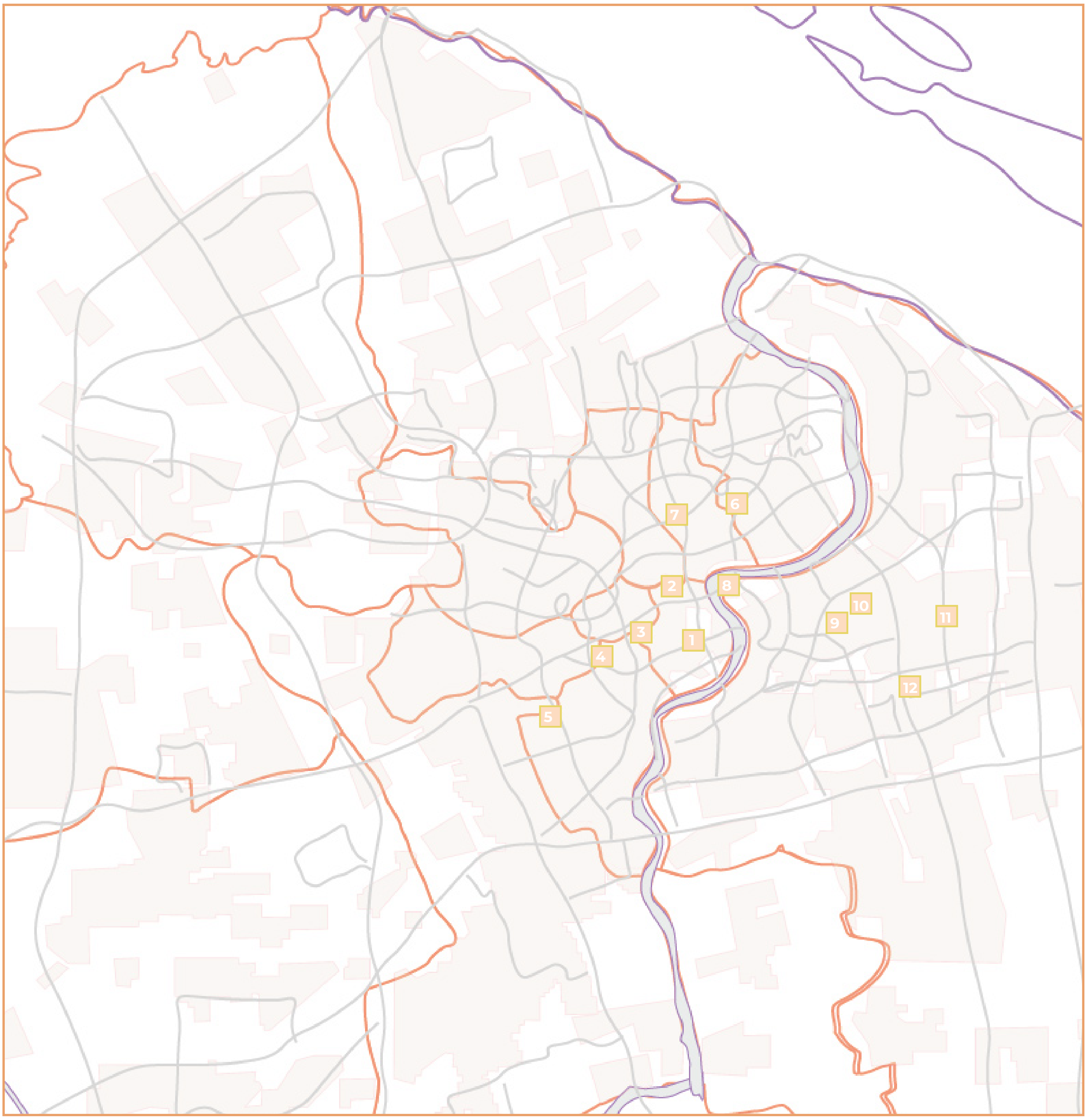


ANALYSIS
CURRENT SCENARIOS

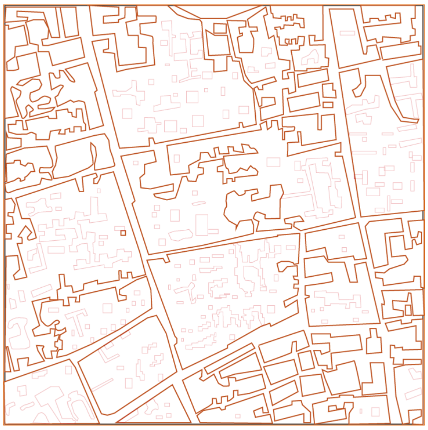



Shanghai
Lao-Cheng-Xiang
The Bund Area
emerged new urban fabric
of the 1990s within Linong area in central
Shanghai
Quyang New Village
Lujiazui CBD
Huamu Civic Centre
Lilong Housing
Center
the former
West French Concession
Shanghai
Lao-Cheng-Xiang
the Bund Area
Hongqiao area
Xinchang Town

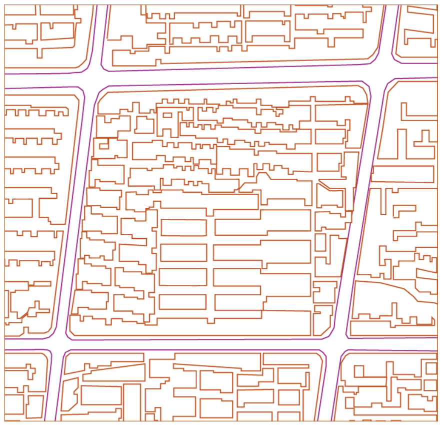
ANALYSIS
URBAN PATTERNS



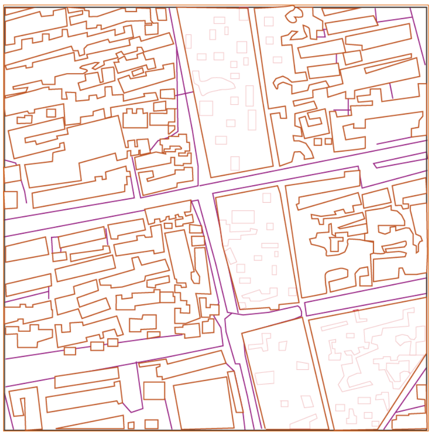
Mapping of Variant Urban Patterns



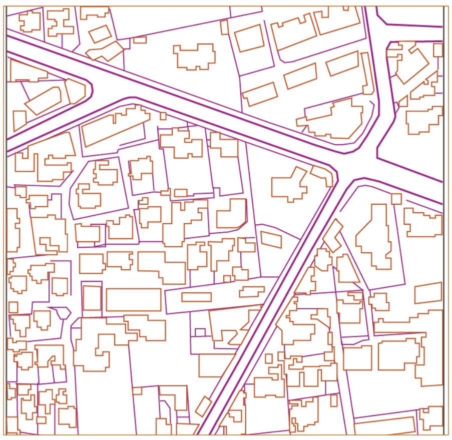
1 Lao-Cheng-Xiang



2 Lilong Housing Area

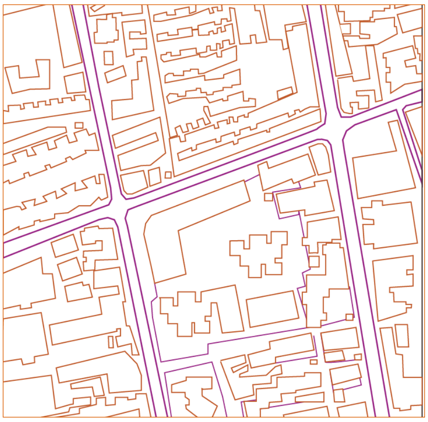


3 Xchang Town

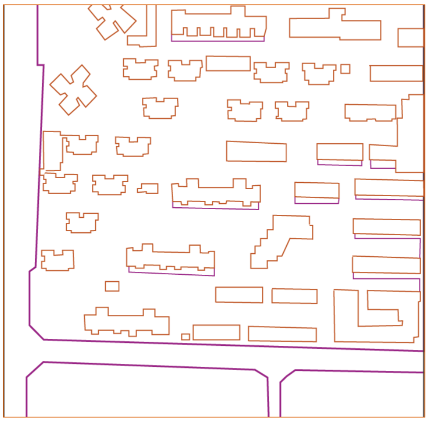


4 Former French Concession

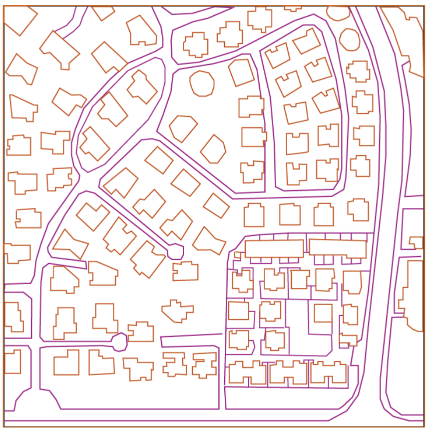
ANALYSIS
URBAN PATTERNS



5 Central Shanghai



6 Qyang New Village



7 Hongquiao Area

8 Huamu Civic Centre

The Traditional Chinese Town: Shanghai Lao- Cheng- Xiang

The form and organisation of presentday streets evolved from a canal network. Its clear hierarchy yet organic web-like pattern of street– lane–path–end leads from the city's public areas to the private realm as it weaves through densely packed low-rise buildings. The old areas generally have low-quality, slum-like living conditions. Due tothe high level of subdivision within units, manydwellings lack basic amenities such as toilets for every unit. Shared cooking and washing spaces are common. There is liberal use of the already narrow public streets due to overly cramped private spaces.

Figure 17: The living conditions of Lao-Cheng- Xiang today, along the stretch from Penglai Road to Wangyun Road View of a typical old street

ANALYSIS
URBAN PATTERNS

‘There is liberal use of the already narrow public streets due to overly cramped private spaces.’

Shared facilities, washing spaces, kitchen...

Poor quality of living conditions

Figure 18, 19:: New and old urban fabrics in Lao-Cheng- Xiang are starkly juxtaposed (Courtesy of Hailin Zhai

Lilong Typology: Center of Shanghai

Figure 20: Rooftop scene of a Linong area. This widespread homogenous rooftop image is one of the most typical urbanscapes in central modern Shanghai. It is created by the repetition of a basic housing unit, a modified traditional Chinese town house, to form rows

The Linong (also called Lilong or Longtang) typology is a well-developed urban housing typology at Shanghai in China's modern history. As a response to rapid urbanisation, a massive population influx (creating the need to accommodate higher densities) and a shift to urban lifestyles, the Linong typology, evolved from the 1860s to the 1930s, combined traditional Chinese dwellings within an overall Western structure. Linongs are generally 2–3 storeys high, with a clear hierarchy of spaces from public to private.
Linongs were originally designed to house the middle class. However, due to certain historical factors, it gained a slum-like image as the units became subdivided and overcrowded.

With a clear hierarchy of spaces from public to private

The street entrance to the Linong, which leads directly into the main lane, is usually integrated with the street front consisting of an outer layer of shops.

ANALYSIS
URBAN PATTERNS

Figure 21: Photos refl ect typical living conditions in the late 1980s Linong housing. The lanes formed safe play spaces for children and good daily gathering spaces for all, enhancing the sense of community. These would have been familiar scenes to most Shanghainese. Due to certain historical factors such as war causing the population to swell and the unreasonable density and conditions following New China's establishment, this kind of housing gained a slum-like image as the units became subdivided and overcrowded

Figure 22: The street entrance to the Linong, which leads directly into the main lane, is usually integrated with the street front consisting of an outer layer of shops.

The Bund Area: Ficancial Symbol of Far East

Figure 23: Aerial views of the Bund Area. Although not considered high-rise today, this area is still densely packed.

The Bund Area was the fi nancial engine of Asia during Shanghai's golden era of the 1920s–1930s, leading the rest of East Asia's financial development. Urban life and financial activity were interwoven, making this urban spatial model very adaptable, and this was planned as such. From the 1990s onwards, the Bund Area has faced a fourth wave of urban renewal, with many transformations and new construction projects. The biggest challenge is how to retain the historical characteristics of this area, enhance its urban spatial quality and strengthen its legacy of the Asian financial engine.

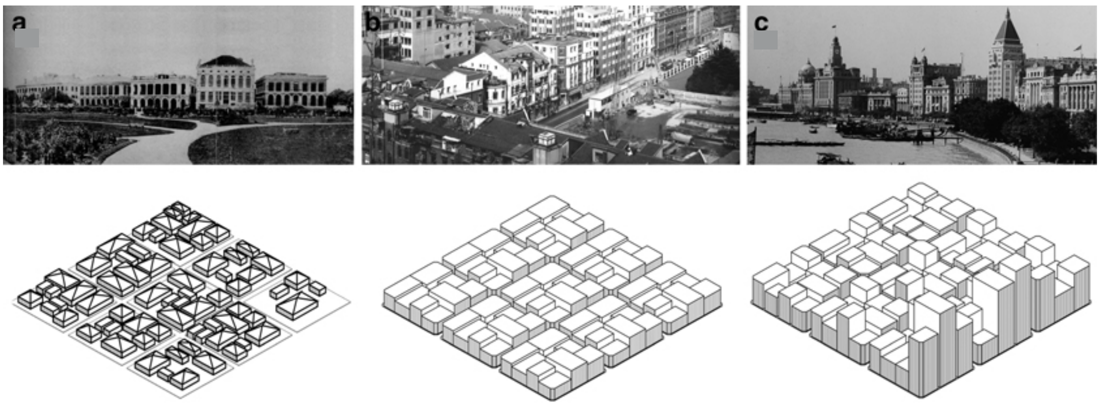


Figure 24: Aerial views of the Bund Area. Although not considered high-rise today, this area is still densely packed.

The city witnessed three major stages of urban transformation before 1991's rapid development.

- the 1840s to the late nineteenth century: typical colonial style 2–3 storey buildings, placed in the middle of the plot, surrounded by gardens and lawns enclosed by fence walls;

- the late nineteenth century to the early twentieth century: a fully typical European urbanism in a modern Chinese city was achieved – a grid street network, with many buildings rebuilt to 4–6 storeys high, leaving the colonial typology for one that filled the plot right up to the street, forming a continuous street wall, and very European facades;

- the1920s–1930s: some buildings were renovated or rebuilt, with many becoming 8 storeys and up, although the building and street relationship and the street grid system were not altered

Figure 25: The 1980s back view of the Bund. The opposite bank in the background is the location of today's Pudong Lujiazui CBD; the Bund in the beginning of the twenty-first century. The highway ramp seen here was demolished after the underground highway was constructed, prior to the 2010 Shanghai EXPO (Source: Shanghai Planning and Land Resources Administration Bureau)

Lujiazui Central Business District (CBD)

If the Bund is the iconic representation of the financial centre of the Far East during modern Shanghai's golden era, then the Lujiazui CBD's skyline, as seen from the Bund, can be said to be Shanghai's symbol of progress towards becoming a global financial centre in the twenty-first century. Since 1991, when China's central government announced the development
and opening of Shanghai Pudong, until the beginning of the twenty-first century, this area grew from a single Oriental Pearl TV Tower to a whole new CBD within a decade. It represents Shanghai city rebuilding its image as a financial hub, and it has greatly helped the city attract and retain many international financial institutions.
The typical urban pattern of Lujiazui is towers placed in large urban blocks with an abundance of open space surrounding each tower, and each block is surrounded by wide traffic roads which lead to main entrance plaza or underground parking of each tower. These towers usually contain commercial office spaces or major shopping complexes. Some footbridges have been added in recent years to form a second street level for pedestrians, due to the high traffic volume on the ground.

Shanghai city rebuilding its image as a financial hub. Towers placed in large urban blocks with an abundance of open space surrounding each tower. Towers contain commercial office spaces or major shopping complexes

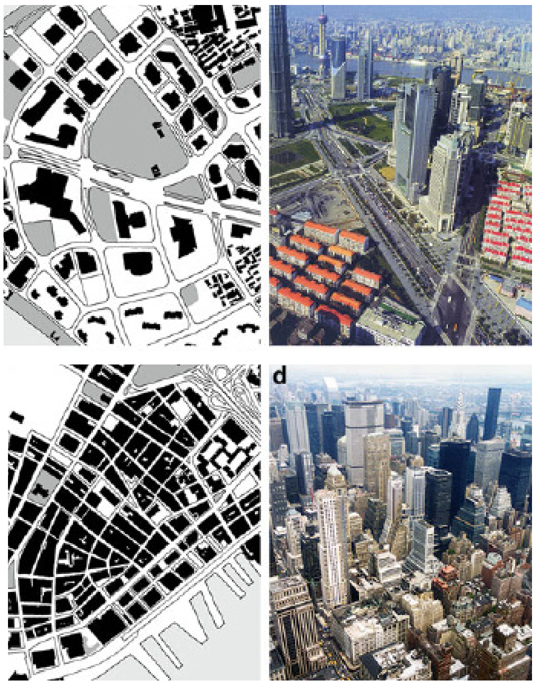


Figure 26:Comparing the urban fabrics of Lujiazui CBD, Shanghai and Lower Manhattan, New York City. The black areas are building footprints, and the dark grey are public greens

Civic Centre Complex:
Huamu Civic Centre Area

The Huamu Civic Centre Area was publicly funded to drive Pudong's urban development deeper into the rest of the land away from the Huangpu River. It has been quite successful in achieving this aim as planned in the beginning of the 1990s, but not without some criticism on urban pattern.

At the heart of the civic centre is a large open square. It is surrounded by important civic buildings mainly designed as landmarks and used as a visual end to the grand axis of Century Avenue that started in Lujiazu area.

This has encouraged the widespread development of luxury residential apartments around it. Therefore, this has become a high-class residential area.

Large open square in the middle of civic centre.

Good quality public space leads the other building complexes to appear around.

Large open square in the middle of civic centre

Luxury Residential Area: Huamu Residental Area

Close to the civic centre and Century Park is a concentration of high-class luxury residences in Huamu. Much of the residential areas are targeted at the upper-class population from the Lujiazui CBD, Jinqiao and Zhangjiang's white- collared workers and foreign expatriates.

This case study also highlights another situation that has arisen: huge commercial complexes have become very important to formation and success of new residential districts.

The luxury residential buildings have a large footprint, but the built density is comparatively lower than the city centre. The housing architecture often stresses varietywith several typologies and designs, such as separated villas, high-class condominiums, mid-rise and high-rise. This case study also highlights another situation that has arisen: huge commercial complexes have become- very important to formation and success of new residential districts.

Figure 27:The environment within a typical residential development. Within these large compounds, there is much attention placed on provision of play areas and high-quality landscaping

Figure 28: Aerial views of Huamu residential area. A primary school lies in the foreground

ANALYSIS
URBAN PATTERNS

Jinqiao Manufacturing Zone

Jinqiao manufacturing zone is located in the central part of Pudong. There are industrial manufacturing, trade operations, financial services and other functions, such as a modern industrial park, lifestyle services centre and customs management. Since the district was developed independently,
it lacks integration with the surrounding urban areas in terms of traffic, pedestrian movement and mix of uses and so on. The typical factories and offi es are low-rise building sitting in the middle of gated compounds, creating street images made up of the walls enclosing the compounds and guardhouses at the entrances.

manufacturing zone is located in the central part of Pudong

it lacks integration with the surrounding urban areas in terms of traffic, pedestrian movement and mix of uses

Zhangjiang High-Tech Park

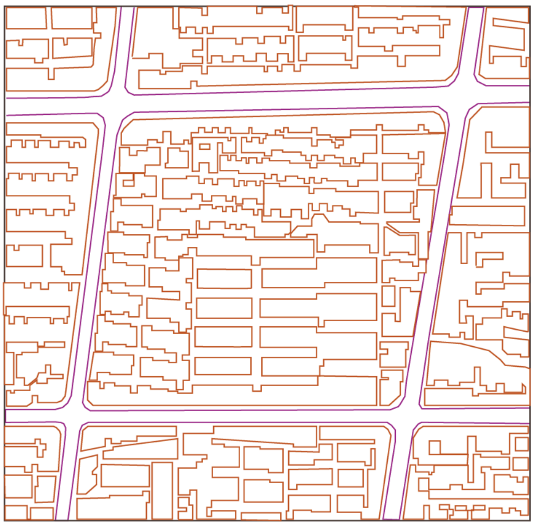
Residential and recreational functions are not well-planned and built in the area; hence, most of people working in the high-tech part do not live nearby their workplaces, resulting in an estimated 180,000 people flooding in and out of Zhangjiang High-Tech Park everyday. Compared to the Jinqiao Manufacturing Zone, Zhangjiang has more public green; however, there is still a lack of public urban life. The urbanscape is still made up of the same typology of buildings seated in the middle of large gated compounds, with a lot of open space left for landscaping, be it residential, factories, offices, schools or other amenities.

has more public green; however, there is still a lack of public urban life

residential and recreational functions are not well-planned

ame typology of buildings seated in the middle of large gated compounds

Urban Pattens, Traditional and Modern Housing, Highrise & Site

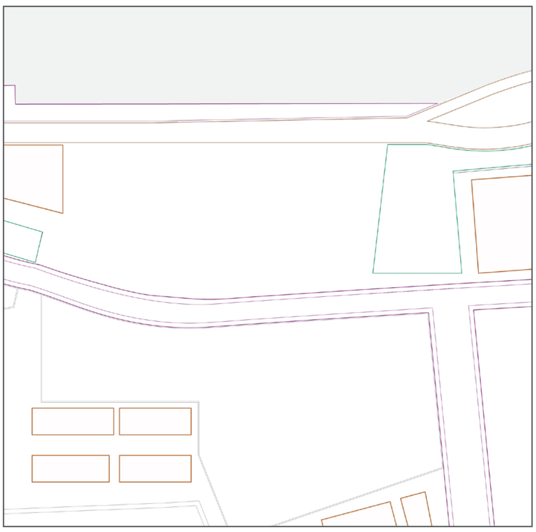


Lilong Typology

Huamu Residential Area

ANALYSIS
URBAN PATTERNS


Lujlazul CBD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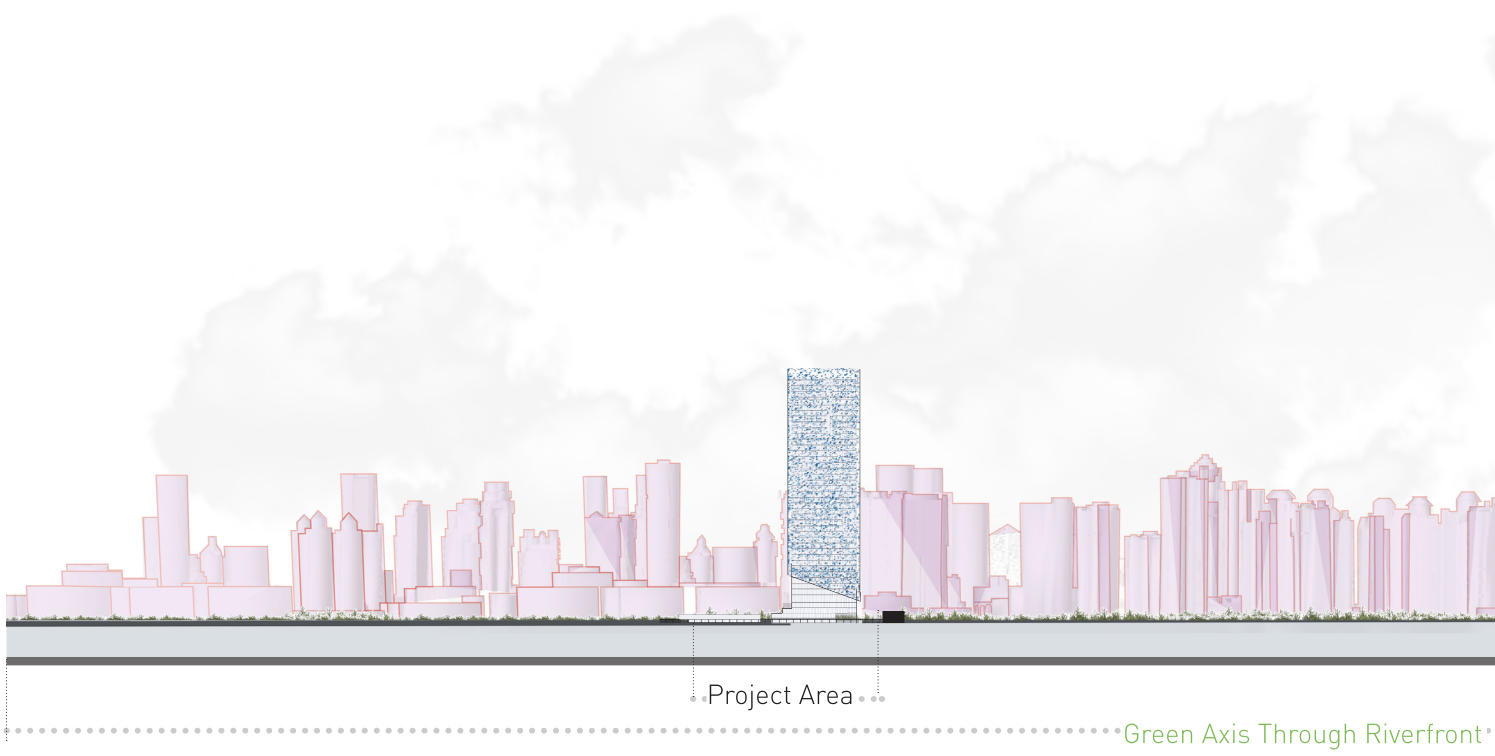
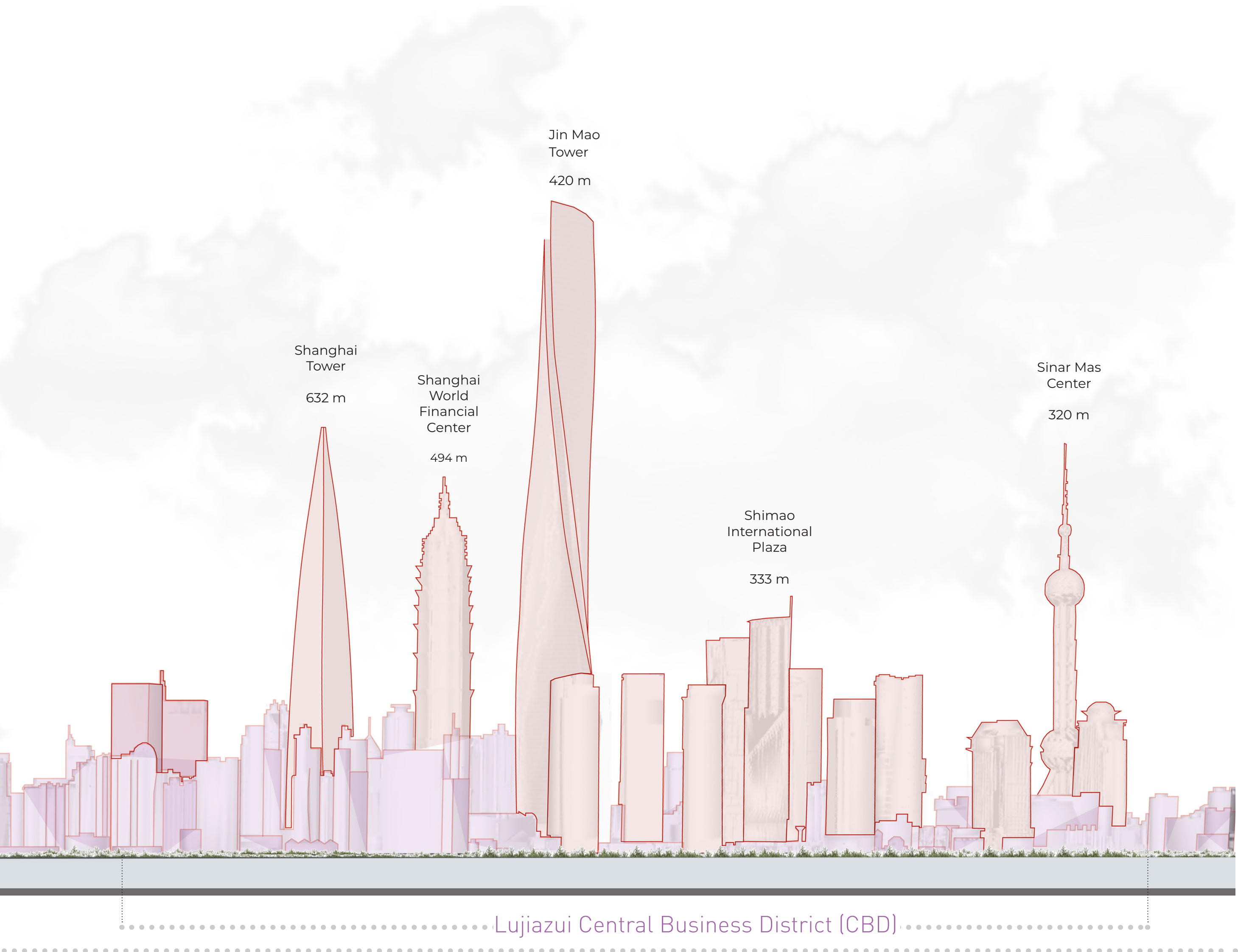


Project Area
Green Axis Through Riverfront

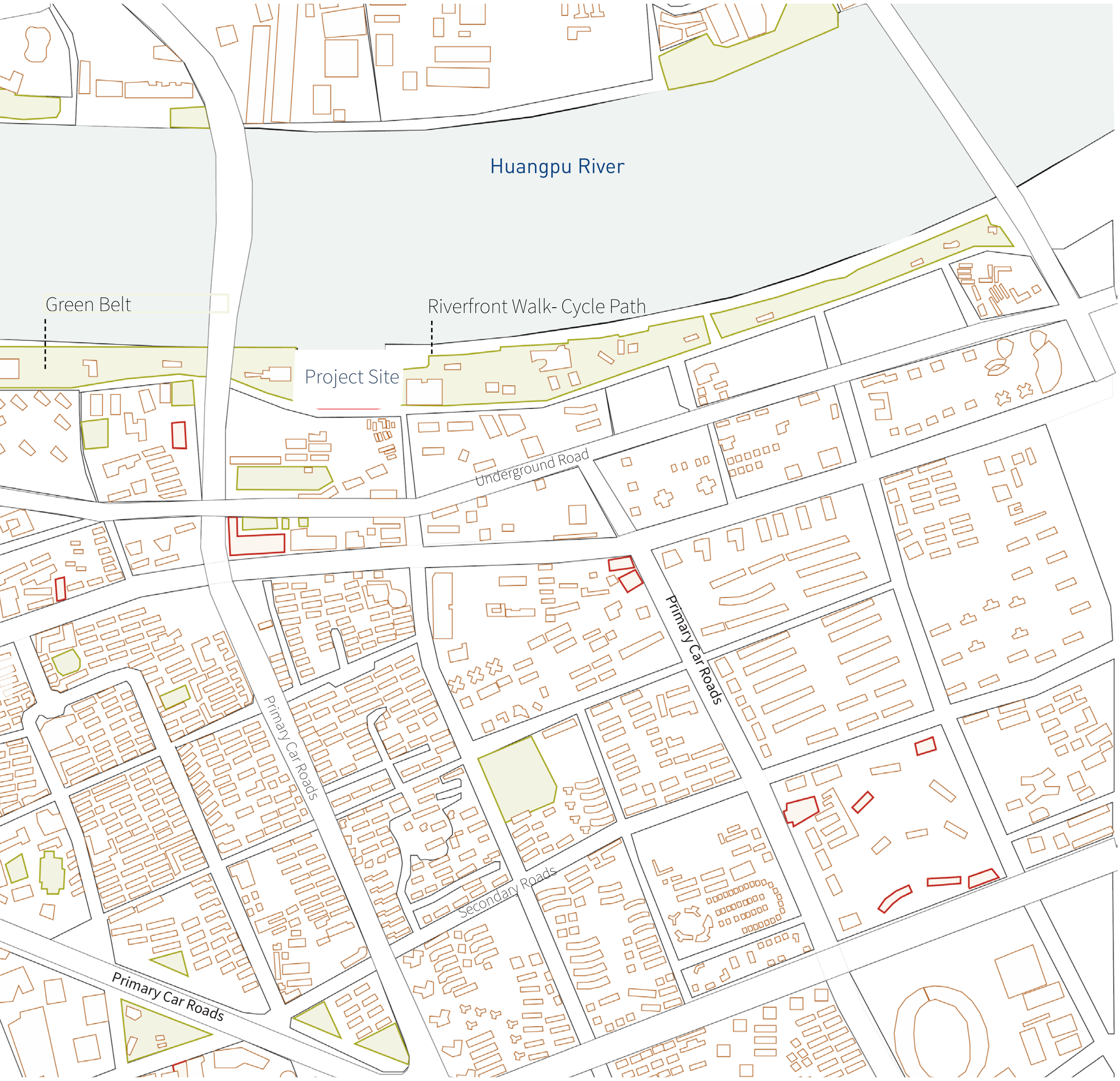
ANALYSIS
CLOSE CONTEXT

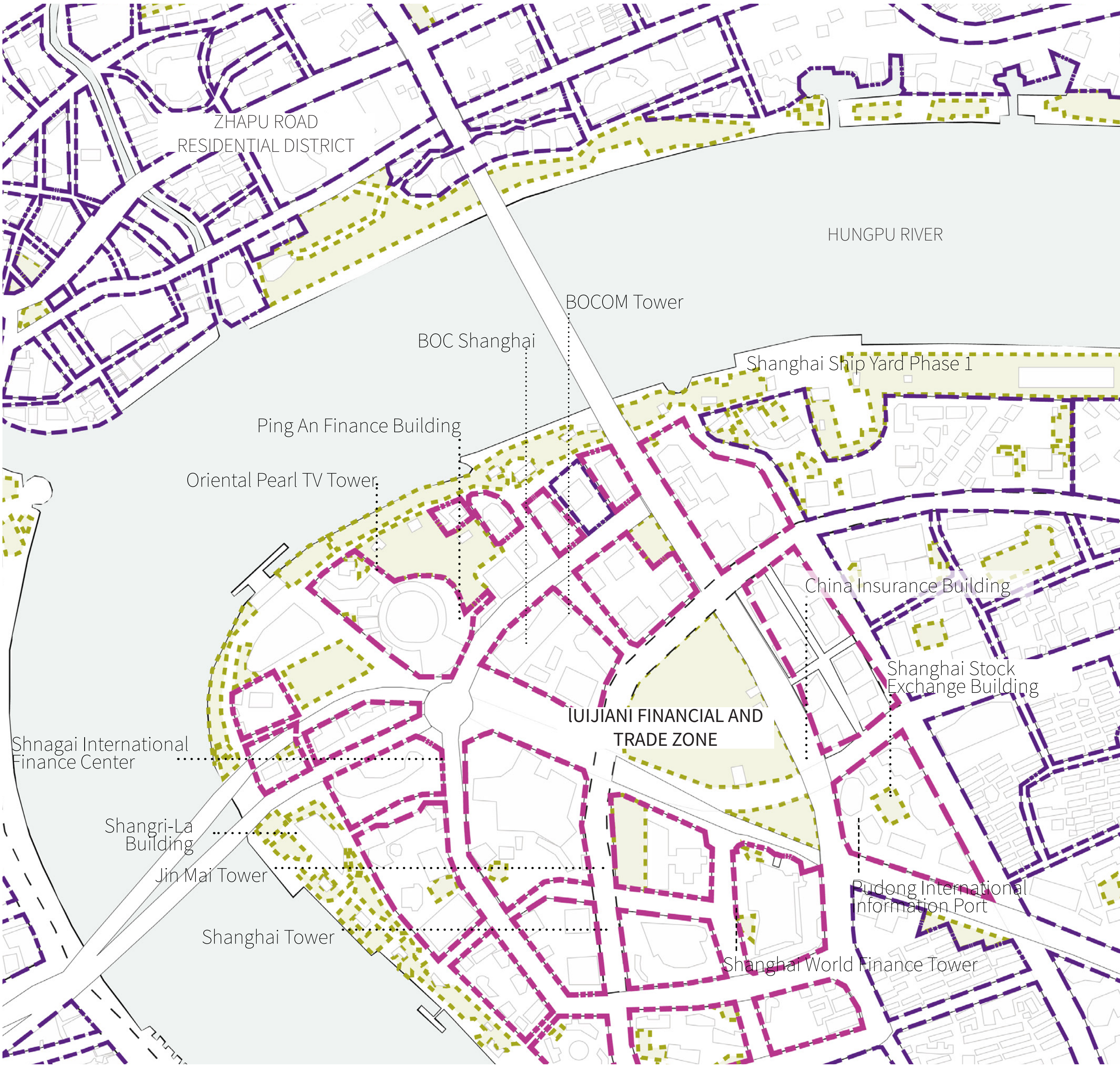


Close Context

High Rise Buildings

ANALYSIS
CLOSE CONTEXT

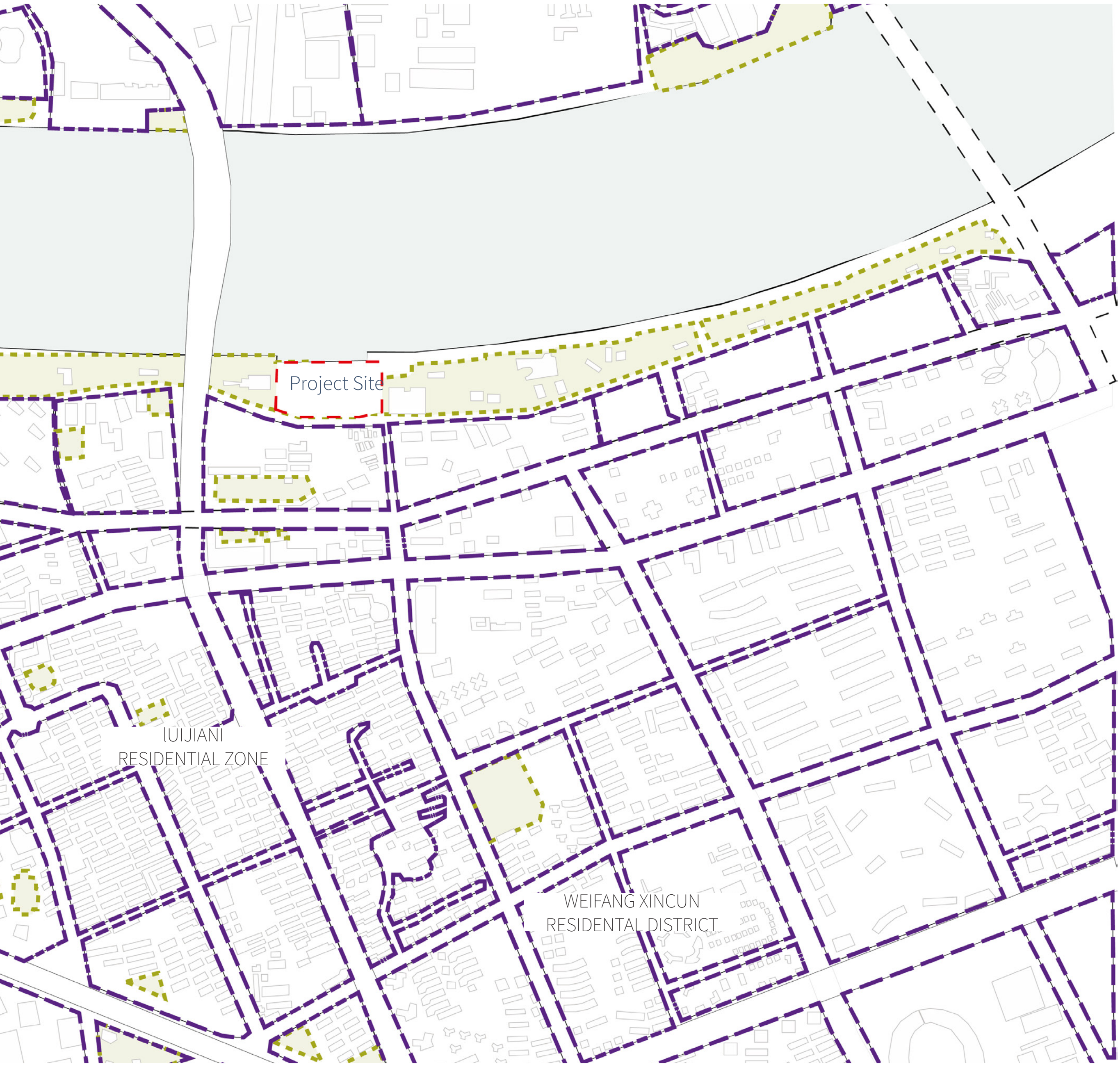


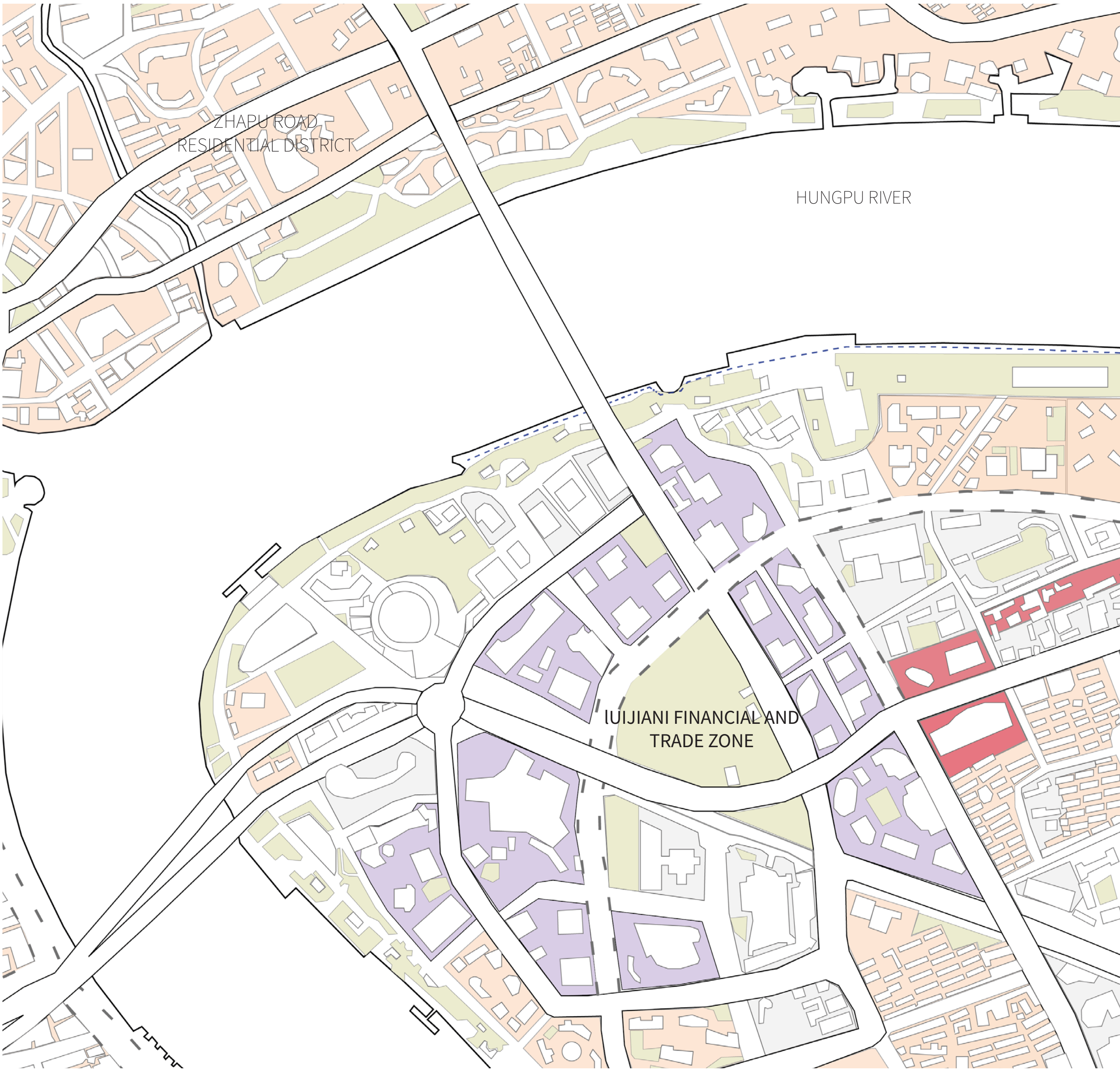


Close Context- Functional Zoning

Residential   Financial Center   Parks, Greenery

ANALYSIS
CLOSE CONTEXT





Close Context

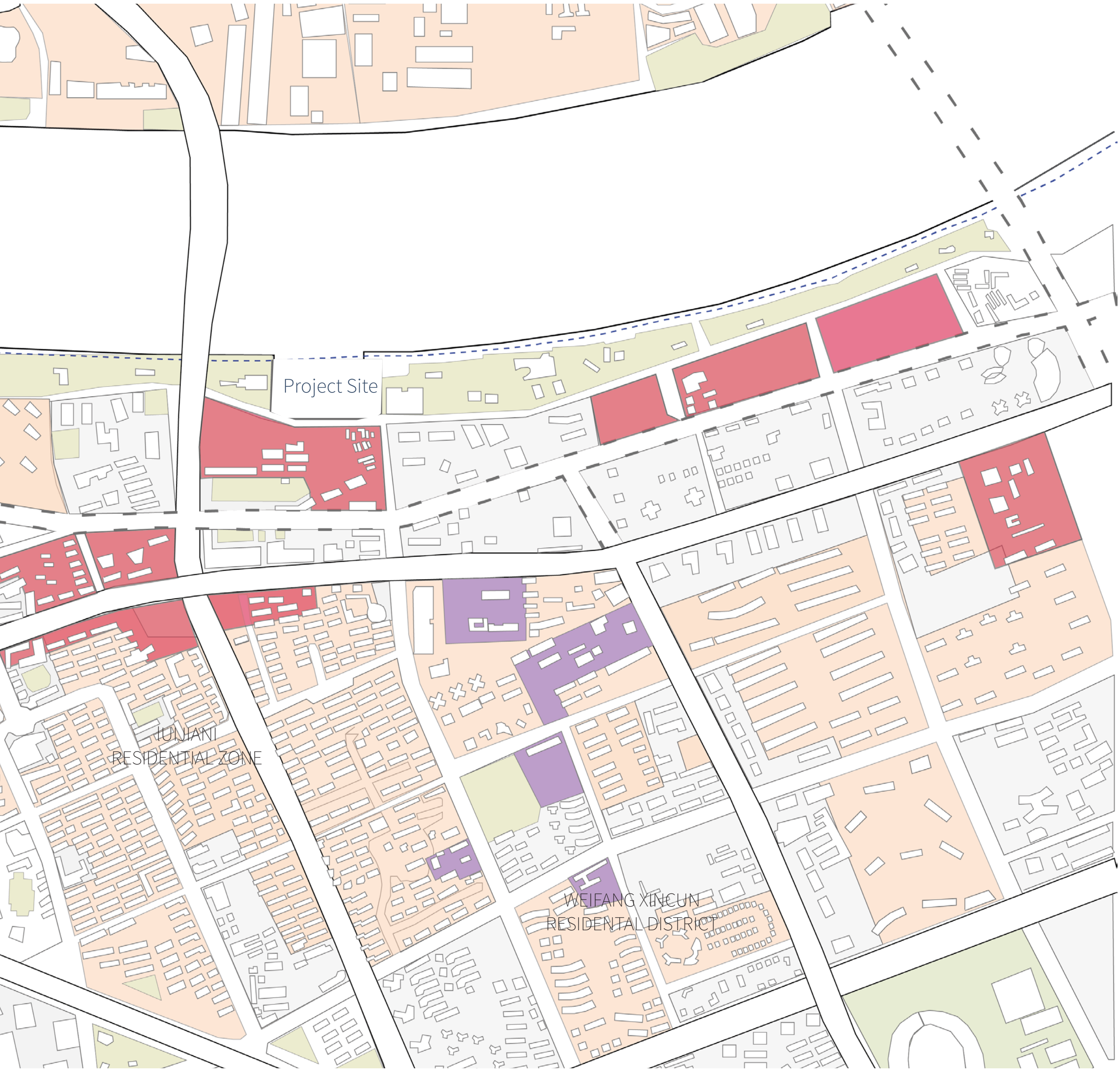
Financial Cneter

Residential Zones

Parks, Greenery

Under Construction

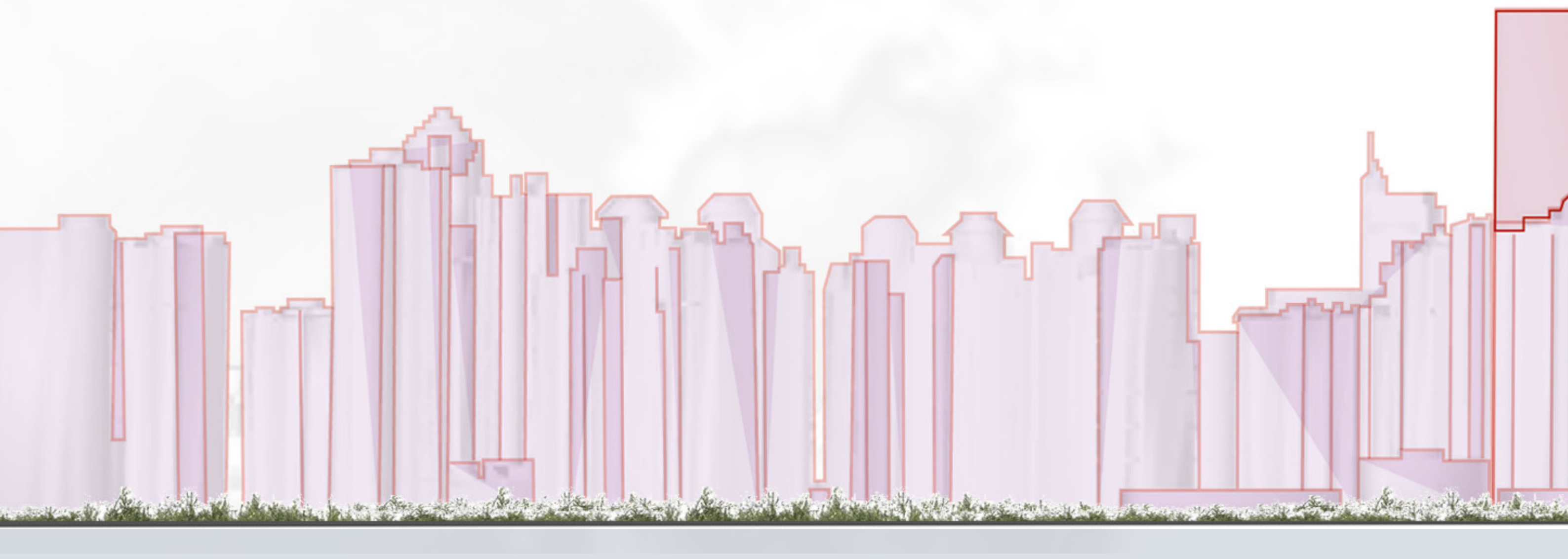
ANALYSIS
CLOSE CONTEXT



School

ARCHITECTURE

The key to understanding how to reinterpretate the functional role of the couryard in a tall building was to study and deeply comprehend for which aim it has been used from the early dates in Chinese history, until the contemporary way of life of young Chinese. Use of the courtyard in traditional ways was in a private. Being surrounded with different functions, or in spesific examples different family houses, created a protected place for people to gather such as for families that children can play, the market place and housings that people can meet, have free spaces to have physical exercises and so on.
With the demographic analysis around the site, and the approximated inhabitant user profiles of the tall building, the idea of living together in a tall building is generated around of contemporary 'courtyard' became 'loggia's on the 4 corners of the building, with a goal to keep its traditions on the society as being a social condencer, a place that people can spend quailty time, protected and used daily in which people can interract, as they used to interact with in the traditional courtyard.

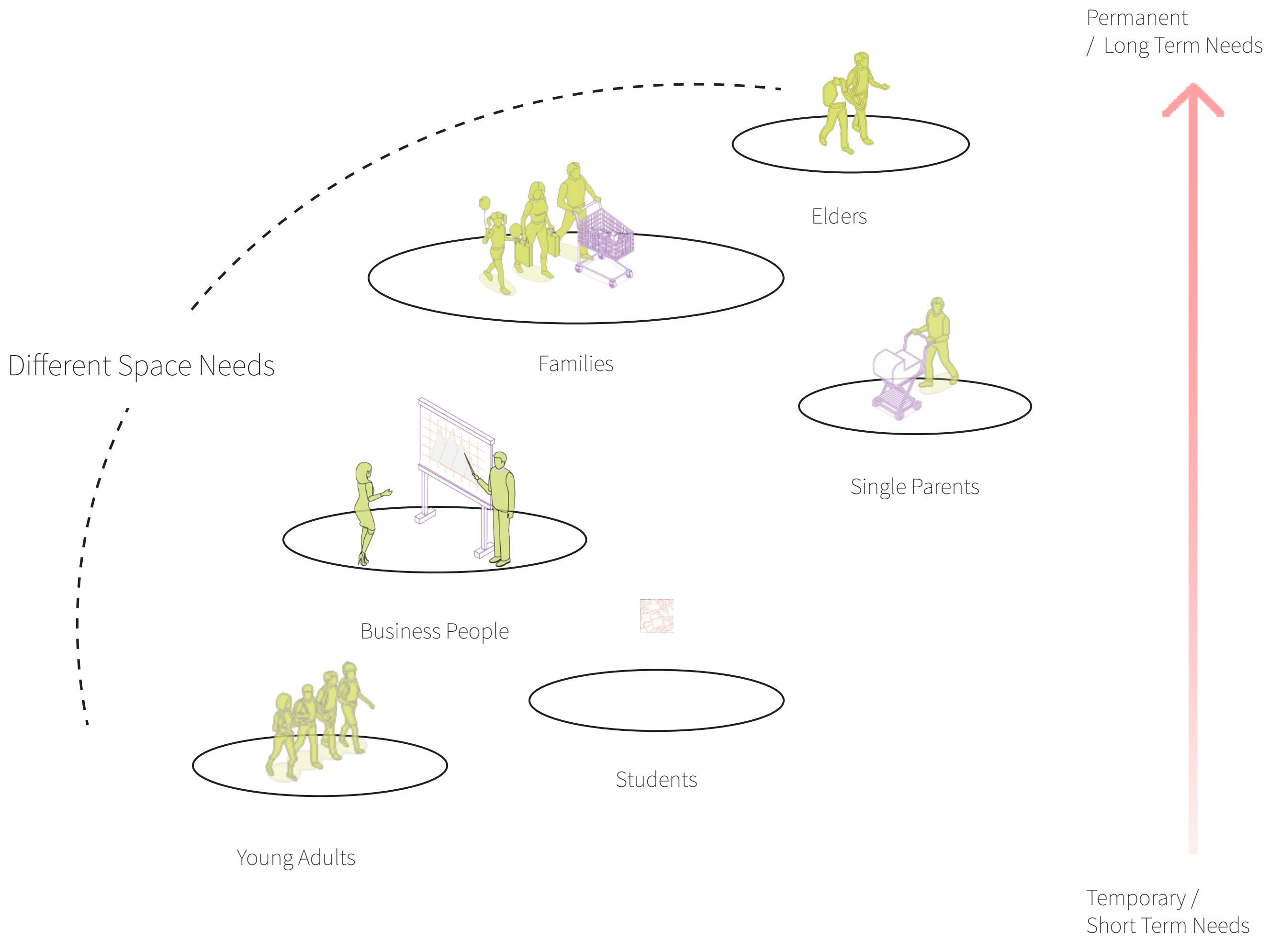


Understanding Daily Life & Space Needs

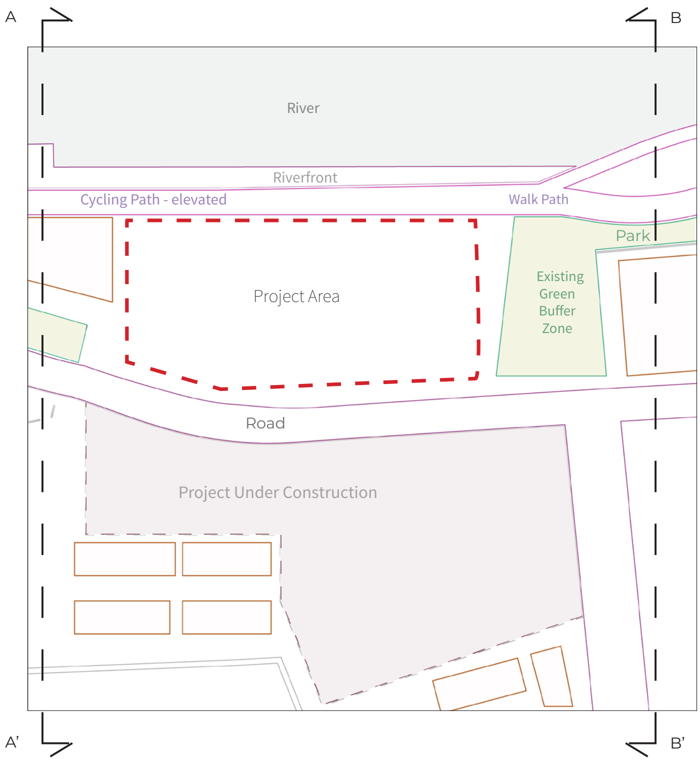
The aim with this tall building is to introduce a new concept on living in the 'tall building'. The analysis that is made on the other tall buildings in Shanghai, shows that the way of life in these areas are all other areas, are switched on and off according to the time of day or the day of the week. People living these places defining themselves as dormitories around which the presence of places that host other types of activities is rare and where the users, or rather the inhabitants, do not find places and ways to interact, interrupting those social movements that give life to a community.
It is essential to the the tower is the quality of life, of the spaces and interactions that, this time, take place inside a tower. On this, we would like to discuss three fundamental points that we believe to be among the major contributors to the theme: the psychological effects of living vertically, the monotonous repetition of floors that leads to the disorienting indistinguishability of spaces, the discordance between the programmatic layout and the reality of the users. (i.e. towers created for an indistinct "user X" far from the reality of the Shanghai inhabitants and their needs).

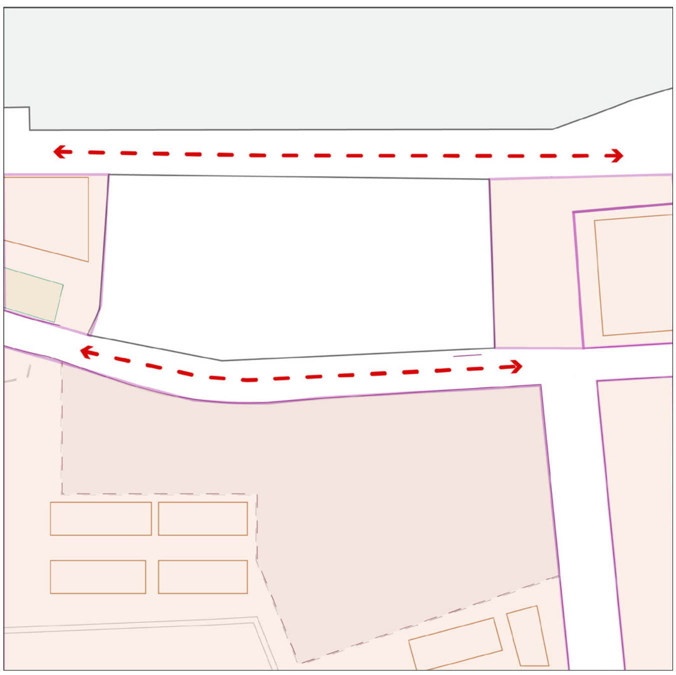
So why not work on this critical architectural typology with the intention of finding new solutions, given that it will not abandon the "Port of the Orient" so quickly, but instead is becoming increasingly representative of it.
The approach we propose is to develop a tower that adapts to the real needs of those who use it, that is shaped according to the reality of the social structure of the community to which it will belong, and that creates a new way of contemplating the relationship between the tower and the city; blurring through the podium towards the level of the public street.

ARCHITECTURE
USERS & SPACE NEEDS



User Profile and Space Needs

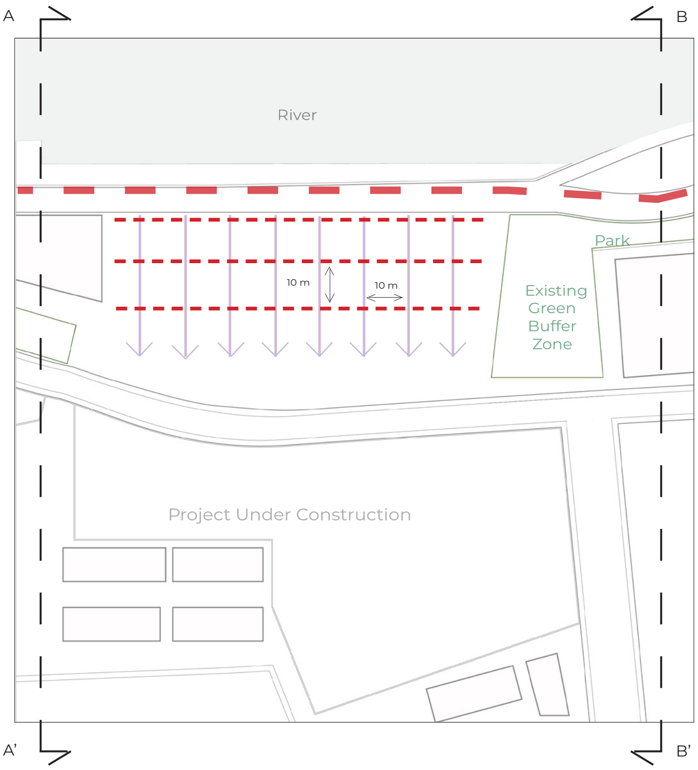


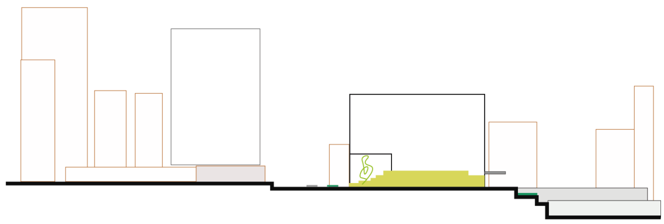


Understanding the existing conditions of the context was a crucial step to have proper approach on design decisi-ons such as footprint, height, and defining the relations-hio with ground.

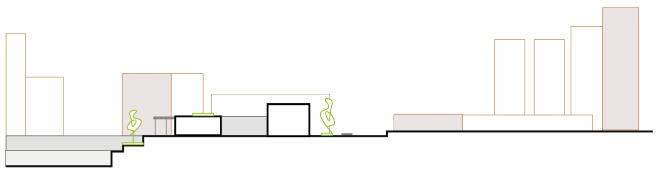
The pedestrian flow is following the riverfront, further through the west meeting with the green axis. While

PROJECT SITE
CLOSE CONTEXT



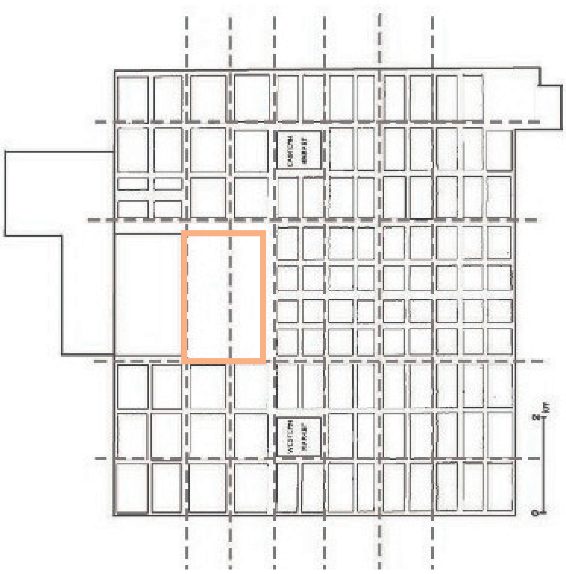


Section AA

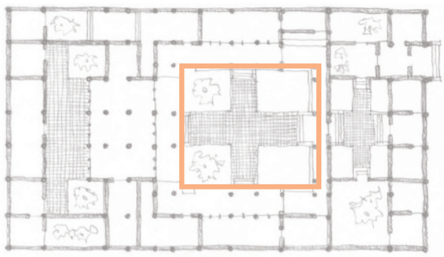


Section BB

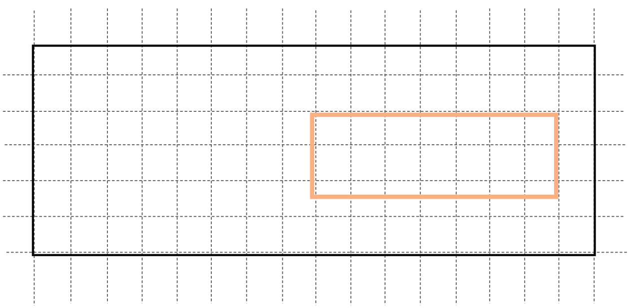
Taking the elevated cycle path as the main reference axis to form the building footprint- as it is a pattern that all the river front buildings in context.



City of the Kings Structure



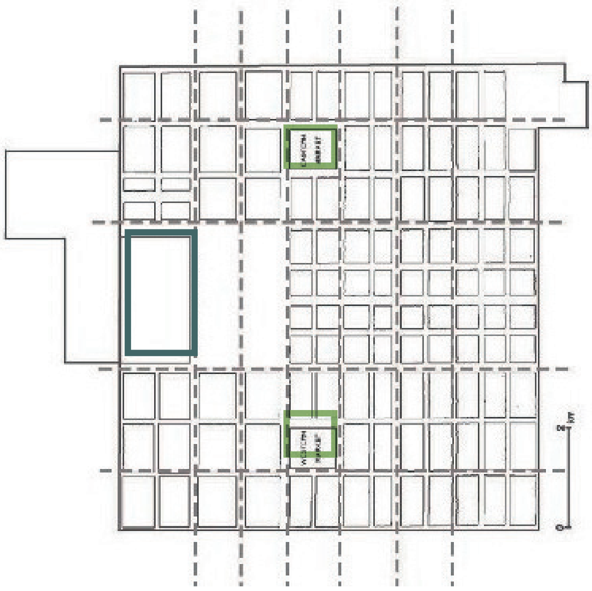
Ming-Cing Quadrangular Courtyard



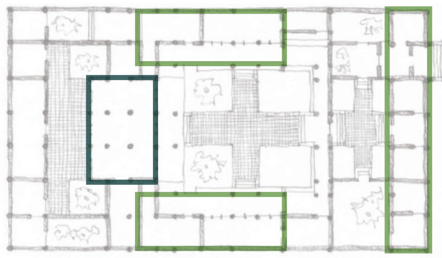
Project Adaptation

COURTYARD & CHINESE TRADITIONS

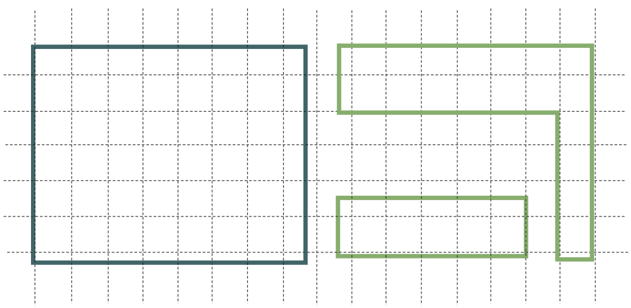
ARCHITECTURE



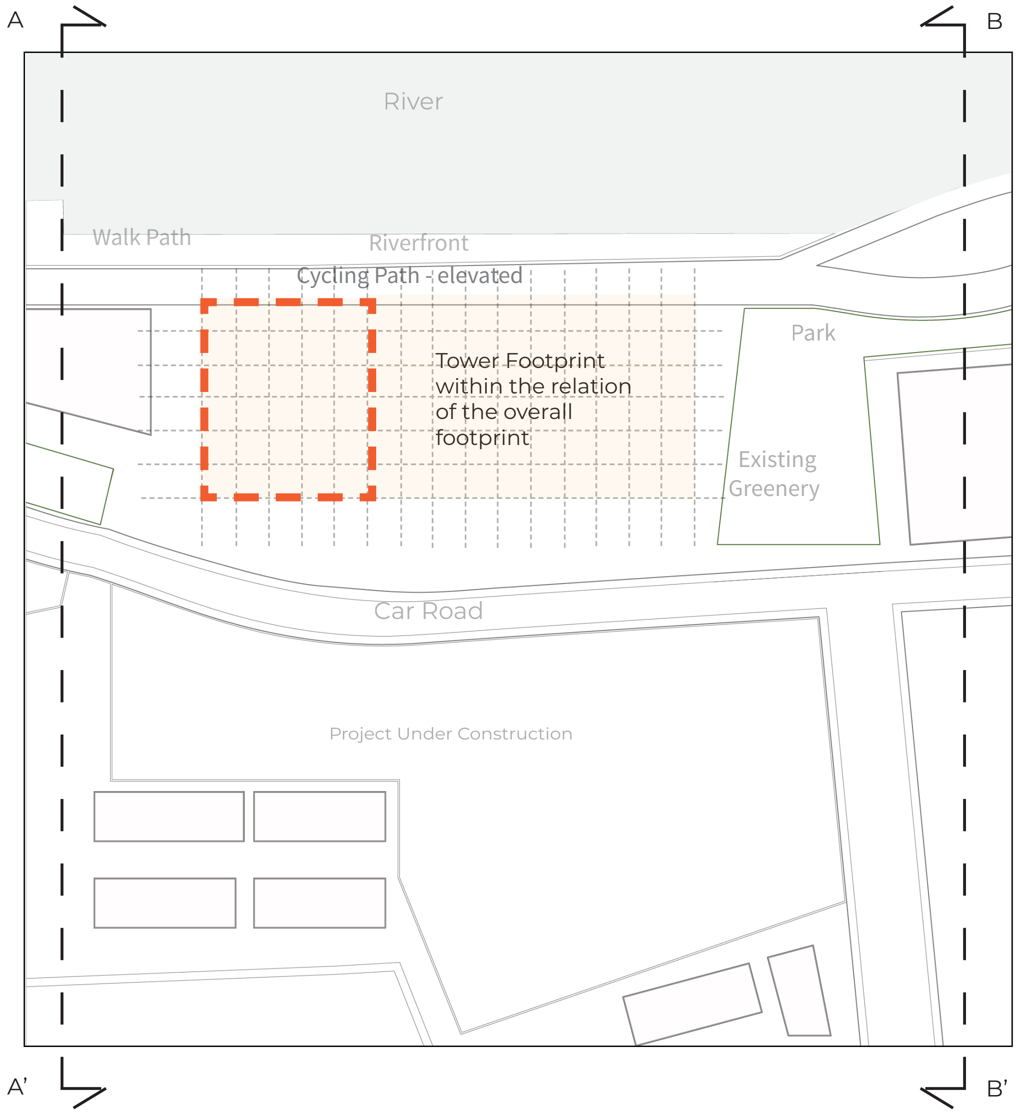
City of the Kings Structure



Ming-Cing Quadrangular Courtyard



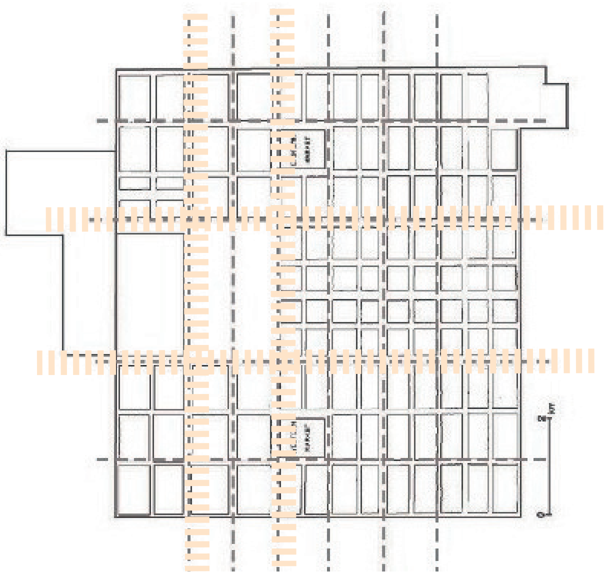
Project Adaptation



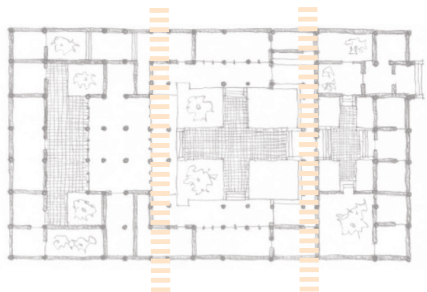
Footprint that is generated from the main bike road axis; formed with 10x10 m units.

Taking the elevated cycle path as an axis to form the building - as it is a pattern that all the river front buildings in context.

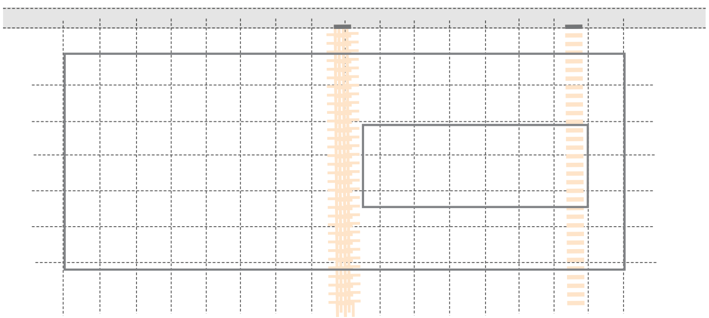
COURTYARD & CHINESE TRADITIONS



City of the Kings Structure

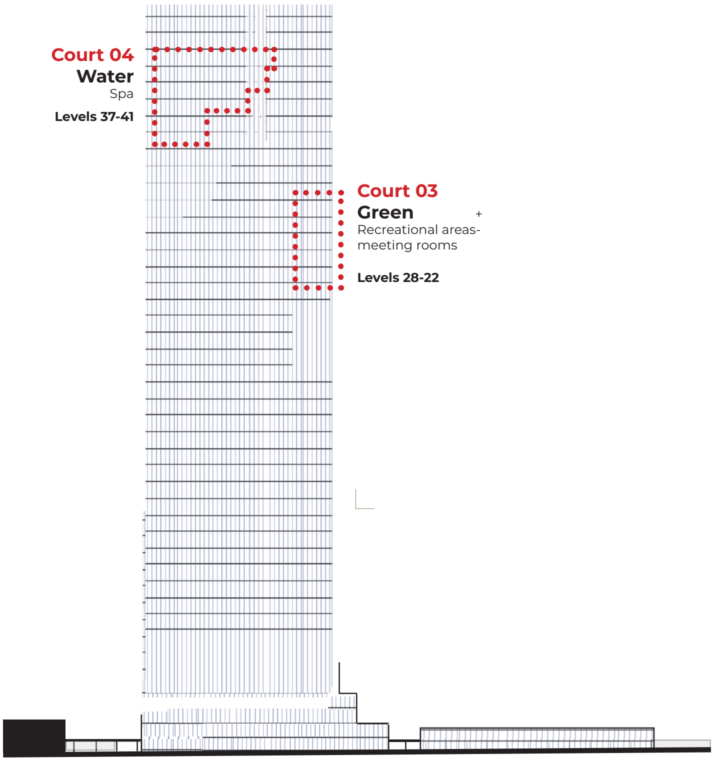


Ming-Cing Quadrangular Courtyard

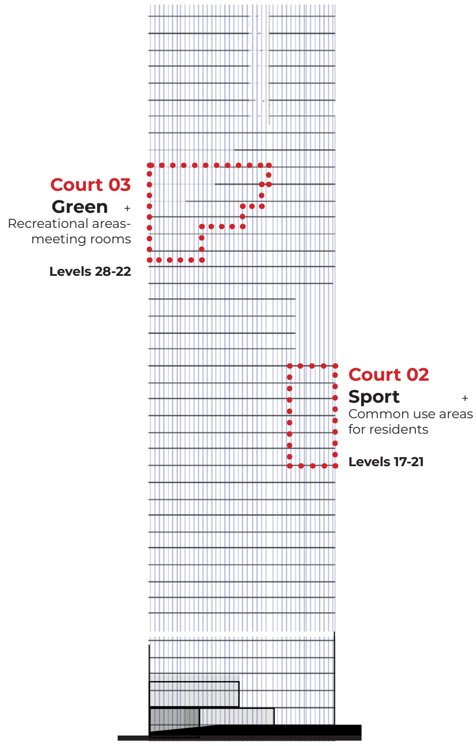


Project Adaptation

ARCHITECTURE
SPACE CONFIGIRATIONS

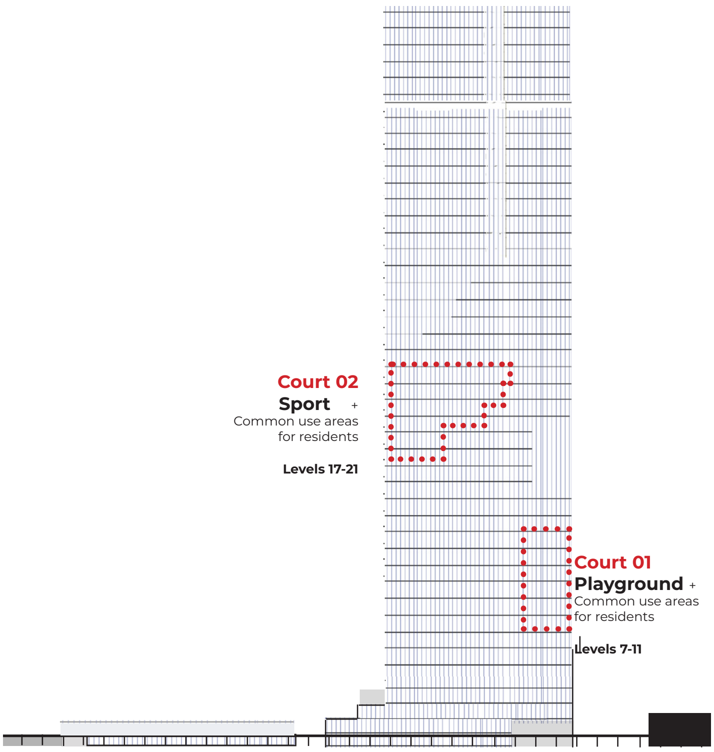


South Side

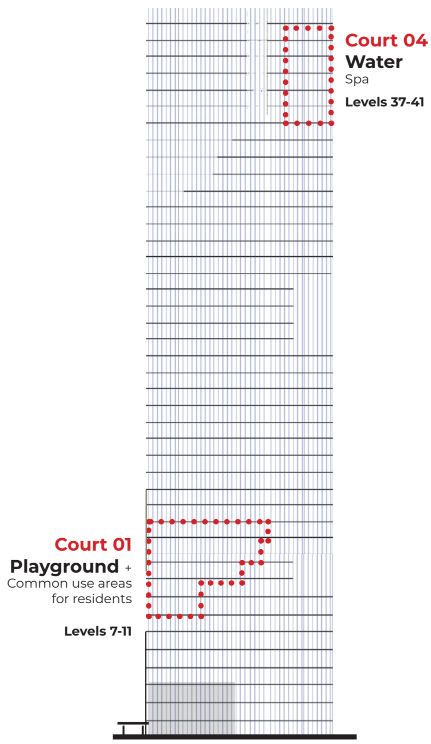


East Side

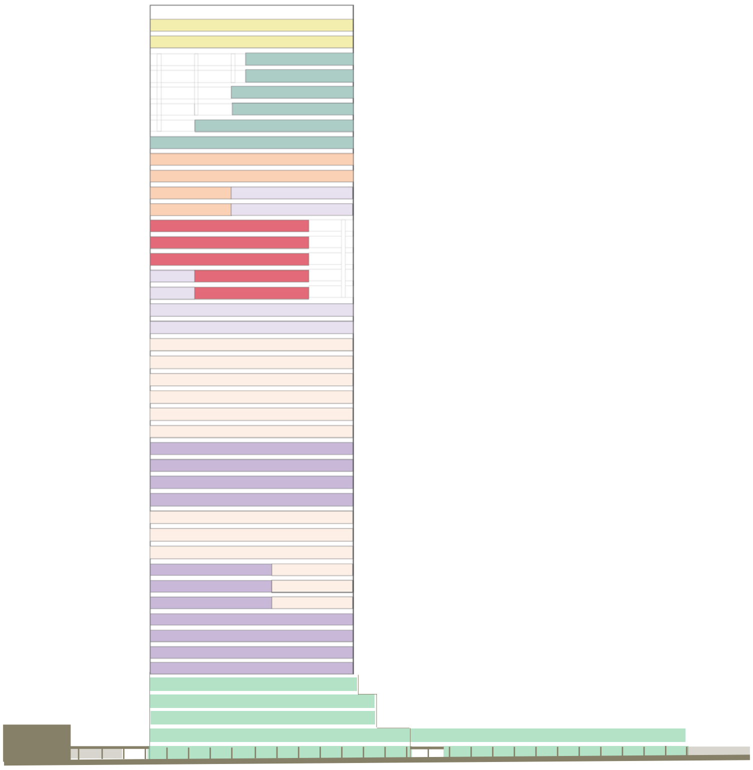
ARCHITECTURE
LOGGIA & COURTYARD



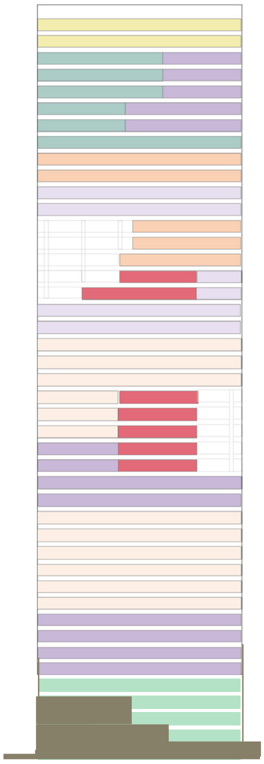
North Side



West Side



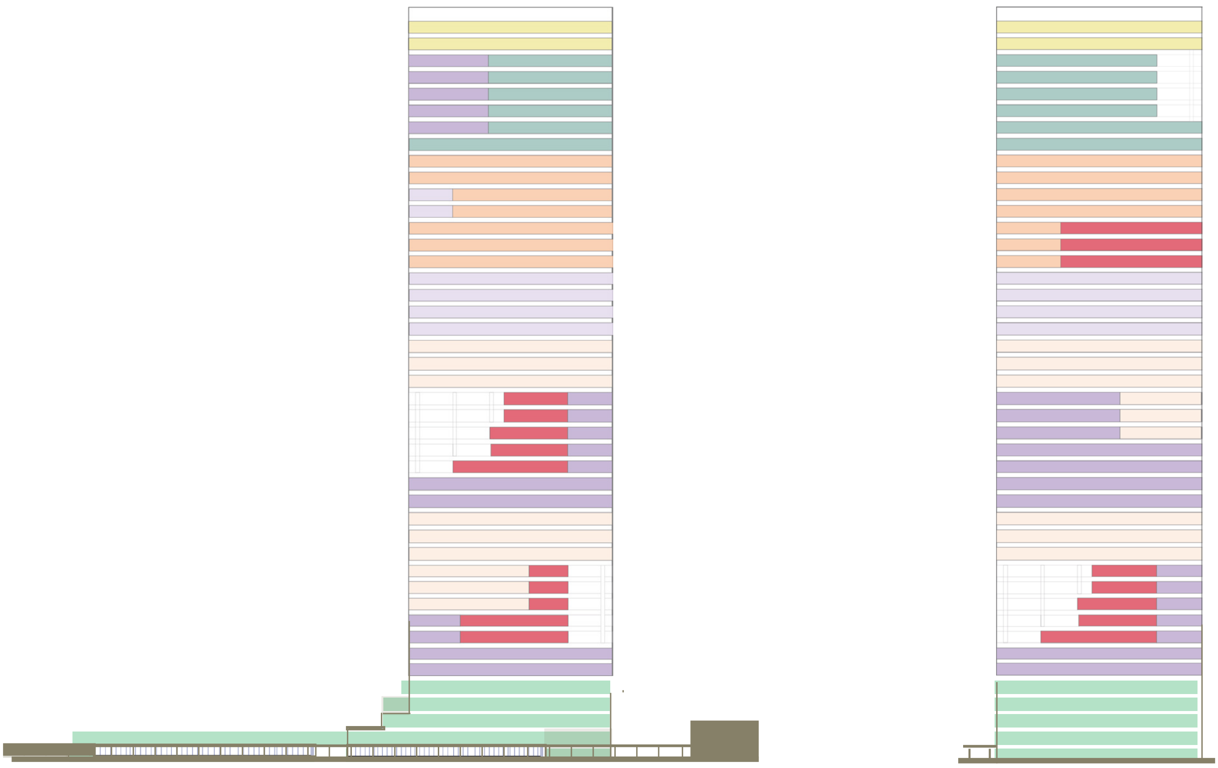
South Side



East Side

ARCHITECTURE
FUNCTION PROGRAM

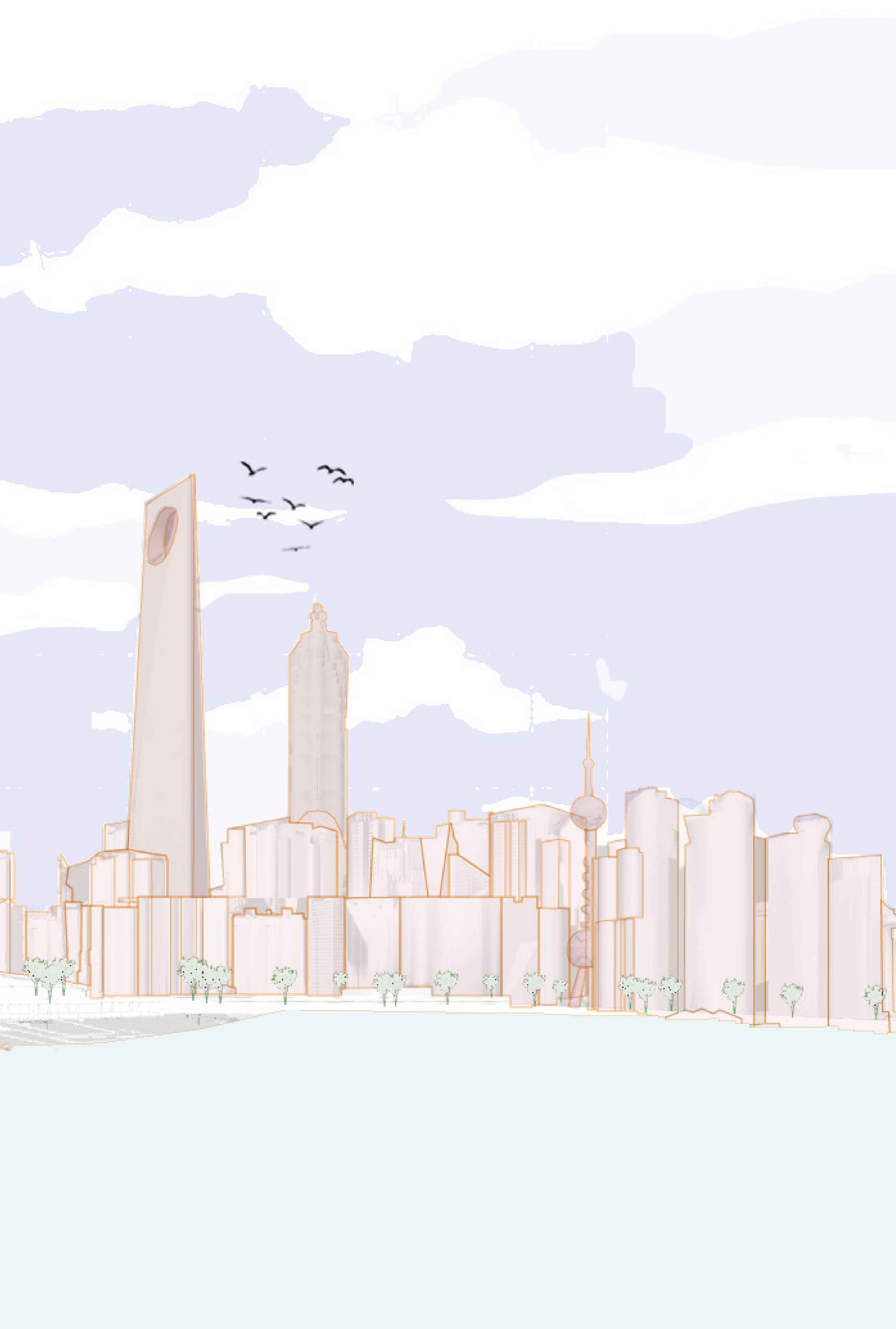
ARCHITECTURE



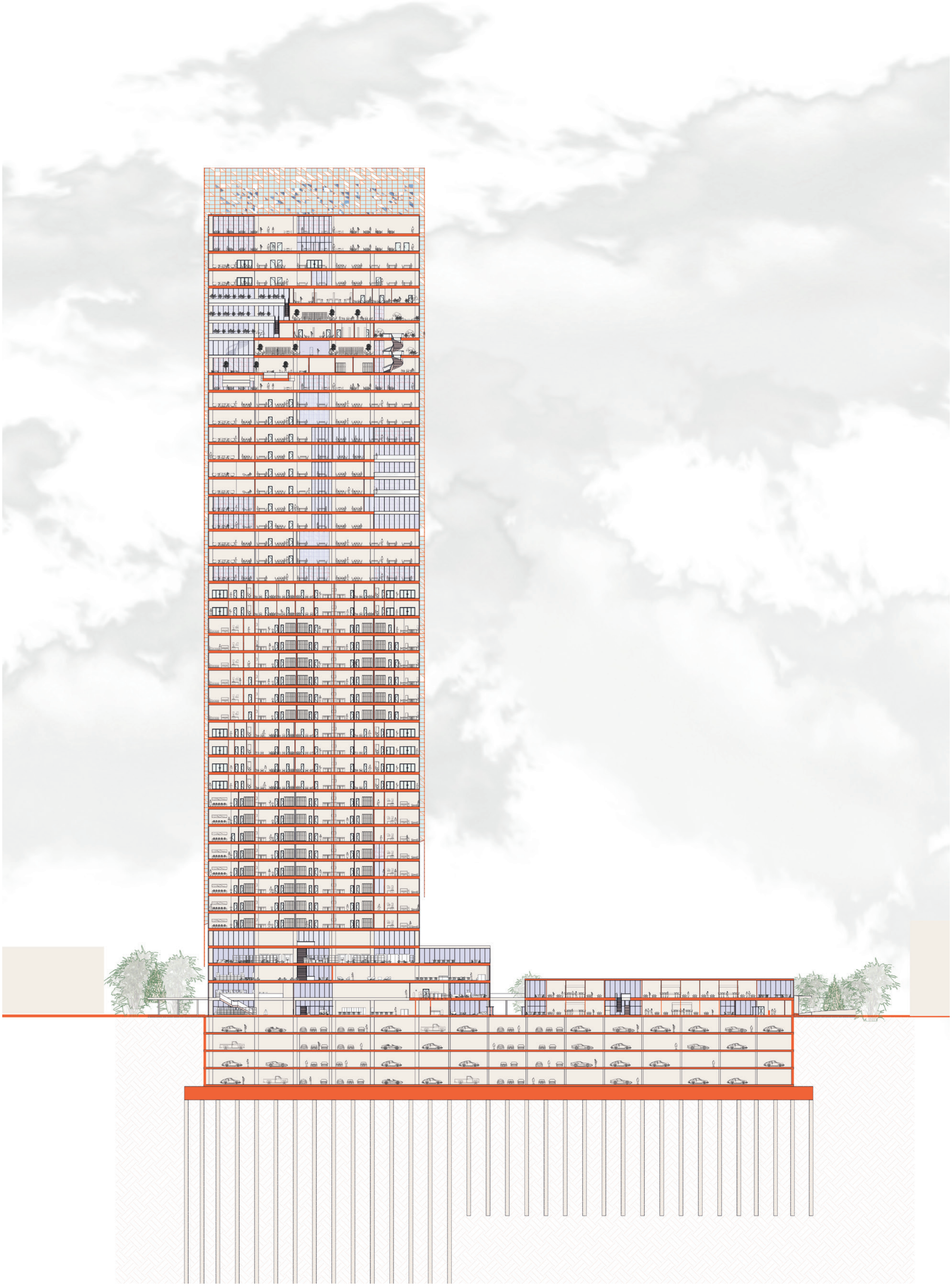
North Side

West Side

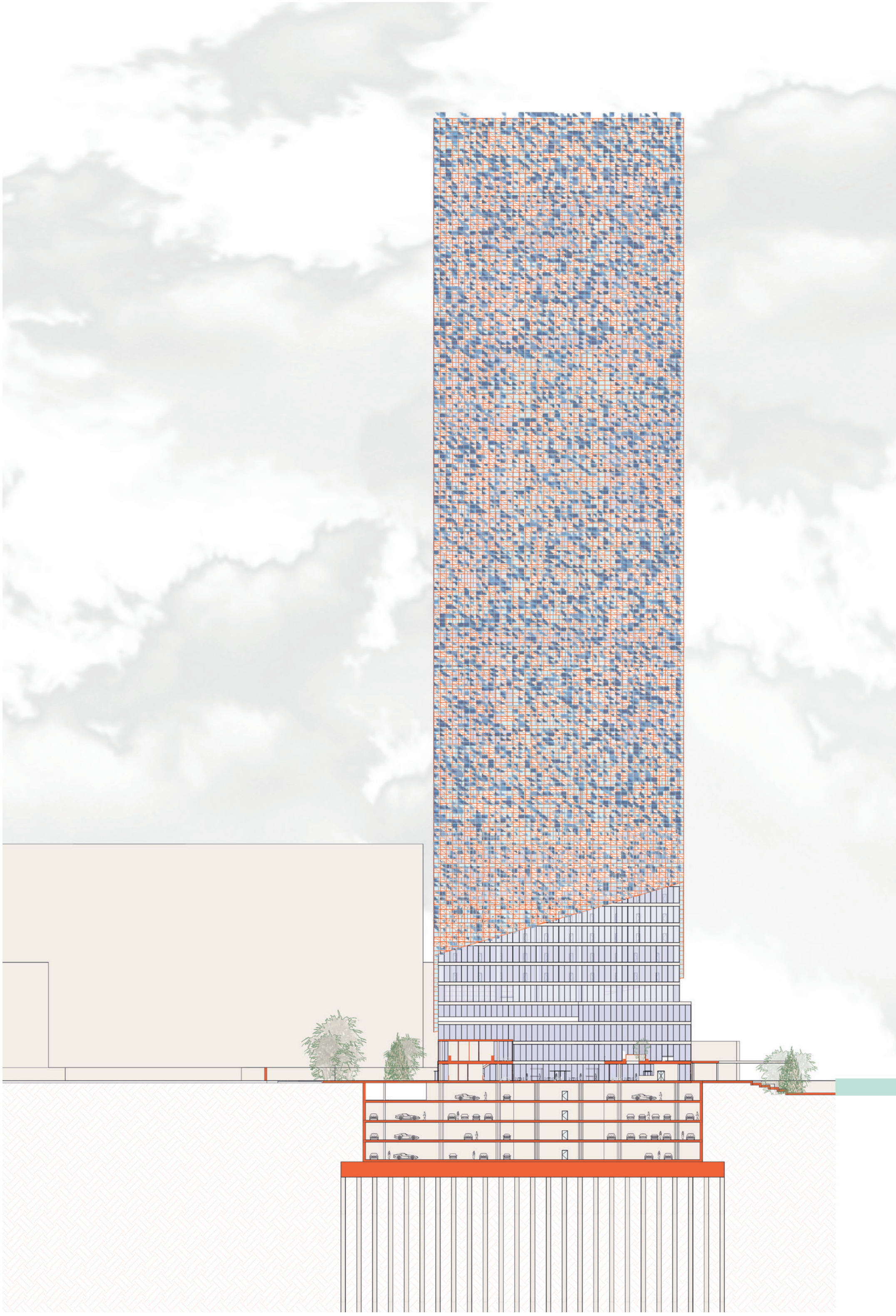
Spa & Recreational Area
Commercial & Public Facilities
Offices Small Scale
Offices Big Scale
Residential- Short Term
Residential- Long Term
Loggias
Theme Related Functions
Restaurant & View Terrace



ARCHITECTURE

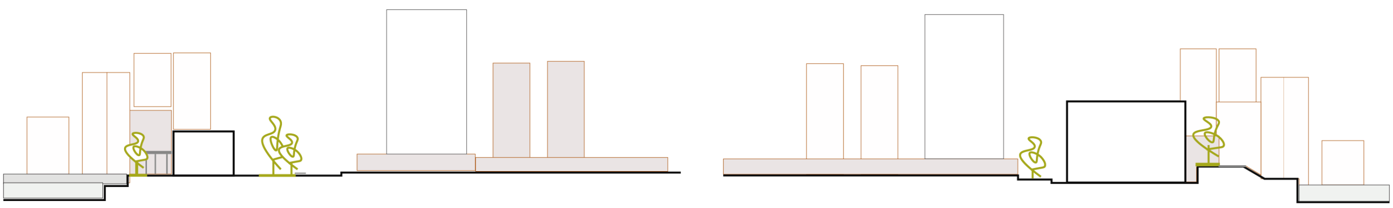


SECTIONS

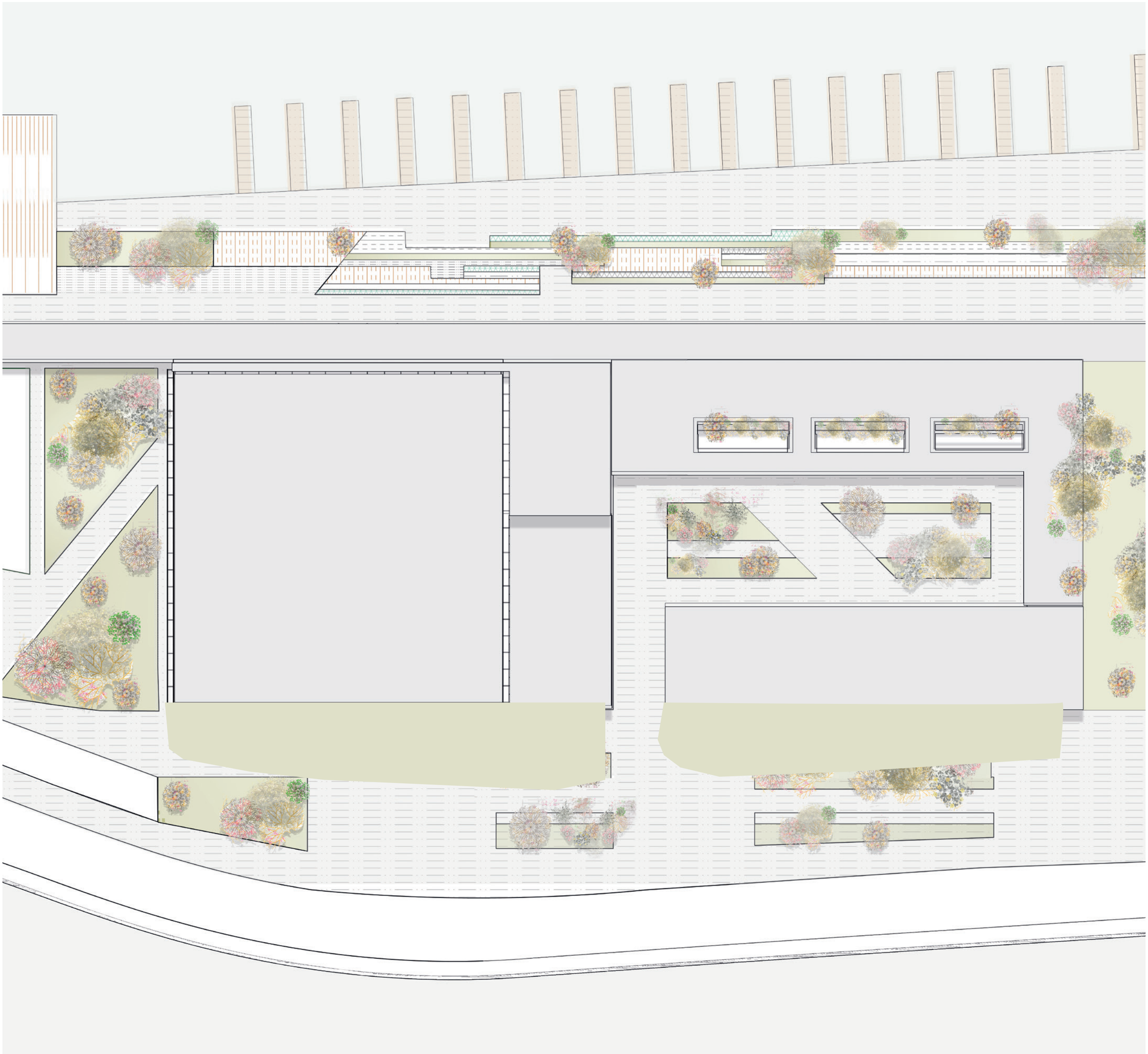


City Skyline

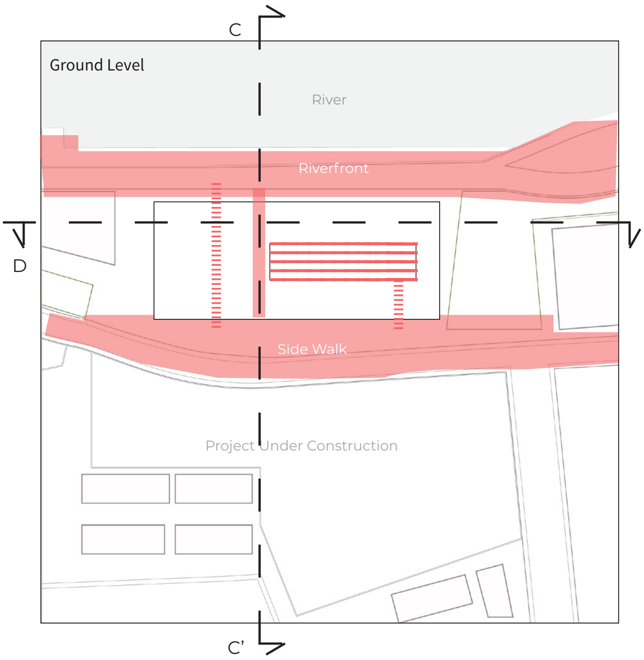
MASTERPLAN



ARCHITECTURE

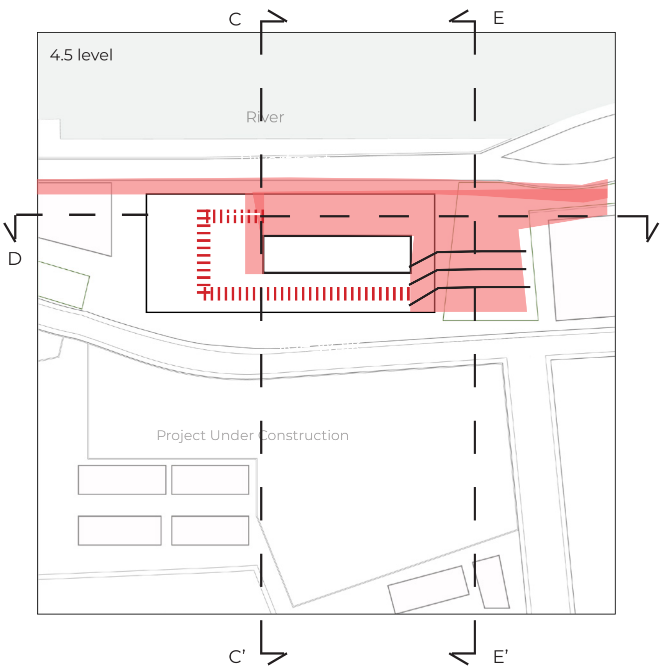


MASTERPLAN
RELATIONS WITH THE GROUND

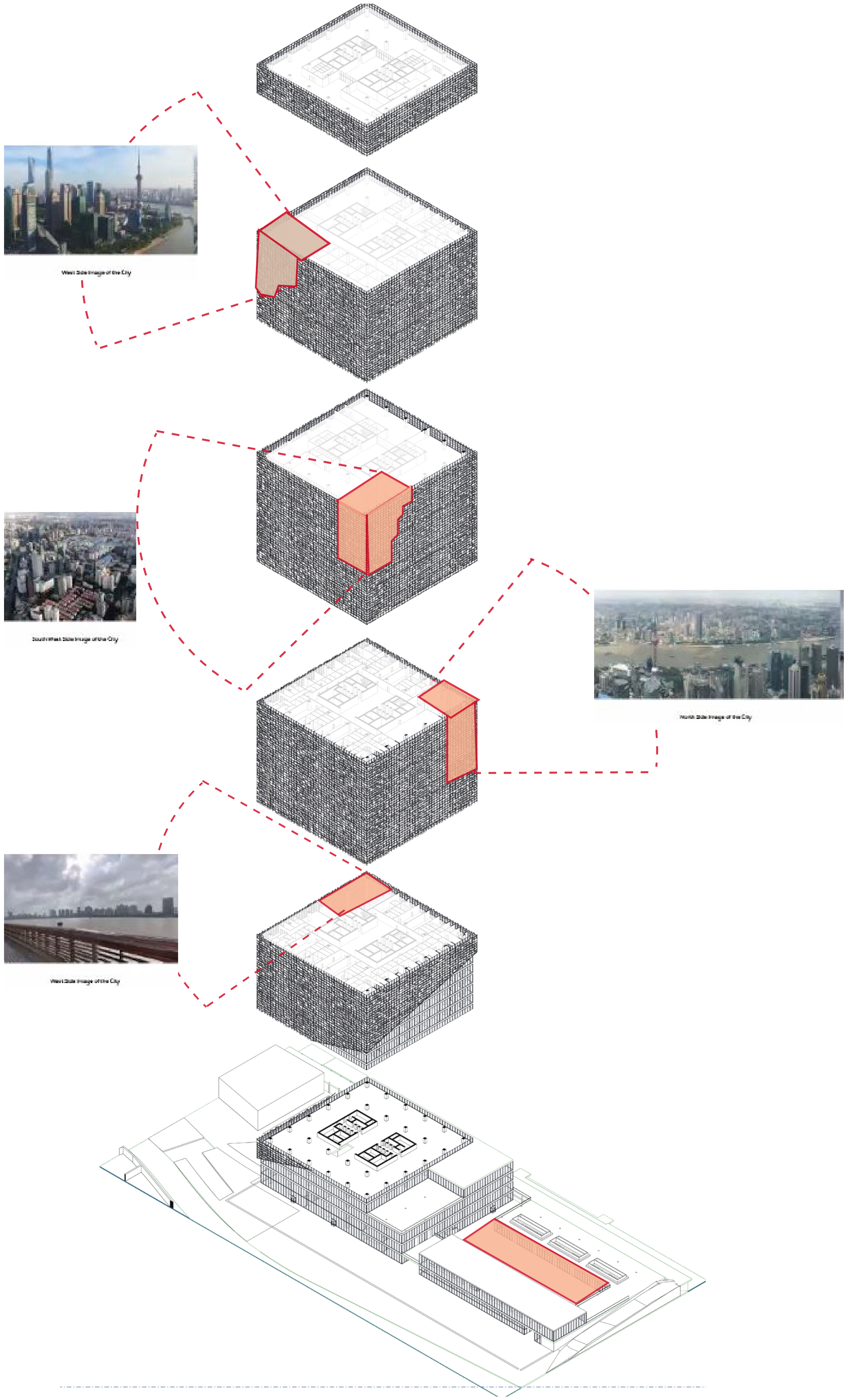


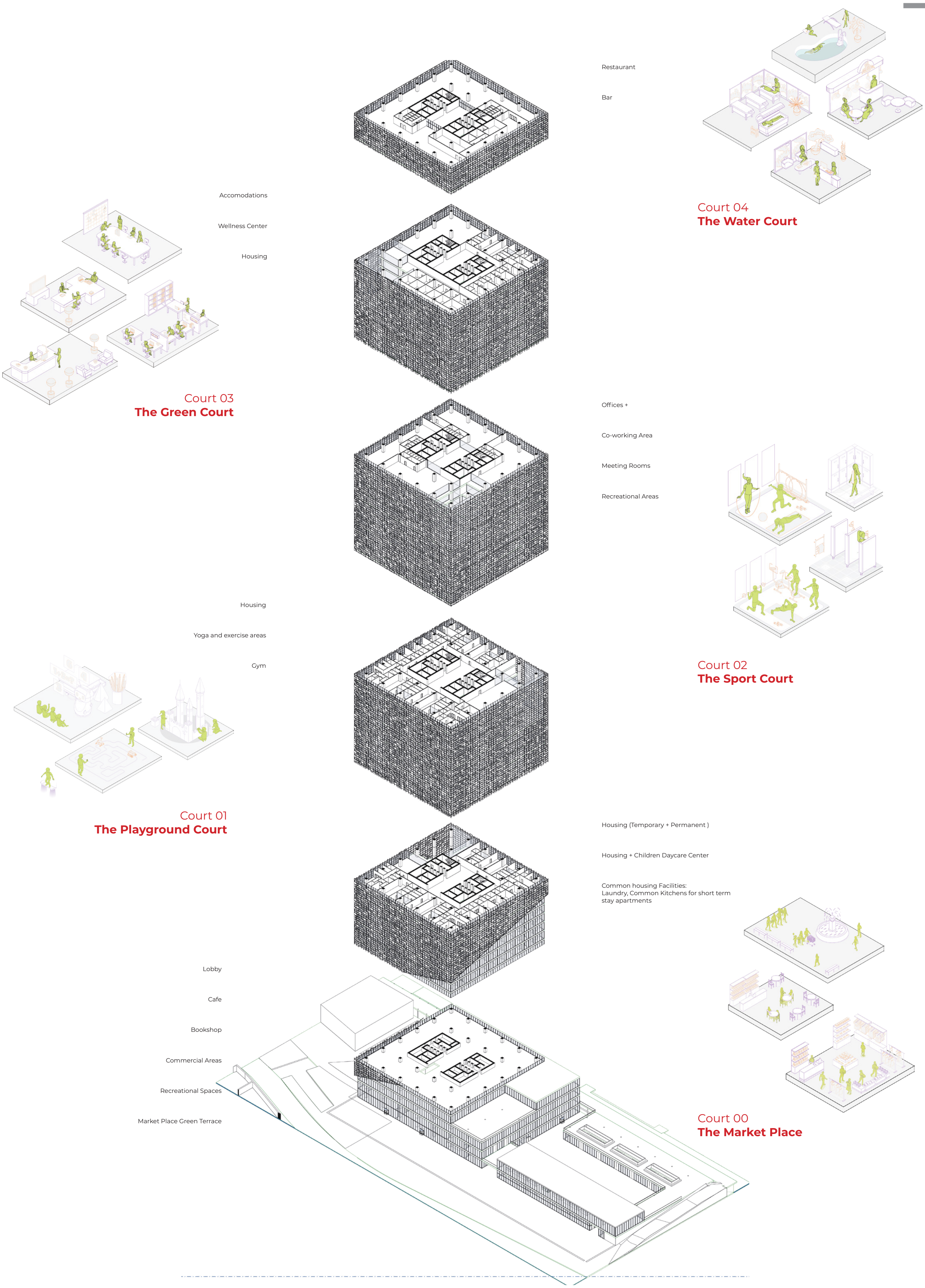
Defining the footprint of the tall building and the position on the site

Forming relationships with different levels of 2 sides with the aim of strengthing the pedestrian and bike flow from city side walk to river side.

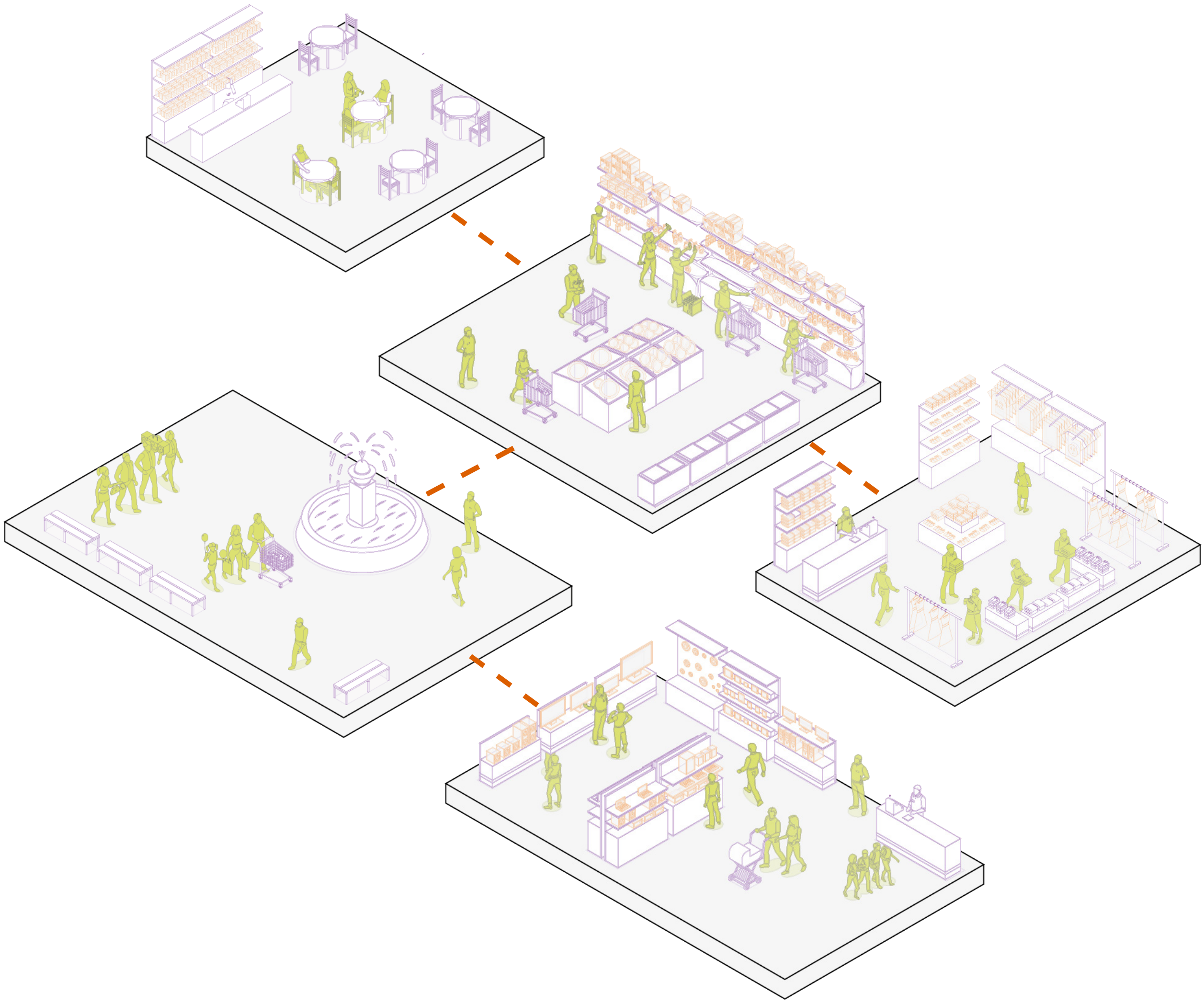


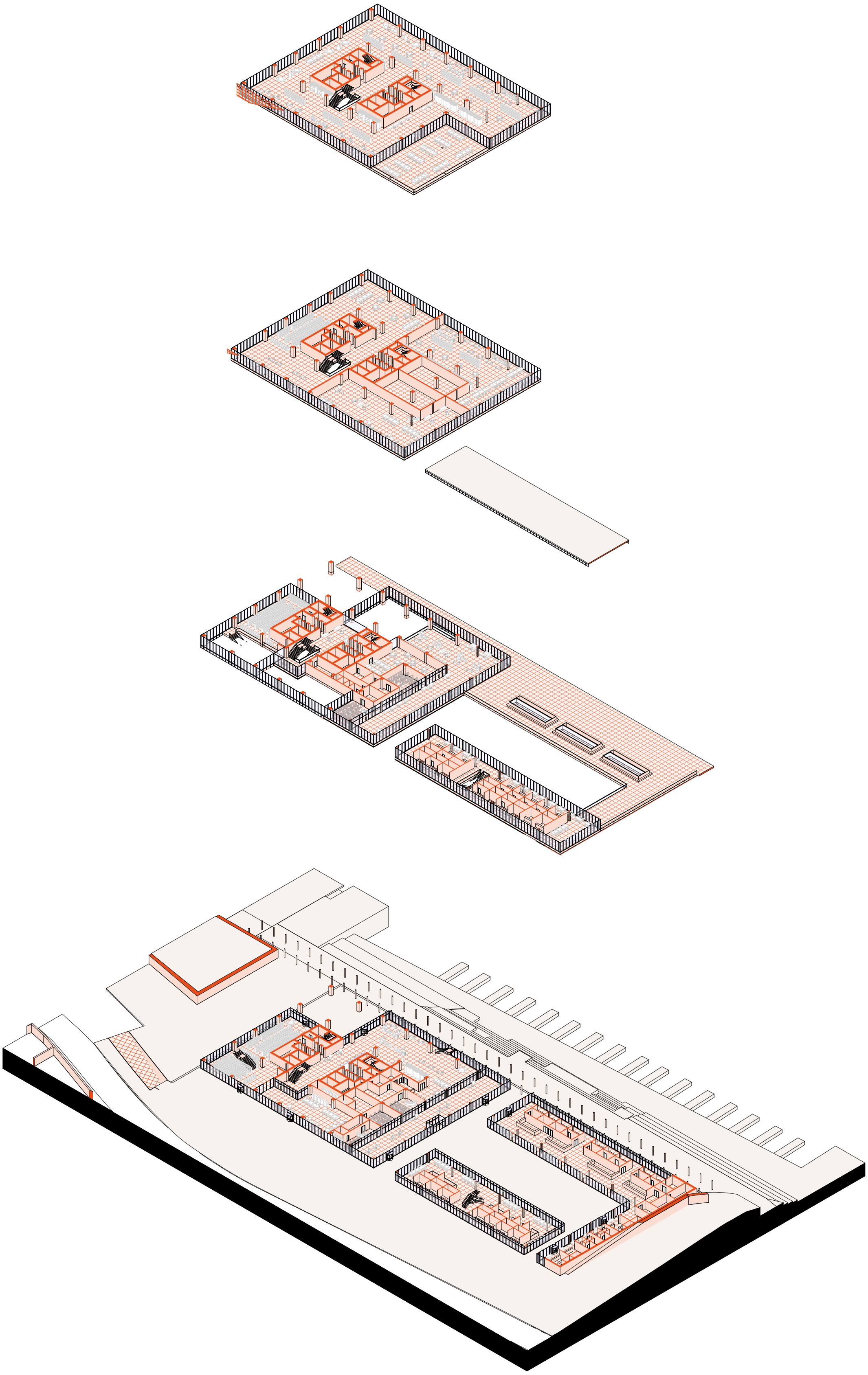
Blending in with the existing park on east and the bike road on rivers side


West Side Image of the City
South West Side Image of the City
North Side Image of the City
West Side Image of the City

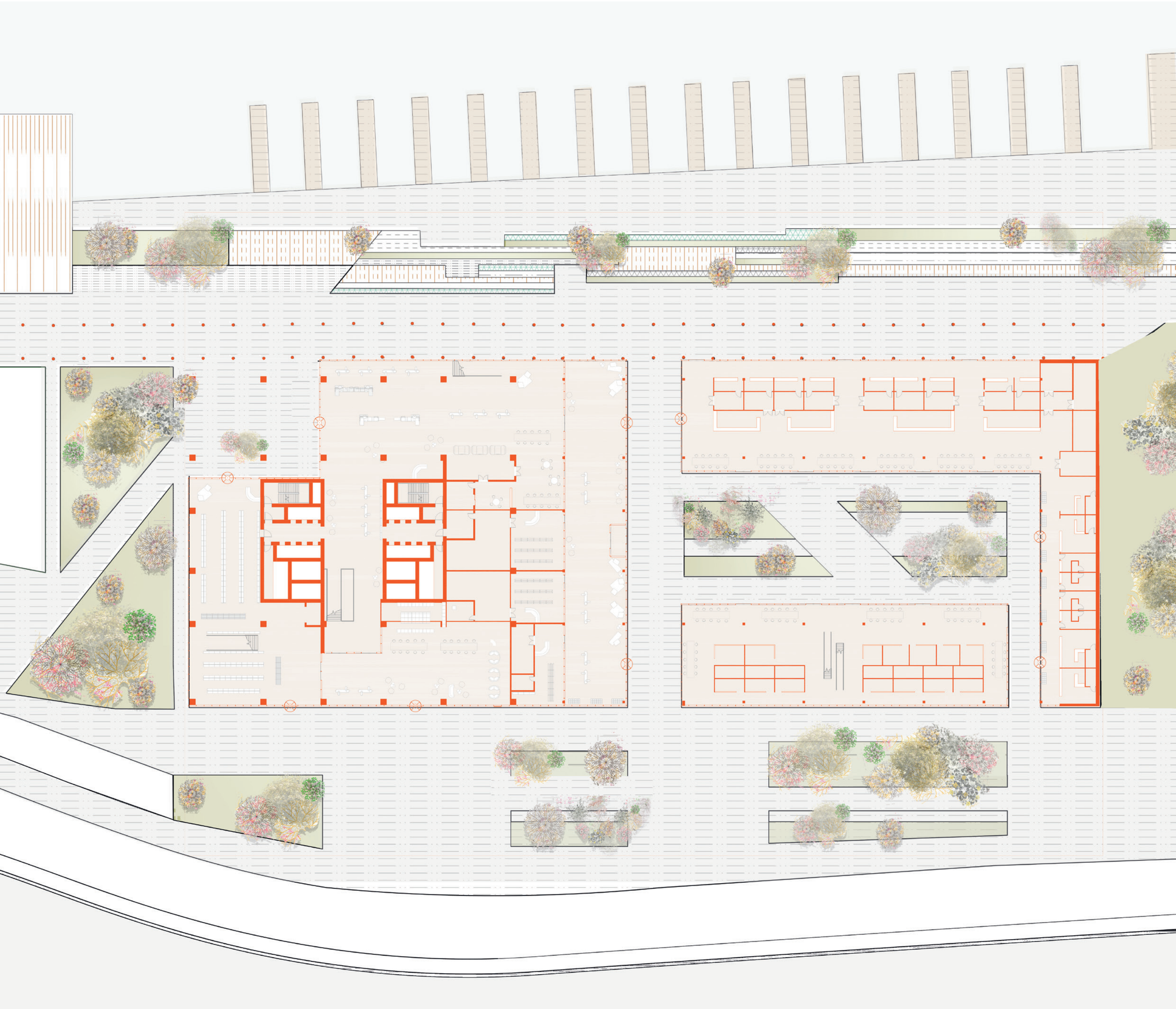

Restaurant
Bar
Court 04
The Water Court
Accomodations
Wellness Center
Housing
Court 03
The Green Court
Offices +
Co-working Area
Meeting Rooms
Recreational Areas
Housing
Yoga and exercise areas
Gym
Court 02
The Sport Court
Court 01
The Playground Court
Housing (Temporary + Permanent)
Housing + Children Daycare Center
Common housing Facilities:
Laundry, Common Kitchens for short term
stay apartments
Lobby
Cafe
Bookshop
Commercial Areas
Recreational Spaces
Market Place Green Terrace
Court 00
The Market Place

COURTYARD
MARKET

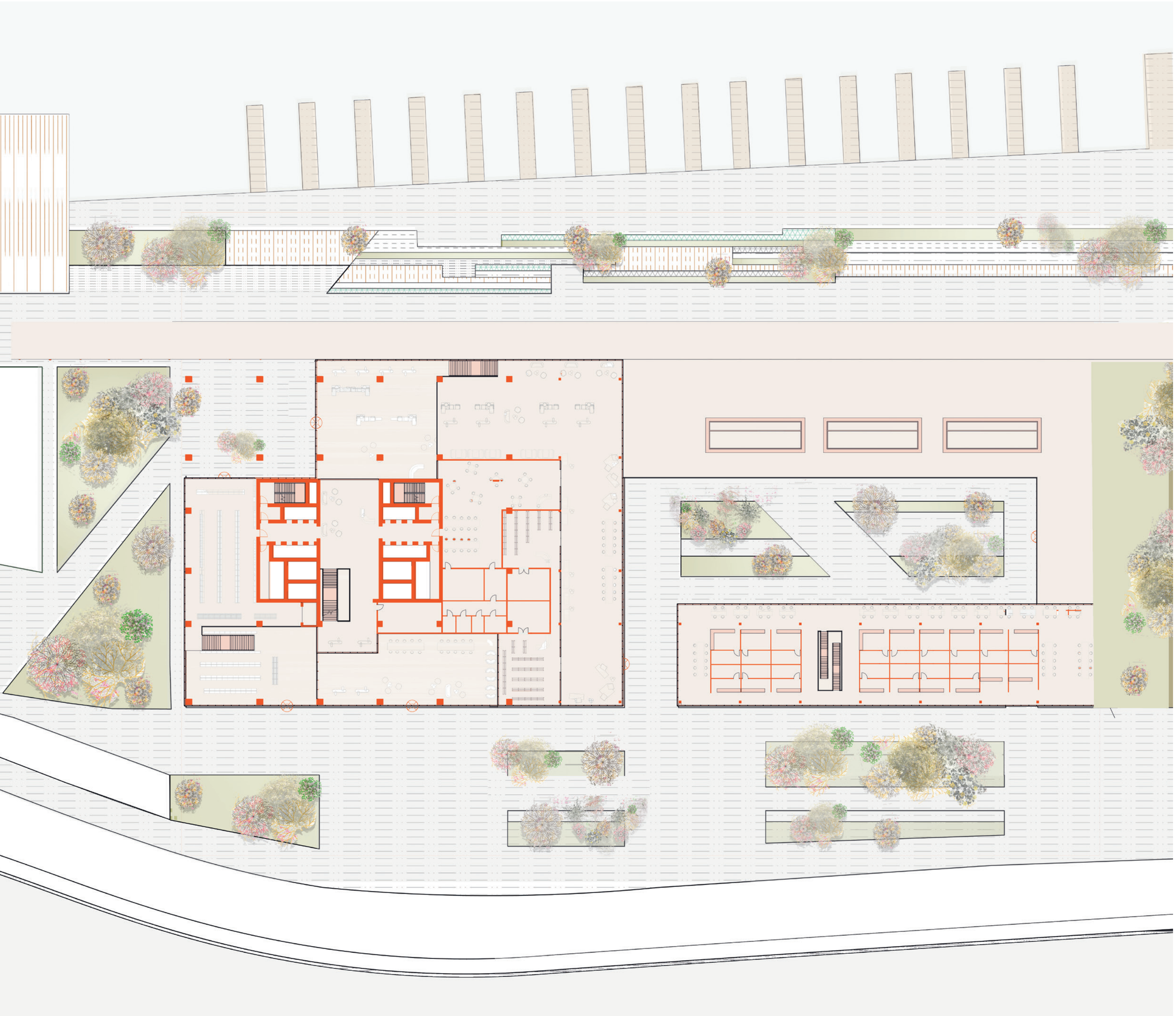




COURTYARD
MARKET

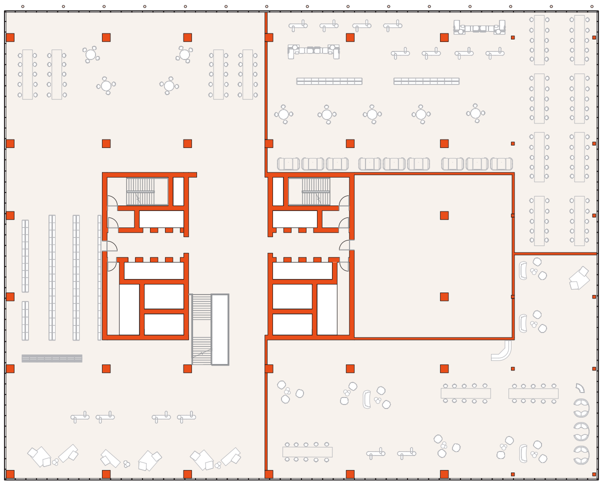


Ground Floor

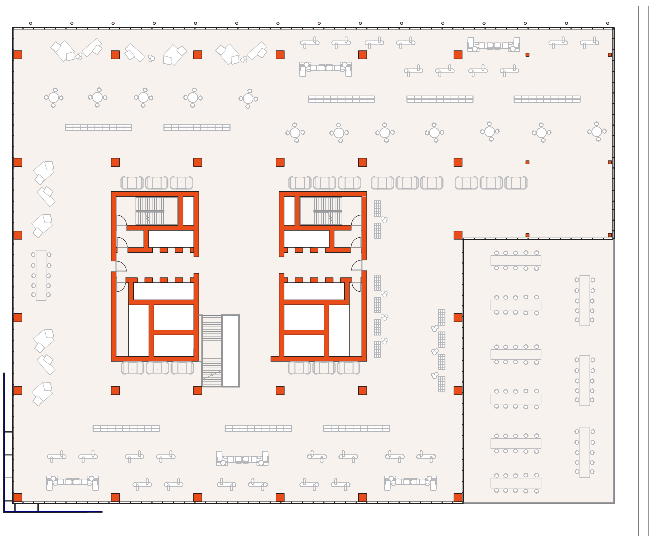


1st Floor

COURTYARD
MARKET

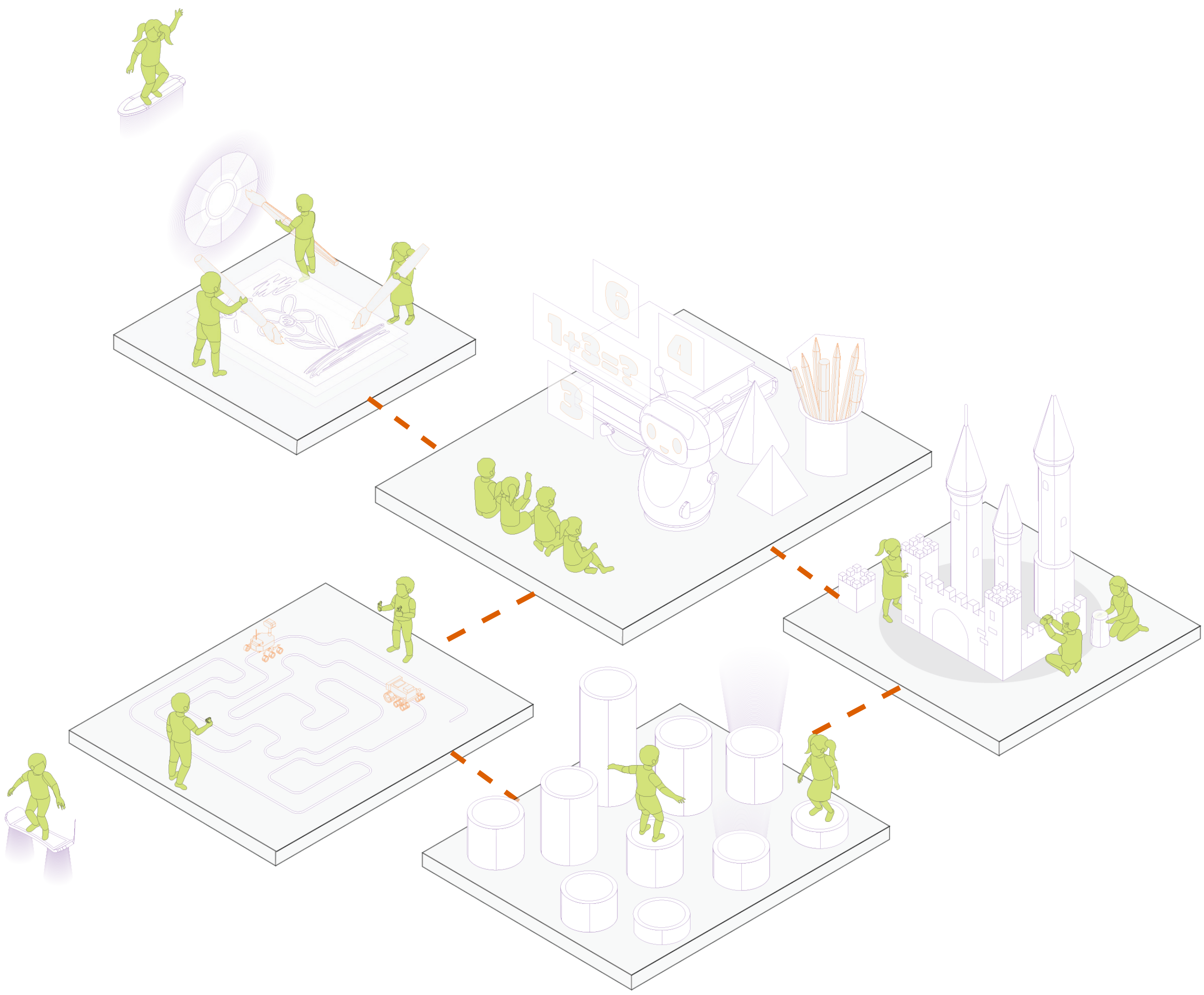


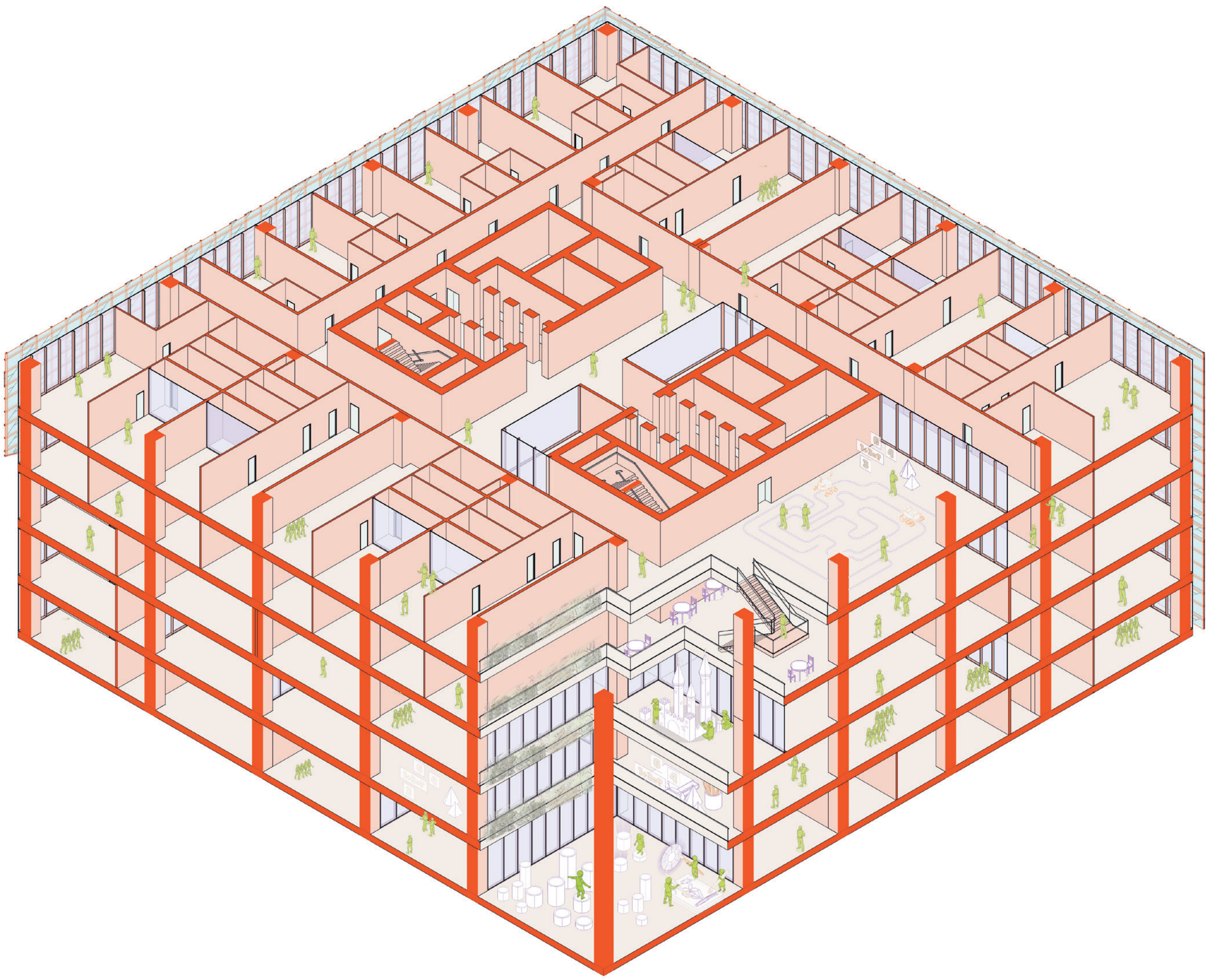
2nd Floor



3rd Floor

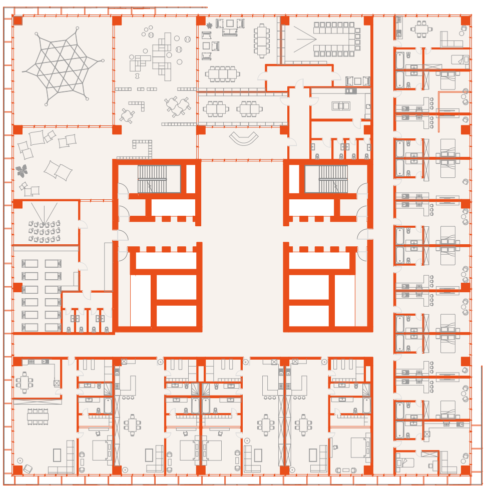
LOGGIA 1
PLAY



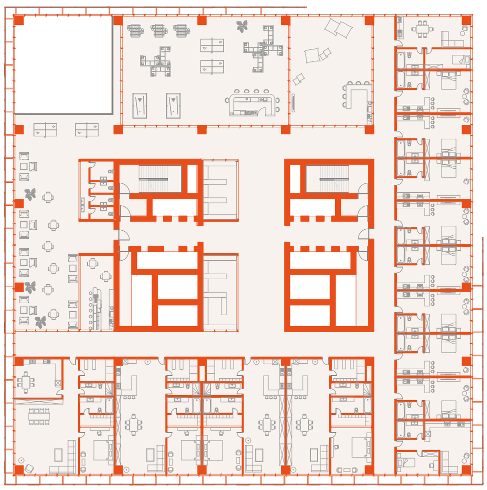


LOGGIA 1
PLAY

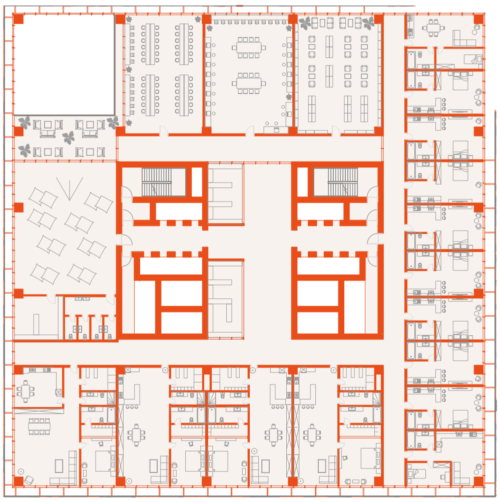
ARCHITECTURE



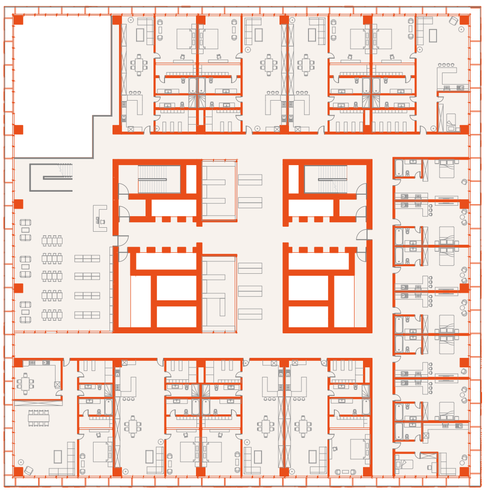
7th Floor



8th Floor



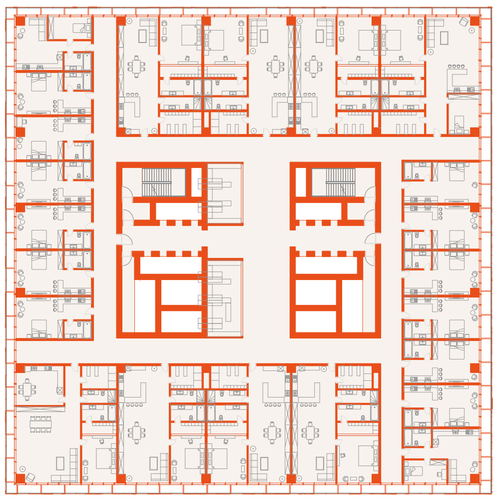
9th Floor



10th Floor

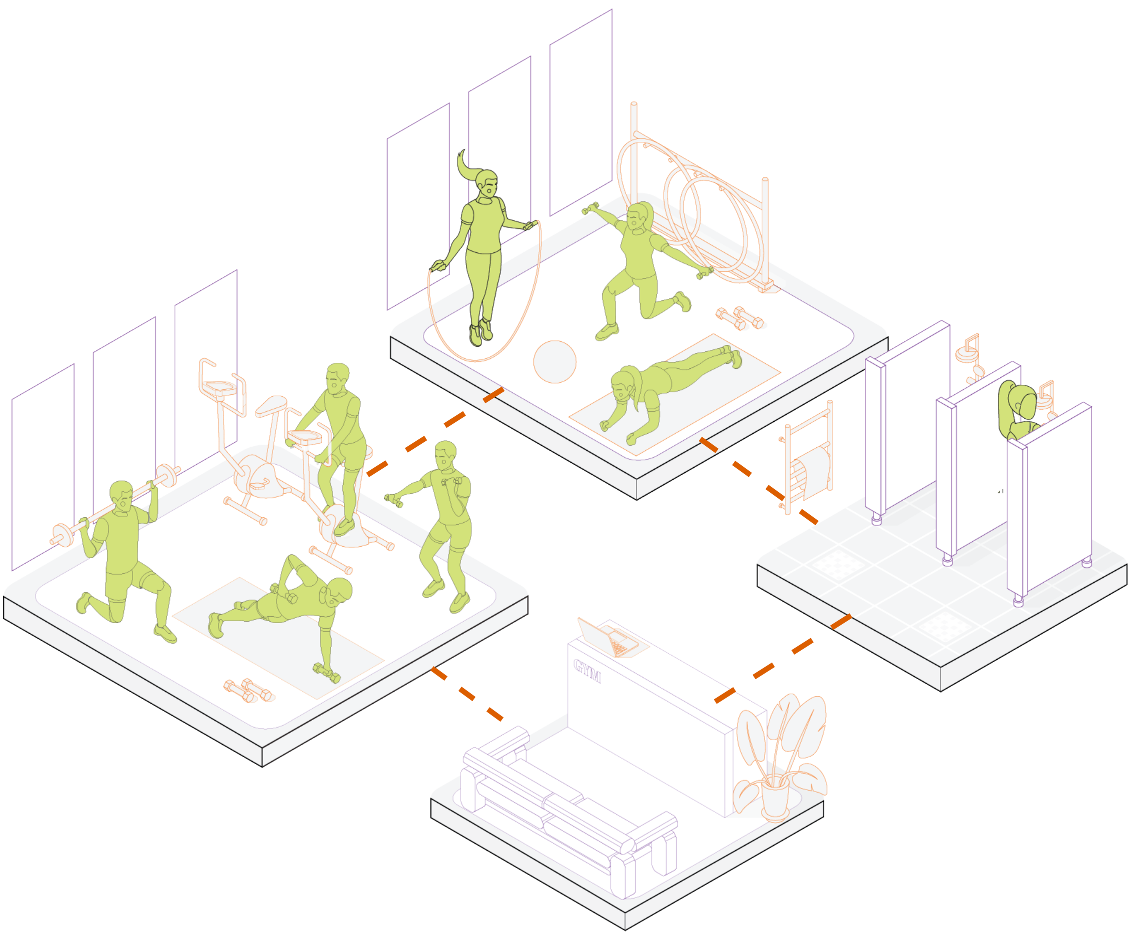
LOGGIA 1
PLAY

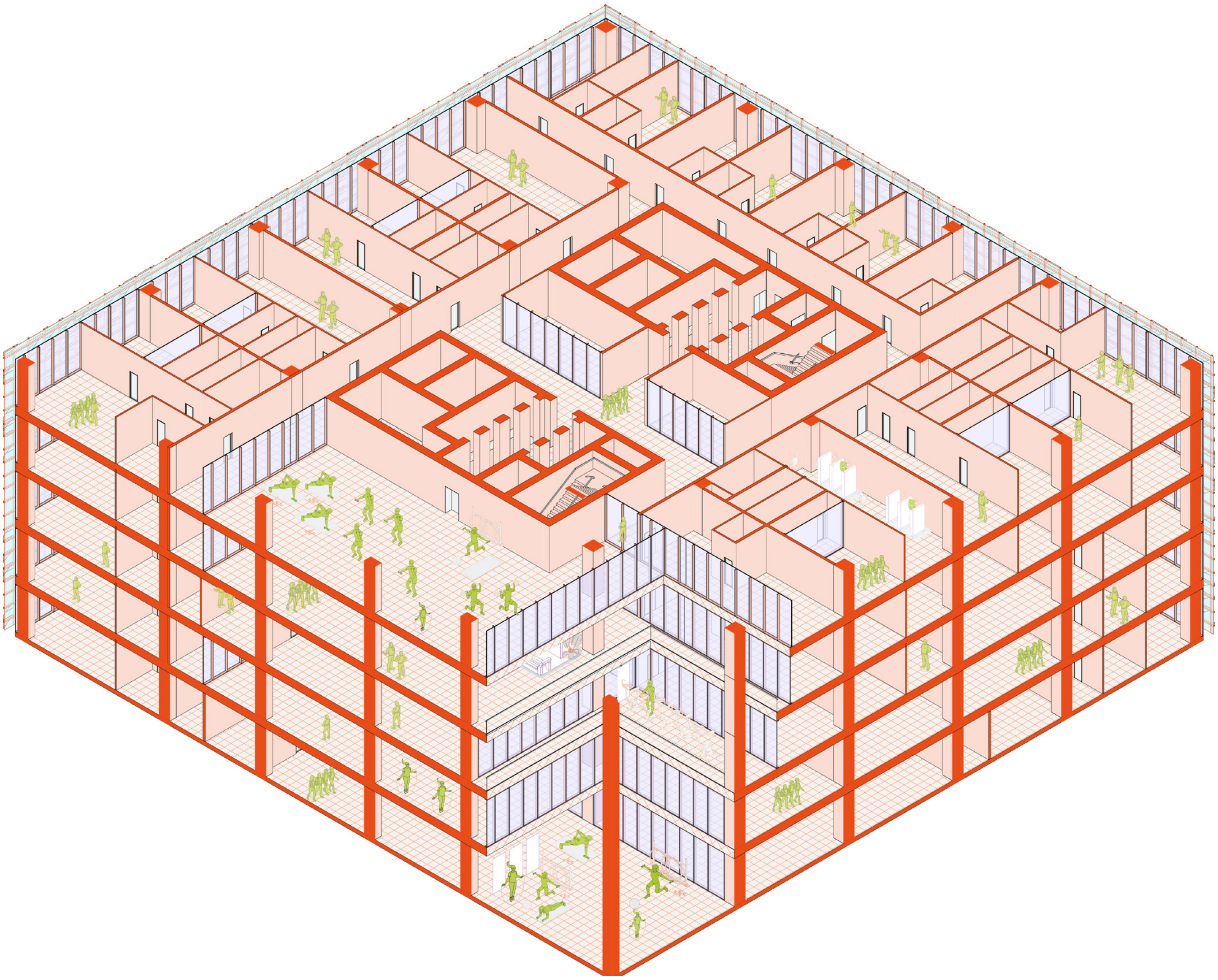
11th Floor



12th Floor

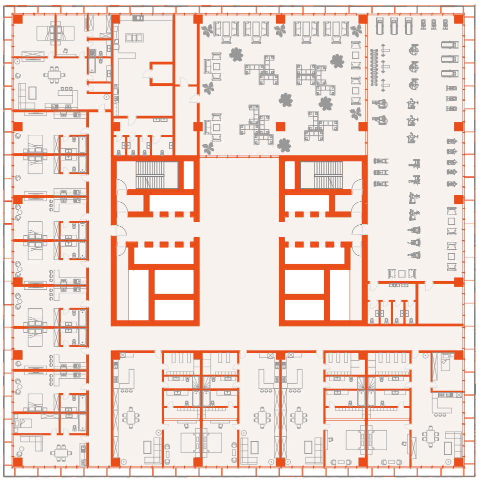
LOGGIA 2
SPORT



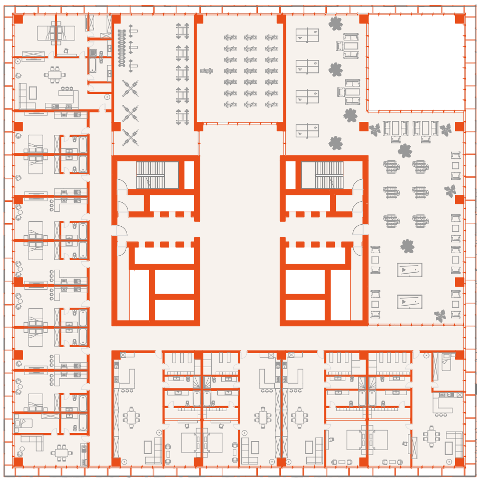


LOGGIA 2
SPORT

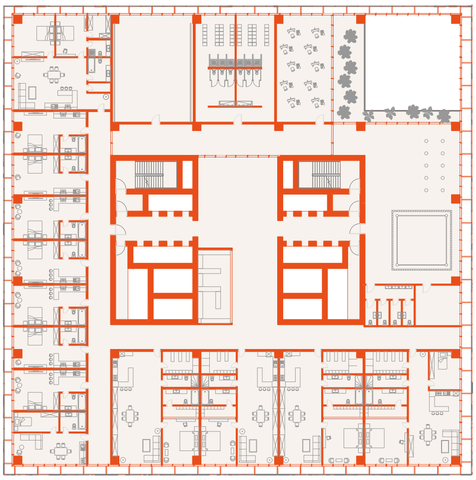
ARCHITECTURE



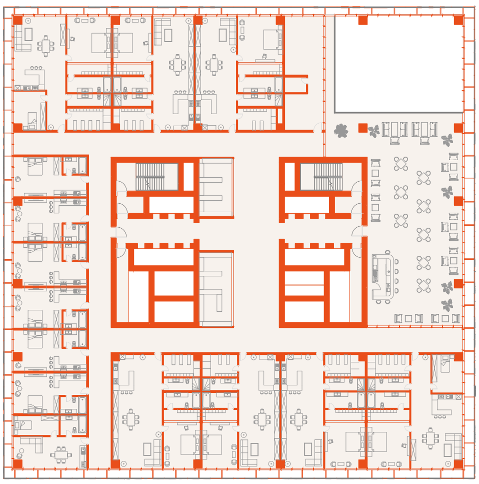
17th Floor



18th Floor

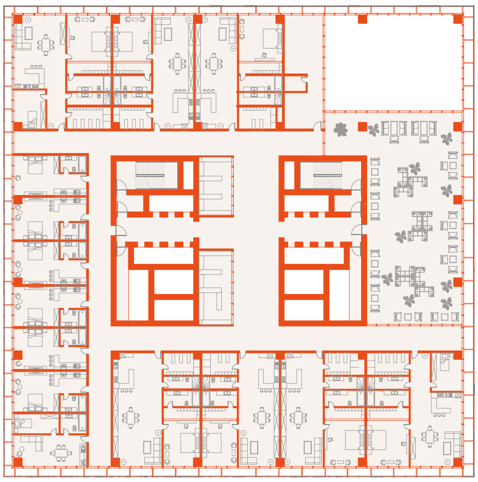


19th Floor

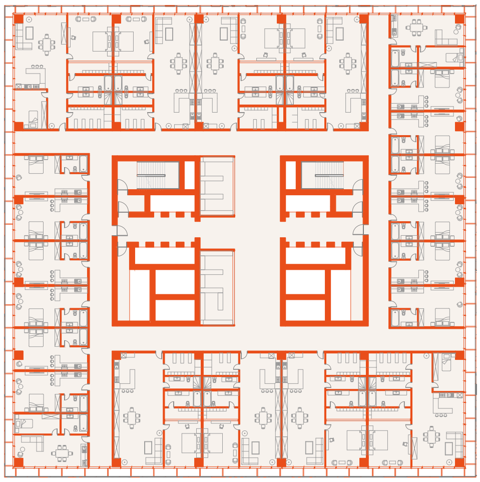


20th Floor

LOGGIA 2
SPORT



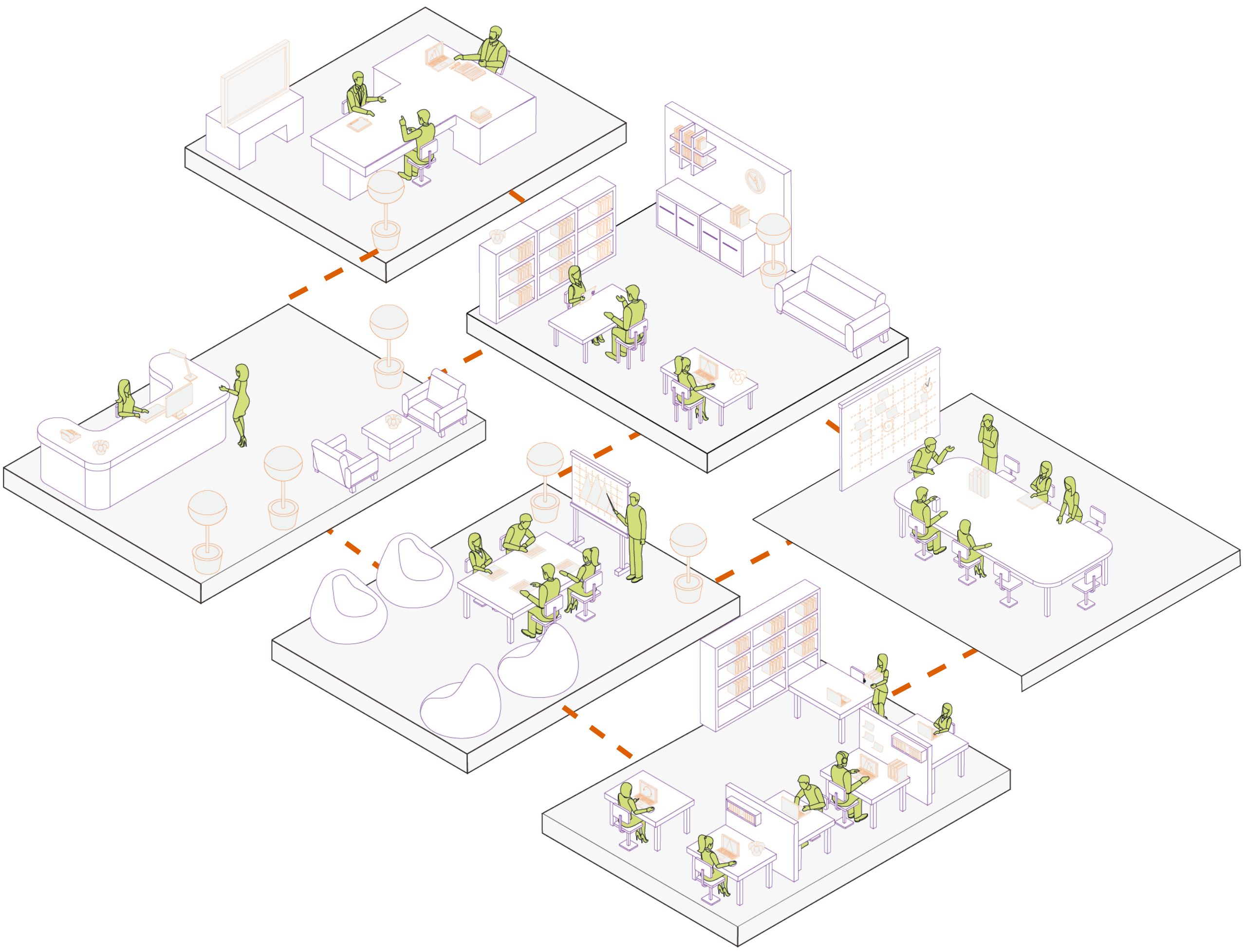
21st Floor

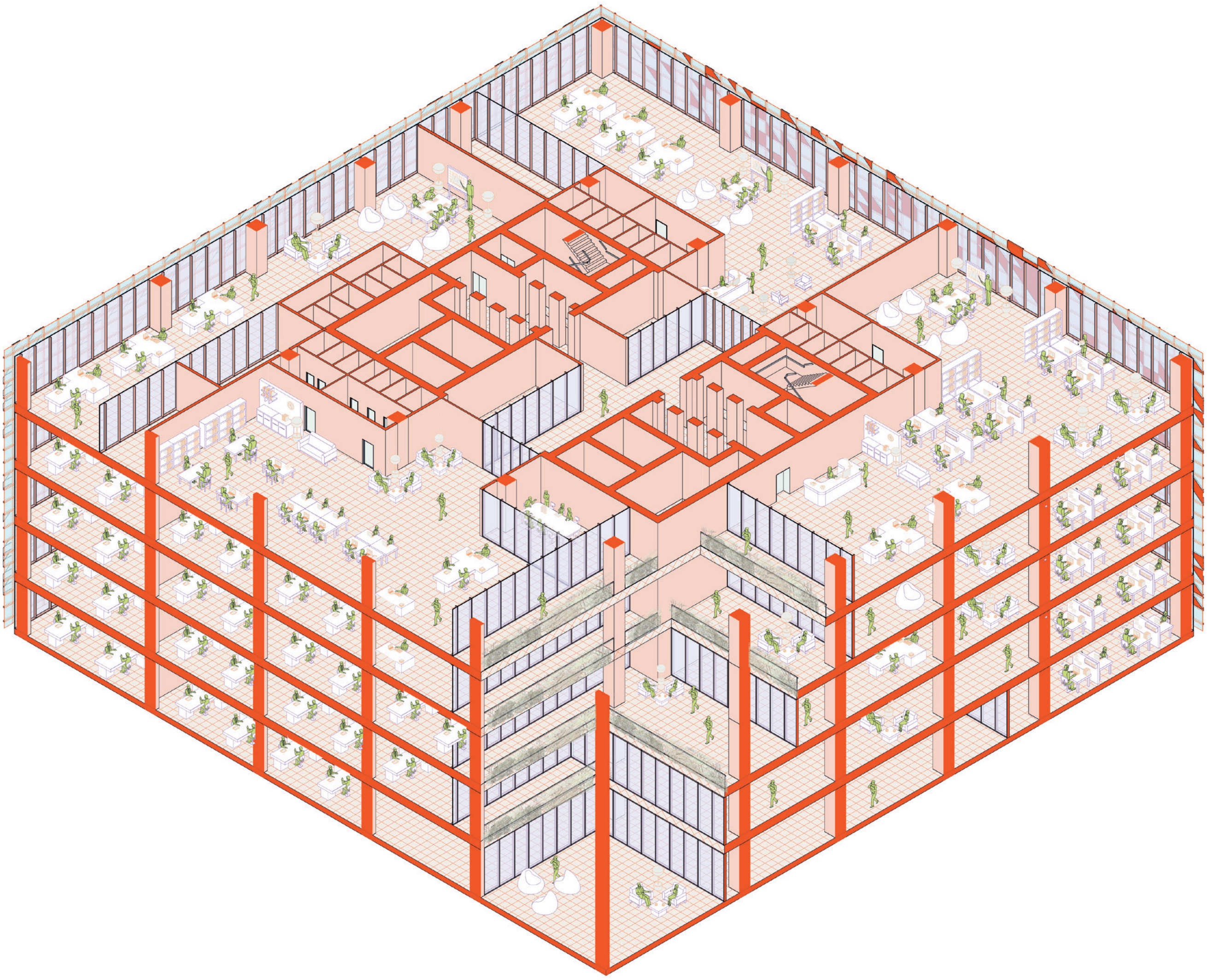


22nd Floor

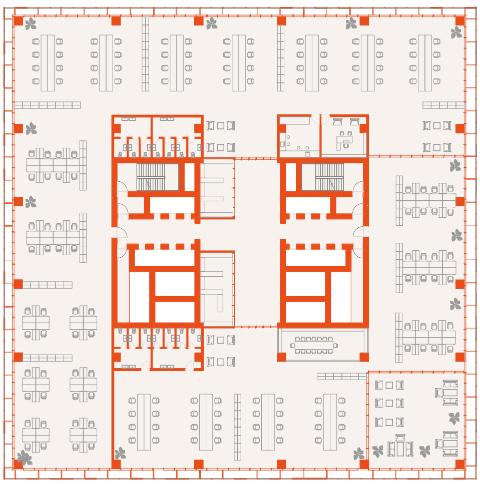
LOGGIA 3
OFFICE

ARCHITECTURE

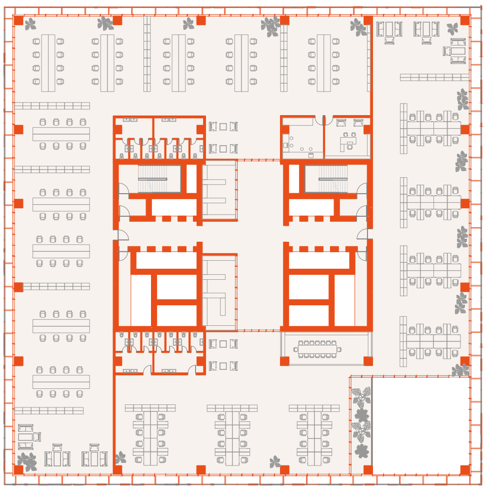




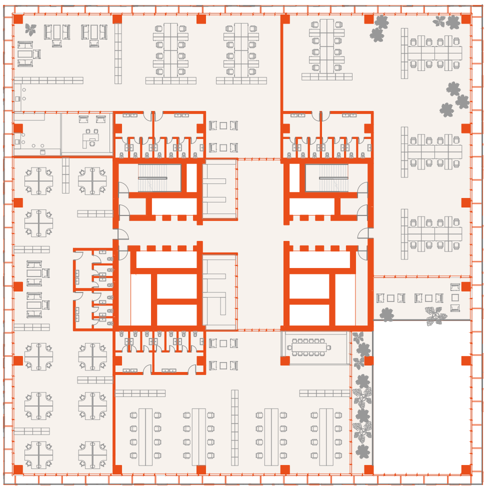
LOGGIA 3
OFFICE



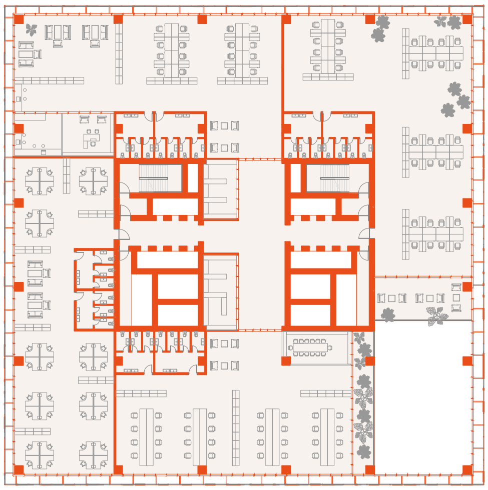
28th Floor



29th Floor

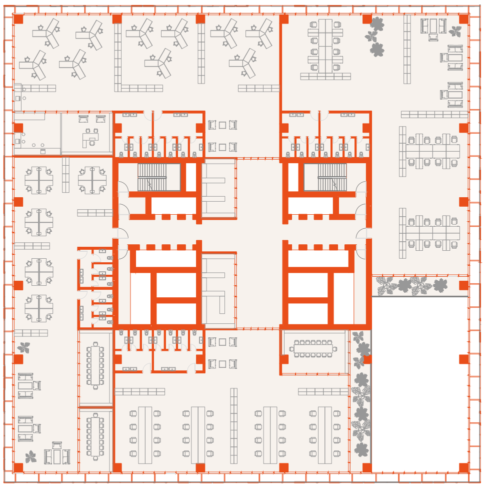


28th Floor

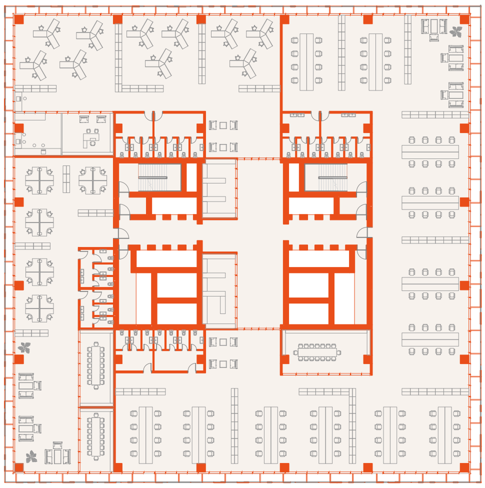


29th Floor

LOGGIA 3
OFFICE

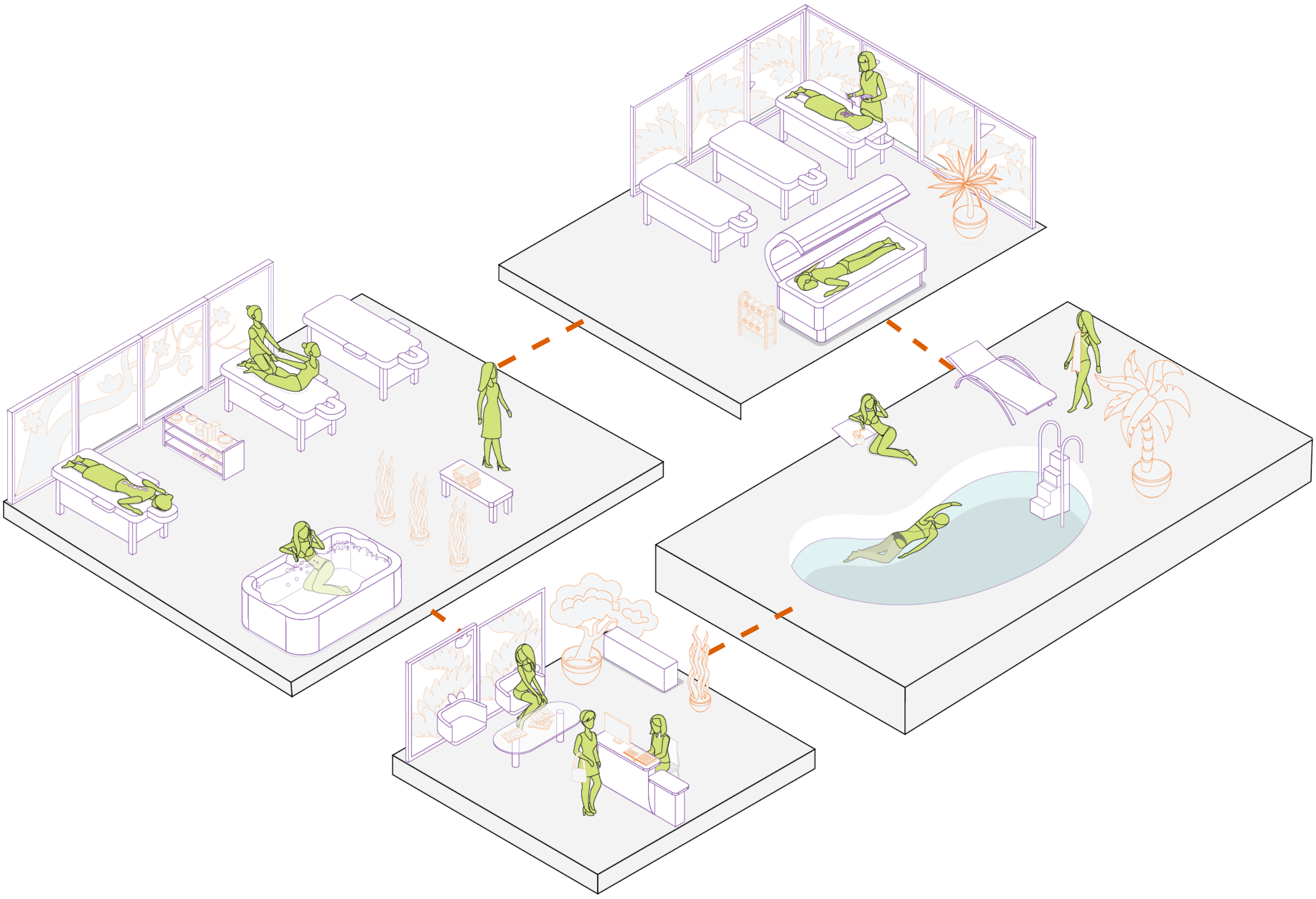


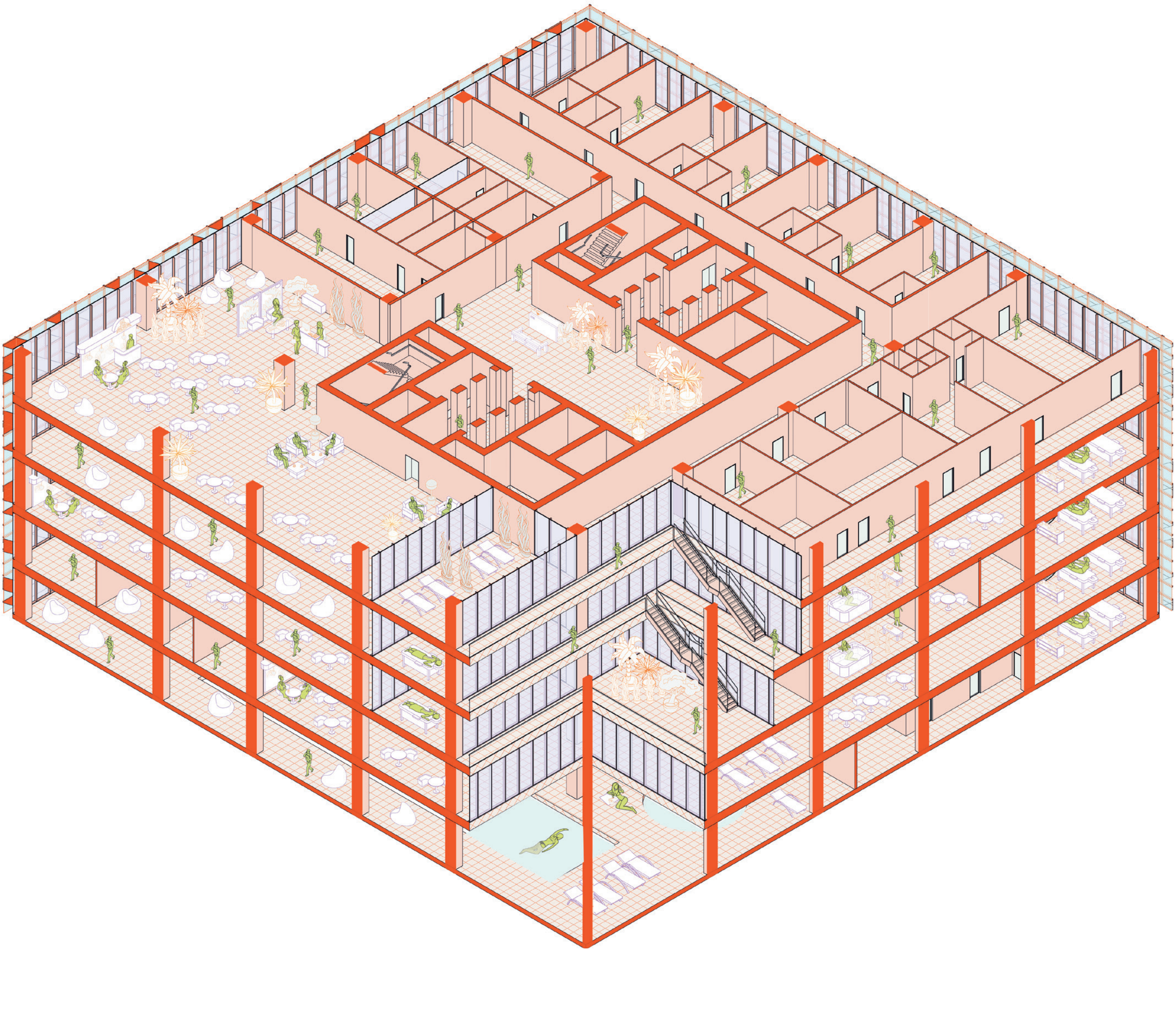
28th Floor



29th Floor

LOGGIA 4
SPA





LOGGIA 4
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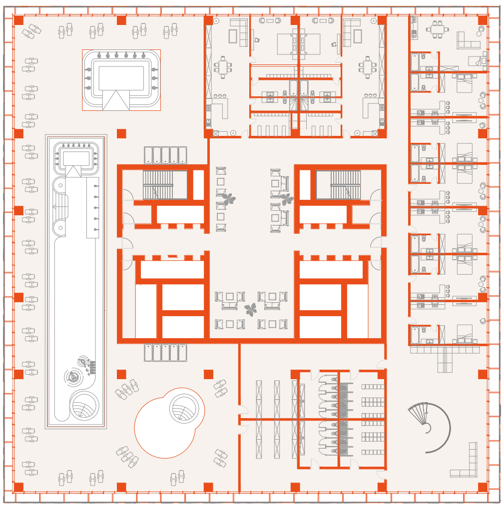
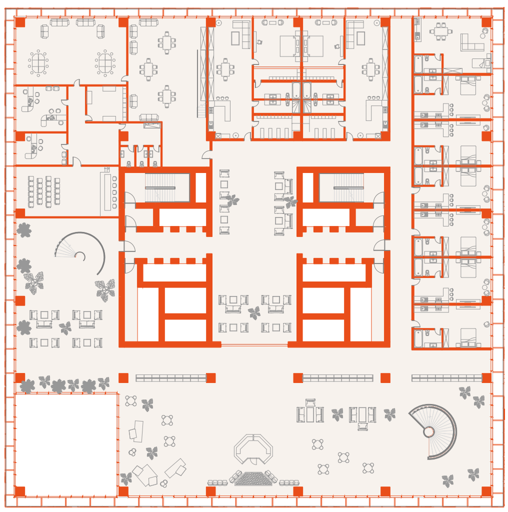
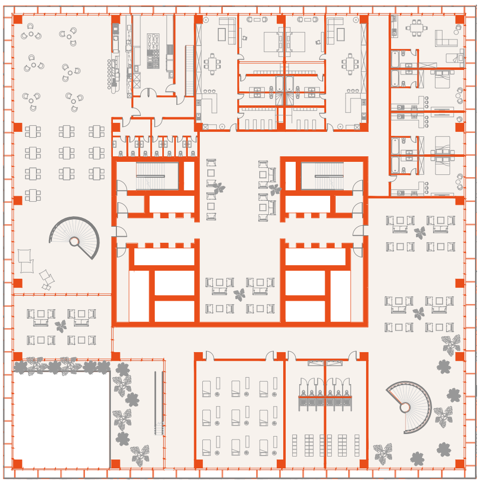


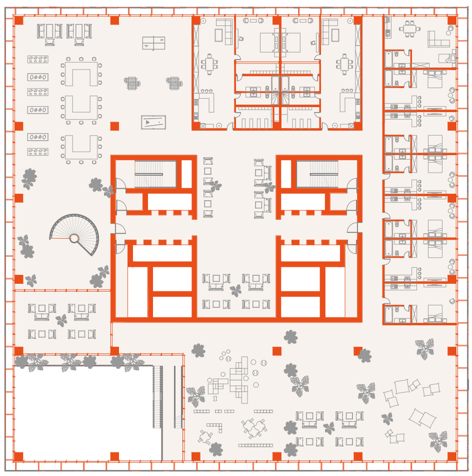
38th Floor



39th Floor

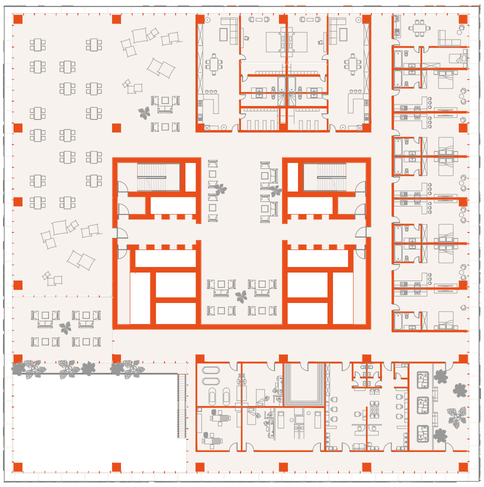


28th Floor

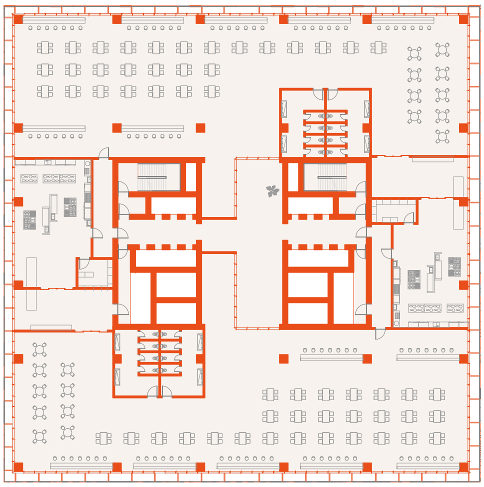


29th Floor

LOGGIA 4
SPA

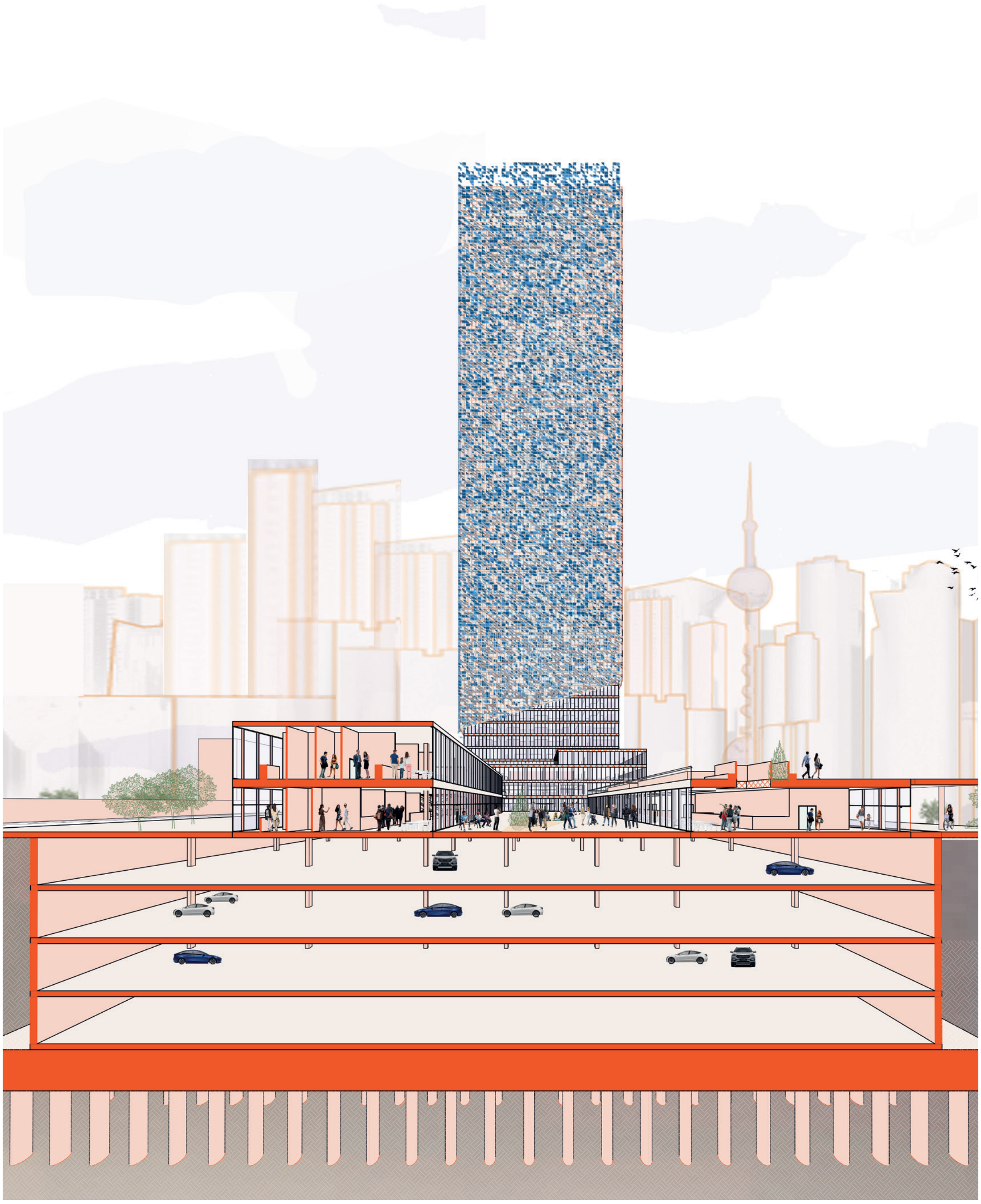


42th Floor



43th Floor

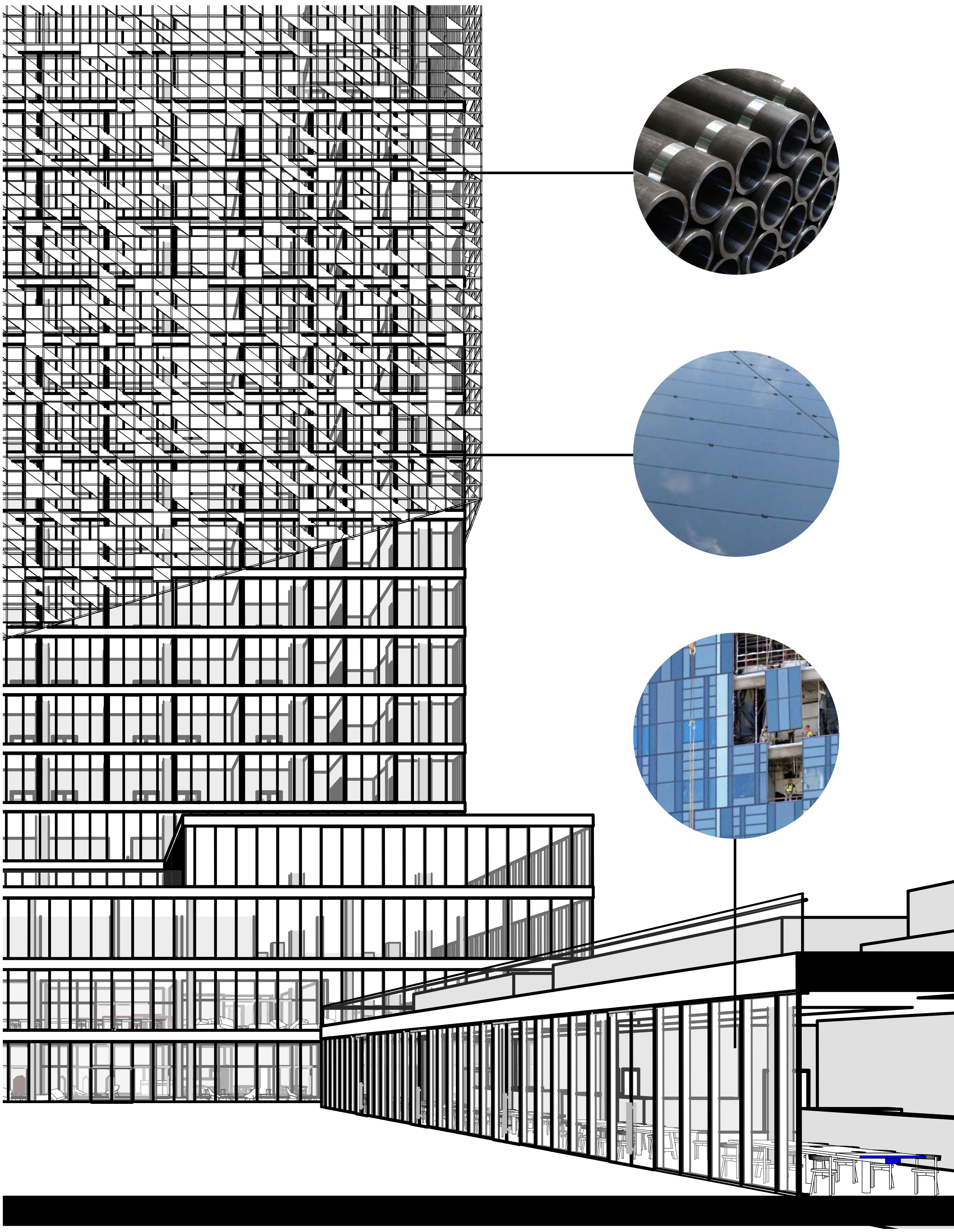
SECTION



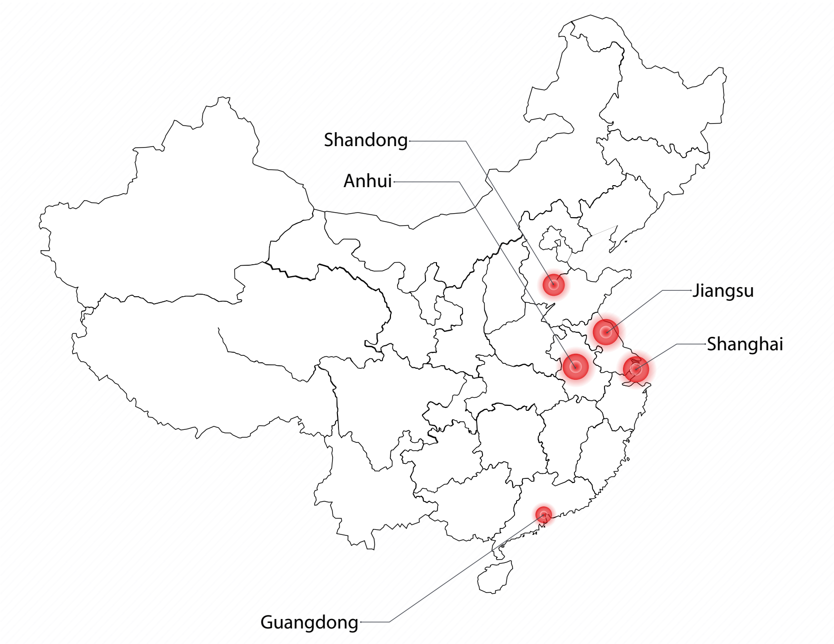
Render view, Loggia 4

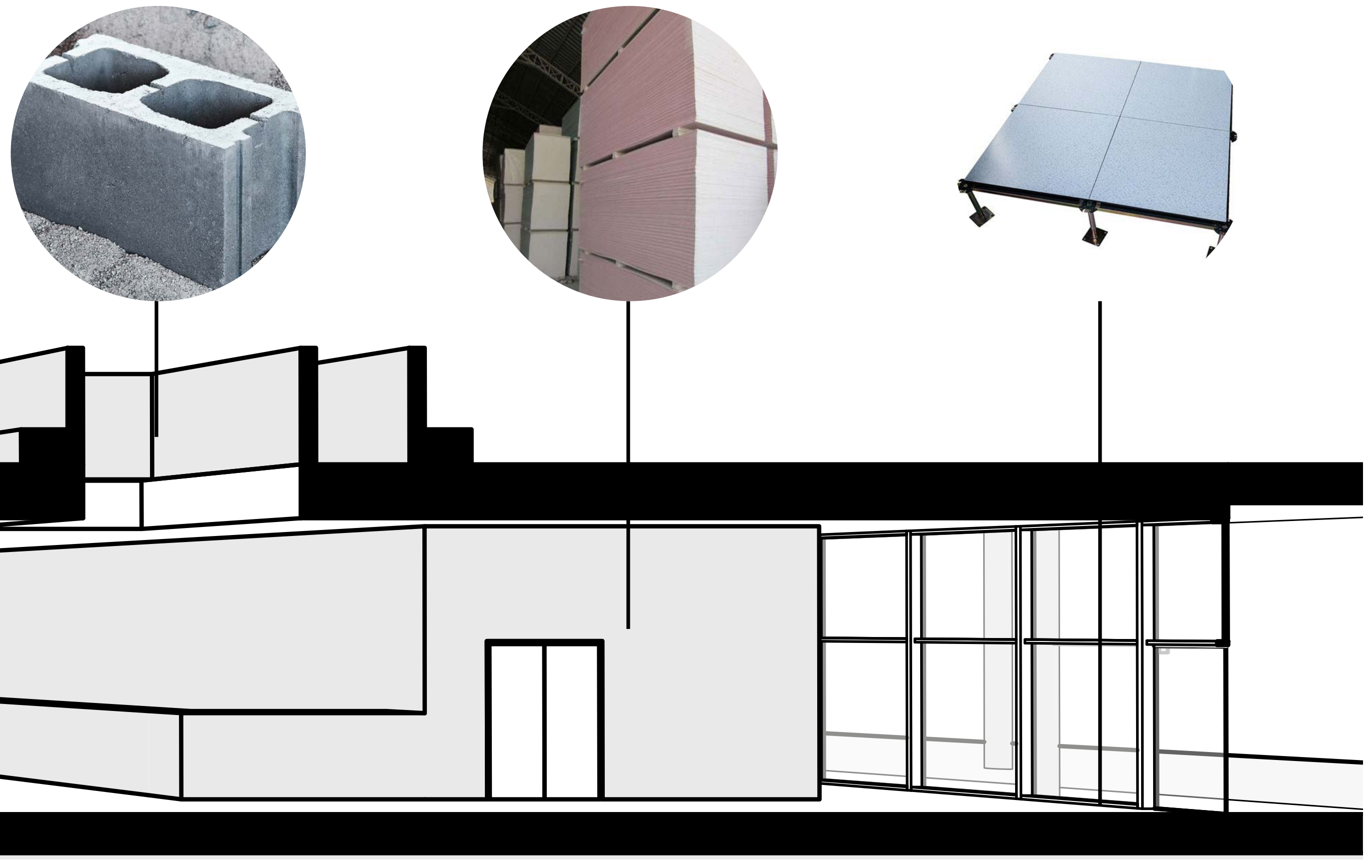
Render view, Loggia 1

06. TECHNOLOGY



MATERIAL





Product company

Foshan Rogenilan Windows And Doors System Co., Ltd

Business Type: Manufacturer
Main Products: Aluminium Thermal-Break Sliding Windows/Aluminium Thermal-Break Casement Windows, Aluminium
Year Established: 2014
Country / Region: Guangdong, China

Shandong Yuanda Innovative Materials Co., Ltd.

Business Type: Manufacturer, Trading Company
Main Products: AAC panel, AAC blocks, Mortar, professional accessories, Anti-cracking plate, concrete
Year Established: 2014
Country / Region: Shandong, China

Anhui Shangxia Solar Energy Co., Ltd.

Business Type: Manufacturer Trading Company
Main Products: Solar Panel, mono solar panel, poly solar panel, solar power system, Solar Module
Year Established: 2020
Country / Region: Anhui, China

Jiangsu Senmai Floor Technology Co., Ltd.

Business Type: Manufacturer
Main Products: Raised floor, calcium sulphate raised floor, GRC raised floor, anti static raised floor
Year Established: 2017
Country / Region: Jiangsu, China

Guangzhou Panda Commercial Development Co., Ltd.

Business Type: Manufacturer
Main Products: PVC Panel, SPC Flooring, WPC Deck, Fiber Cement Board, Gypsum Board
Year Established: 2007
Country / Region: Guangdong, China

Qingdao Director steel structure Co.,Ltd

Business Type: Manufacturer
Main Products: Steel Structure (H/C/Z Section Steel), Steel Building, Steel Warehouse, Steel Workshop, Sandwich Panel
Year Established: 2011
Country / Region: Shandong, China

MATERIAL

Cristalline Silicon PV

General Properties	
Density	2.35e3 - 2.45e3 kg/m^3
Price	*40 - 64.6 CNY/kg
Material Form That Data Applies To	
Bulk	✓
Sheet	✓
Building System	
Superstructure	✓
Enclosure	✓
Interiors	✓
Services	✓
Mechanical Properties	
Young's modulus	*66 - 68 GPa
Shear modulus	*27 - 29 GPa
Bulk modulus	*37 - 40 GPa
Poisson's ratio	*0.22 - 0.24
Yield strength (elastic limit)	*33 - 38 MPa
Tensile strength	*33 - 38 MPa
Compressive strength	*370 - 410 MPa
Bending strenth	*40 - 45 MPa
Elongation	*0.05 - 0.06 %strain
Hardness - Vickers	*438 - 483 HV
Fatigue strength at 10^7 cycles	*26.5 - 31.8 MPa

Thermal & Combustion Properties	
Thermal conductor or insulator?	Poor insulator
Thermal resistivity	0.9 - 1.6 m.℃/W
Thermal expansion coefficient	9.1 - 9.5 μstrain/℃
Specific heat capacity	850 - 950 J/kg.℃
Glass temperature	100 - 592 ℃
Maximum service temperature	63.2 - 76.9 ℃
Flammability	Non-flammable
Hygro - thermal Properties	
Water absorption	0 %
Water vapor permeability	0 kg.m/s.m^2.Pa
Air permeability	0 kg.m/s.m^2.Pa
Frost resistance	Very good
Electrical Properties	
Electrical conductor or insulator?	Good insulator
Electrical resistivity	8e17 - 8e18 μohm.cm
Dielectric constant	5.6 - 6.2
Dissipation factor	0.027 - 0.037
Dielectric strength	*12 - 14 MV/m
Optical Properties	
Transparency	Optical Quality
Transmissivity	89 %
Refractive index	1.5 - 1.52

Low E-glass

General Properties	
Density	7.8e3 - 7.82e3 kg/m^3
Price	*5.22 - 5.43 CNY/kg
Material Form That Data Applies To	
Bulk	✓
Sheet	✓
Building System	
Superstructure	✓
Enclosure	✓
Interiors	✓
Services	✓
Mechanical Properties	
Young's modulus	200 - 220 GPa
Shear modulus	79 - 84 GPa
Bulk modulus	160 - 180 GPa
Poisson's ratio	0.28 - 0.29
Yield strength (elastic limit)	255 - 355 MPa
Tensile strength	379 - 532 MPa
Compressive strength	*255 - 355 MPa
Bending strenth	*250 - 395 MPa
Elongation	25 - 45 %strain
Hardness - Vickers	113 - 168 HV
Fatigue strength at 10^7 cycles	*203 - 278 MPa

Thermal & Combustion Properties	
Thermal conductor or insulator?	Good insulator
Thermal resistivity	0.0185 - 0.0204 m.℃/W
Thermal expansion coefficient	11.5 - 13 μstrain/℃
Specific heat capacity	460 - 505 J/kg.℃
Melting point	1.48e3 - 1.53e3 ℃
Maximum service temperature	*340 - 357 ℃
Flammability	Non-flammable
Emissivity	0.06 - 0.32
Hygro - thermal Properties	
Water absorption	0 %
Water vapor permeability	0 kg.m/s.m^2.Pa
Air permeability	0 kg.m/s.m^2.Pa
Frost resistance	Very good
Electrical Properties	
Electrical conductor or insulator?	Good conductor
Electrical resistivity	15 - 20 μohm.cm
Optical Properties	
Transparency	Opaque
Transmissivity	0 %
Acoustic Properties	
Sound Absorption	Poor
Sound isolation	Very good

Low carbon steel

General Properties	
Density	2.44e3 - 2.49e3 kg/m^3
Price	*9.82 - 11.6 CNY/kg
Material Form That Data Applies To	
Bulk	✓
Sheet	✓
Building System	
Superstructure	✓
Enclosure	✓
Interiors	✓
Services	✓
Mechanical Properties	
Young's modulus	*68 - 72 GPa
Shear modulus	*28 - 29.5 GPa
Bulk modulus	*39.8 - 41.9 GPa
Poisson's ratio	*0.21 - 0.22
Yield strength (elastic limit)	*31 - 35 MPa
Tensile strength	*33 - 38 MPa
Compressive strength	*360 - 420 MPa
Bending strenth	*32 - 35 MPa
Elongation	*0.04 - 0.05 %strain
Hardness - Vickers	*438 - 483 HV
Fatigue strength at 10^7 cycles	*26.5 - 29.3 MPa

Thermal & Combustion Properties	
Thermal conductor or insulator?	Poor insulator
Thermal resistivity	0.77 - 1.4 m.℃/W
Thermal expansion coefficient	9.1 - 9.5 μstrain/℃
Specific heat capacity	850 - 950 J/kg.℃
Glass temperature	441 - 590 ℃
Maximum service temperature	150 - 260 ℃
Flammability	Non-flammable
Emissivity	0.1 - 0.4
Hygro - thermal Properties	
Water absorption	0 %
Water vapor permeability	0 kg.m/s.m^2.Pa
Frost resistance	Very good
Electrical Properties	
Electrical conductor or insulator?	Good insulator
Electrical resistivity	8e17 - 8e18 μohm.cm
Dielectric constant	6 - 7
Dissipation factor	0.027 - 0.037
Dielectric strength	12 - 14 MV/m
Optical Properties	
Transparency	Transparent
Transmissivity	75 %
Refractive index	1.5 - 1.52

Solar Radiation Analysis | LadyBug

Climate visualizations in 2D and 3D are included to facilitate decision-making early on in the design process. In addition to solar radiation studies, view analyses, and sunlight hours models, Ladybug also assists design stages with the evaluation of initial design options. A high degree of customization is possible with integration with visual programming environments, which provides instant feedback on design changes and allows instant feedback on modifications.

The results of the Ladybug analysis show that the building complex has overheated surfaces at the top of the building, while the radiation levels on the facades vary depending on the orientation.

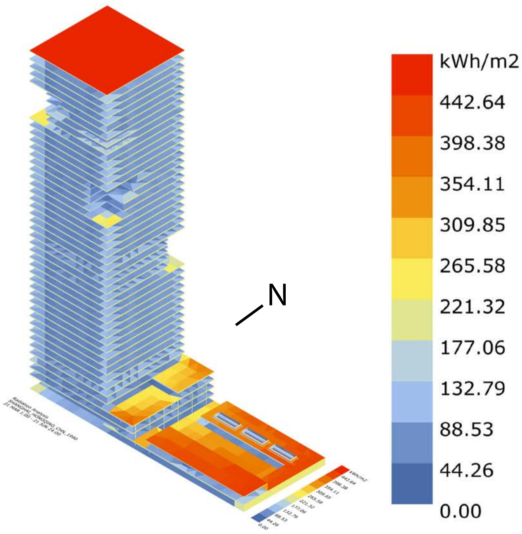
In the analysis, it was decided to pay attention to the difference between the data with the second skin facade and the one without.

Due to reduce the solar radiation on the building's inner space a second skin with an opaque pattern has been designed.

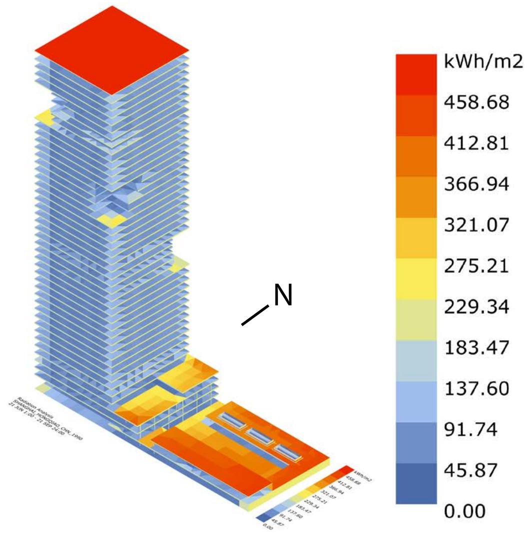
All this opaque pannel are made of photovoltaic panels with the double aim of, take advantage from the sun radiation generating electrical energy and in the meanwhile create shadow to the building.

SECOND-SKIN FACADE

Solar radiation analysis without second facade and solar panel

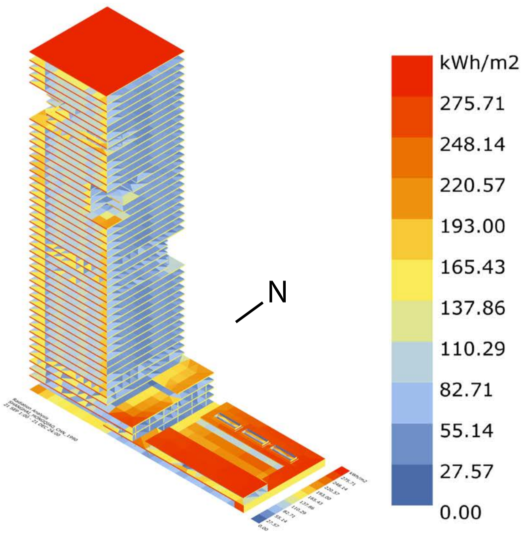


Spring

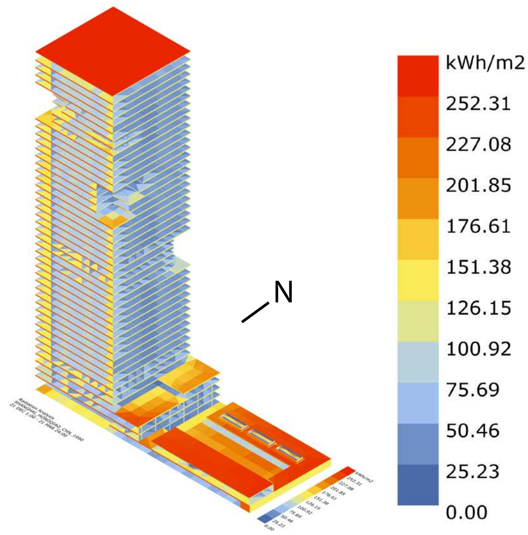


Summer

Autumn



Winter



Photovoltaic Estimation | OnyxSolar
The photovoltaic estimation tool has been integrated for the design of the shading panels.

RESULTS EAST SIDE

3092 MQ

CRYSTALLINE PV

ELECTRICITY GENERATED IN 35 YEARS

8,367,606 kWh *

TOTAL LIGHTING POINTS OPERATING 4 HOURS PER DAY

16,418 Lights **

AVOIDED CO_2 EMMISIONS IN 35 YEARS

6,393 t CO2

The CO2 emissions avoided have been calculated with the customized energy mix value of the selected country.

BARRELS OF OIL SAVED IN 35 YEARS

4,924 Barrels

LITERS OF OIL SAVED IN 35 YEARS

782,891 liters

ELECTRIC CAR MILEAGE IN 35 YEARS THANKS TO THE ENERGY GENERATED

48,113,737 km

TREES PLANTED IN THE AMAZON THANKS TO THE INSTALLATION

3,092 Trees

Thanks to our initiative #OneMeterOneTree, for every square meter of photovoltaic solar glass sold we will plant a tree in the Amazon.

BY INSTALLING OUR SOLAR PV GLASS YOU CAN REACH

UP TO 8 LEED POINTS

RENEWABLE ENERGY PRODUCTION ON-SITE............UP TO 3 POINTS

HEAT ISLAND REDUCTION..UP TO 2 POINTS

OPTIMIZE ENERGY PERFORMANCE...............................UP TO 2 POINTS

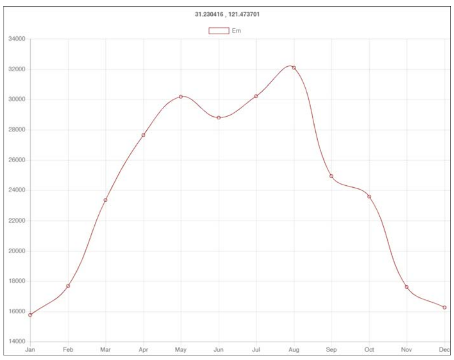
INNOVATIVE PRODUCT...UP TO 1 POINTS

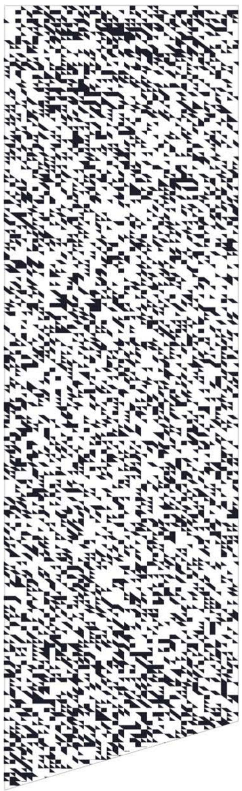
* The energy production is just an estimation where factors like surrounding shadows, self-shades or other external impacts have not been taking into account. These factors might lead to reduction in energy production. In addition, other potential losses due to BOS are also excluded from these calculations. The calculation has been done using PVGIS and PVWATTS.

** Calculated with energy efficient light bulbs of 12W

Month	E_d	E_m	H_d	H_m
January	508.31	15,757.68	1.25	38.62
February	631.22	17,674.21	1.54	43.00
March	752.80	23,336.69	1.83	56.84
April	921.35	27,640.42	2.27	68.13
May	973.69	30,184.43	2.42	75.14
June	959.84	28,795.12	2.39	71.80
July	974.60	30,212.69	2.47	76.49
August	1,034.84	32,080.10	2.62	81.32
September	831.44	24,943.20	2.08	62.40
October	760.16	23,564.95	1.90	58.82
November	586.69	17,600.76	1.46	43.79
December	524.23	16,251.28	1.30	40.31
Yearly average	788.26	24,003.46	1.96	59.72
Total for year		288,041.53		716.65

Ed: Average daily electricity production from the given system (kWh)
Em: Average monthly electricity production from the given system (kWh)
Hd: Average daily sum of global irradiation per square meter received by the modules of the given system (kWh/m2)
Hm: Average sum of global irradiation per square meter received by the modules of the given system (kWh/m2)





TECHNOLOGY

RESULTS SOUTH SIDE

4042 MQ

CRYSTALLINE PV

ELECTRICITY GENERATED IN 35 YEARS

18,952,361 kWh *

TOTAL LIGHTING POINTS OPERATING 4 HOURS PER DAY

37,187 Lights **

AVOIDED CO_2 EMMISIONS IN 35 YEARS

14,480 t CO2

The CO2 emissions avoided have been calculated with the customized energy mix value of the selected country.

BARRELS OF OIL SAVED IN 35 YEARS

11,152 Barrels

LITERS OF OIL SAVED IN 35 YEARS

1,773,223 liters

ELECTRIC CAR MILEAGE IN 35 YEARS THANKS TO THE ENERGY GENERATED

108,976,078 km

TREES PLANTED IN THE AMAZON THANKS TO THE INSTALLATION

4,042 Trees

Thanks to our initiative #OneMeterOneTree, for every square meter of photovoltaic solar glass sold we will plant a tree in the Amazon.

BY INSTALLING OUR SOLAR PV GLASS YOU CAN REACH

UP TO 8 LEED POINTS

RENEWABLE ENERGY PRODUCTION ON-SITE............UP TO 3 POINTS

HEAT ISLAND REDUCTION..UP TO 2 POINTS

OPTIMIZE ENERGY PERFORMANCE...............................UP TO 2 POINTS

INNOVATIVE PRODUCT..UP TO 1 POINTS

* The energy production is just an estimation where factors like surrounding shadows, self-shades or other external impacts have not been taking into account. These factors might lead to reduction in energy production. In addition, other potential losses due to BOS are also excluded from these calculations. The calculation has been done using PVGIS and PVWATTS.

** Calculated with energy efficient light bulbs of 12W

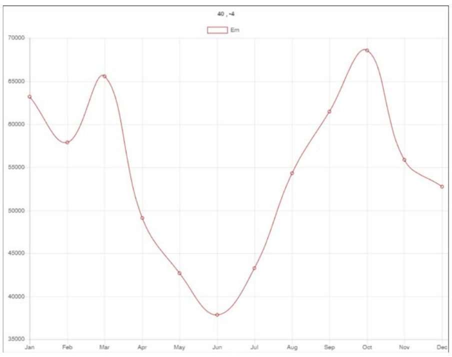
Month	E_d	E_m	H_d	H_m
January	2,039.31	63,218.64	3.73	115.52
February	2,066.96	57,874.87	3.81	106.80
March	2,114.26	65,542.18	4.04	125.17
April	1,636.16	49,084.71	3.20	96.11
May	1,377.06	42,689.00	2.81	87.07
June	1,261.35	37,840.64	2.66	79.65
July	1,395.92	43,273.49	2.98	92.48
August	1,750.82	54,275.53	3.63	112.50
September	2,048.10	61,442.95	4.05	121.52
October	2,211.55	68,558.11	4.19	129.88
November	1,862.11	55,863.29	3.44	103.13
December	1,701.34	52,741.46	3.11	96.46
Yearly average	1,788.75	54,367.07	3.47	105.52
Total for year		**652,404.87**		**1,266.30**

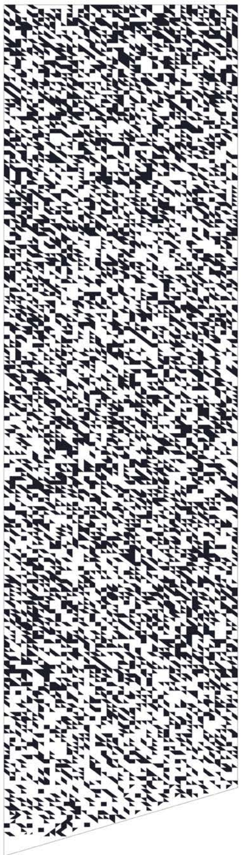
Ed: Average daily electricity production from the given system (kWh)

Em: Average monthly electricity production from the given system (kWh)

Hd: Average daily sum of global irradiation per square meter received by the modules of the given system (kWh/m2)

Hm: Average sum of global irradiation per square meter received by the modules of the given system (kWh/m2)





SECOND-SKIN FACADE

RESULTS

WEST SIDE
3065 MQ

CRYSTALLINE PV

ELECTRICITY GENERATED IN 35 YEARS

8,235,894 kWh *

TOTAL LIGHTING POINTS OPERATING 4 HOURS PER DAY

16,160 Lights **

AVOIDED CO_2 EMMISIONS IN 35 YEARS

6,292 t CO2

The CO2 emissions avoided have been calculated with the customized energy mix value of the selected country.

BARRELS OF OIL SAVED IN 35 YEARS

4,846 Barrels

LITERS OF OIL SAVED IN 35 YEARS

770,568 liters

ELECTRIC CAR MILEAGE IN 35 YEARS THANKS TO THE ENERGY GENERATED

47,356,392 km

TREES PLANTED IN THE AMAZON THANKS TO THE INSTALLATION

3,065 Trees

Thanks to our initiative #OneMeterOneTree, for every square meter of photovoltaic solar glass sold we will plant a tree in the Amazon.

BY INSTALLING OUR SOLAR PV GLASS YOU CAN REACH
UP TO 8 LEED POINTS

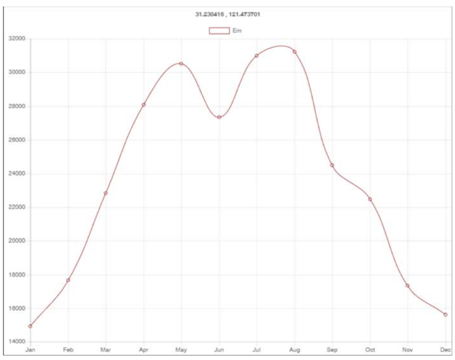
RENEWABLE ENERGY PRODUCTION ON-SITE............UP TO 3 POINTS
HEAT ISLAND REDUCTION..UP TO 2 POINTS
OPTIMIZE ENERGY PERFORMANCE..............................UP TO 2 POINTS
INNOVATIVE PRODUCT...UP TO 1 POINTS

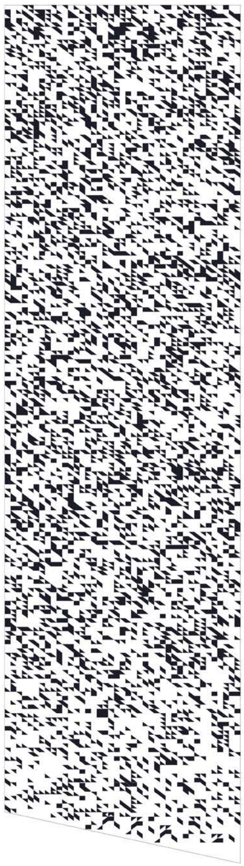
* The energy production is just an estimation where factors like surrounding shadows, self-shades or other external impacts have not been taking into account. These factors might lead to reduction in energy production. In addition, other potential losses due to BOS are also excluded from these calculations. The calculation has been done using PVGIS and PVWATTS.

** Calculated with energy efficient light bulbs of 12W

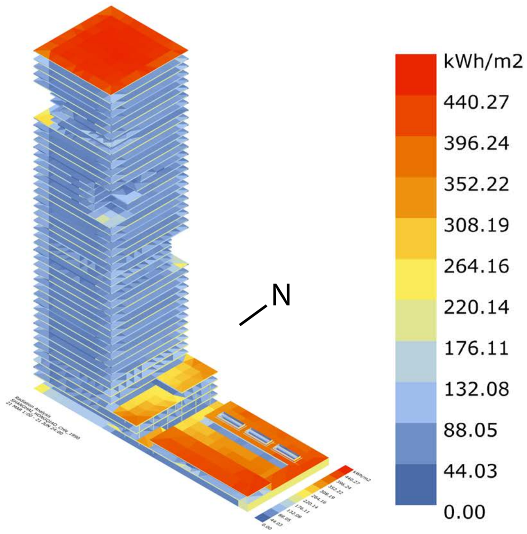
Month	E_d	E_m	H_d	H_m
January	481.60	14,929.56	1.19	37.01
February	630.71	17,659.81	1.55	43.46
March	736.41	22,828.80	1.81	56.20
April	936.41	28,092.44	2.33	69.90
May	984.33	30,514.16	2.47	76.66
June	911.25	27,337.54	2.29	68.73
July	999.70	30,990.65	2.56	79.21
August	1,007.59	31,235.39	2.58	79.89
September	816.33	24,489.76	2.06	61.82
October	724.89	22,471.63	1.83	56.67
November	578.15	17,344.46	1.45	43.55
December	503.66	15,613.35	1.26	39.16
Yearly average	775.92	23,625.63	1.95	59.35
Total for year		**283,507.55**		**712.24**

Ed: Average daily electricity production from the given system (kWh)
Em: Average monthly electricity production from the given system (kWh)
Hd: Average daily sum of global irradiation per square meter received by the modules of the given system (kWh/m2)
Hm: Average sum of global irradiation per square meter received by the modules of the given system (kWh/m2)

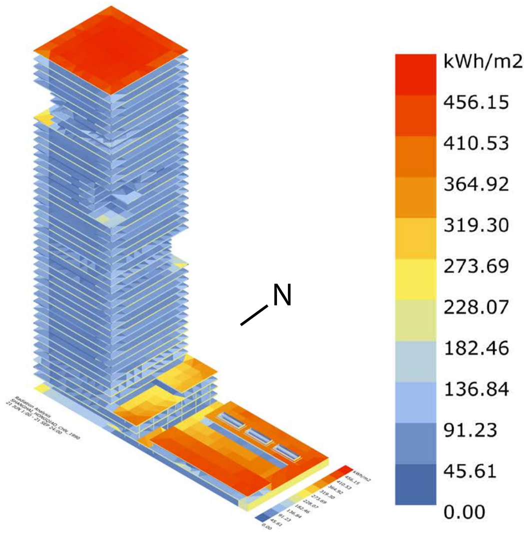




Radiation analysis with second facade and solar panel

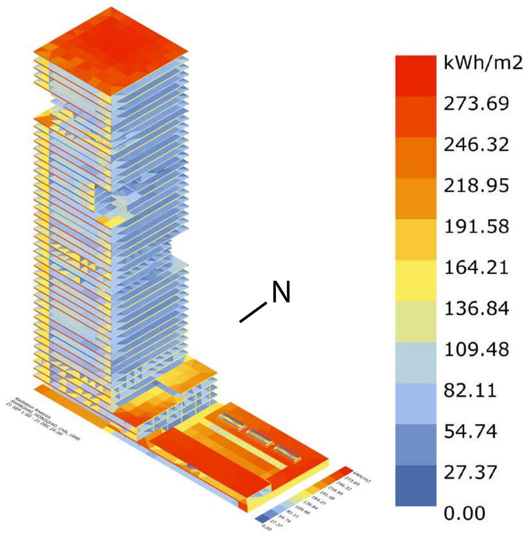


Spring

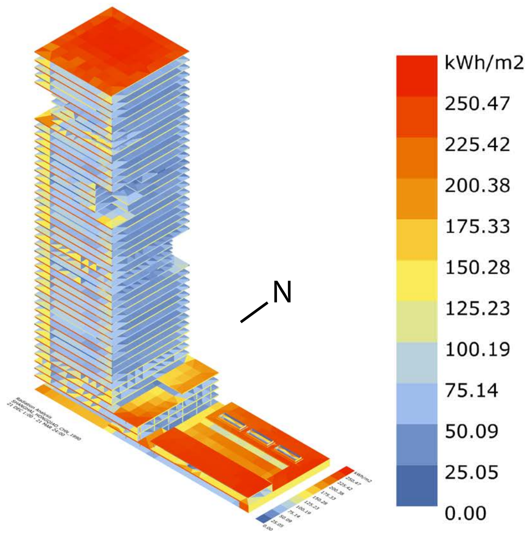


Summer

Autumn

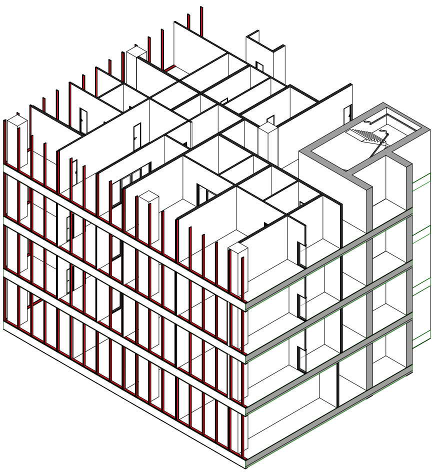


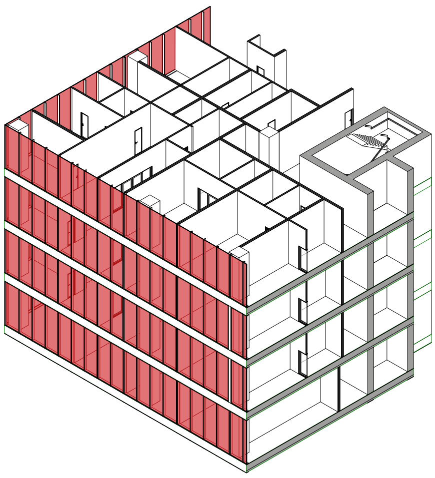
Winter



SECOND-SKIN FACADE

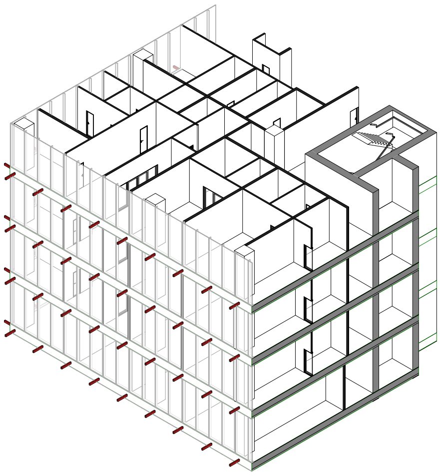
Catalogue facade composition



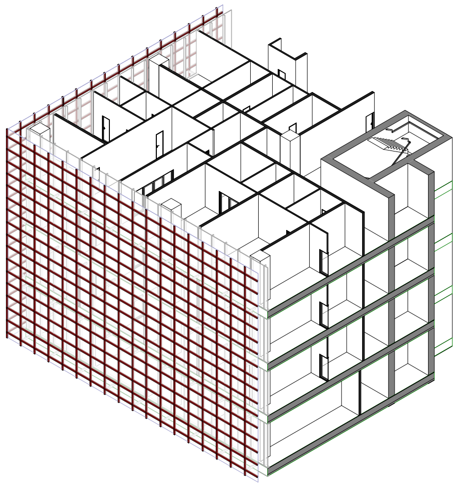


1. Interior curtain wall mullion
-Alluminium frame
-To divide the 1st layer of facade

2. Interior curtain wall glass
-Low E-Glass
-Transparent
-To let in the sun light

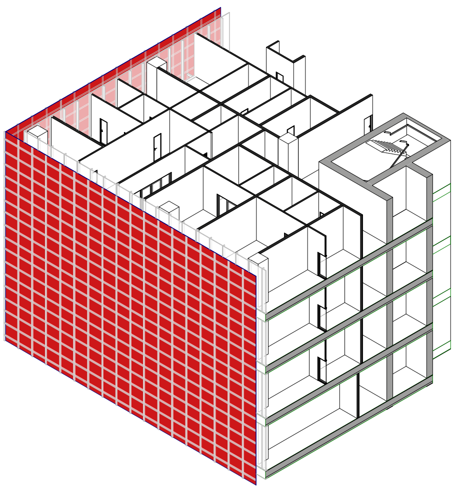


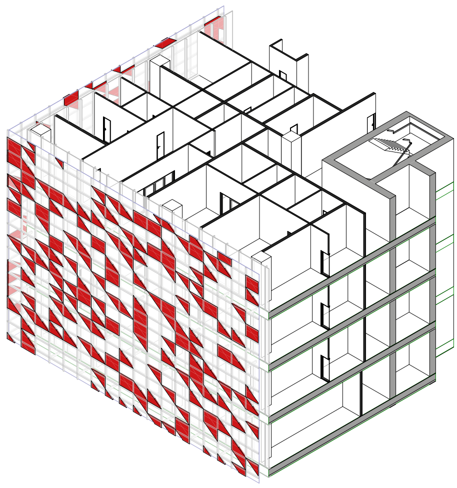
3. Cantiliver beams
-HEB 260
-To support the 2nd layer of facade and deliver the load to the columns



4. Second skin framing
-Stainless steel frame
-DN 100mm
-To support the 2nd layer of facade

SECOND-SKIN FACADE

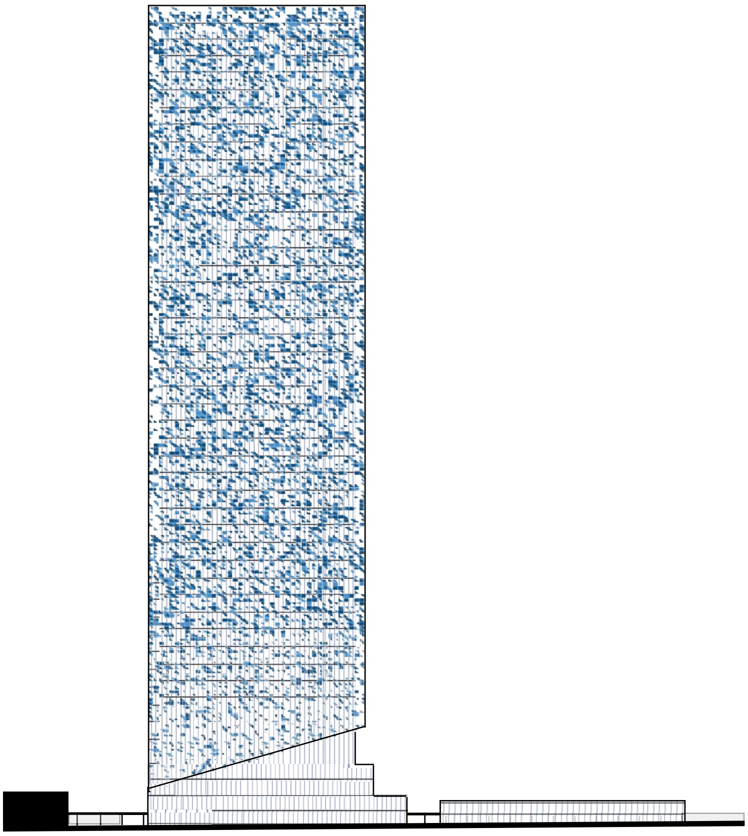




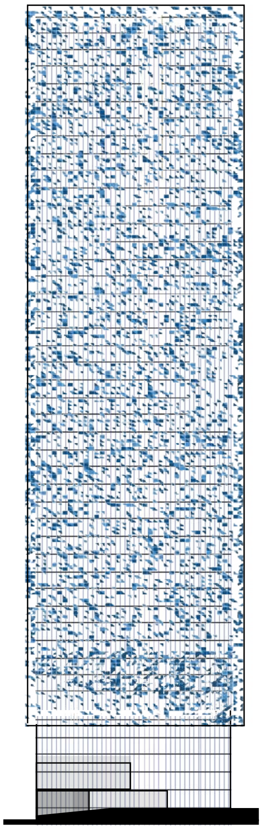
5. Exterior curtain panel glass
-Low E-Glass
-Transparent
-To let in the sun light

6. Solar panel
-Crisalline silicon PV
-To generate elettricity

Elevation

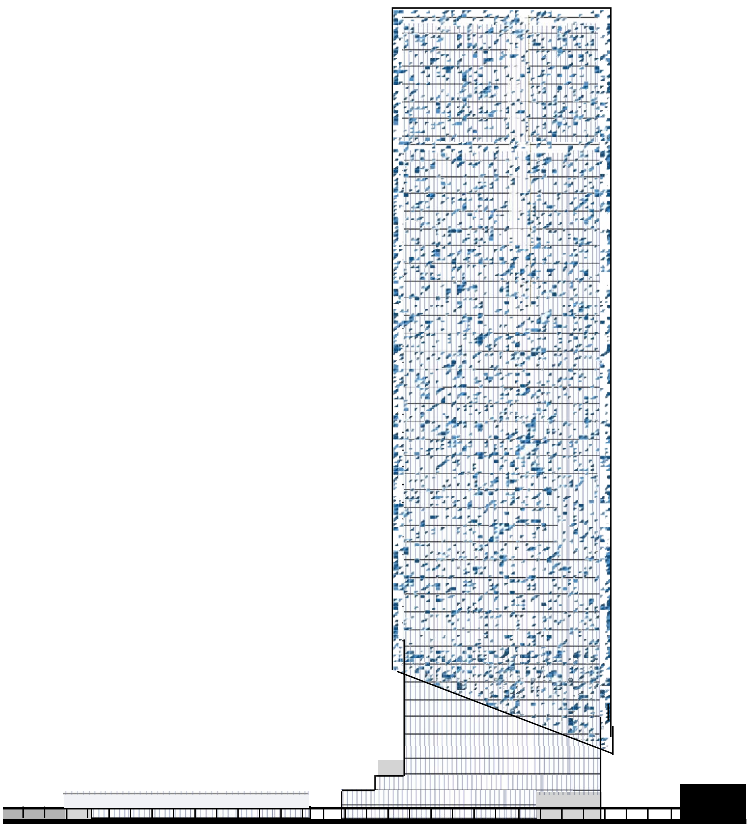


South

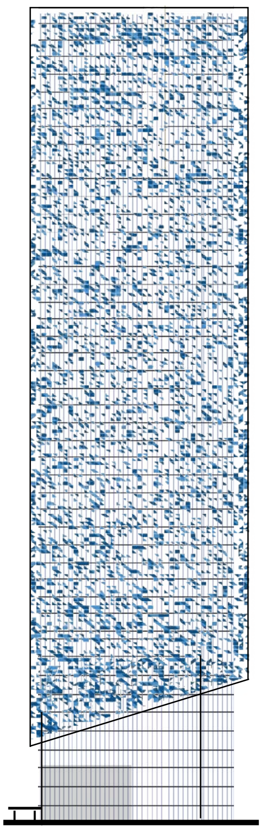


East

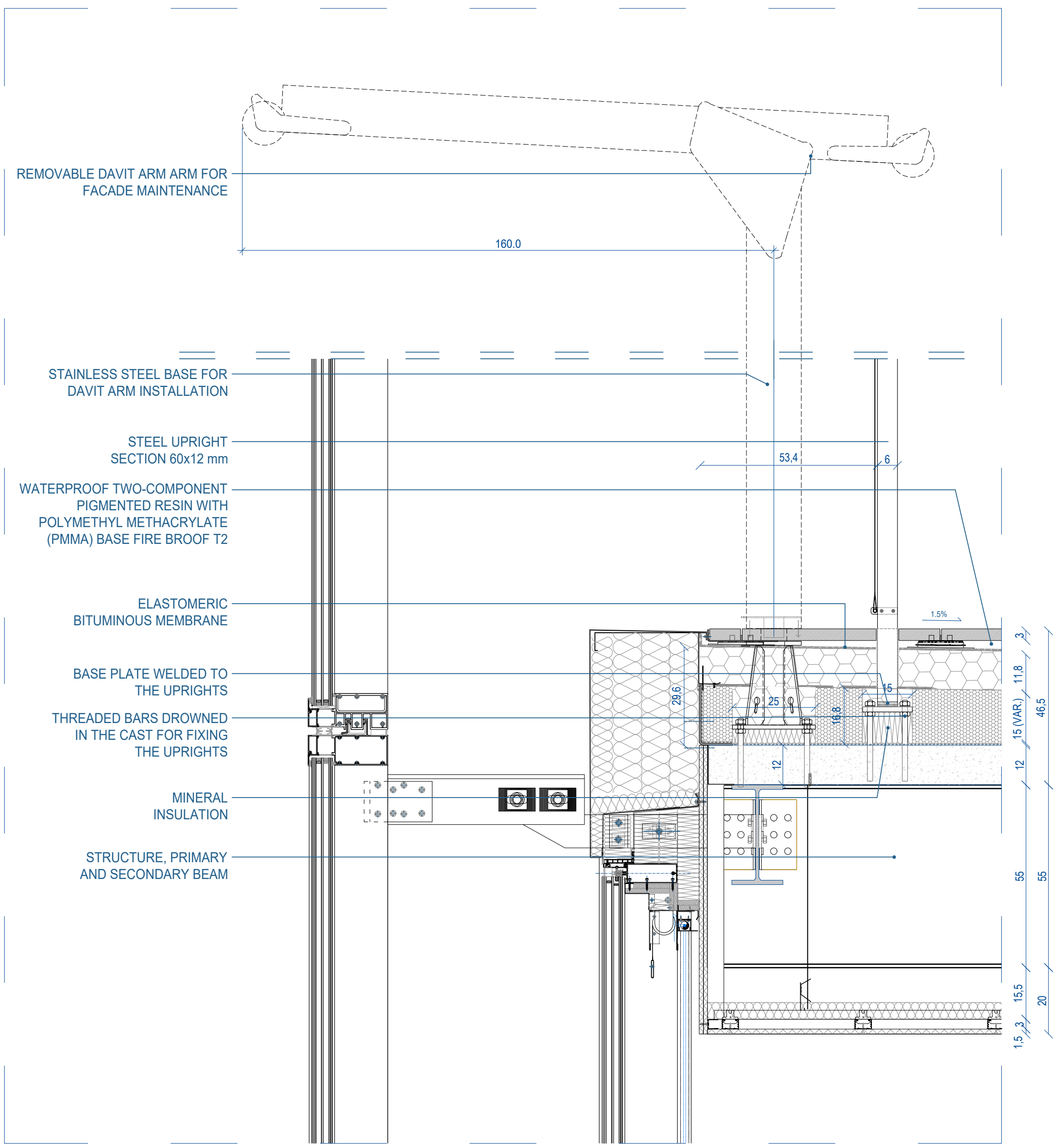
SECOND-SKIN FACADE



North

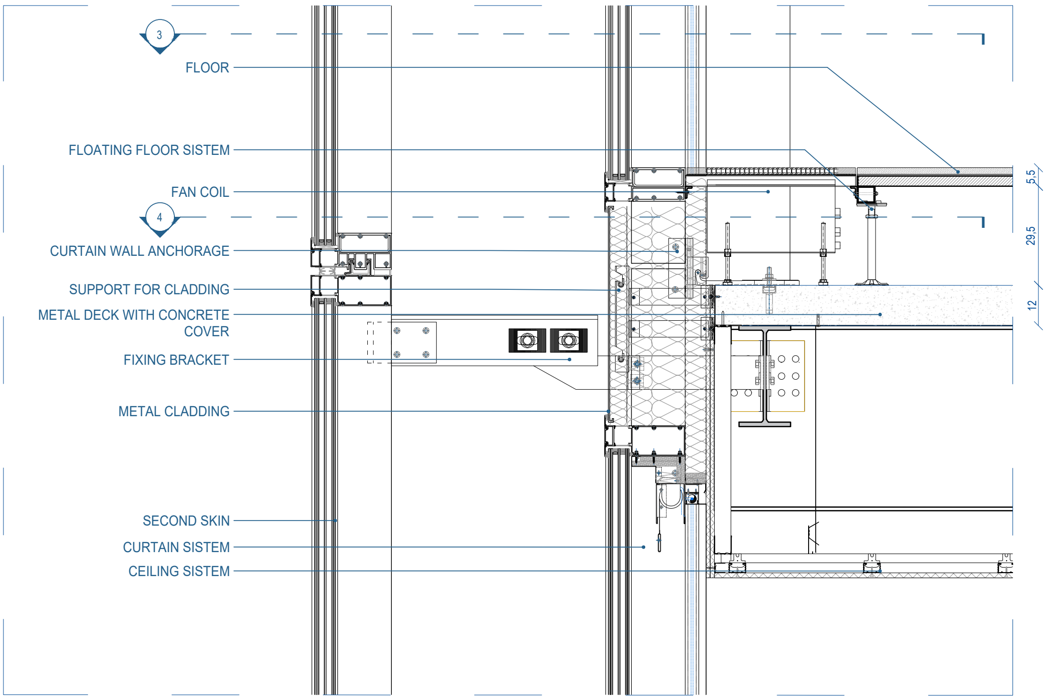


West

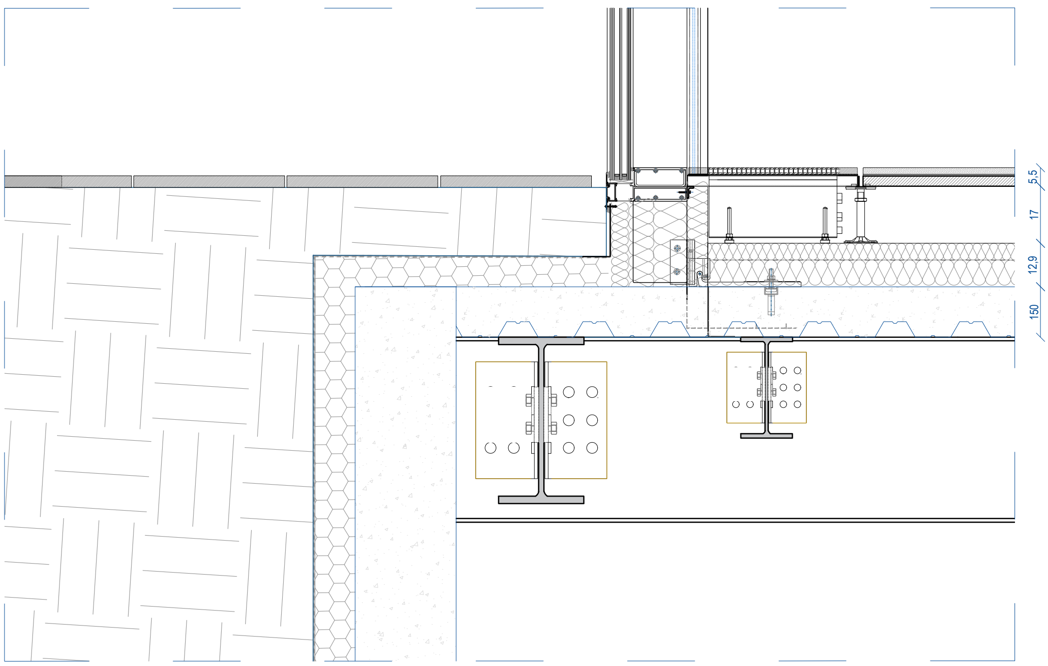


Curtain Wall and roof, section

TECHNOLOGICAL DETAILS

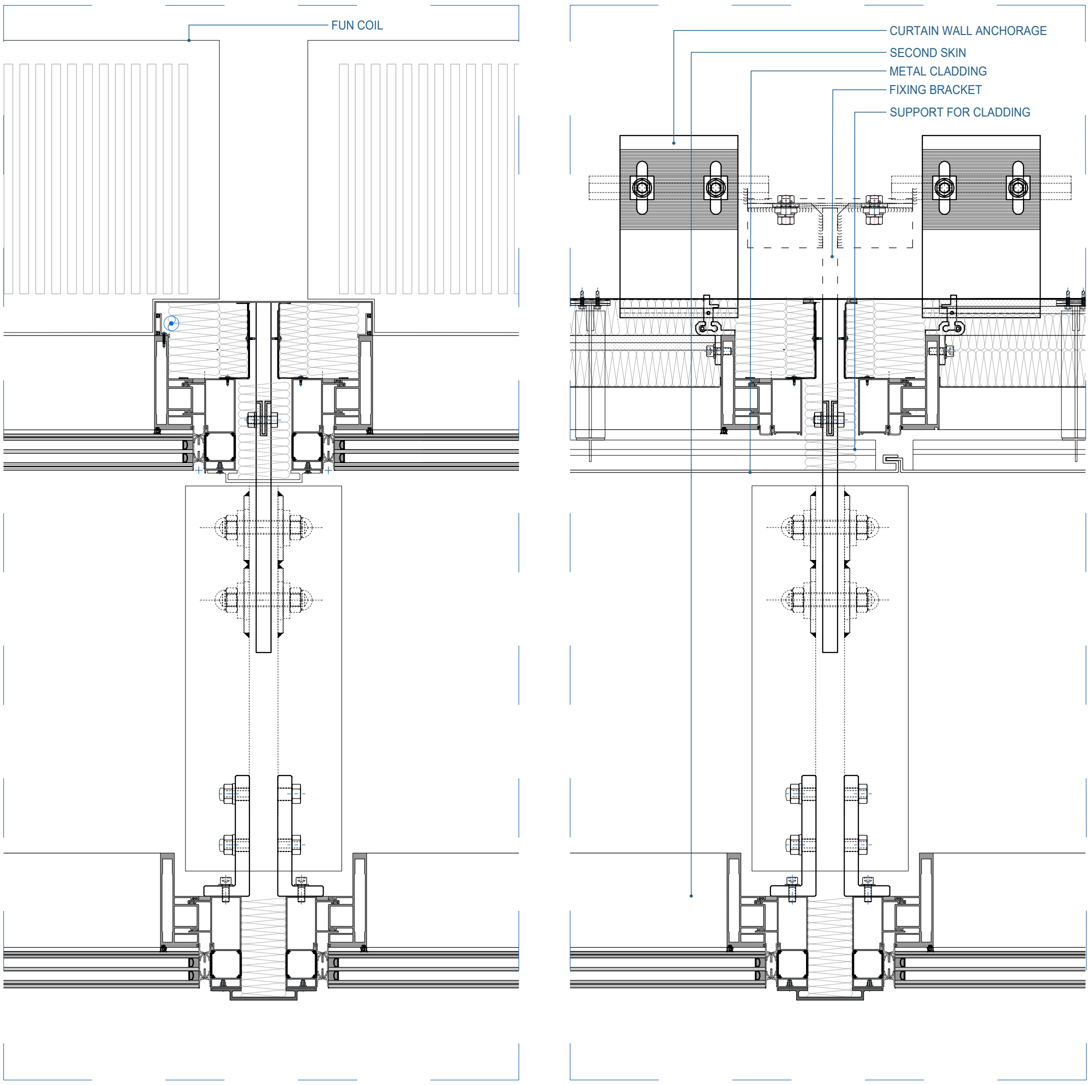


Curtain Wall and slab, section

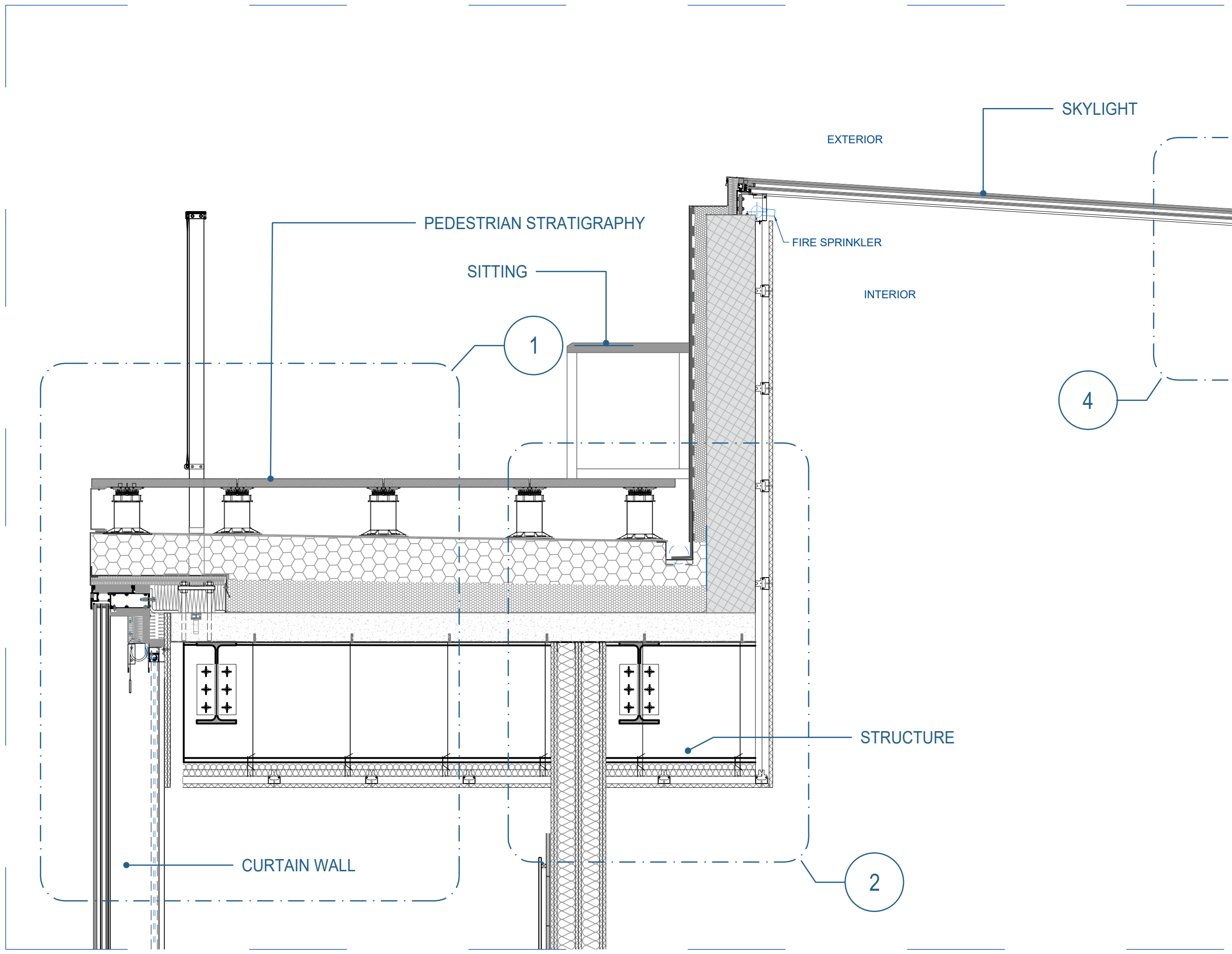


3. Curtain Wall and ground, section

TECHNOLOGICAL DETAILS

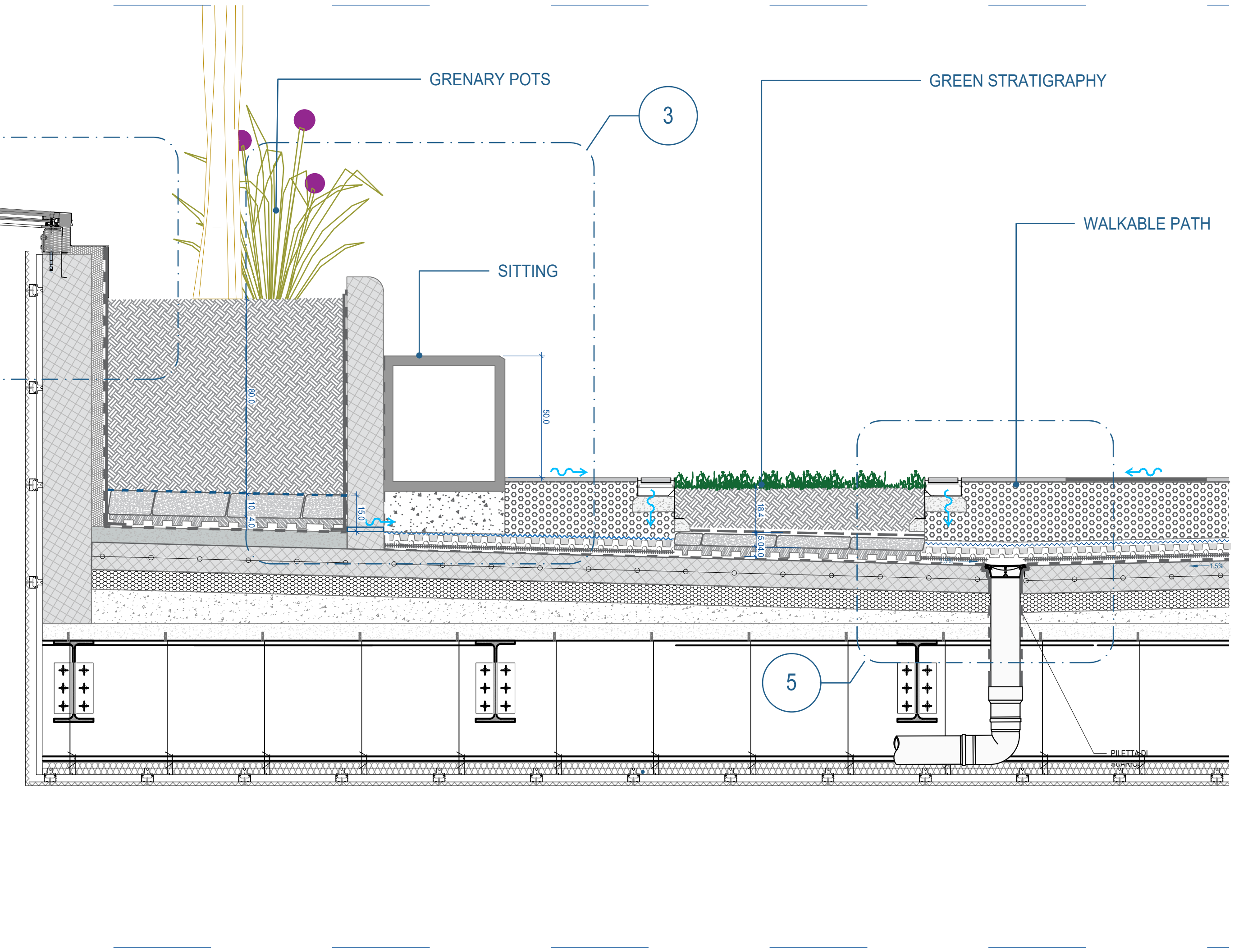


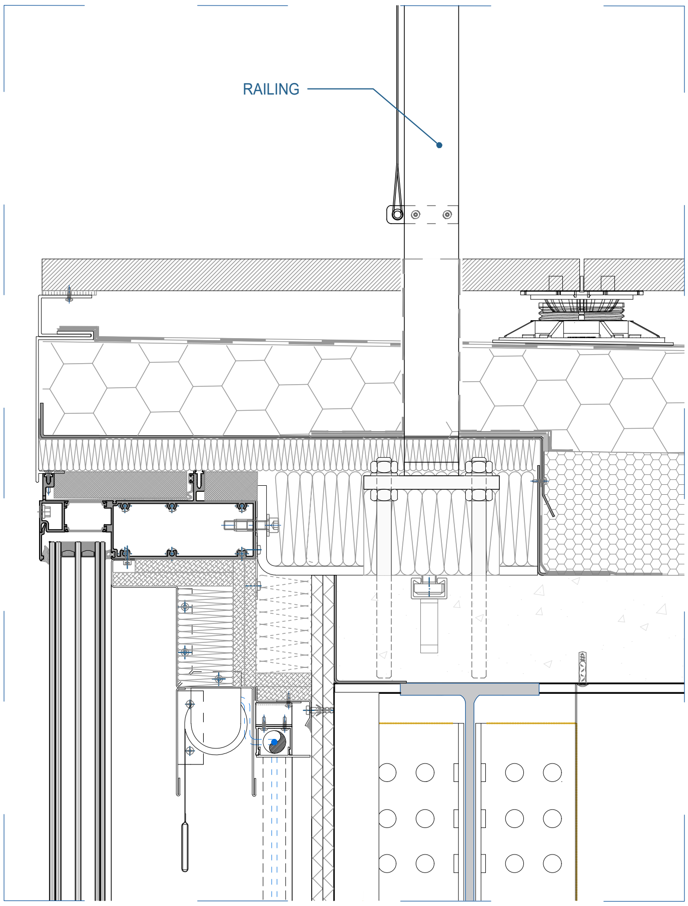
Curtain Wall, plan



Green roof, section

TECHNOLOGICAL DETAILS

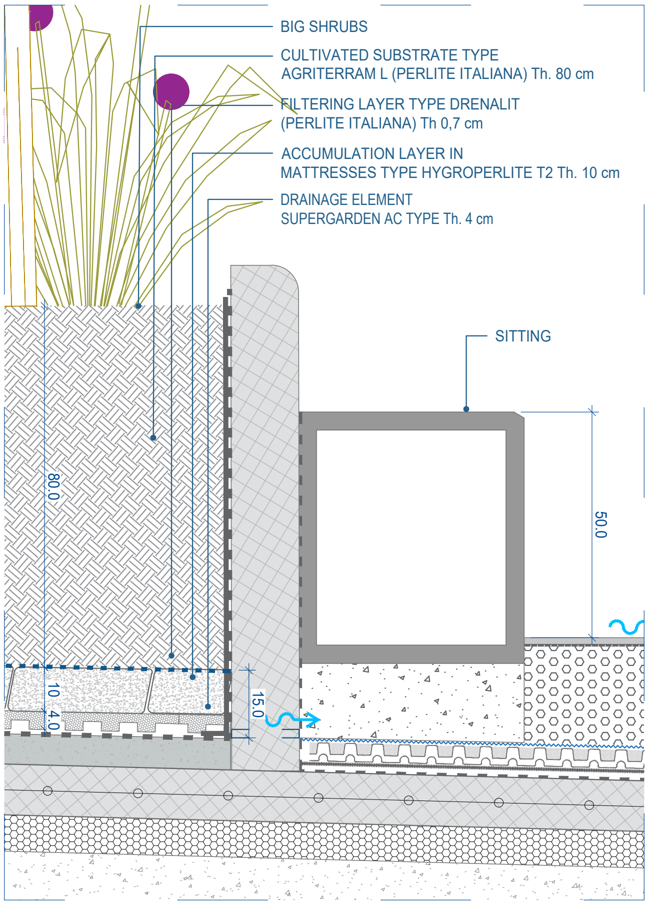




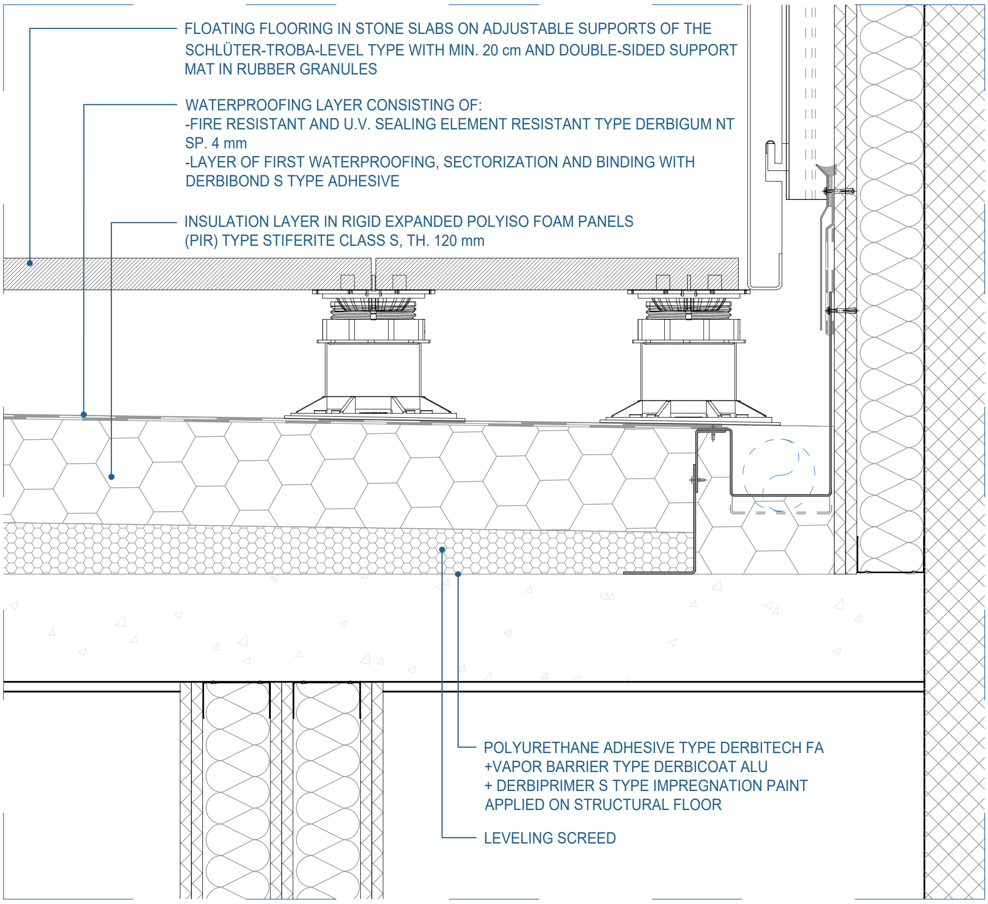
DETAIL - FACADE, SECTION
1 : 5

1. Curtain Wall and roof, section

TECHNOLOGICAL DETAILS

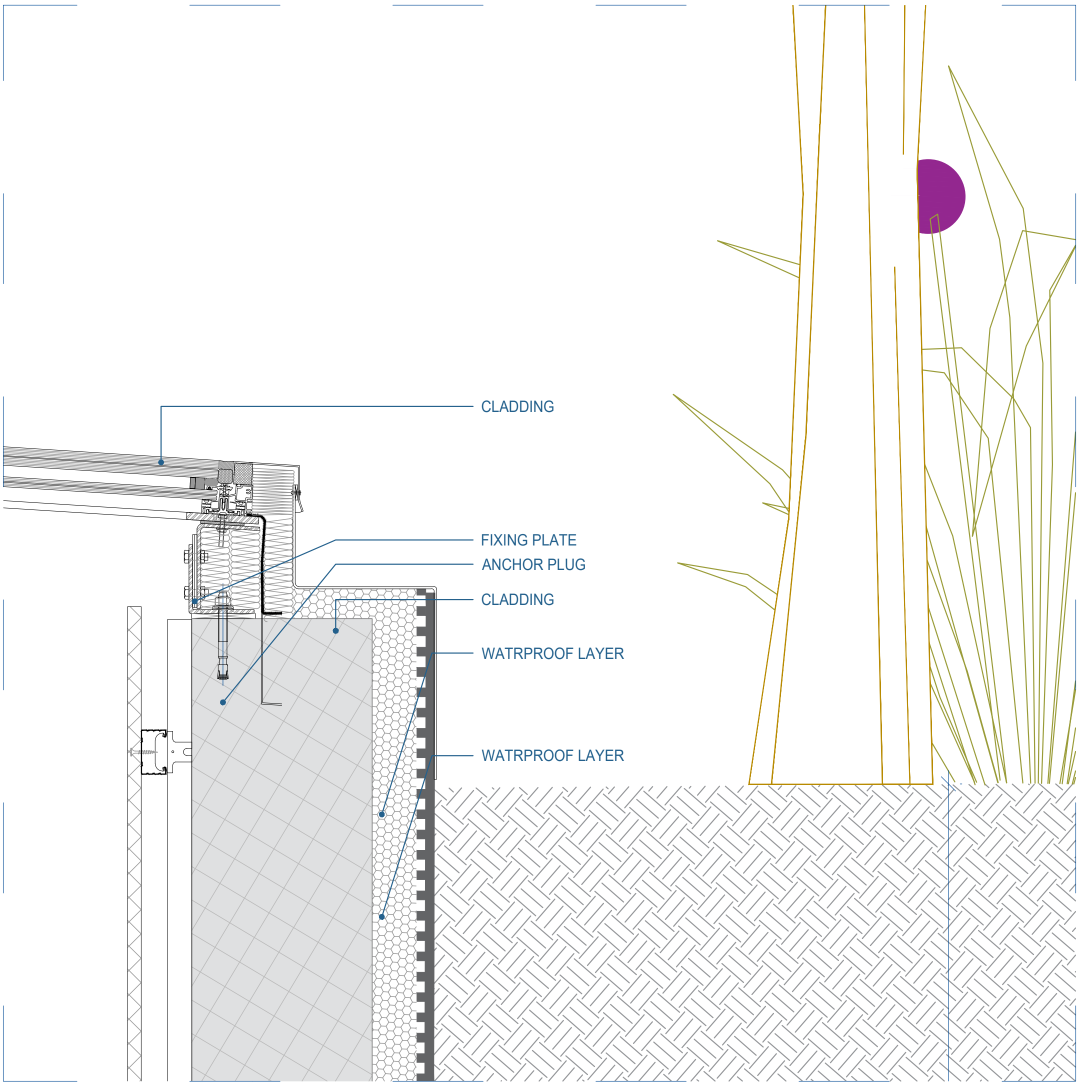


3. Gree pot, section

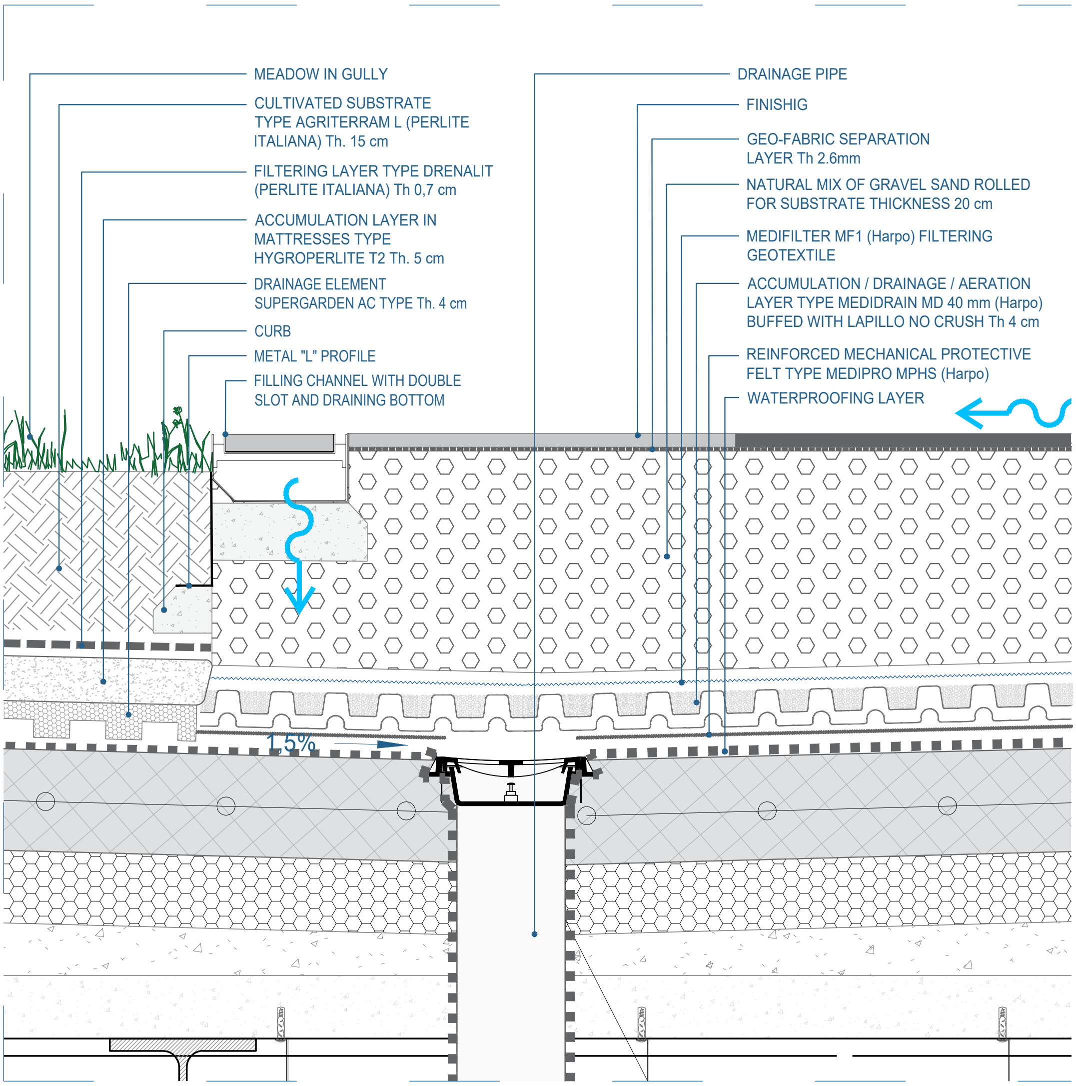


2. Pedestrian roof, section

TECHNOLOGICAL DETAILS

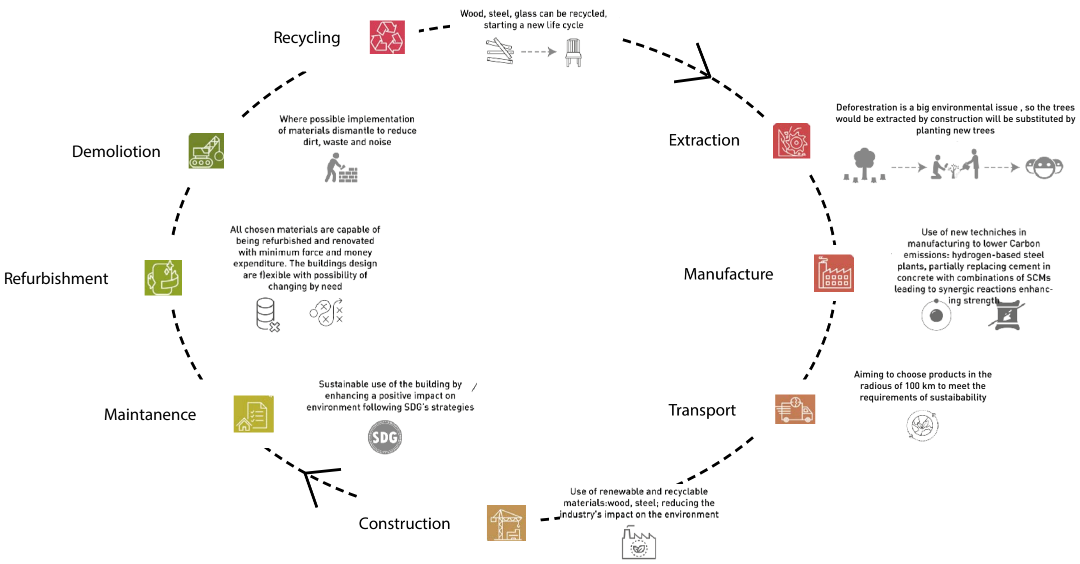


4. Curtain Wall and roof section



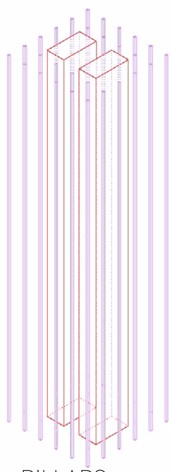
5. Drainage, section

TECHNOLOGICAL DETAILS

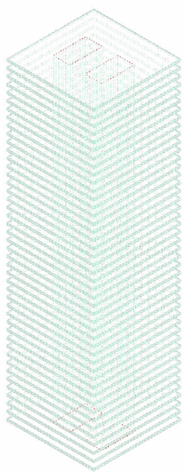


07. STRUCTURE

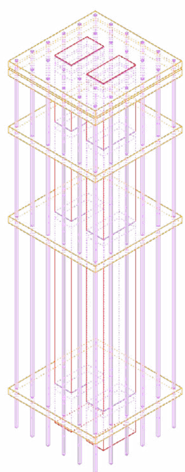
2 CORES



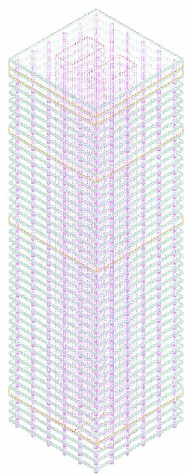
PILLARS



SLABS



BRACING FLOORS



FINAL

STRUCTURE COMPOSITION

Understanding Daily Life & Space Needs

Two cores: To give more stability to the tower especially when subjected to the strong horizontal thrust of the strong winds caused by the seasonal monsoons. Having two cores in which to place the vertical road system allows us to have an efficient escape route system by ensuring two separate escape columns.

Columns: We chose to use no less than 28 columns running the full height of the tower; from the foundations to the top. This was to be able to support all the loads the floors are subjected to without the need for a massive structure that would also take a central role in the overall external appearance of the tower.

Metal sheet: The chosen construction system is that of trapezoidal sheet metal floors. This was the preferred system from the outset due to the high lightness and mechanical strength of the material. The ceilings are then completed in different variants so that adoc ceiling packages can be created according to the functional area served.

Wind: Wind is a key element in the design of tall buildings in Shanghai; not only because of the natural predisposition of this architectural type to suffer more than others from the force of the wind. Seasonal typhoons are a major issue, so we have inserted stiffening planes along the tower to hold the structure together. These floors will also serve as a support surface for the MEP system.

This is to get to the heart of what we wanted to achieve in developing our structure: a tower element that is not just a skeleton but serves as a solid base from which to start, as with the static nature of the type of tower chosen, to be able to feed the functional complexity that we want to host within our spaces.

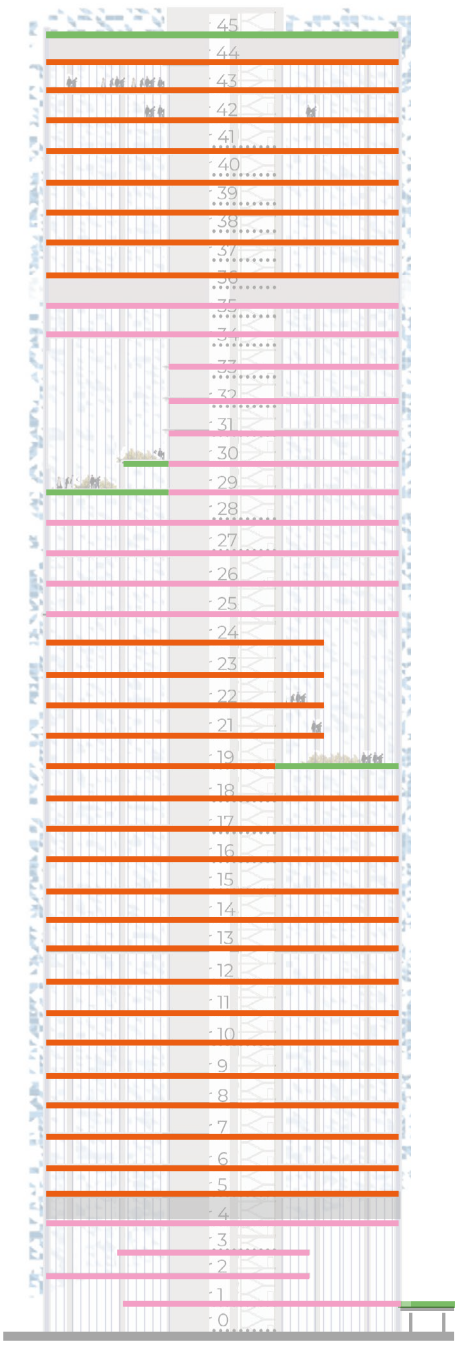
Sizing Structural Elements

In this chapter of the report we will focus on the pre-dimensioning, analysis and verification of the most stressed structural elements of the tower.

The structural analysis is mainly divided into three parts where we focused on the structural elements of a typical floor, plus the structural elements of two “Loggia” floors: the floor of the “Courtyard” space and the green roof of the podium.

In this way we were able to dimension the structural elements more carefully, reinforcing them where the increased forces acting on the structure made it necessary.

SLAB TIPOLOGY

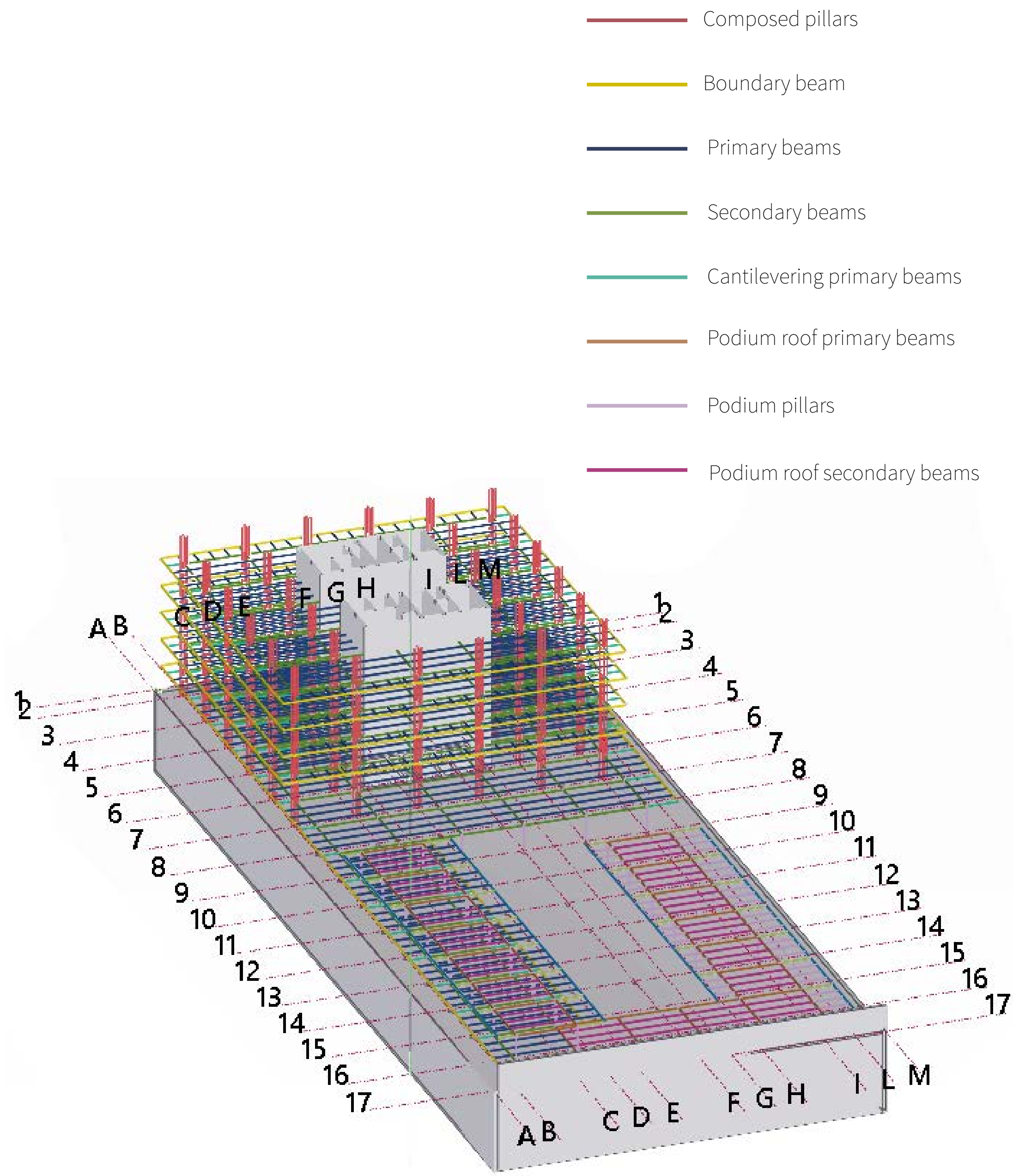


1st typology

2nd typology

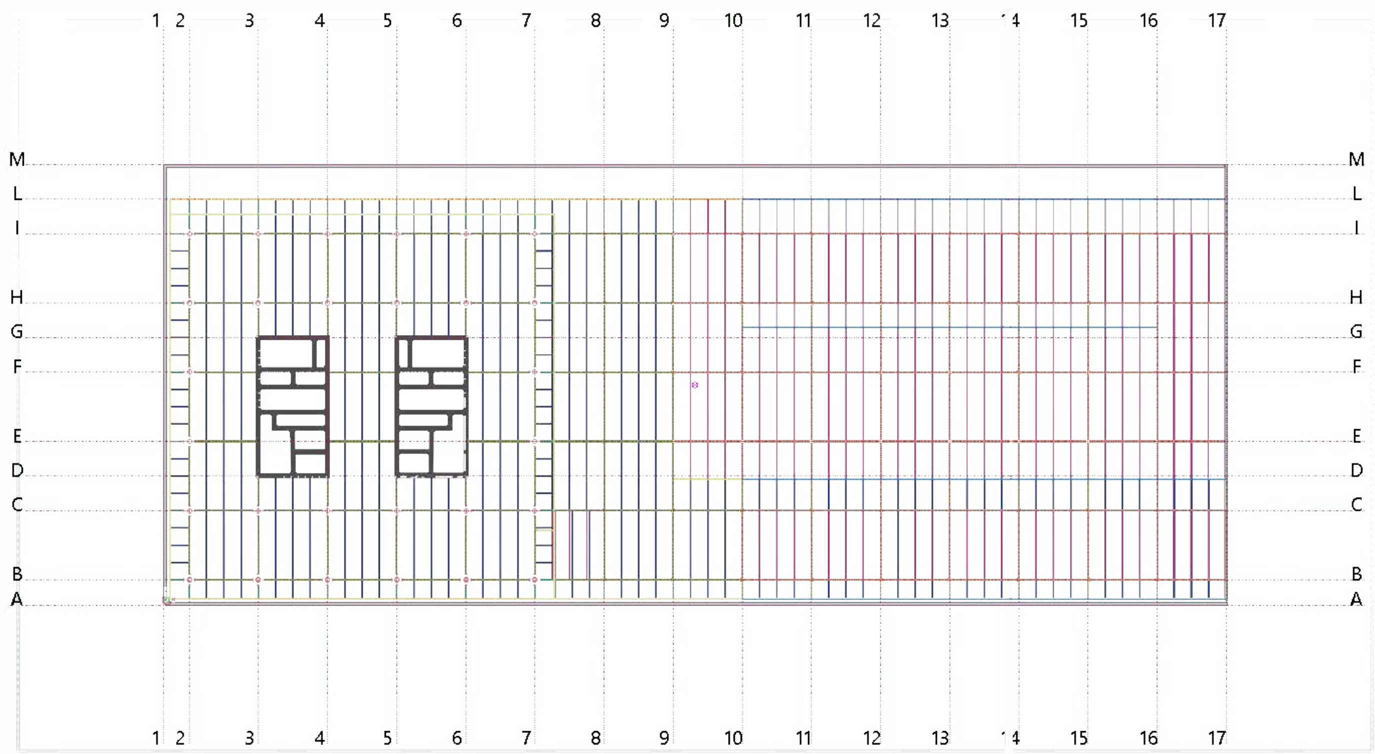
3th typology

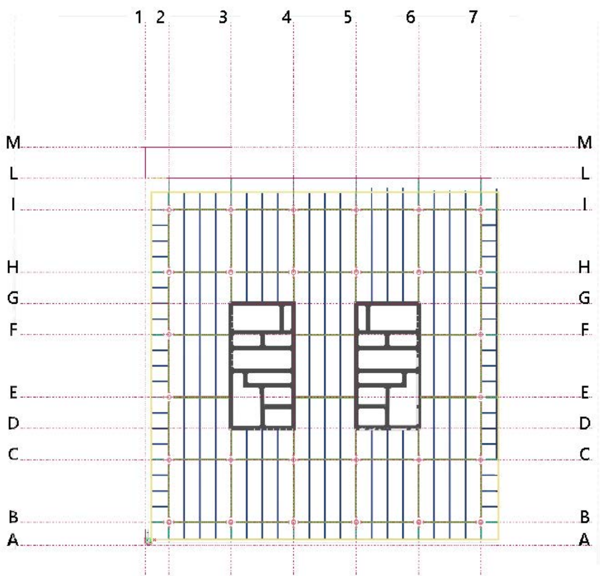
4th typology



Tekla structures, view

STRUCTURAL ANALYSIS

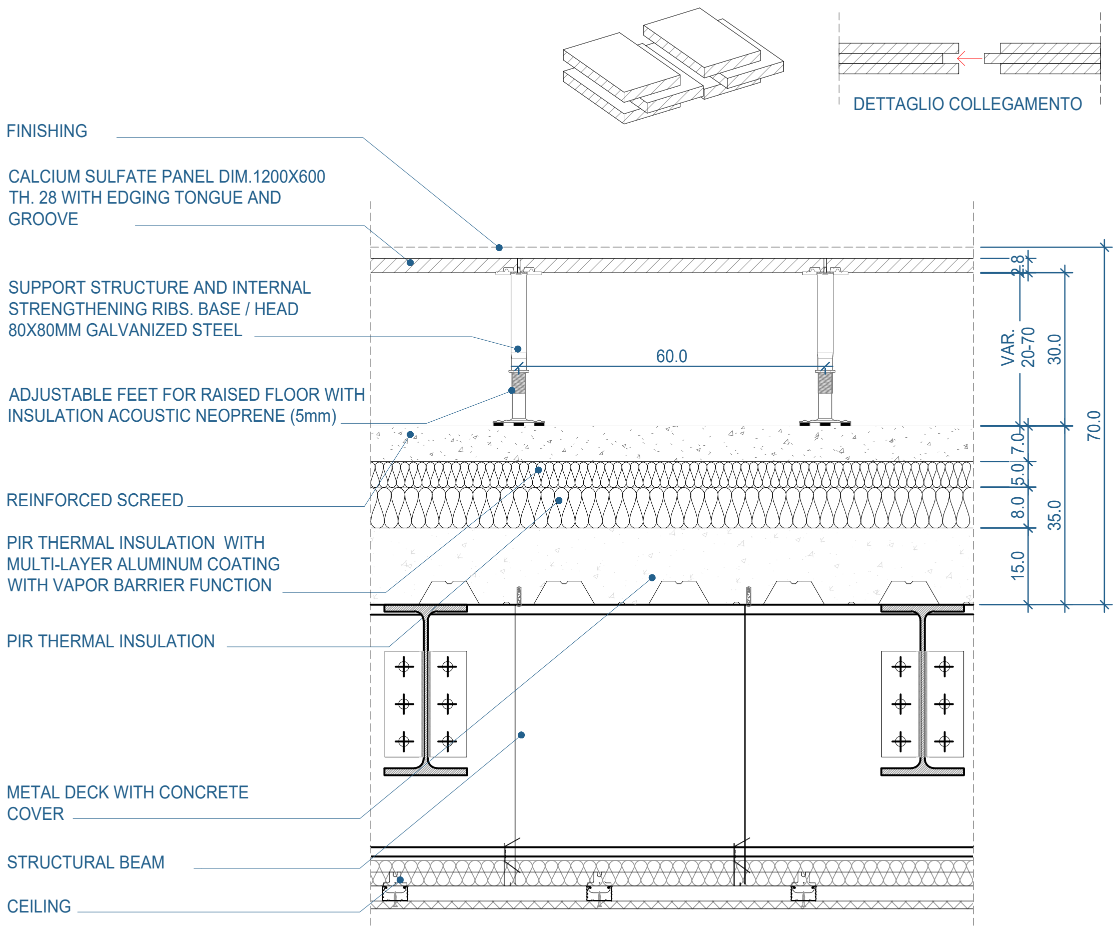




Tekla structures, plan

- Secondary beams HEB 450
- Primary beams HEB 500
- Cantilevering primary beam HEB 400
- Boundary beam HEB 260
- Concrete Cores
- Podium roof primary beam
- Podium roof secondary beam

1) Typical apartment floors slab stratigraphy analysis



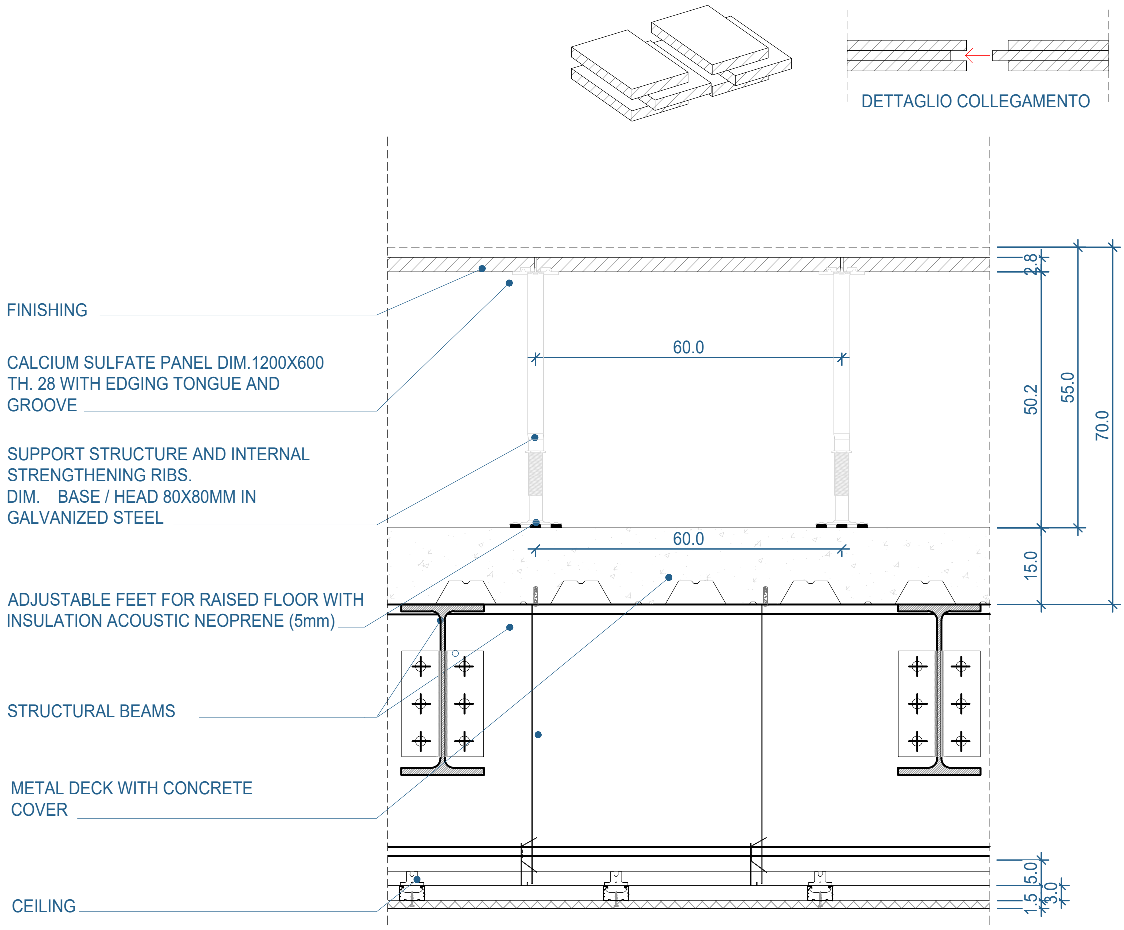
Detail, section

TYPE 1
APARTMENT FLOORS

Material	Height (mm)	Height (m)	Width (m)	Lenght (m)	Kg/mc	Unit Weight (KN/mc)	Tot
Flooring (12mm Tiles + 6mm Adhesive	18	0.018	1	1	-	-	0.4
Panel in calcium sulphate	30	0.03	1	1	1500	14.7	0.441
Floating floor system	300	0.3	1	1	-	-	0.049
Mechanical plats	-	-	1	1	-	-	0.198
Screed	70	0.07	1	1	600	5.88	0.4116
Insulation	50	0.05	1	1	34	0.3332	0.0167
Insulation	80	0.08	1	1	43	0.4214	0.0337
Metal deck with concrete cover	150	0.15	1	1	-	-	2.31
Insulation	50	0.05	1	1	90	0.882	0.0441
Ceiling	30	0.03	1	1	-	-	0.35
							4.2541

load

2) Typical offices floors slab stratigraphy analysis



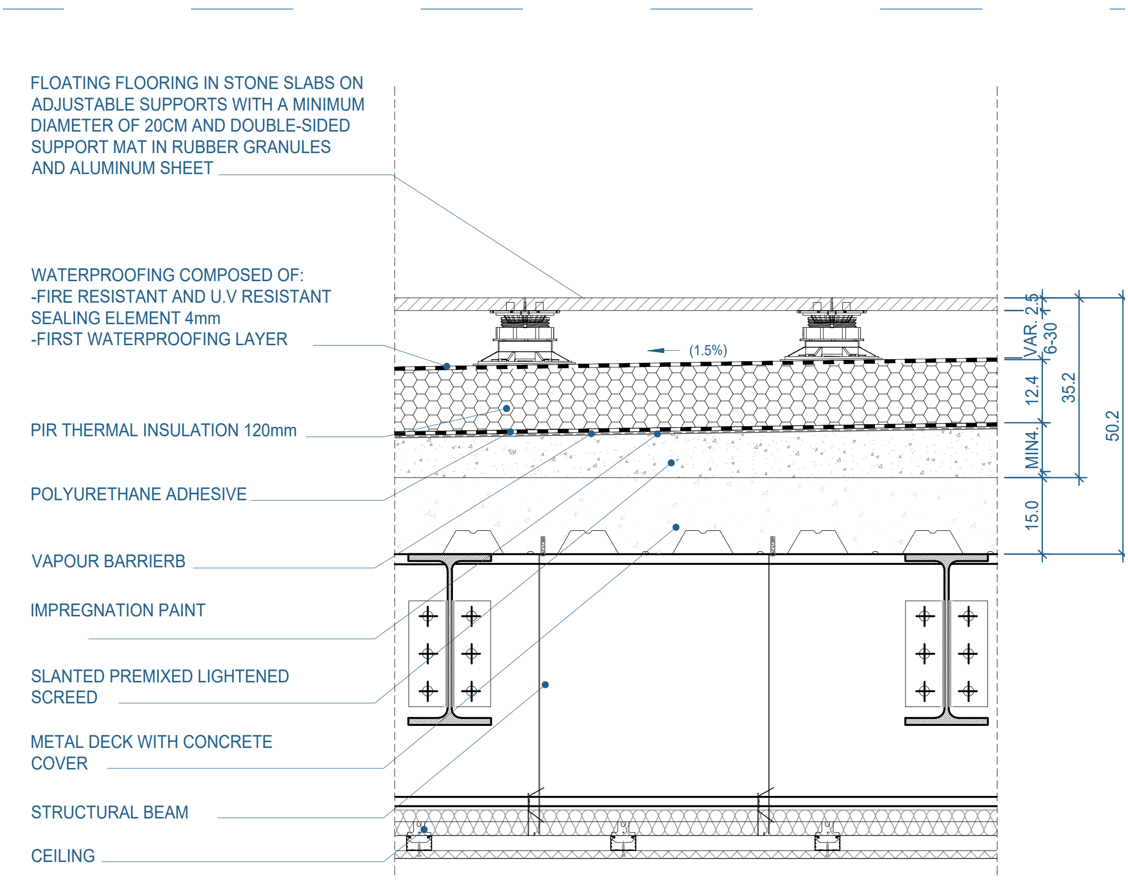
Detail, section

TYPE 2
OFFICE FLOORS

Material	Height (mm)	Height (m)	Width (m)	Lenght (m)	Kg/mc	Unit Weight (KN/mc)	Tot
Flooring (12mm Tiles + 6mm Adhesive	18	0.018	1	1	-	-	0.4
Panel in calcium sulphate	30	0.03	1	1	1500	14.7	0.441
Floating floor system	300	0.3	1	1	-	-	0.049
Mechanical plats	-	-	1	1	-	-	0.198
Acoustic panel	-	-	-	-	-	-	-
Metal deck with concrete cover	150	0.15	1	1	-	-	2.31
Ceiling	30	0.03	1	1	-	-	0.35
							3.748

Load

3) Typical terraces slab stratigraphy analysis



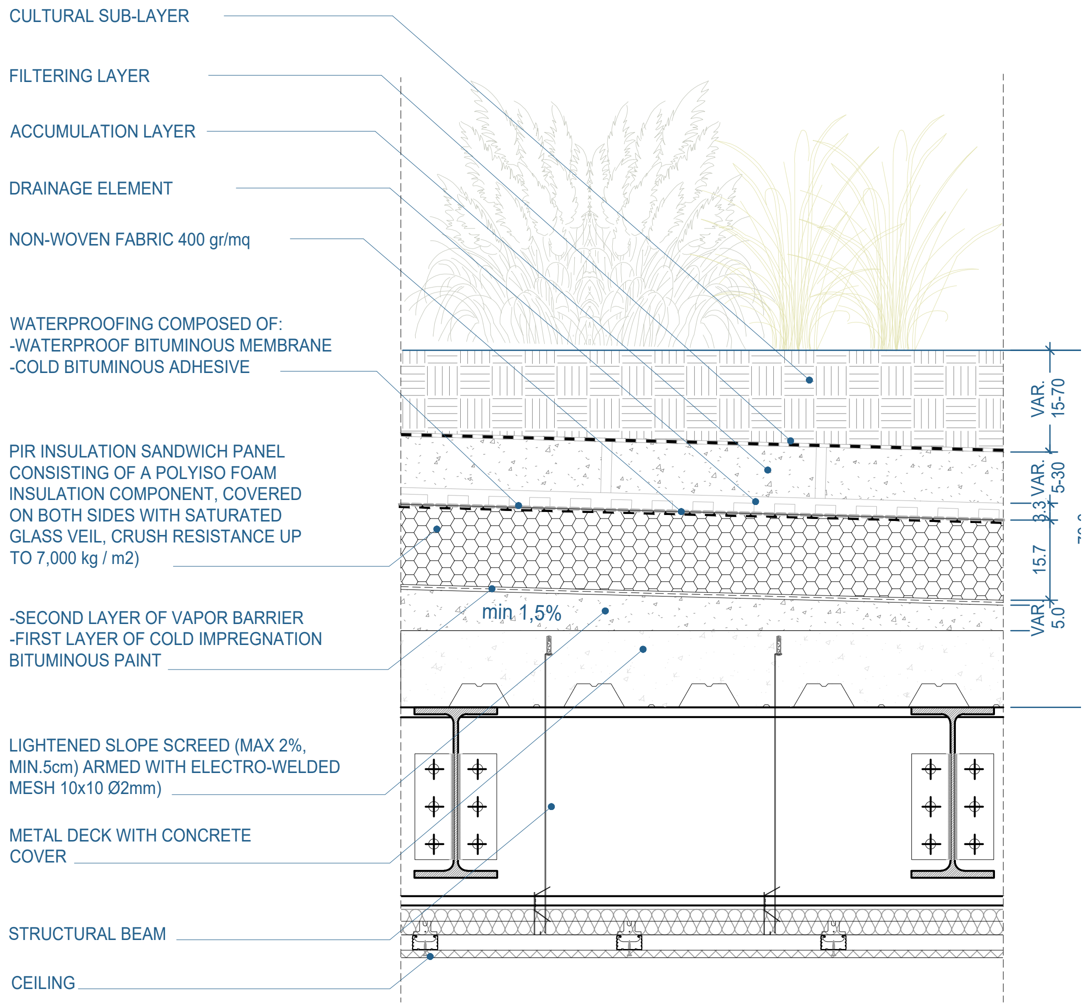
Detail, section

TYPE 3
TERRACE FLOORS

Material	Height (mm)	Height (m)	Width (m)	Lenght (m)	Kg/mc	Unit Weight (KN/mc)	Tot
Flooring (25mm tiles)	25	0.025	1	1	1320	12.936	0.3234
Floating floor system	-	-	-	-	-	-	0.0294
Insulation	120	0.12	1	1	43	0.4214	0.0506
Sloped screed	150	0.15	1	1	600	5.88	0.882
Vapour barrier	-	-	-	-	-	-	-
Water proof layer	-	-	-	-	-	-	-
Metal deck with concrete cover	150	0.15	1	1	-	-	2.31
Insulation	50	0.05	1	1	90	0.882	0.0441
Ceiling	30	0.03	1	1	-	-	0.35
							3.9895

Load

4) Typical green roof slab stratigraphy analysis



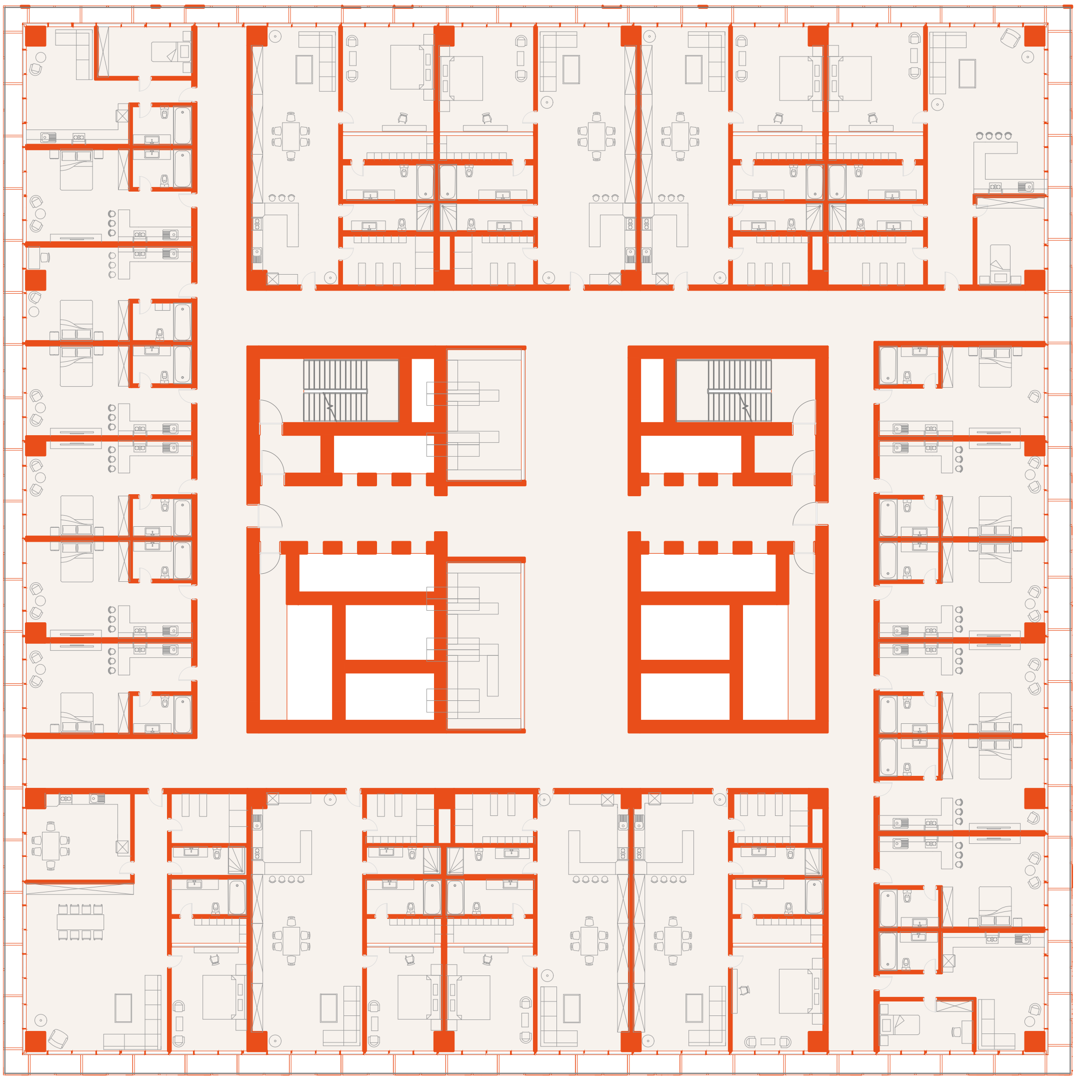
Detail, section

TYPE 4
GREEN ROOF

Material	Height (mm)	Height (m)	Width (m)	Lenght (m)	Kg/mc	Unit Weight (KN/mc)	Tot
Grass	-	-	-	-	-	-	0.098
Terrain	700	0.7	1	1	1150	11.27	7.889
Filtration layer	-	-	-	-	-	-	-
Accumulation layer	300	0.3	-	-	125	1.225	0.3675
Water drainage	33	0.033	1	1	24	0.2352	0.0078
Anti-root barrier	-	-	-	-	-	-	-
Water proof layer	-	-	-	-	-	-	-
Insulation	120	0.12	1	1	43	0.4214	0.0506
Vapoor layer	-	-	-	-	-	-	-
Sloped screed	150	0.15	1	1	600	5.88	0.882
Metal deck with concrete cover	150	0.15	1	1	-	-	2.31
Insulation	50	0.05	1	1	90	0.882	0.0441
Ceiling	30	0.03	1	1	-	-	0.35
							11.99

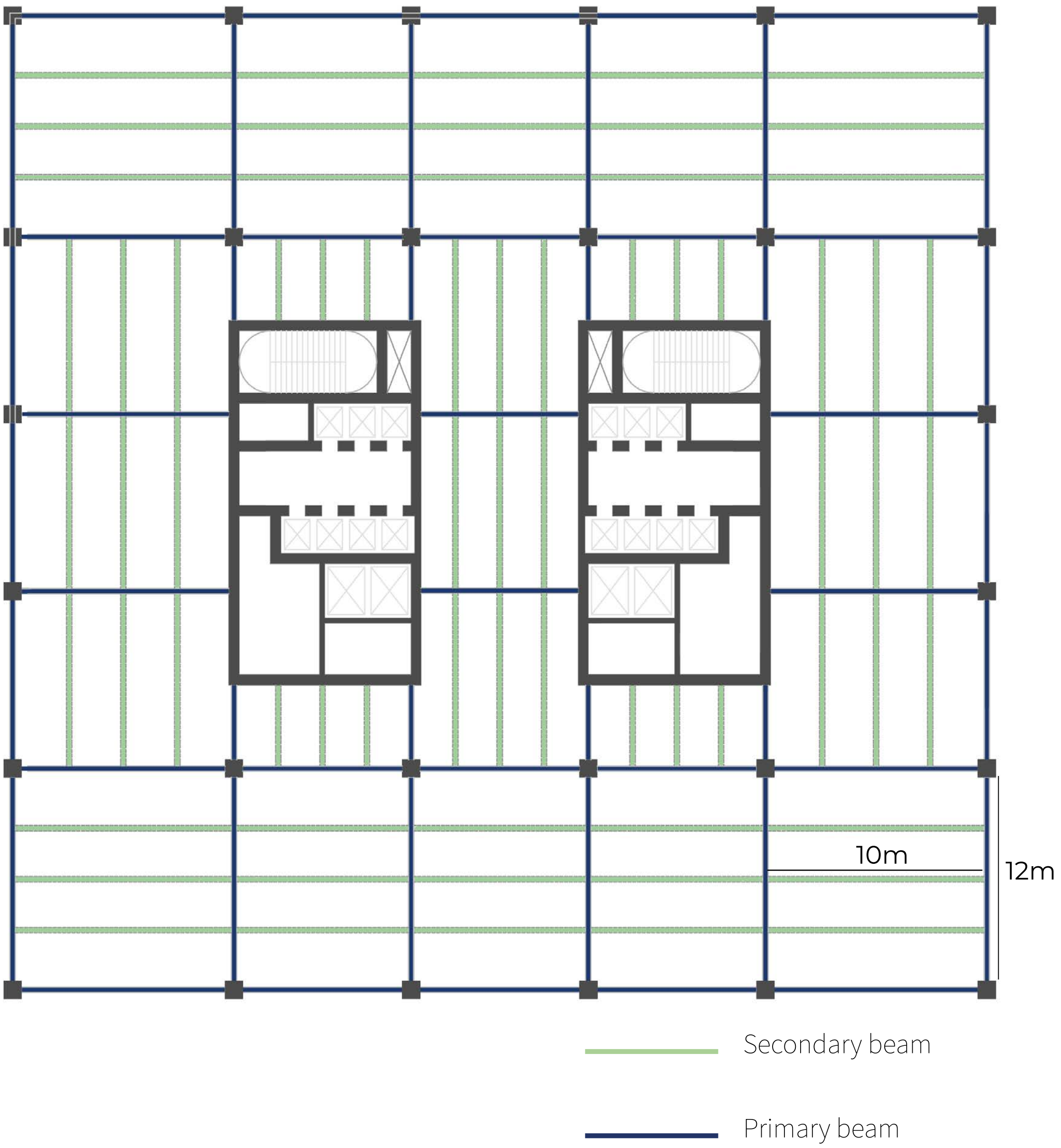
Load

Full apartments typical floor plan



TYPE 1
APARTMENT FLOORS

Strucrural full apartment typical floor plan scheme



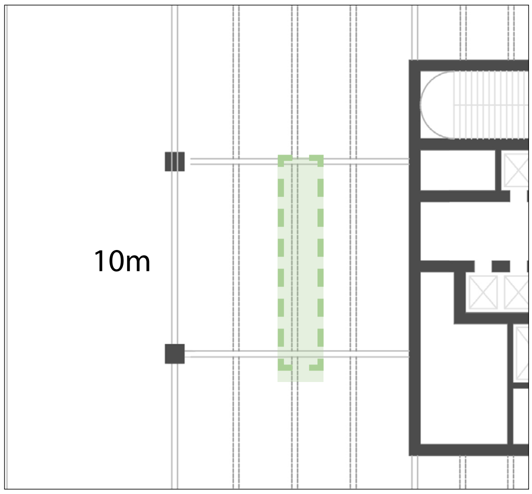
Category of use study

Category	Specific Use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets.
B	Office areas	
C	Areas where people may congregate (with the exception of areas defined under category A, B, and D[1])	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. **C2**: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. **C3:** Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. **C4**: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. **C5**: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms.
D	Shopping areas	**D1:** Areas in general retail shops **D2**: Areas in department stores

Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A		
- Floors	1,5 to2,0	2,0 to 3,0
- Stairs	2,0 to4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0
Category B	2,0 to 3,0	1,5 to 4,5
Category C		
- C1	2,0 to 3,0	3,0 to 4,0
- C2	3,0 to 4,0	2,5 to 7,0 (4,0)
- C3	3,0 to 5,0	4,0 to 7,0
- C4	4,5 to 5,0	3,5 to 7,0
- C5	5,0 to 7,5	3,5 to 4,5
category D		
- D1	4,0 to 5,0	3,5 to 7,0 (4,0)
- D2	4,0 to 5,0	3,5 to 7,0

1.1 Typical secondary beam calculation

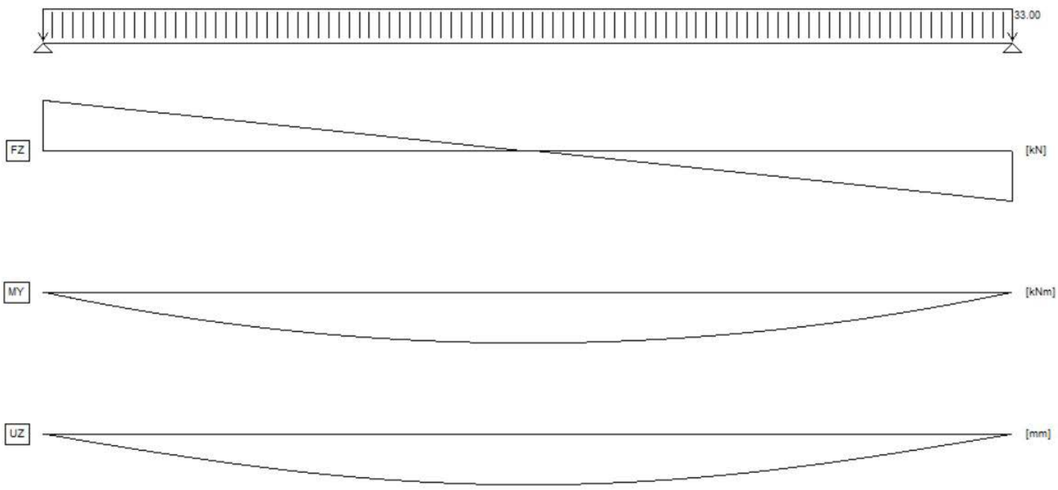
This type of secondary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



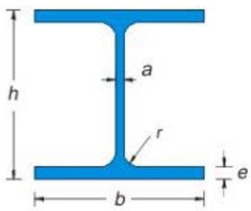
Slab typology: 1st

Gk = 4,25 kN/mq

Live load = Qk = 3 kN/mq



HEB 450



b = 300mm
h = 450mm
a = 14,0mm
e = 26,0mm
r = 27mm
Weight = 171,0 kG/m
Area = 218,0 mq
Jx = 79.890 cm^4
Jy = 11.720 cm^4
Wx = 3.551 mc
Wy = 781,4 mc

$$q = (2{,}5 \cdot 4{,}25) + (1{,}5 \cdot 4) = 29{,}34\ kN/m$$

$$Mmax = \frac{ql^2}{8} = 366{,}79\ kN/m$$

$$We,d = \frac{m}{f_y} = \frac{366{,}79}{338{,}09 \cdot 1000} = 1085\ cm^3$$

Beam typology selected: HEB 450

$$q_{new} = q + beam\ self\ weight = 29{,}34 + 2{,}22 = 31{,}56\ kN/m$$

$$Mmax = \frac{ql^2}{8} = 394{,}5\ kN/m$$

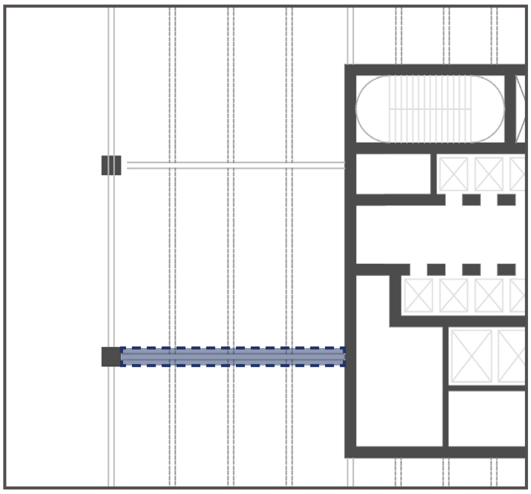
$$We,d = \frac{m}{f_y} = \frac{394{,}5}{338{,}09 \cdot 1000} = 1266{,}8\ cm^3$$

$$\Delta = \frac{5 \cdot q \cdot 10^4}{384 \cdot E \cdot I} = \frac{5\ \cdot 31{,}56 \cdot\ 10^4}{384\ \cdot 210E6\ \cdot 0{,}0007989} = 0{,}024\ m < 0{,}033\ m$$

VERIFIED

1.2 Typical primary beam calculation

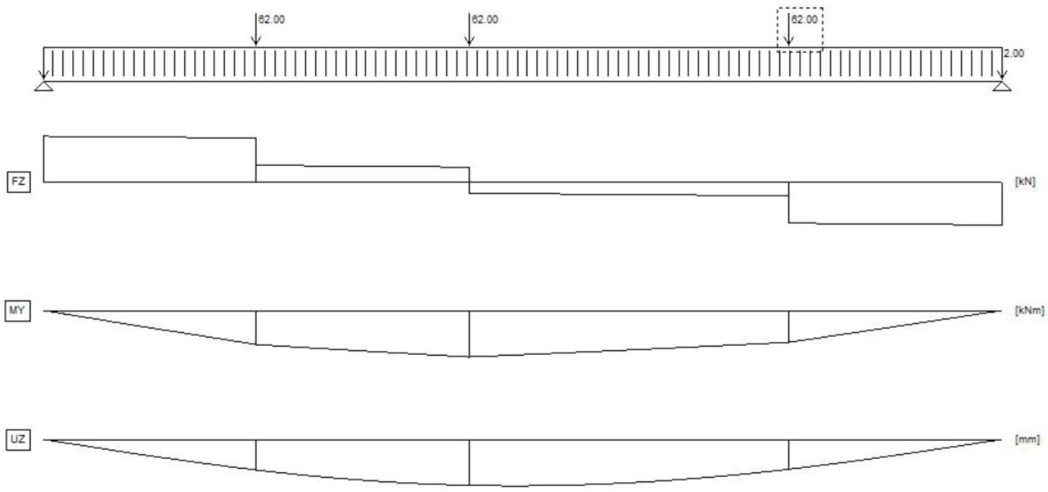
This type of primary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



Slab typology: 1st

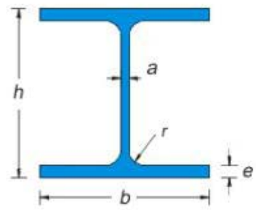
qd = 13,96 kN

P =62,8 kN



TYPE 1
APARTMENT FLOORS

HEB 500



b = 300mm
h = 500mm
a = 14,5mm
e = 28,0mm
r = 27mm
Weight = 187,0 kG/m
Area = 238,6 mq
Jx = 107.200 cm^4
Jy = 12.620 cm^4
Wx = 4.287 mc
Wy = 841,6 mc

$$Me,d = \frac{q \cdot l}{3} = 418{,}8\ kNm$$

$$We,d = \frac{m}{f_y} = \frac{418{,}8}{338{,}09 \cdot 1000} = 1238\ cm^3$$

Beam typology selected: HEB 500

Self Weight contribution 2,43 kN/m

$$Me,d = \frac{139{,}6 \cdot 9}{3} + \frac{2{,}43 \cdot 9^2}{8} = 443{,}4\ kNm$$

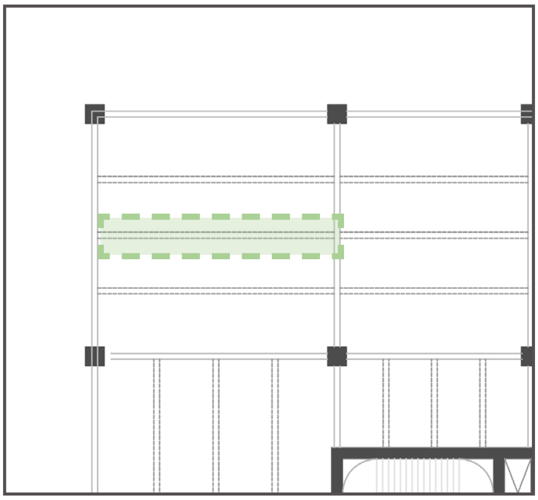
$$We,d = \frac{443{,}4}{338{,}09 \cdot 1000} = 1311\ cm^3$$

$$\Delta_{e,d} = \frac{19 \cdot P \cdot l^3}{384 \cdot E \cdot I} + \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{19 \cdot 139{,}6 \cdot 9^3}{384 \cdot (210E6) \cdot 0{,}001072} + \frac{5 \cdot 2{,}43 \cdot 9^4}{384 \cdot (210E6) \cdot 0{,}001072}$$
$$= 0{,}0233 < 0{,}036$$

VERIFIED

1.3 Typical secondary beam calculation

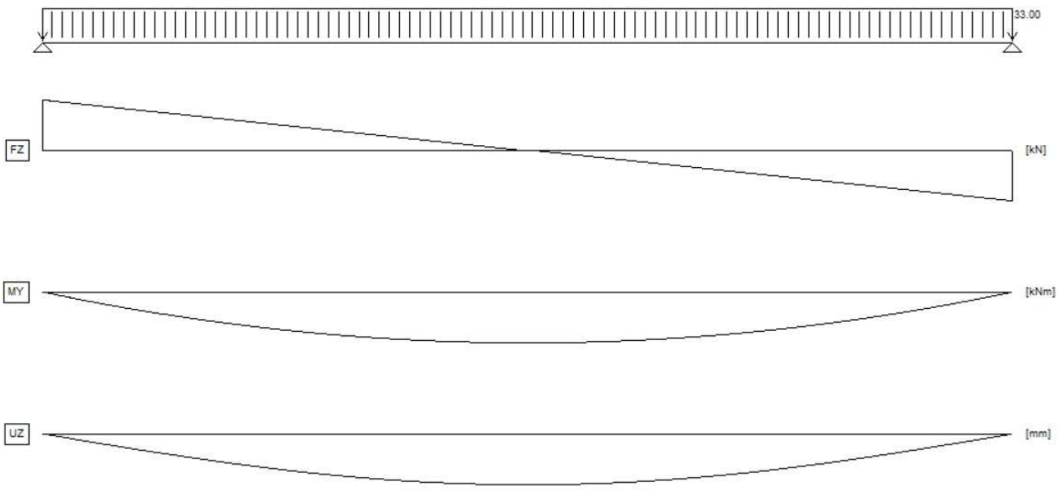
This type of secondary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



Slab typology: 3th

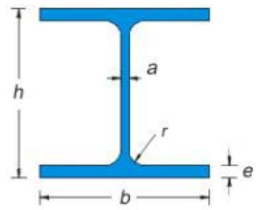
Gk = 3,98 kN/mq

Live load = Qk = 5 kN/mq



TYPE 1
APARTMENT FLOORS

HEM 400



b = 307mm
h = 432mm
a = 21,0mm
e = 40,0mm
r = 27mm
Weight = 256,0 kG/m
Area = 325,8 mq
Jx = 104.100 cm^4
Jy = 19.340 cm^4
Wx = 4.820 mc
Wy = 1.260 mc

$$q = 2{,}5 \cdot (1{,}35 \cdot 3{,}98 + 1{,}5 \cdot 5) = 32{,}18\ kN/m$$

$$M_{max} = \frac{ql^2}{8} = 402{,}28\ kNm$$

$$W_{e,d} = \frac{402{,}28}{338{,}09 \cdot 1000} = 1189{,}86\ cm^3$$

Beam typology selected: HEM 400

Self weight = 2,56 kN/m --> 2,56 * 1,3 = 3,32 kN/m

$$M_{max} = \frac{ql^2}{8} = \frac{35{,}5 \cdot 10^2}{8} = 443{,}75\ kNm$$

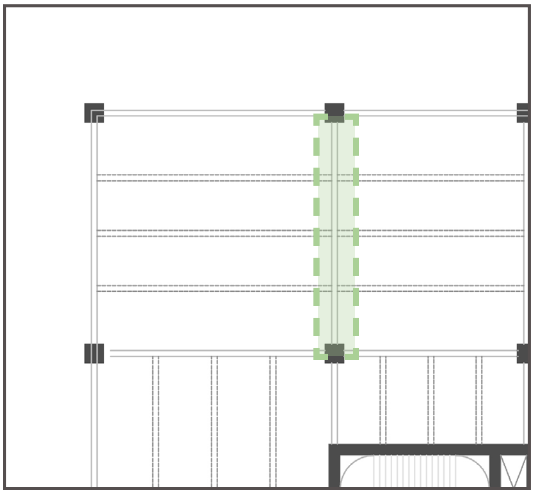
$$W_{e,d} = \frac{443{,}75}{338{,}09 \cdot 1000} = 1312{,}5\ cm^3$$

$$\Delta_{e,d} = \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{5 \cdot 35{,}5 \cdot 10^4}{384 \cdot 210E6 \cdot 0{,}001041} = 0{,}021 < 0{,}033$$

VERIFIED

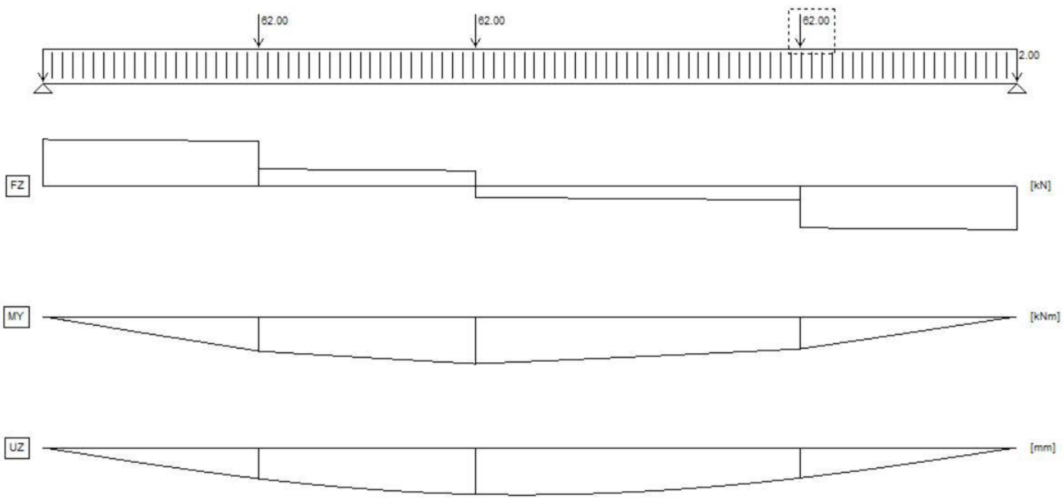
1.4 Long primary beam calculation

This type of boundary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



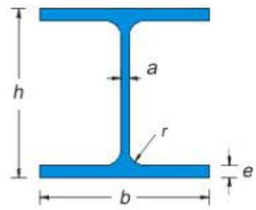
q=(12,85 *5) + (11,73 *5) = 123kN

P = Ve,d = 123 kN



TYPE 1
APARTMENT FLOORS

HEM 500



b = 306mm
h = 524mm
a = 21,0mm
e = 40,0mm
r = 27mm
Weight = 270,0 kG/m
Area = 344,3 mq
Jx = 161.900 cm^4
Jy = 19.150 cm^4
Wx = 6.180 mc
Wy = 1.252 mc

$$M_{e,d} = \frac{P \cdot l}{3} = \frac{123 \cdot 9}{3} = 369\ kNm$$

$$W_{e,d} = \frac{369}{338{,}09 \cdot 1000} = 1091\ cm^3$$

Beam typology selected: HEM 500

Self Weight = 2,7 * 1,3 = 3,21 kN/m

$$M_{e,d} = \frac{P \cdot l}{3} + \frac{q \cdot l^2}{8} = \frac{123 \cdot 9}{3} + \frac{2{,}51 \cdot 9^2}{8} = 404{,}54\ kNm$$

$$W_{e,d} = \frac{404{,}54}{338{,}09 \cdot 1000} = 1196{,}5\ cm^3$$

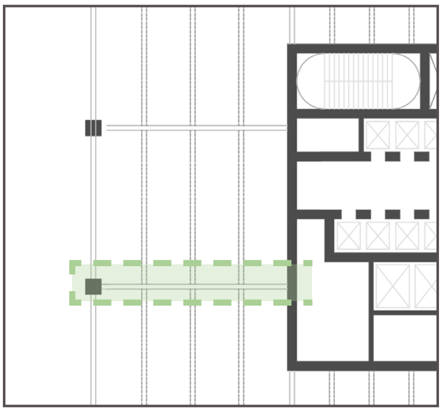
$$\Delta_{e,d} = \frac{19 \cdot P \cdot l^3}{384 \cdot E \cdot I} + \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{19 \cdot 123 \cdot 9^3}{384 \cdot 210E6 \cdot 0{,}001619} + \frac{5 \cdot 3{,}51 \cdot 9^4}{384 \cdot 210E6 \cdot 0{,}001619} =$$

$$= 0{,}014\ m < 0{,}036\ m$$

VERIFIED

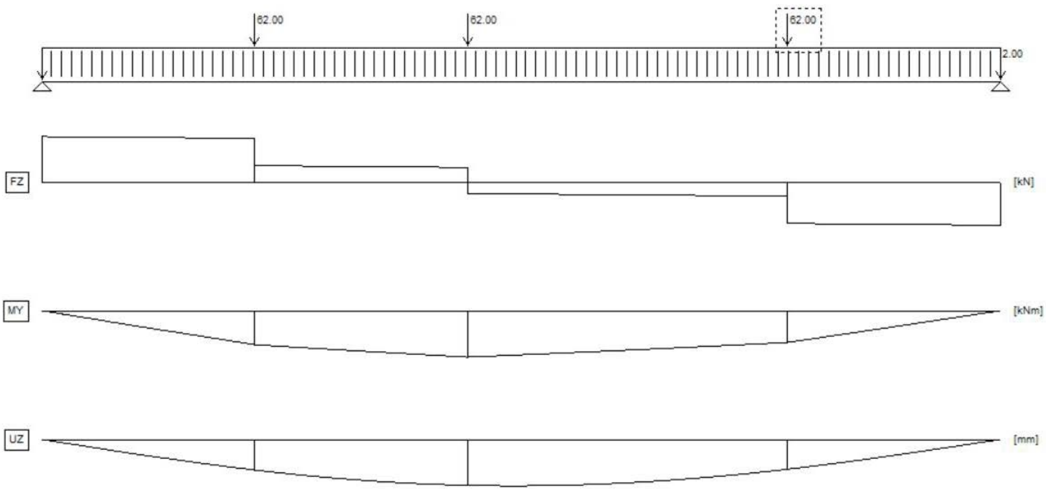
1.5 Edge primary beam calculation

This type of boundary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.

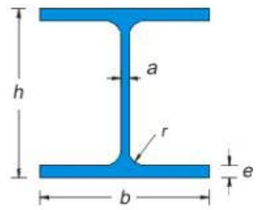


qd = 9,77 kN

P =24,42 kN



HEB 340



b = 300mm
h = 340mm
a = 12,0mm
e = 21,5mm
r = 27mm
Weight = 134,0 kG/m
Area = 170,9 mq
Jx = 36.660 cm^4
Jy = 9.690 cm^4
Wx = 2.156 mc
Wy = 646,0 mc

$$M_{e,d} = \frac{24{,}42 \cdot 10}{3} = 81{,}42\ kNm$$

$$W_{e,d} = \frac{81{,}42}{338{,}09 \cdot 1000} = 240{,}8\ cm^3$$

Beam typology selected: HEB 340

Self Weight contribution 1,742 kN/m

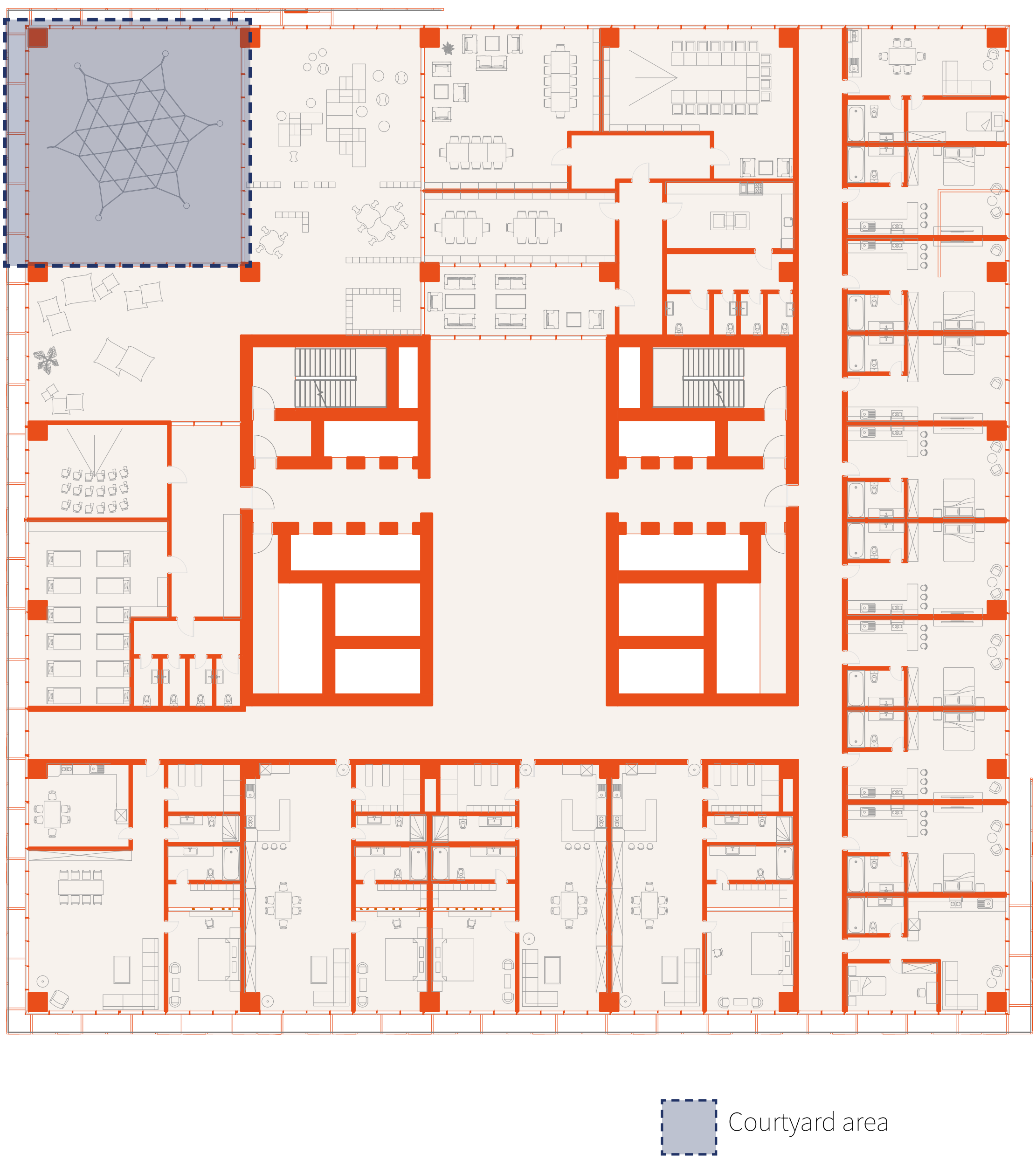
$$M_{e,d} = \frac{24{,}42 \cdot 10}{3} + \frac{1{,}74 \cdot 10^2}{8} = 103{,}15\ kNm$$

$$W_{e,d} = \frac{103{,}15}{338{,}09 \cdot 1000} = 305\ cm^3$$

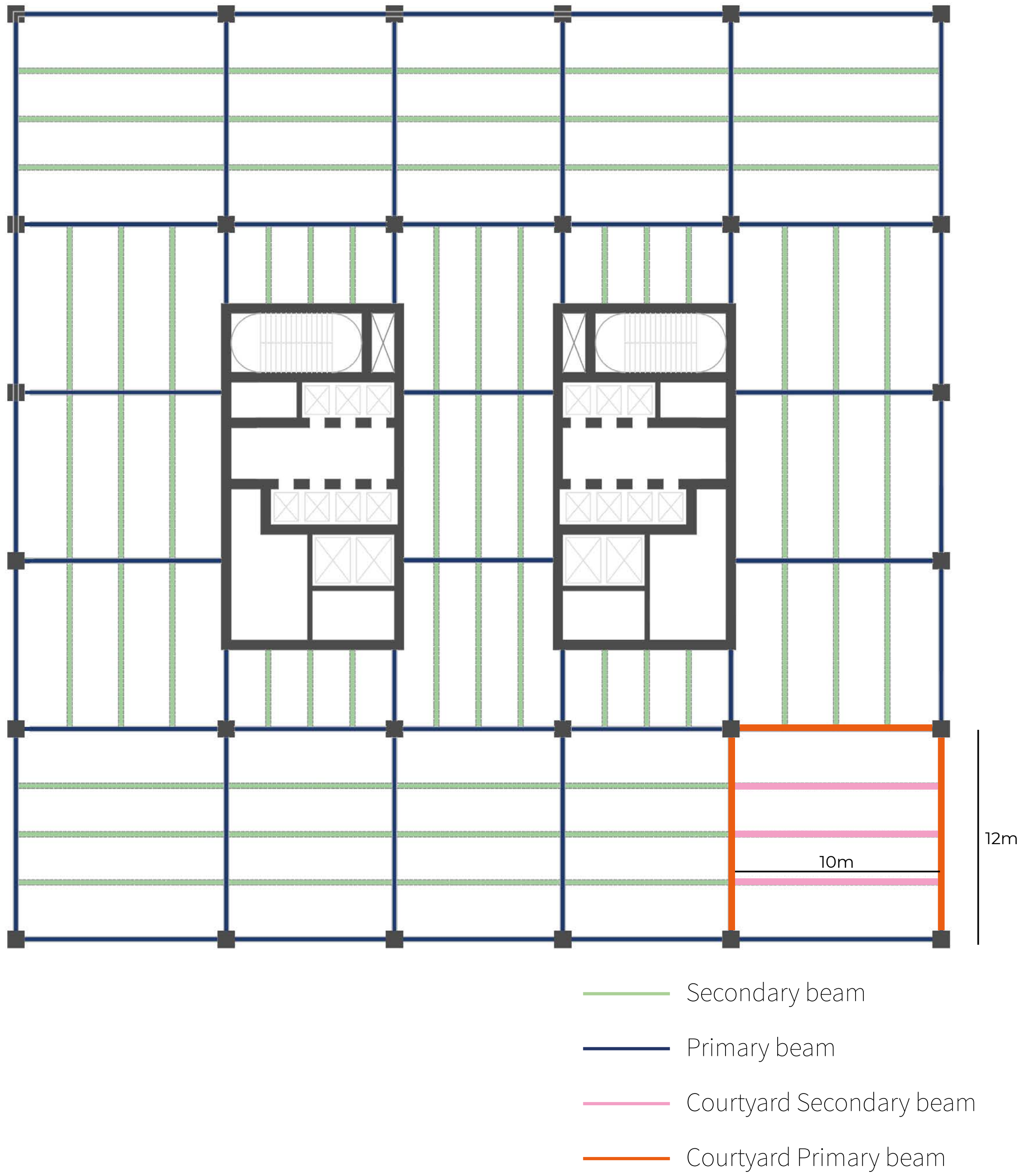
$$\Delta_{e,d} = \frac{19 \cdot p \cdot l^3}{384 \cdot E \cdot I} + \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{19 \cdot 24{,}42 \cdot 10^3}{384 \cdot 210E6 \cdot 0{,}0003666} + \frac{5 \cdot 1{,}74 \cdot 10^4}{384 \cdot 210E6 \cdot 0{,}0003666} = 0{,}0186 < 0{,}04\ m$$

VERIFIED

Loggia floor plan



Strucrural loggia floor plan scheme



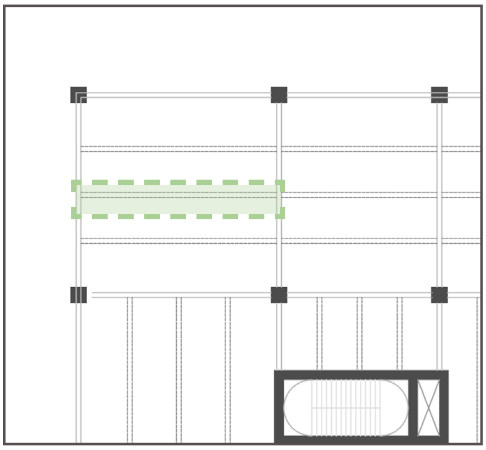
2.0 Category of use study

Category	Specific Use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets.
B	Office areas	
C	Areas where people may congregate (with the exception of areas defined under category A, B, and D[1)])	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. **C2**: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. **C3:** Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. **C4**: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. **C5**: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms.
D	Shopping areas	**D1:** Areas in general retail shops **D2**: Areas in department stores

Categories of loaded areas	q_k [kN/m²]	Q_k [kN]
Category A		
- Floors	1,5 to2,0	2,0 to 3,0
- Stairs	2,0 to4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0
Category B	2,0 to 3,0	1,5 to 4,5
Category C		
- C1	2,0 to 3,0	3,0 to 4,0
- C2	3,0 to 4,0	2,5 to 7,0 (4,0)
- C3	3,0 to 5,0	4,0 to 7,0
- C4	4,5 to 5,0	3,5 to 7,0
- C5	5,0 to 7,5	3,5 to 4,5
category D		
- D1	4,0 to 5,0	3,5 to 7,0 (4,0)
- D2	4,0 to 5,0	3,5 to 7,0

2.1 Loggia secondary beam calculation

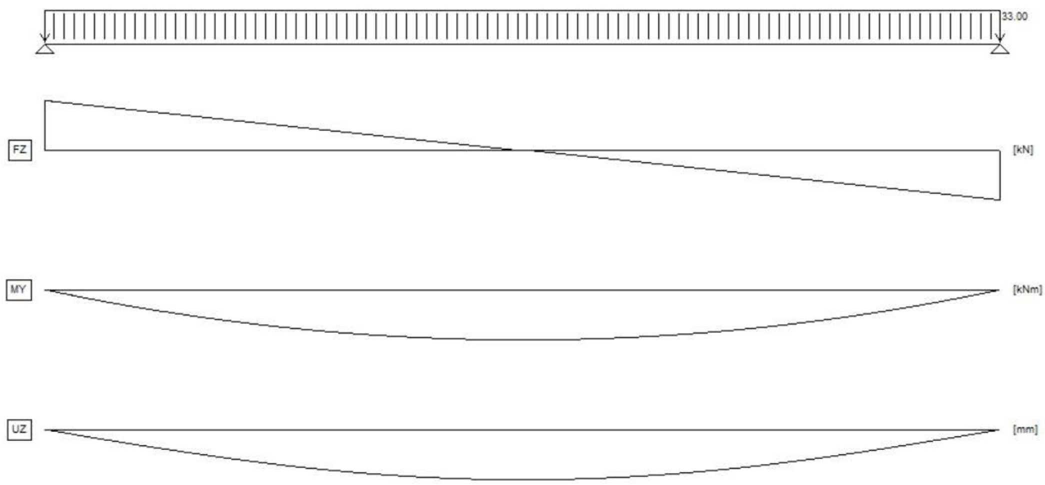
This type of secondary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



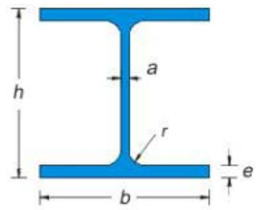
Slab typology: 3th

Gk = 3,98 kN/mq

Live load = Qk = 5 kN/mq



HEM 400



b = 307 mm
h = 432 mm
a = 21,0 mm
e = 40,0 mm
r = 27 mm
Weight = 256,0 kG/m
Area = 325,8 mq
Jx = 104.100 cm^4
Jy = 19.340 cm^4
Wx = 4.820 mc
Wy = 1.260 mc

$$q = 2{,}5 \cdot (1{,}35 \cdot 3{,}98 + 1{,}5 \cdot 5) = 32{,}18\ kN/m$$

$$M_{max} = \frac{ql^2}{8} = \frac{32{,}18 \cdot 10^2}{8} = 402{,}28\ kNm$$

$$W_{e,d} = \frac{402{,}28}{338{,}09 \cdot 1000} = 1189{,}86\ cm^3$$

Beam typology selected: HEM 400

Self weight = 2,56 kN/m --> 2,56 * 1,3 = 3,32 kN/m

$$M_{max} = \frac{ql^2}{8} = \frac{35{,}5 \cdot 10^2}{8} = 443{,}75\ kNm$$

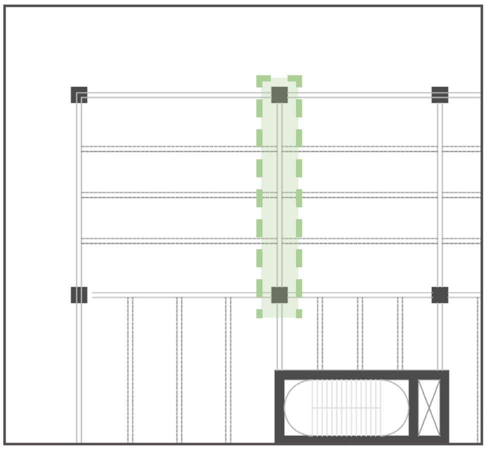
$$W_{e,d} = \frac{443{,}75}{338{,}09 \cdot 1000} = 1312{,}5\ cm^3$$

$$\Delta_{e,d} = \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{5 \cdot 35{,}5 \cdot 10^4}{384 \cdot 210E6 \cdot 0{,}001041} = 0{,}021 < 0{,}033$$

VERIFIED

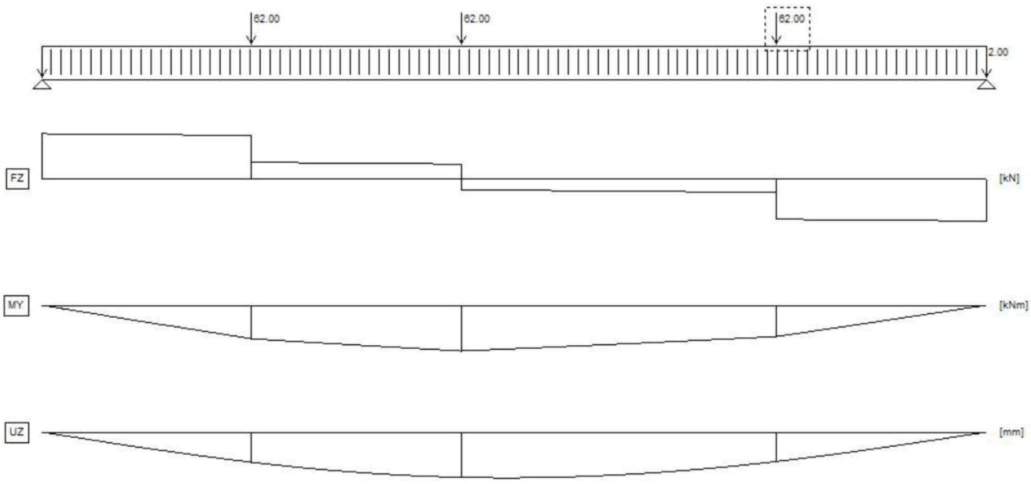
2.2 Loggia primary beam calculation

This type of boundary beam supports the tower-type floor. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.

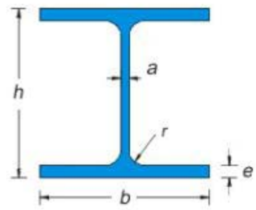


q=(12,85 *5) + (11,73 *5) = 123kN

P = Ve,d = 123 kN



HEM 500



b = 306 mm
h = 524 mm
a = 21,0 mm
e = 40 mm
r = 27 mm
Weight = 270 kG/m
Area = 344,3 mq
Jx = 161.900 cm^4
Jy = 19.150 cm^4
Wx = 6.180 mc
Wy = 1.252 mc

$$M_{e,d} = \frac{P \cdot l}{3} = \frac{123 \cdot 9}{3} = 369\ kNm$$

$$W_{e,d} = \frac{369}{338{,}09 \cdot 1000} = 1091\ cm^3$$

Beam typology selected: HEM 500

Self Weight = 2,7 * 1,3 = 3,21 kN/m

$$M_{e,d} = \frac{P \cdot l}{3} + \frac{q \cdot l^2}{8} = \frac{123 \cdot 9}{3} + \frac{2{,}51 \cdot 9^2}{8} = 404{,}54\ kNm$$

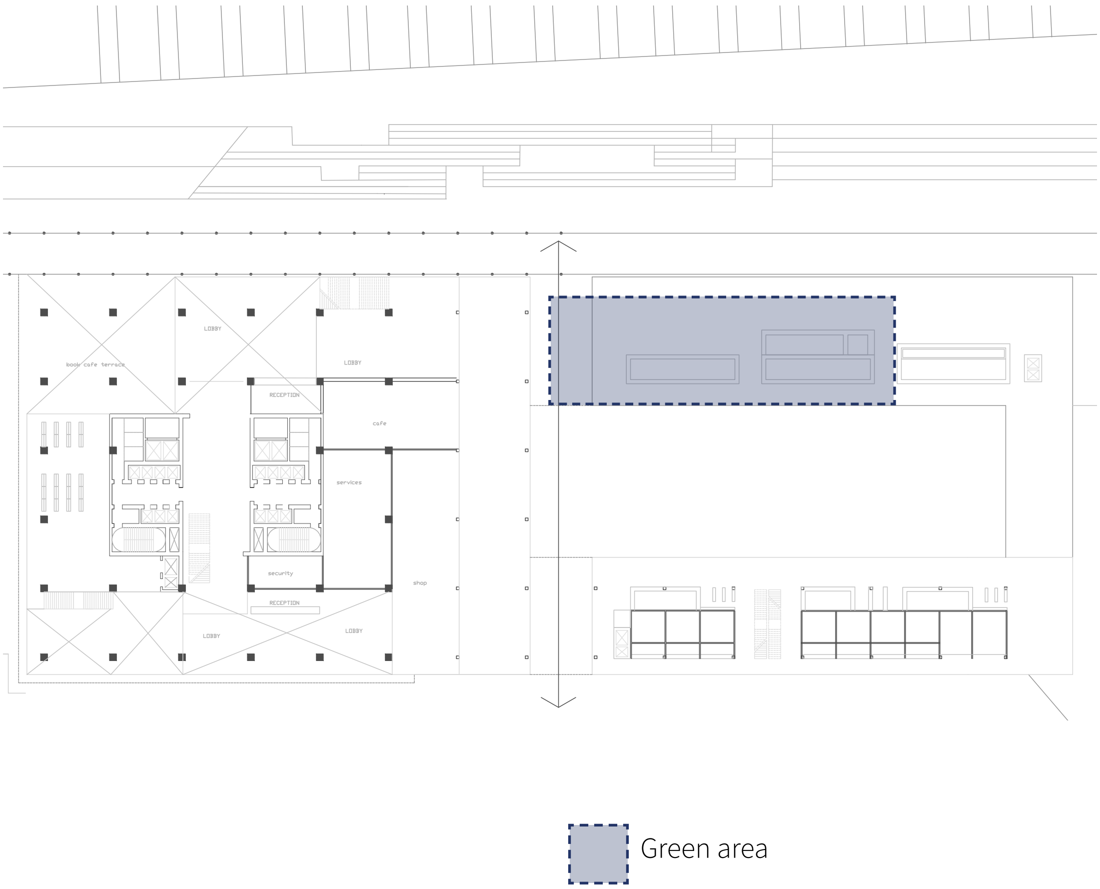
$$W_{e,d} = \frac{404{,}54}{338{,}09 \cdot 1000} = 1196{,}5\ cm^3$$

$$\Delta_{e,d} = \frac{19 \cdot P \cdot l^3}{384 \cdot E \cdot I} + \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{19 \cdot 123 \cdot 9^3}{384 \cdot 210E6 \cdot 0{,}001619} + \frac{5 \cdot 3{,}51 \cdot 9^4}{384 \cdot 210E6 \cdot 0{,}001619} =$$

$$= 0{,}014\ m < 0{,}036\ m$$

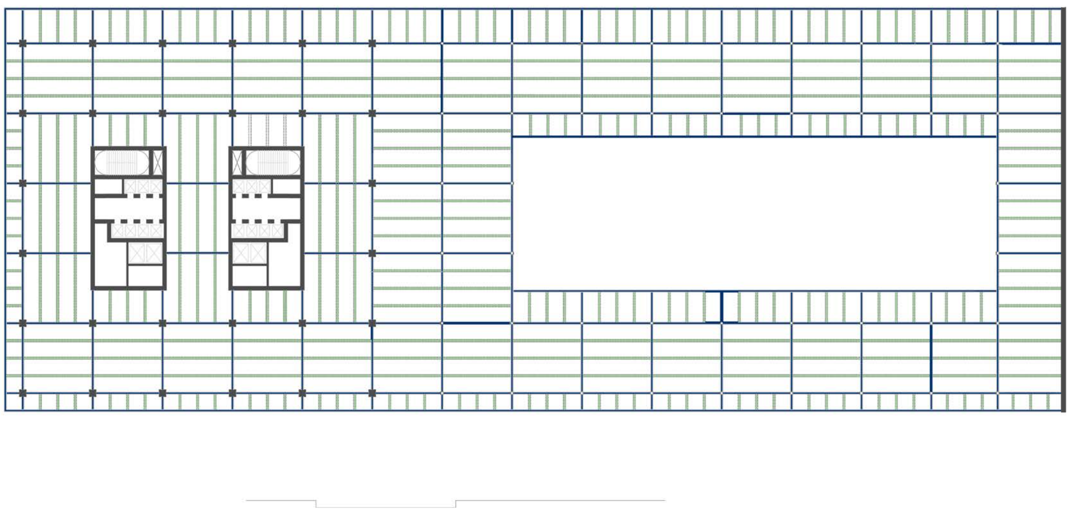
VERIFIED

Podium roof floor plan



PODIUM

Strucrural Podium roof floor plan scheme



Secondary beam

Primary beam

3.0 Category of use study

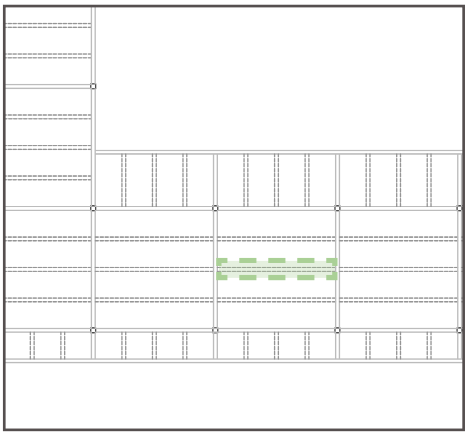
Category	Specific Use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets.
B	Office areas	
C	Areas where people may congregate (with the exception of areas defined under category A, B, and D[1])	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. **C2**: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. **C3**: Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. **C4**: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. **C5**: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms.
D	Shopping areas	**D1**: Areas in general retail shops **D2**: Areas in department stores

Action	Ψ_0	Ψ_1	Ψ_2
Imposed loads in buildings category (EN 1991-1.1)			
Category A: domestic, residential areas	0.7	0.5	0.3
Category B: office areas	0.7	0.5	0.3
Category C: congregation areas	0.7	0.7	0.6
Category D: shopping areas	0.7	0.7	0.6
Category E: storage areas	1.0	0.9	0.8
Category F: traffic area, weight ≤ 30 kN	0.7	0.7	0.6
Category G: traffic area, 30kN < weight ≤ 160 kN	0.7	0.5	0.3
Category H: roofs[a]	0.7	0.0	0.0
Snow loads on buildings (EN 1991-1.3)			
• for sites located at altitude H > 1,000m above sea level	0.7	0.5	0.2
• for sites located at altitude H ≤ 1,000m above sea level	0.5	0.2	0.0
Wind loads on buildings (EN 1991-1.4)	0.5	0.2	0.0
Temperature (non-fire) in buildings (EN 1991-1.5)	0.6	0.5	0.0
[a] See also EN 1991-1.1, 3.3.2(1)			

Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A		
- Floors	1,5 to 2,0	2,0 to 3,0
- Stairs	2,0 to 4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0
Category B	2,0 to 3,0	1,5 to 4,5
Category C		
- C1	2,0 to 3,0	3,0 to 4,0
- C2	3,0 to 4,0	2,5 to 7,0 (4,0)
- C3	3,0 to 5,0	4,0 to 7,0
- C4	4,5 to 5,0	3,5 to 7,0
- C5	5,0 to 7,5	3,5 to 4,5
category D		
- D1	4,0 to 5,0	3,5 to 7,0 (4,0)
- D2	4,0 to 5,0	3,5 to 7,0

3.1 Podium green roof secondary beam calculation

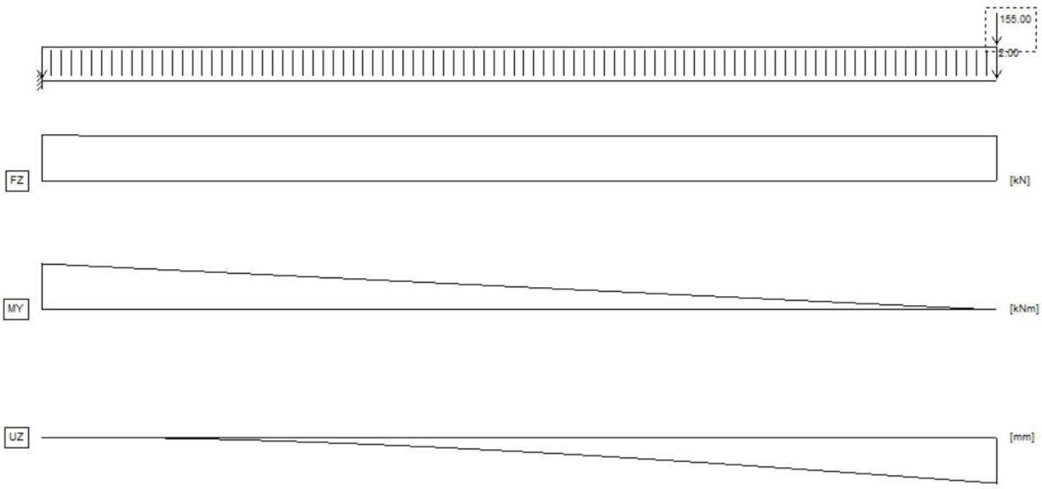
This type of secondary beam supports the podium green roof. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.



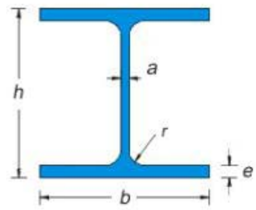
Qk=8,748 kN/mq

Gk = 4 + snow load = 4 + 1,2 = 5,2 kN/mq

q = 2,5 * (8,748 * 1,35 + 5,2 * 1,5) = 49 kN/m



HEM 400



b = 307 mm
h = 432 mm
a = 21,0 mm
e = 40,0 mm
r = 27 mm
Weight = 256,0 kG/m
Area = 325,8 mq
Jx = 104.100 cm^4
Jy = 19.340 cm^4
Wx = 4.820 mc
Wy = 1.260 mc

$$M_{max} = \frac{ql^2}{8} = \frac{49 \cdot 10^2}{8} = 612{,}8\ kNm$$

$$W_{e,d} = \frac{612{,}8}{338{,}09 \cdot 1000} = 1812\ cm^3$$

Beam typology selected: HEM 400

Self Weight = 2,56 * 1,3 = 3,45 kN/m

$$M_{max} = \frac{ql^2}{8} = \frac{52{,}46 \cdot 10^2}{8} = 655{,}7\ kNm$$

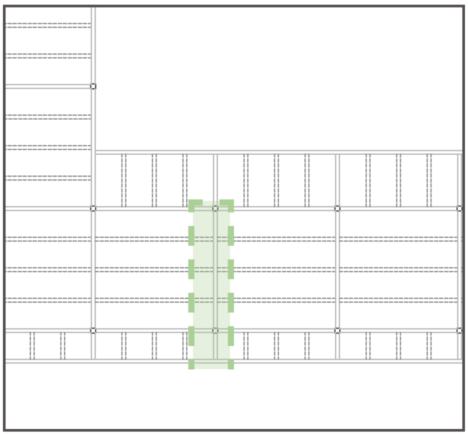
$$W_{e,d} = \frac{655{,}7}{338{,}09 \cdot 1000} = 1939\ cm^3$$

$$\Delta_{e,d} = \frac{5 \cdot q \cdot l^4}{384 \cdot E \cdot I} = \frac{5 \cdot 52{,}46 \cdot 10^4}{384 \cdot 210E6 \cdot 0{,}001041} = 0{,}031\ m < 0{,}033\ m$$

VERIFIED

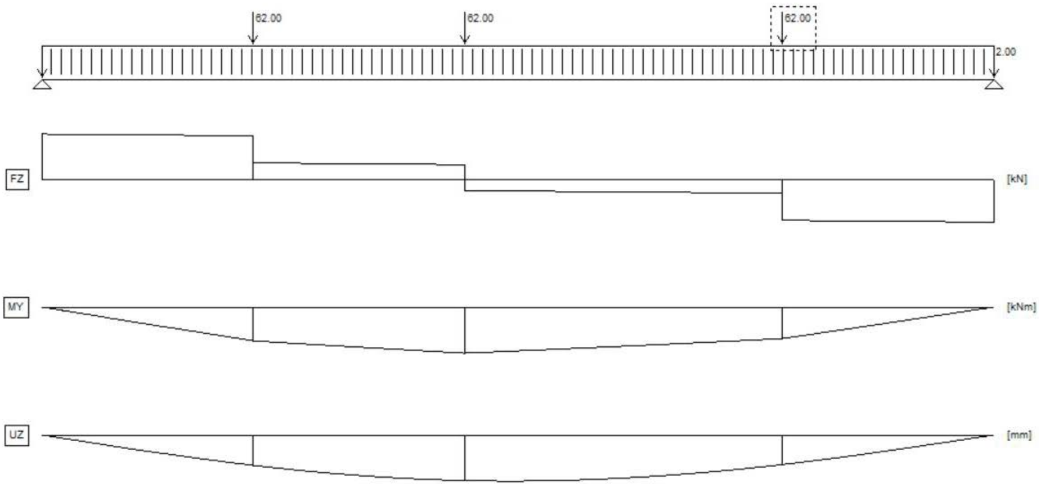
3.2 Podium green roof primary beam calculation

This type of secondary beam supports the podium green roof. In this case it has been dimensioned and verified under the forces of the worst mechanical condition to which it can be subjected.

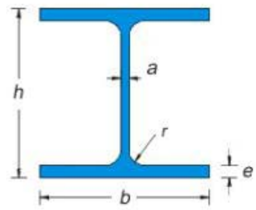


Qk=8,748 kN/mq

Qk=8,748 kN/mq



HEM 500



b = 306 mm
h = 524 mm
a = 21,0 mm
e = 40 mm
r = 27 mm
Weight = 270 kG/m
Area = 344,3 mq
Jx = 161.900 cm^4
Jy = 19.150 cm^4
Wx = 6.180 mc
Wy = 1.252 mc

$$M_{e,d} = \frac{ql}{3} = \frac{176{,}5 \cdot 9}{3} = 529{,}47\ kNm$$

$$W_{e,d} = \frac{529{,}47}{338{,}09 \cdot 1000} = 1566\ cm^3$$

Beam typology selected: HEM 500

Self Weight = 2,7 * 1,3 = 3,51 kN/m

$$M_{e,d} = \frac{ql}{3} + \frac{ql^2}{8} = \frac{176{,}5 \cdot 9}{3} + \frac{3{,}51 \cdot 9^2}{8} = 565{,}04\ kNm$$

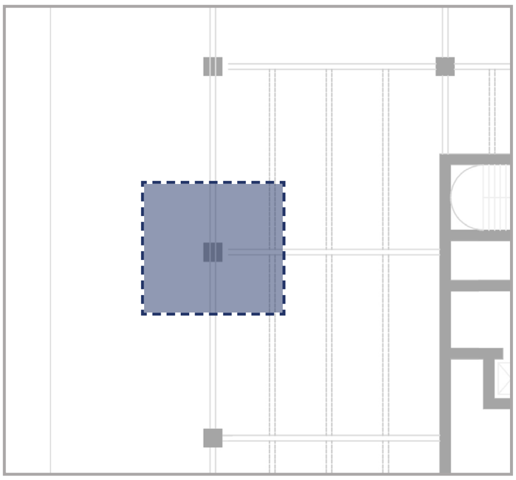
$$W_{e,d} = \frac{m}{f_y} = \frac{565{,}04}{338{,}09 \cdot 1000} = 1671\ cm^3$$

$$\Delta_{e,d} = \frac{19 \cdot q \cdot l^3}{384 \cdot E \cdot I} + \frac{5 \cdot 3{,}51 \cdot l^4}{384 \cdot E \cdot I} = \frac{19 \cdot 176{,}5 \cdot 9^3}{384 \cdot 210E6 \cdot 0{,}001619} + \frac{5 \cdot 3{,}51 \cdot 9^4}{384 \cdot 210E6 \cdot 0{,}001619} =$$

$$= 0{,}0196\ m < 0{,}036\ m$$

VERIFIED

Tower typical pillar load analysis



Column height = 202,5 underground floors = 216m

Area of interest of the pillar = 97 mq

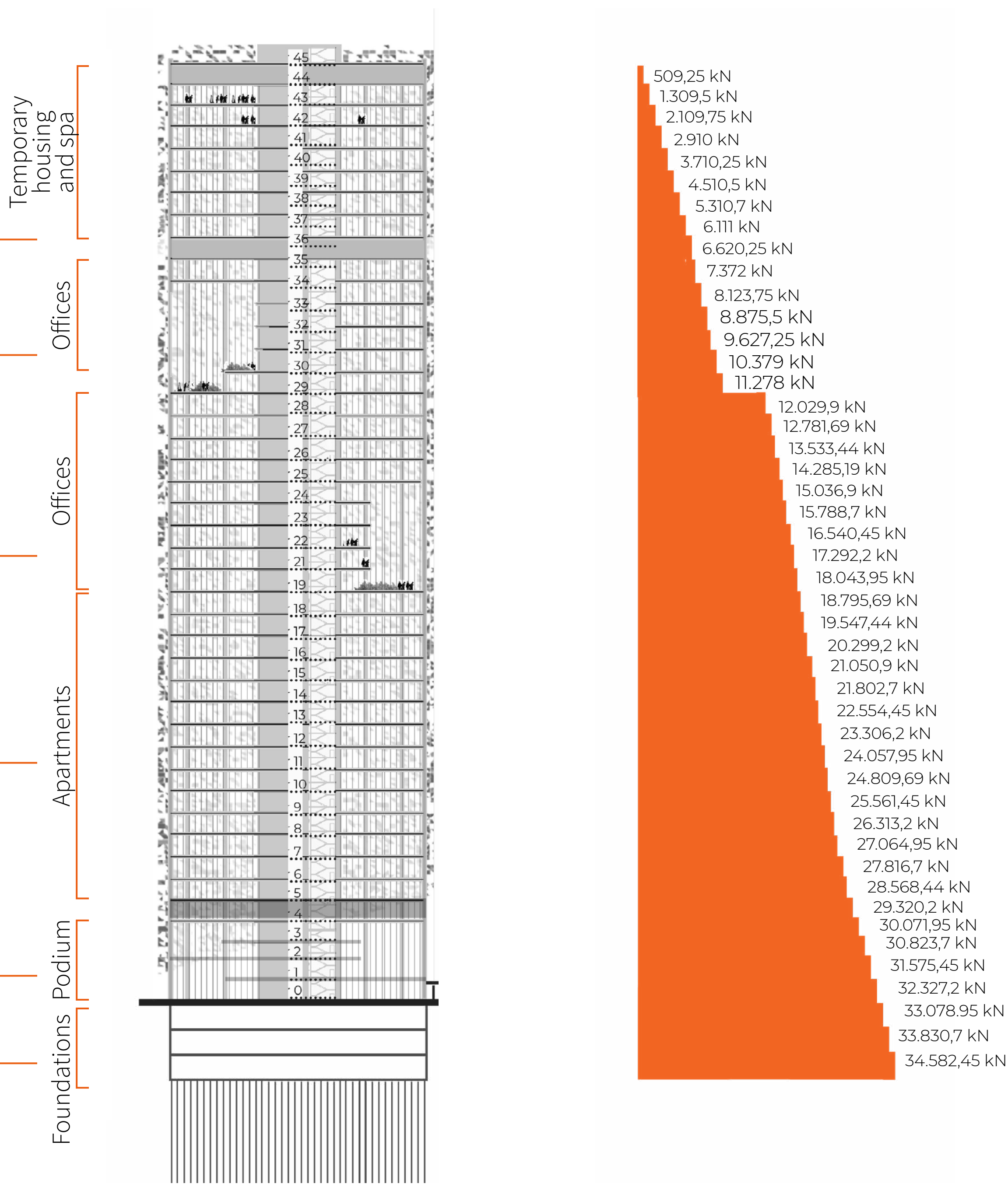
Area of interest of the pillar = 97 mq

Dead load =4,25 kN/mq
Live load =4 kN/mq
Total load = 8,25 kN/mq
Area = 97 mq
Total floor load = 800,25 kN

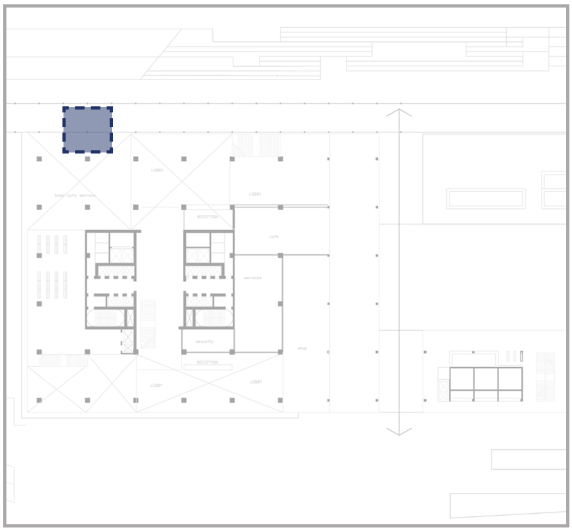
Dead load =3,75 kN/mq
Live load =4 kN/mq
Total load = 7,75kN/mq
Area = 97 mq
Total floor load = 751,75 kN

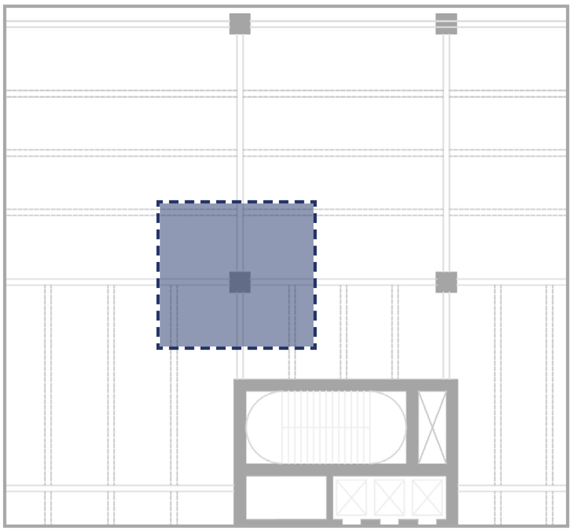
Dead load =4,25 kN/mq
Live load =4 kN/mq
Total load = 8,25 kN/mq
Area = 97 mq
Total floor load = 800,25 kN

COLUMN


Temporary housing and spa
Offices
Offices
Apartments
Podium
Foundations
509,25 kN
1.309,5 kN
2.109,75 kN
2.910 kN
3.710,25 kN
4.510,5 kN
5.310,7 kN
6.111 kN
6.620,25 kN
7.372 kN
8.123,75 kN
8.875,5 kN
9.627,25 kN
10.379 kN
11.278 kN
12.029,9 kN
12.781,69 kN
13.533,44 kN
14.285,19 kN
15.036,9 kN
15.788,7 kN
16.540,45 kN
17.292,2 kN
18.043,95 kN
18.795,69 kN
19.547,44 kN
20.299,2 kN
21.050,9 kN
21.802,7 kN
22.554,45 kN
23.306,2 kN
24.057,95 kN
24.809,69 kN
25.561,45 kN
26.313,2 kN
27.064,95 kN
27.816,7 kN
28.568,44 kN
29.320,2 kN
30.071,95 kN
30.823,7 kN
31.575,45 kN
32.327,2 kN
33.078.95 kN
33.830,7 kN
34.582,45 kN

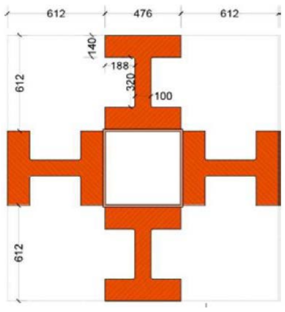
3.2 Tower typical pillar calculations



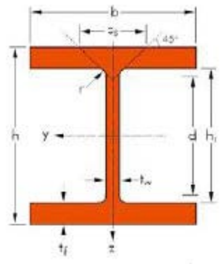


COLUMN

Selected pillar section



HD 400 x 1299



b = 1052mm
h = 1200mm
tw = 100mm
Tf = 140mm
r = 15mm
Weight = 1299 kG/m
Area = 661880 mm^2
iy = 85,4 mm
iz = 496 mm
Jy = 30184000000 mm^4
Jz = 10176000000 mm^4

Compression

$$N_{rdc} = \frac{A \cdot F_y}{y_{m_0}} = 227.835,42\ kN$$

$$\frac{N_{e,d}}{N_{rdc}} = 0,1517$$

Buckling and slenderness

$$N_{cr,ed} = \frac{\pi^2 \cdot E \cdot J_x}{l_0} = 303.185,38\ kN$$

$$\delta = \sqrt{\frac{A(f_{y,d})}{N_{cr,d}}} = 0.27164$$

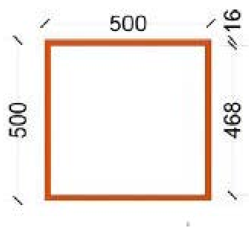
$$\varphi = 0,5\,[\,1 + \alpha\,(\delta - 0,2) + \delta^2] = 0.54907$$

$$X = \frac{1}{\varphi + \sqrt{\varphi^2 - \delta^2}} = 0.97442$$

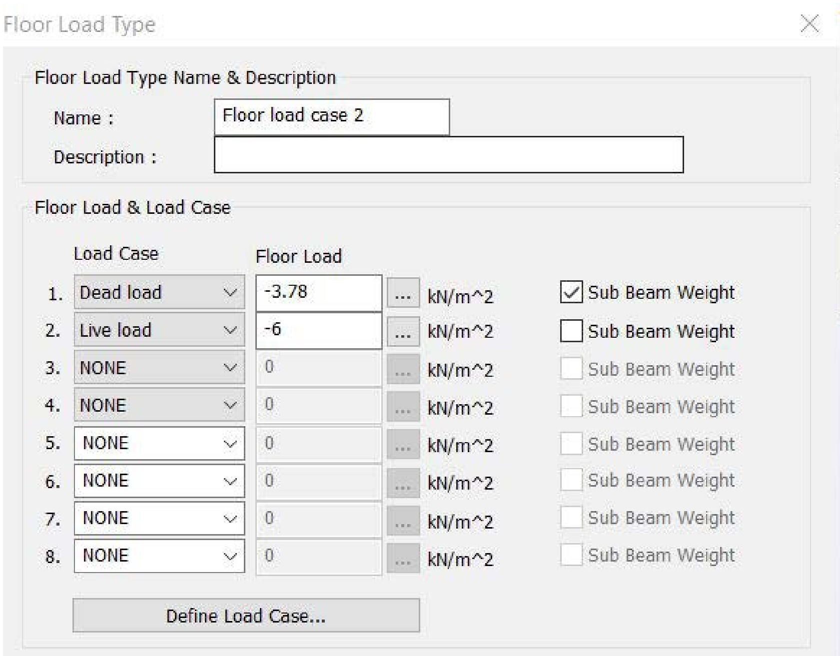
Nrd = A x fyd x X = 227835418.7 > 34.582,45

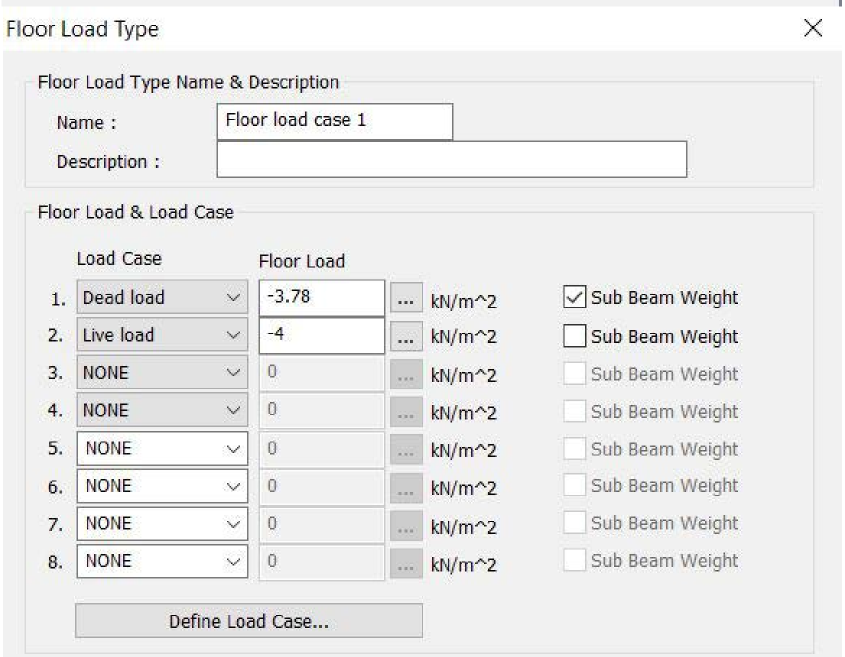
VERIFIED

EN 10219 500 x 500

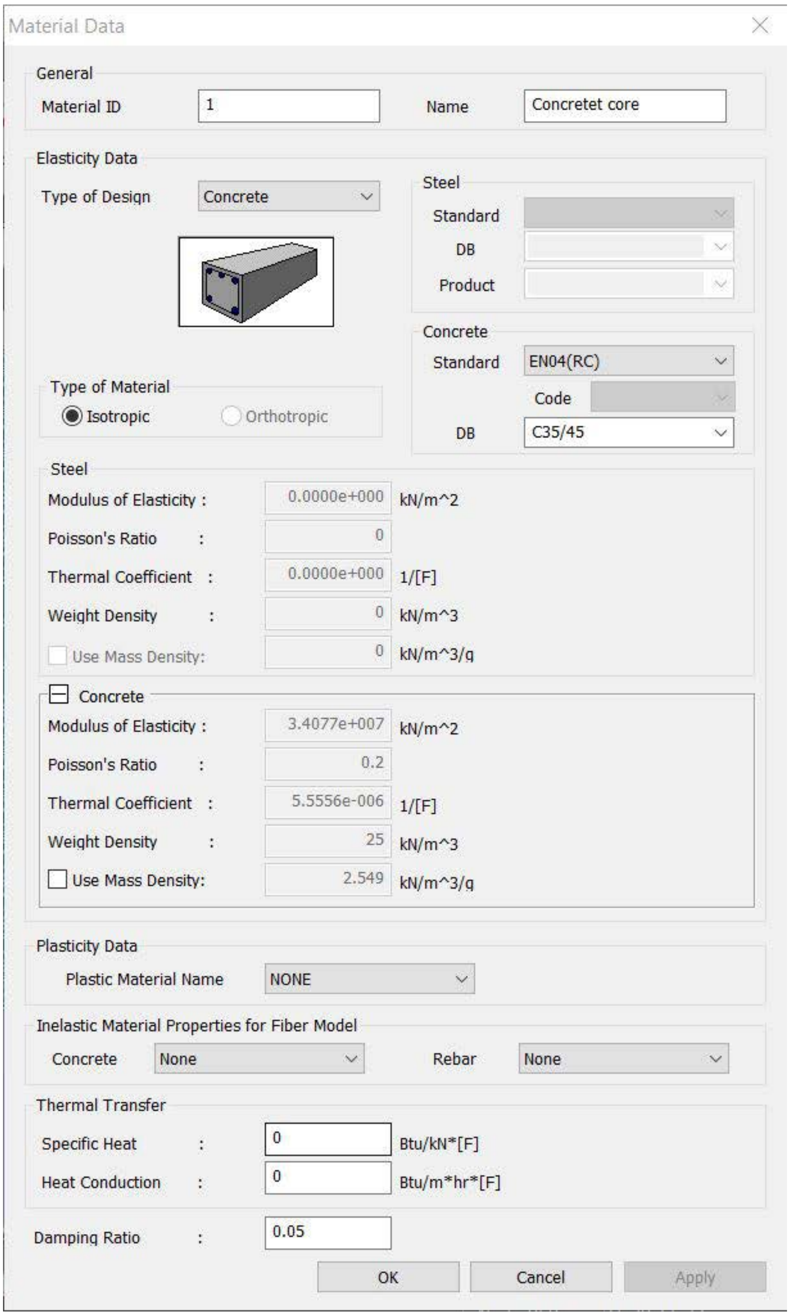


b = 500mm
h = 500mm
tw = 16mm
Area = 29880 mm^2
iy = 196 mm
iz = 196 mm
Jy = 11400000000 mm^4
Jz = 11400000000 mm^4

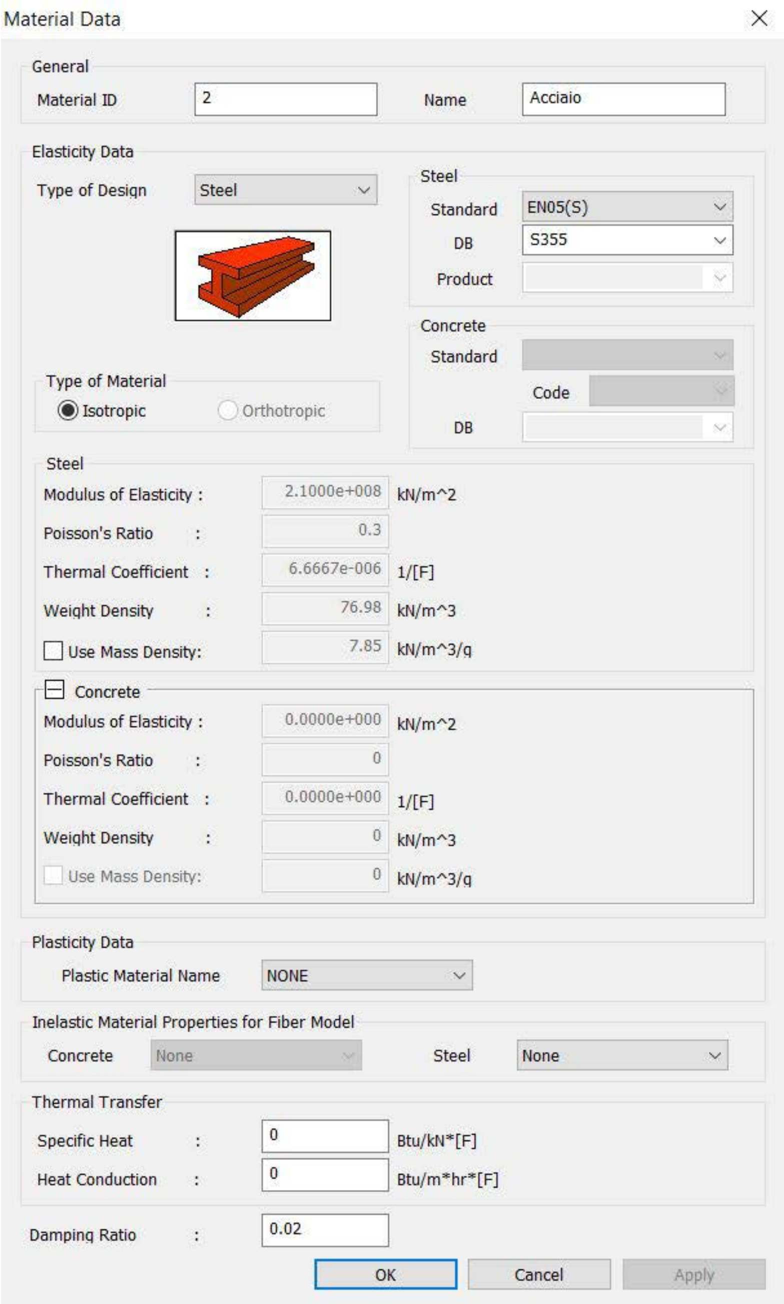




Floor load type

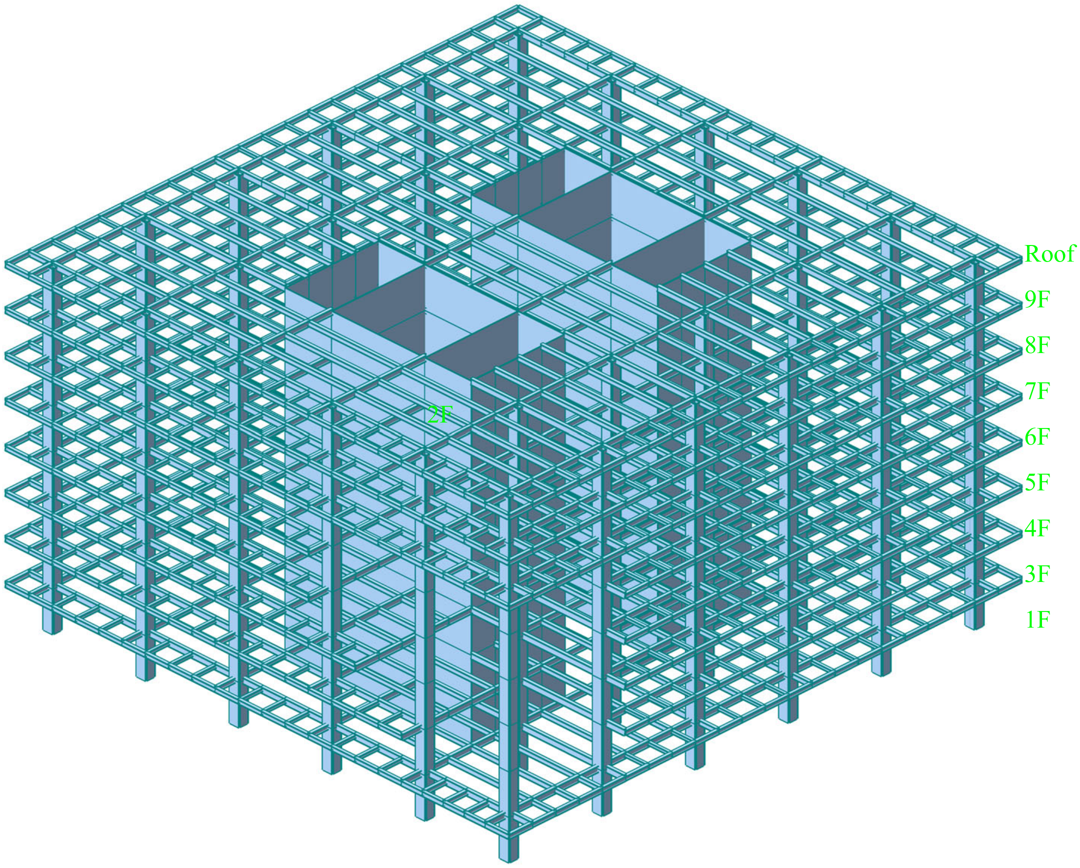

Material Data
General
Material ID
1
Name
Concretet core
Elasticity Data
Type of Design
Concrete
Steel
Standard
DB
Product
Concrete
Standard
EN04(RC)
Code
DB
C35/45
Type of Material
Isotropic
Orthotropic
Steel
Modulus of Elasticity :
0.0000e+000
kN/m^2
Poisson's Ratio :
0
Thermal Coefficient :
0.0000e+000
1/[F]
Weight Density :
0
kN/m^3
Use Mass Density:
0
kN/m^3/g
Concrete
Modulus of Elasticity :
3.4077e+007
kN/m^2
Poisson's Ratio :
0.2
Thermal Coefficient :
5.5556e-006
1/[F]
Weight Density :
25
kN/m^3
Use Mass Density:
2.549
kN/m^3/g
Plasticity Data
Plastic Material Name
NONE
Inelastic Material Properties for Fiber Model
Concrete
None
Rebar
None
Thermal Transfer
Specific Heat :
0
Btu/kN*[F]
Heat Conduction :
0
Btu/m*hr*[F]
Damping Ratio :
0.05
OK
Cancel
Apply

Material

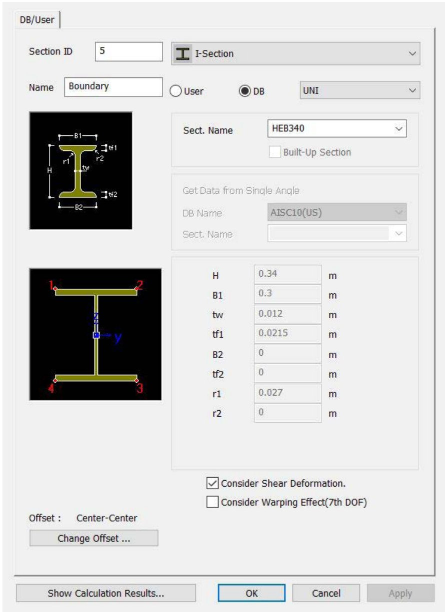

Material Data
General
Material ID
2
Name
Acciaio
Elasticity Data
Type of Design
Steel
Steel
Standard
EN05(S)
DB
S355
Product
Concrete
Standard
Code
DB
Type of Material
Isotropic
Orthotropic
Steel
Modulus of Elasticity :
2.1000e+008
kN/m^2
Poisson's Ratio :
0.3
Thermal Coefficient :
6.6667e-006
1/[F]
Weight Density :
76.98
kN/m^3
Use Mass Density:
7.85
kN/m^3/g
Concrete
Modulus of Elasticity :
0.0000e+000
kN/m^2
Poisson's Ratio :
0
Thermal Coefficient :
0.0000e+000
1/[F]
Weight Density :
0
kN/m^3
Use Mass Density:
0
kN/m^3/g
Plasticity Data
Plastic Material Name
NONE
Inelastic Material Properties for Fiber Model
Concrete
None
Steel
None
Thermal Transfer
Specific Heat :
0
Btu/kN*[F]
Heat Conduction :
0
Btu/m*hr*[F]
Damping Ratio :
0.02
OK
Cancel
Apply

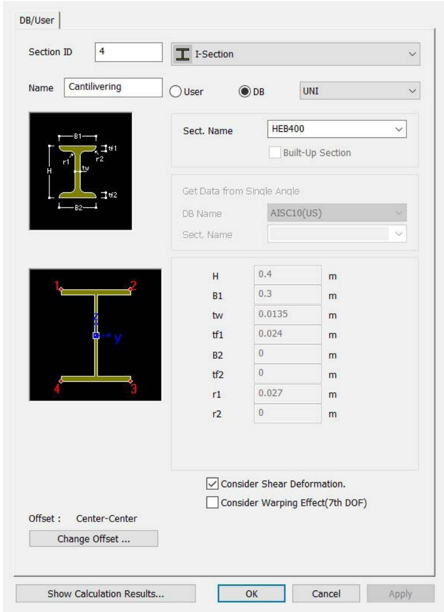
Material

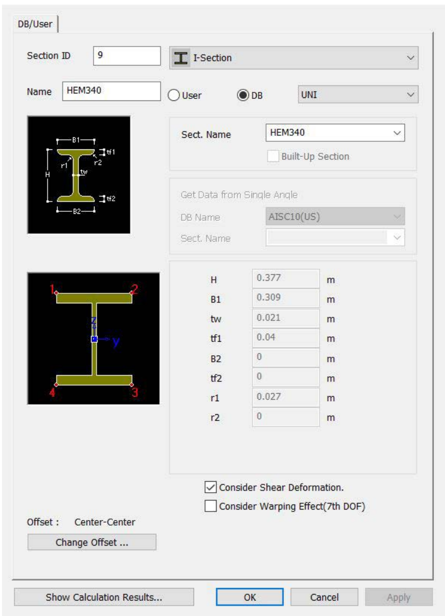
MIDAS

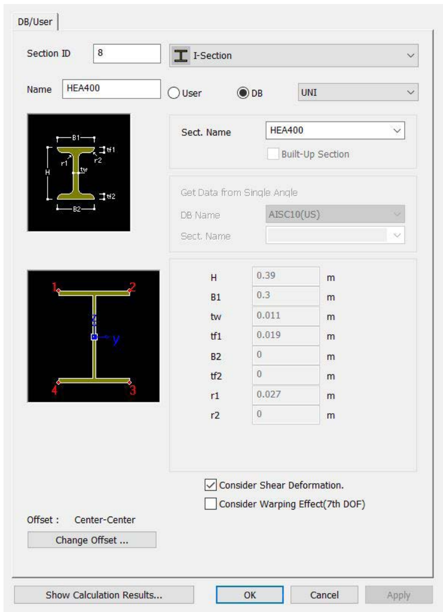


Midad, view

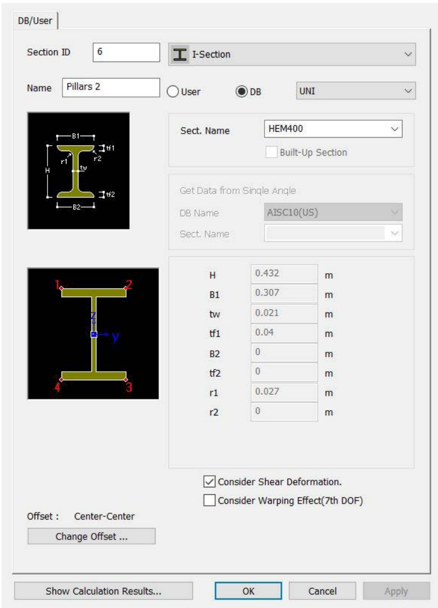


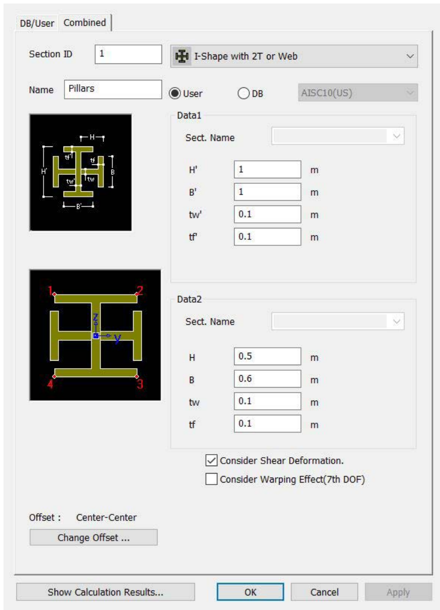


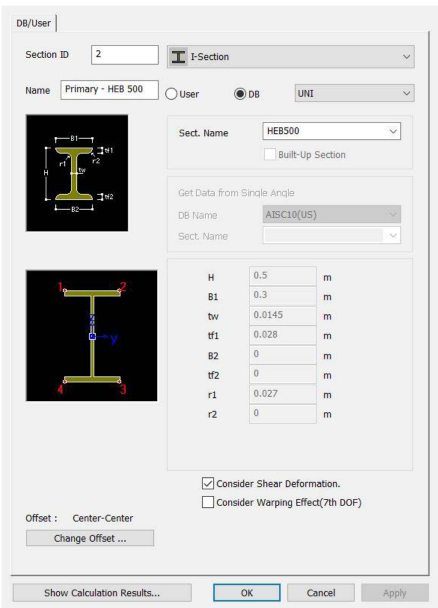


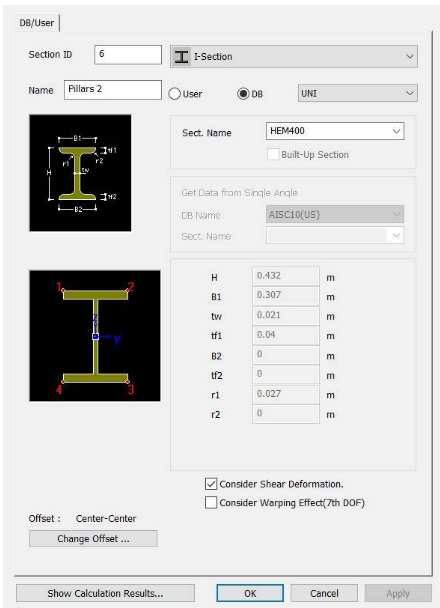


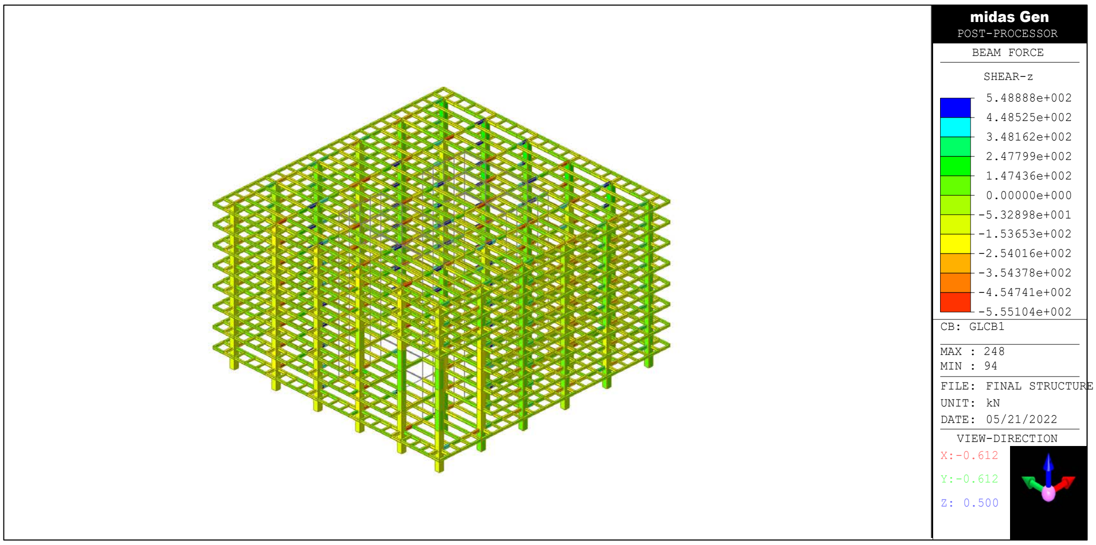
Profile choosed


DB/User
Section ID 6
I-Section
Name Pillars 2
User DB UNI
Sect. Name HEM400
Built-Up Section
Get Data from Single Angle
DB Name AISC10(US)
Sect. Name
H 0.432 m
B1 0.307 m
tw 0.021 m
tf1 0.04 m
B2 0 m
tf2 0 m
r1 0.027 m
r2 0 m
Consider Shear Deformation.
Consider Warping Effect(7th DOF)
Offset : Center-Center
Change Offset ...
Show Calculation Results...
OK
Cancel
Apply

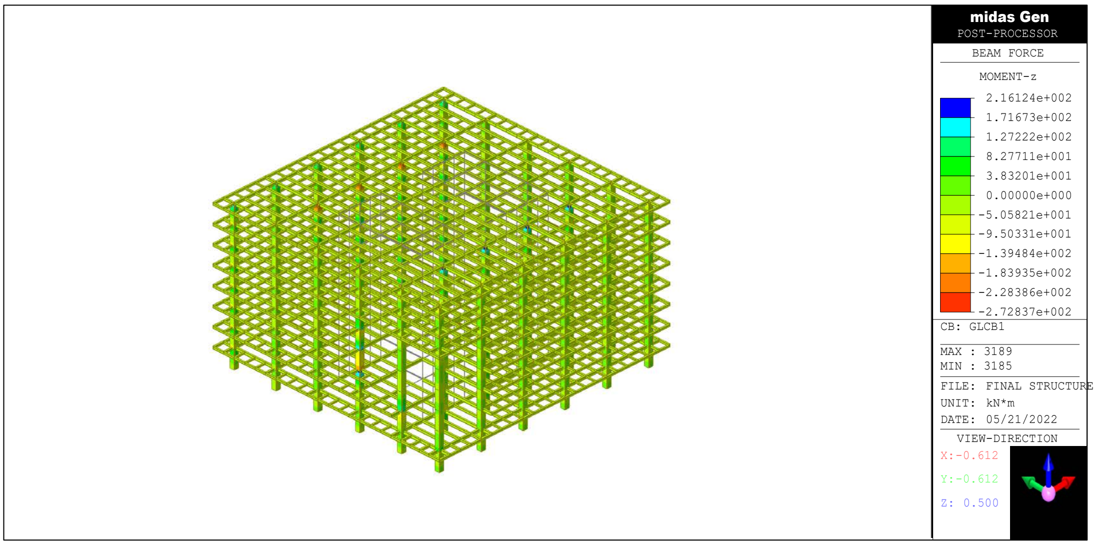

DB/User Combined
Section ID 1
I-Shape with 2T or Web
Name Pillars
User DB AISC10(US)
Data1
Sect. Name
H' 1 m
B' 1 m
tw' 0.1 m
tf' 0.1 m
Data2
Sect. Name
H 0.5 m
B 0.6 m
tw 0.1 m
tf 0.1 m
Consider Shear Deformation.
Consider Warping Effect(7th DOF)
Offset : Center-Center
Change Offset ...
Show Calculation Results...
OK
Cancel
Apply


DB/User
Section ID 2
I-Section
Name Primary - HEB 500
User DB UNI
Sect. Name HEB500
Built-Up Section
Get Data from Single Angle
DB Name AISC10(US)
Sect. Name
H 0.5 m
B1 0.3 m
tw 0.0145 m
tf1 0.028 m
B2 0 m
tf2 0 m
r1 0.027 m
r2 0 m
Consider Shear Deformation.
Consider Warping Effect(7th DOF)
Offset : Center-Center
Change Offset ...
Show Calculation Results...
OK
Cancel
Apply

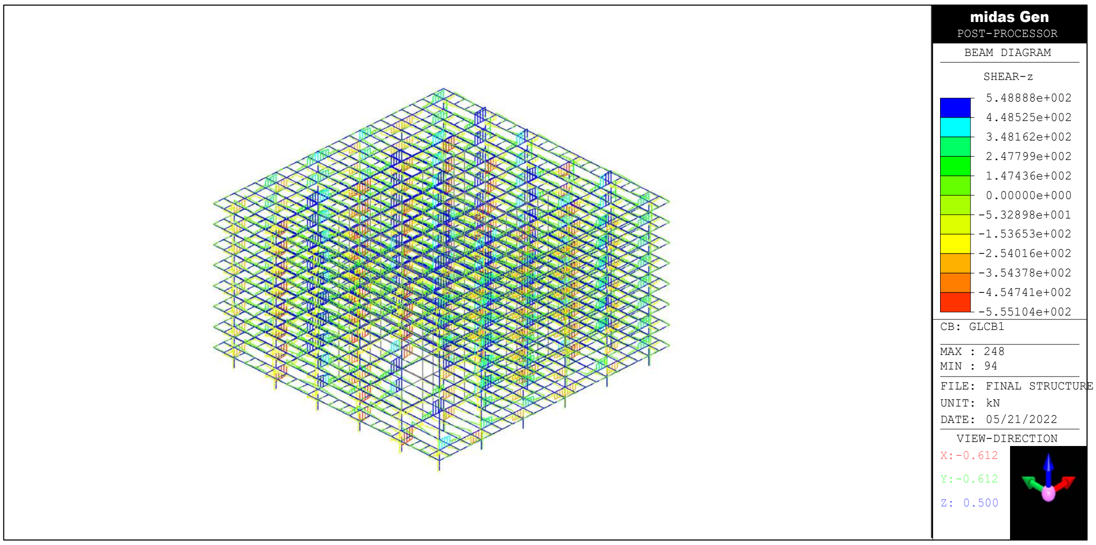

DB/User
Section ID 6
I-Section
Name Pillars 2
User DB UNI
Sect. Name HEM400
Built-Up Section
Get Data from Single Angle
DB Name AISC10(US)
Sect. Name
H 0.432 m
B1 0.307 m
tw 0.021 m
tf1 0.04 m
B2 0 m
tf2 0 m
r1 0.027 m
r2 0 m
Consider Shear Deformation.
Consider Warping Effect(7th DOF)
Offset : Center-Center
Change Offset ...
Show Calculation Results...
OK
Cancel
Apply



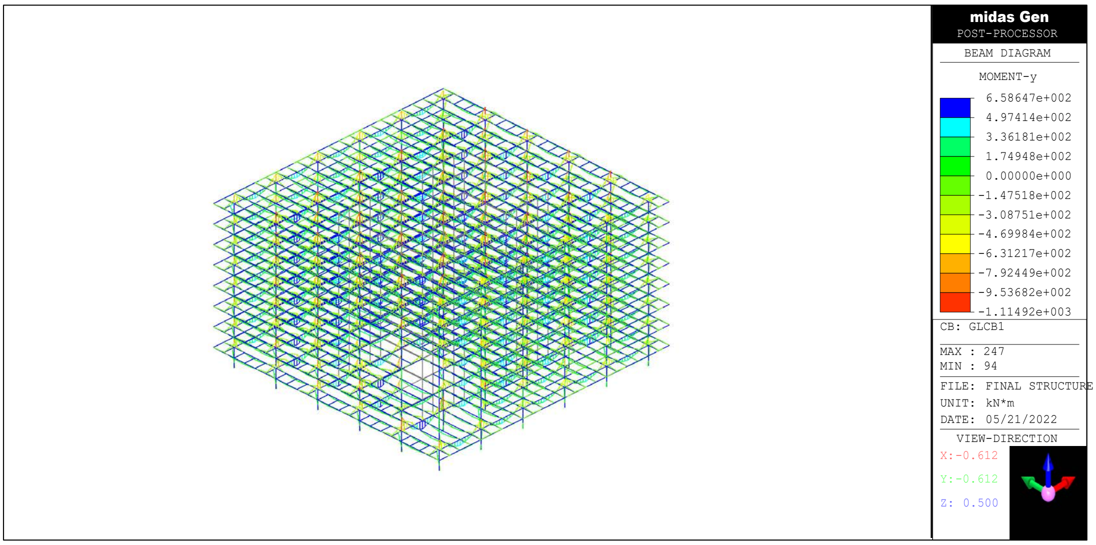
Shear-z



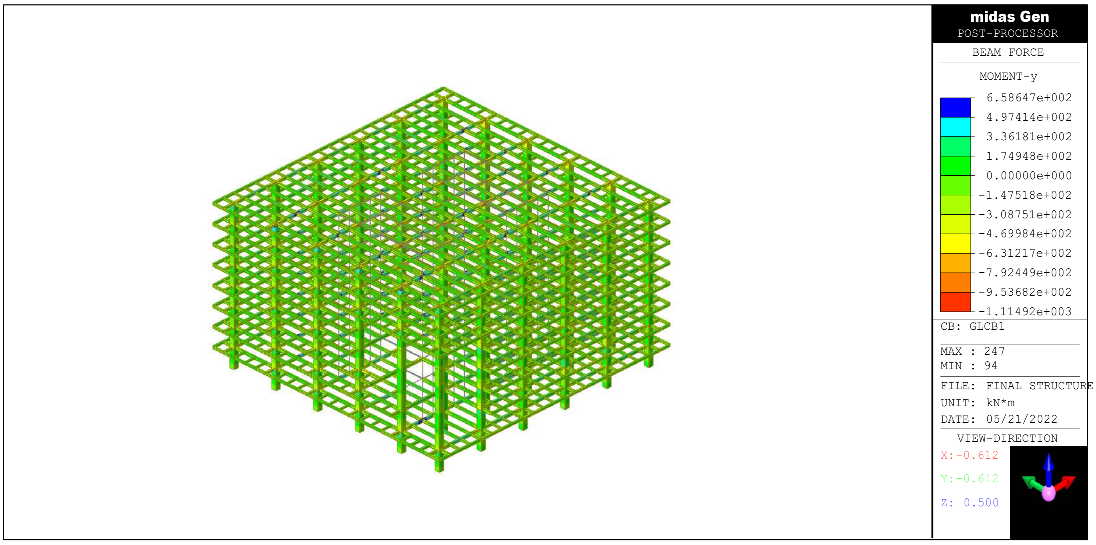
Moment-z



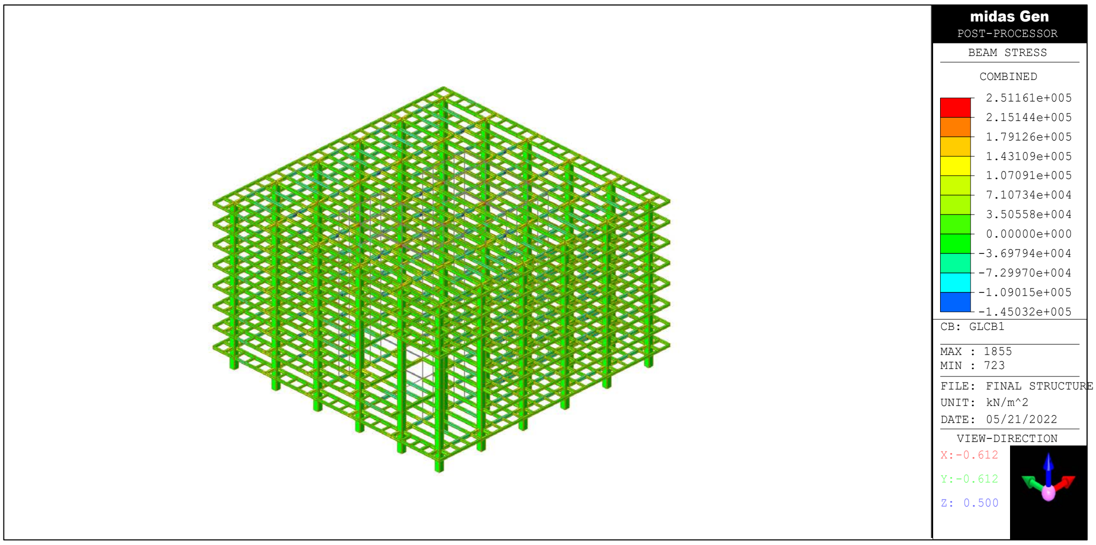
Shear-z



Moment-z

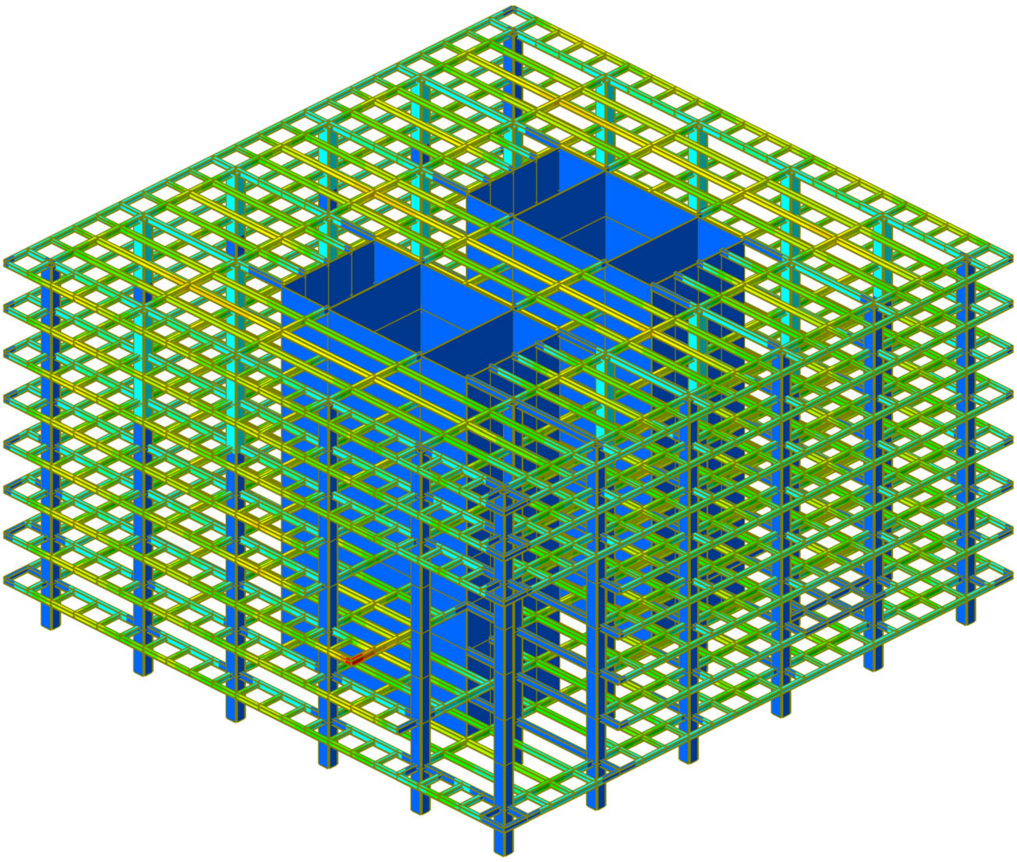


Moment-y

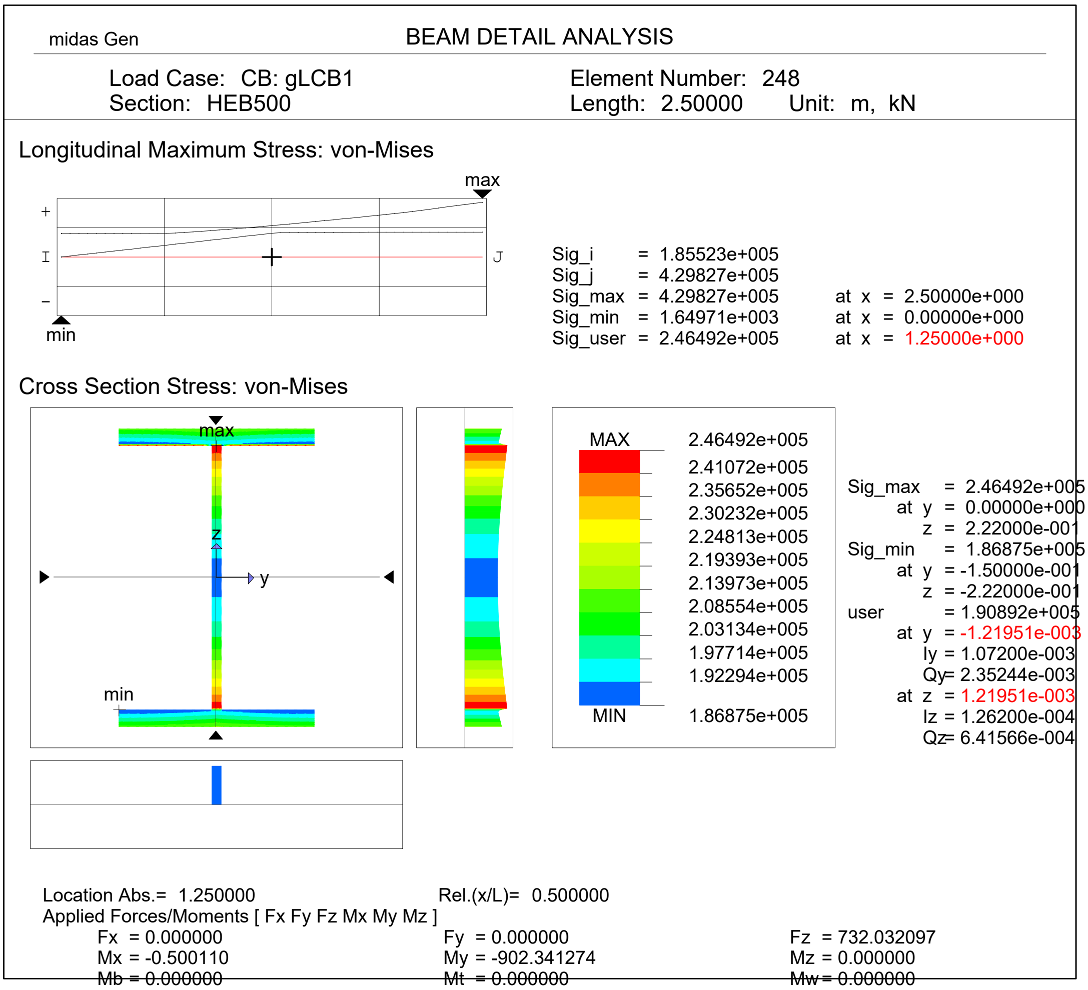


Combined forces

MIDAS



STRUCTURE



Longitudinal stress: Von-Mises

Code : Eurocode3:05 Unit : kN ,

Sorted by ○ Member ◉ Property Change... Update...

CHK	MEMB / COM	SECT / SHR	SEL	Section / Material	Fy
OK	1855	2	☐	HEB500	
	0.508	0.230		S450	440000
OK	2093	3	☐	HEB400	
	0.353	0.090		S450	440000
OK	1060	4	☐	HEB360	
	0.144	0.042		S450	440000
OK	3103	5	☐	HEB260	
	0.191	0.066		S450	440000
OK	94	6	☐	HEM500	
	0.357	0.169		S450	440000
OK	322	7	☐	HEM400	
	0.113	0.062		S450	440000

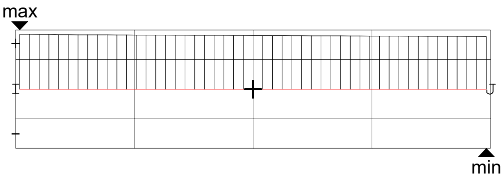
midas Gen

BEAM DETAIL ANALYSIS

Load Case: CB: gLCB1
Section: HEB500

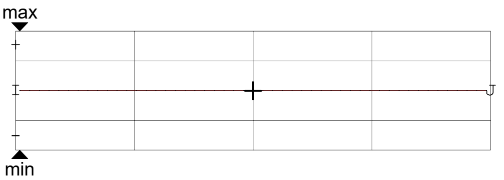
Element Number: 248
Length: 2.50000 Unit: m, kN

Displacement: Dy



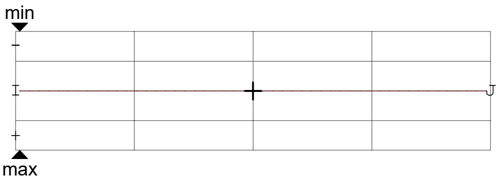
Di(abs)	= 2.44296e-007	Di(rel)	= 9.28538e-009		
Dj(abs)	= 2.35011e-007	Dj(rel)	= 0.00000e+000		
Dmax(abs)	= 2.44296e-007	at x	= 0.00000e+000		
Dmax(rel)	= 9.28538e-009				
Dmin(abs)	= 2.35011e-007	at x	= 2.50000e+000		
Dmin(rel)	= 0.00000e+000				
Duser(abs)	= 2.39654e-007	at x	= 1.25000e+000		
Duser(rel)	= 4.64269e-009				

Shear Force Diagram: Fy



Fi	= 0.00000e+000		
Fj	= 0.00000e+000		
Fmax	= 0.00000e+000	at x	= 0.00000e+000
Fmin	= 0.00000e+000	at x	= 0.00000e+000
Fuser	= -0.00000e+000	at x	= 1.25000e+000

Bending Moment Diagram: Mz



Mi	= 0.00000e+000		
Mj	= 0.00000e+000		
Mmax	= 0.00000e+000	at x	= 0.00000e+000
Mmin	= 0.00000e+000	at x	= 0.00000e+000
Muser	= 0.00000e+000	at x	= 1.25000e+000

Displacement Dy

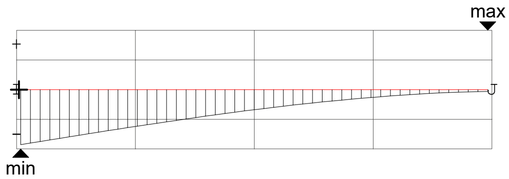
midas Gen

BEAM DETAIL ANALYSIS

Load Case: CB: gLCB1
Section: HEB500

Element Number: 248
Length: 2.50000 Unit: m, kN

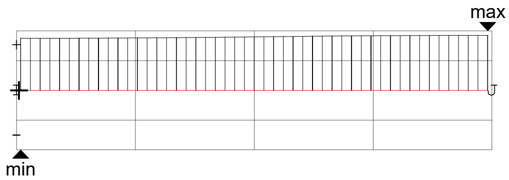
Displacement: Dz



Di(abs) = -2.08538e-002
Dj(abs) = -6.66901e-004
Dmax(abs) = -6.66901e-004
Dmax(rel) = 0.00000e+000
Dmin(abs) = -2.08538e-002
Dmin(rel) = -2.01869e-002
Duser(abs) = 0.00000e+000
Duser(rel) = 6.66901e-004

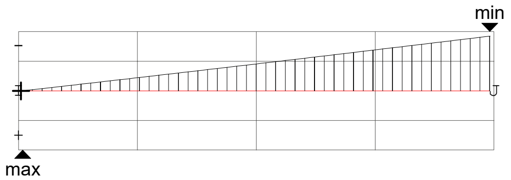
Di(rel) = -2.01869e-002
Dj(rel) = 0.00000e+000
at x = 2.50000e+000
at x = 0.00000e+000
at x = -9.68992e-003

Shear Force Diagram: Fz



Fi = 7.11579e+002
Fj = 7.52485e+002
Fmax = 7.52485e+002 at x = 2.50000e+000
Fmin = 7.11579e+002 at x = 0.00000e+000
Fuser = 0.00000e+000 at x = -9.68992e-003

Bending Moment Diagram: My



Mi = -3.69862e+000
Mj = -1.83378e+003
Mmax = -3.69862e+000 at x = 0.00000e+000
Mmin = -1.83378e+003 at x = 2.50000e+000
Muser = 0.00000e+000 at x = -9.68992e-003

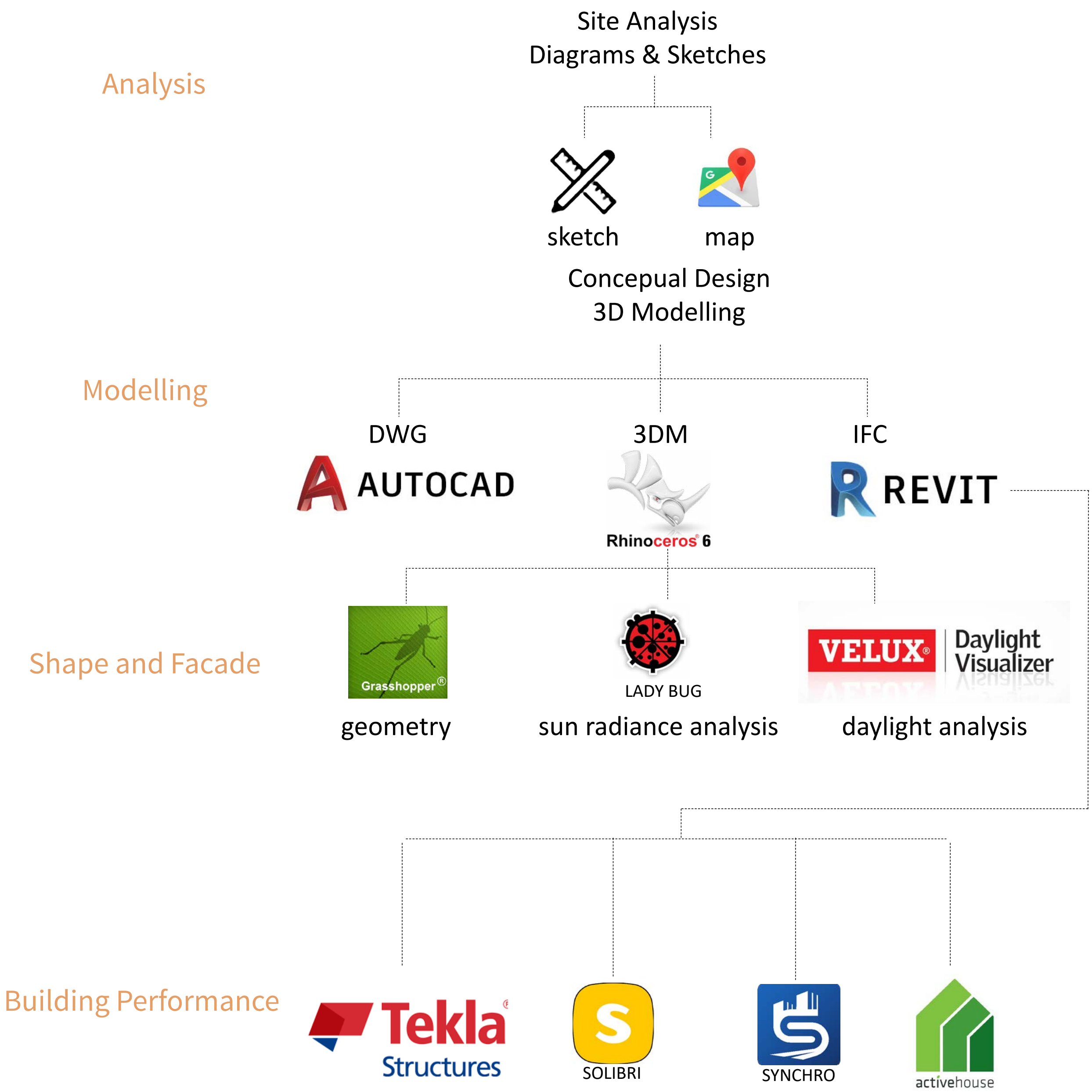
Displacement Dz

08. BIM

Building Information Modeling (BIM) is an intelligent 3D model-based process that gives architecture,engineering, and construction professionals the insight and tools to more efffciently plan, design and construct.
For the architects BIM is a possibility to make better design decisions, improve building performance, and collaborate more effectively throughout the project lifecycle.
Troughout the project it creates conditions to come along with real time inputs on the design process that give a boost in making decisions and finalizing the building idea.
There are 8 dimensions of BIM:
1D: Scratch point
2D: Vector
3D: Shape
4D: Time
5D: Cost
6D: Performance
7D: Sustainability
8D: Safety
On this project 6 dimensions were applied, starting from concept development and research phase to site simulation, there are constant information flow between each step of development.

Constructable dimensions is the phase that aims to achieve the design of the performative and yet also aesthetically complex skin, and the project development focuses on the parametric and constructability of the tower and facade geometry. Moving on the detailed modeling in Revit give an estimate type and quantity of the materials that was used and helps to understand the potential cost which will be clearly seen in further pages.

BIM STRATEGY



The BIM's Level of Development (LOD) defines how the 3D geometry of the building model can achieve different levels of refinement, is used as a measure of the service level required.

There are 3 levels of development were conformed to the project and can be followed on the scheme.

LOD (100) Concept design; The model element may be graphically represented in the model with a symbol or other genereic representation.

LOD (200) Approximate geometry; The model element is represented in the model as a genereic system. With approximate quantities, size, shape,

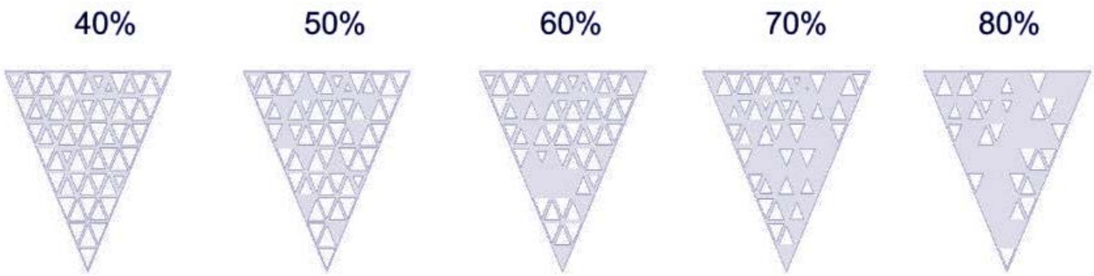
LOD (300) Detailed design; specific assemblies accurate in terms of quantities, size, shape, location and orientation. used for analysis of defined systems and general performance objectives.

LOD (400) Fabrication:

The model element is graphically represented as a specific system. With accurate definition and detailing in dimension and installation.Here models are suited for estimating as well as constuction coordination for clash detection scheduling and visualization.

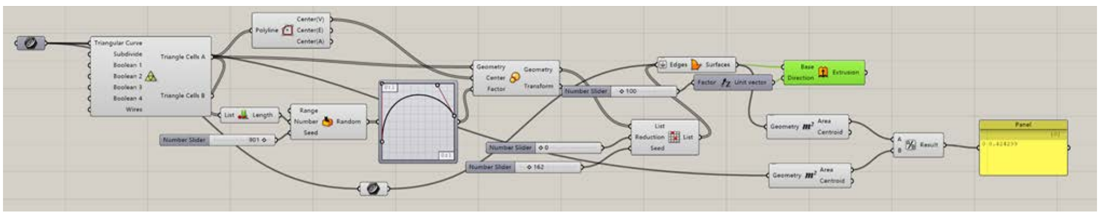
BIM STRATEGY

Shading rate



*Sun analysis and daylight analysis was keeping in consideration to create this patter.

Script



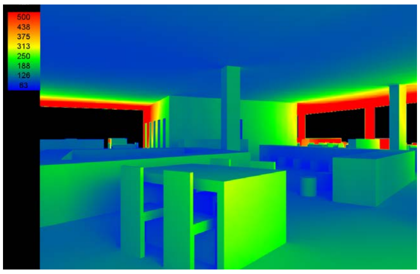
Spliting base triangular

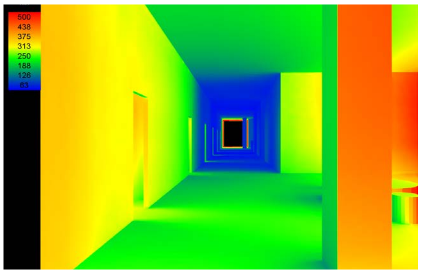
Random reduce cover area

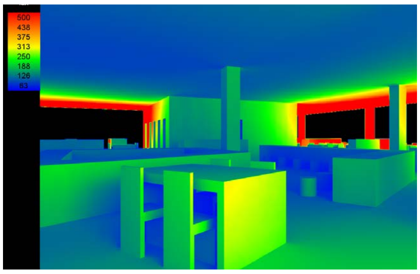
Show shading rate

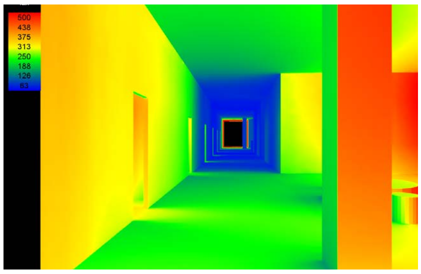
Skin generating

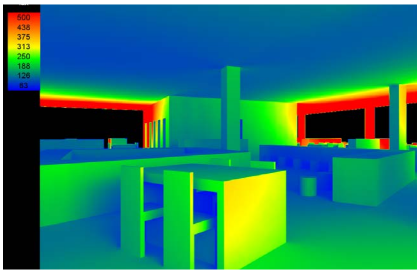
LOD 100: Concept Analysis.
On this phase site analysis, design process diagrams and sketches were made. It helped to define an idea and to clarify the possibility of the building to exist on a chosen site. Modeling.
LOD 200: Analysis and Design
More complex and in deep analysis of the site, location, building form. Furthermore, the softwares on which design could be made were assigned. Rhino and Grasshopper, 3D model and complex form of the second facade. Autodesk Revit, BIM software to design a building and structure and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database.
LOD 300: , Using the Grasshopper plugin
Ladybug to make solar radiation and sun path analysis of the building and land. VELUX daylight visualizer helped to understand and analyze conditions of the daylight inside the building complex. In this phase more detailed design process is held by using Revit. The final result of this stage is a well detailed model with a precise geometry.
LOD 400: Is used to monitoring the construction of the building and its performance.
For the structures Tekla softwares were applied, it gave the idea of the connections and detailed structure performances. Besides, Revit data facilitates the performance of Active House that is a worldwide quality stamp for comfortable and sustainable buildings. Pachyderm Acoustic Performance helped to develop the theater hall and to get there an efiicient performing values.

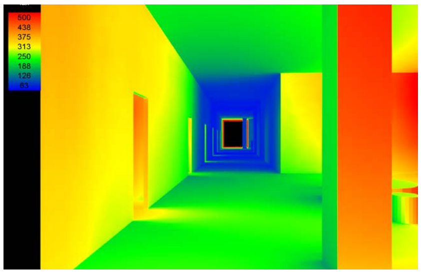

Spring

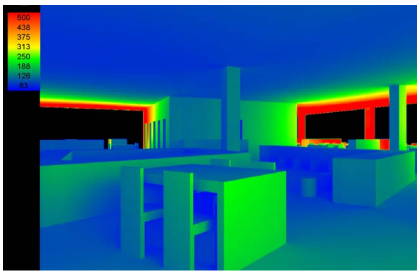

Spring

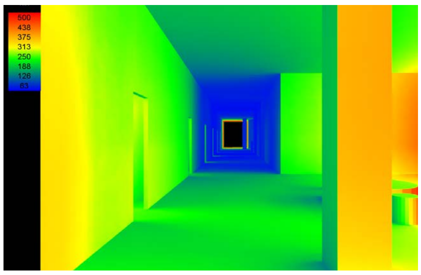

Autumn


Autumn

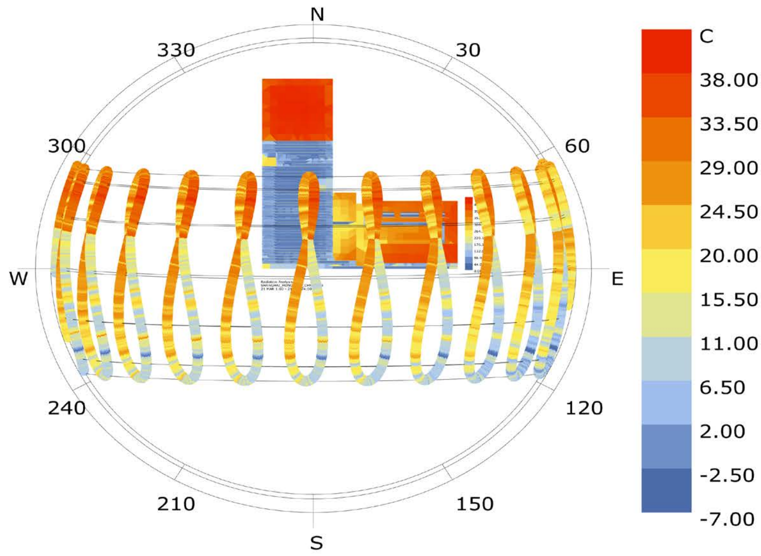

Summer

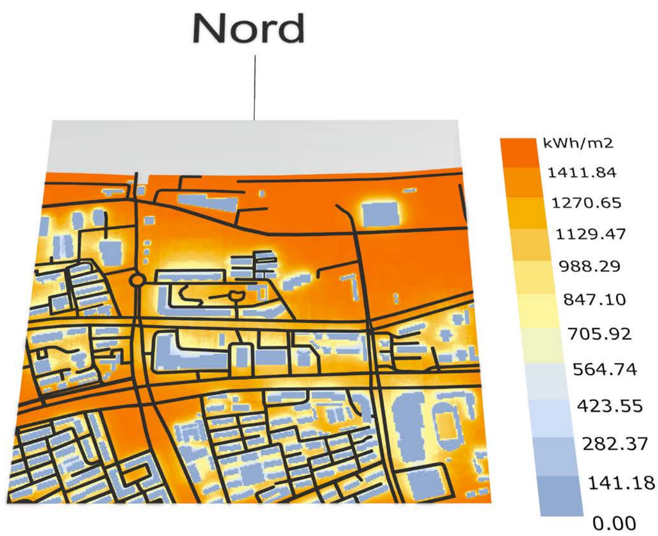

Summer


Winter

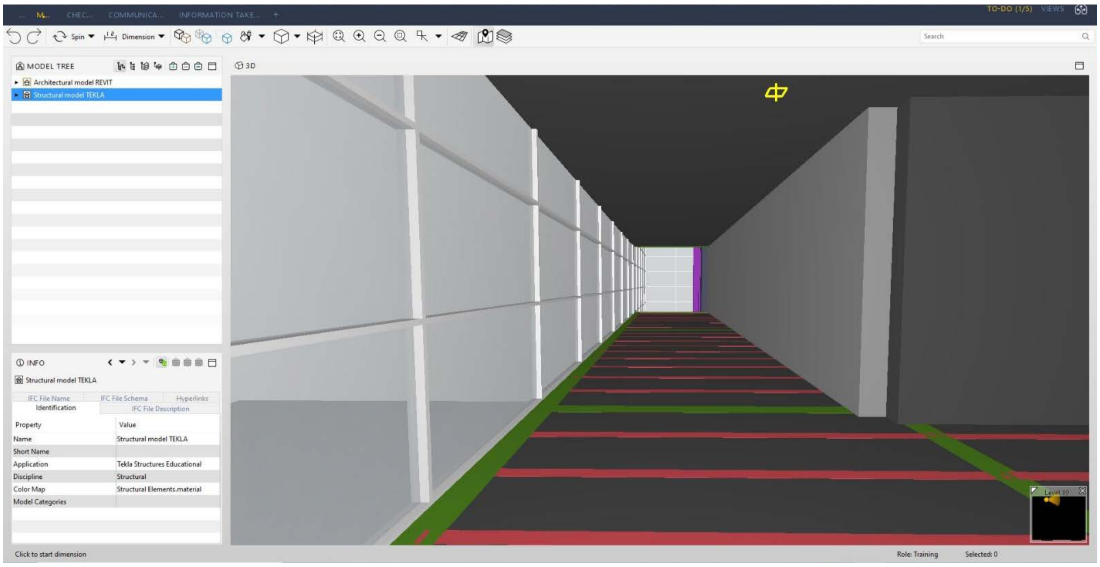

Winter

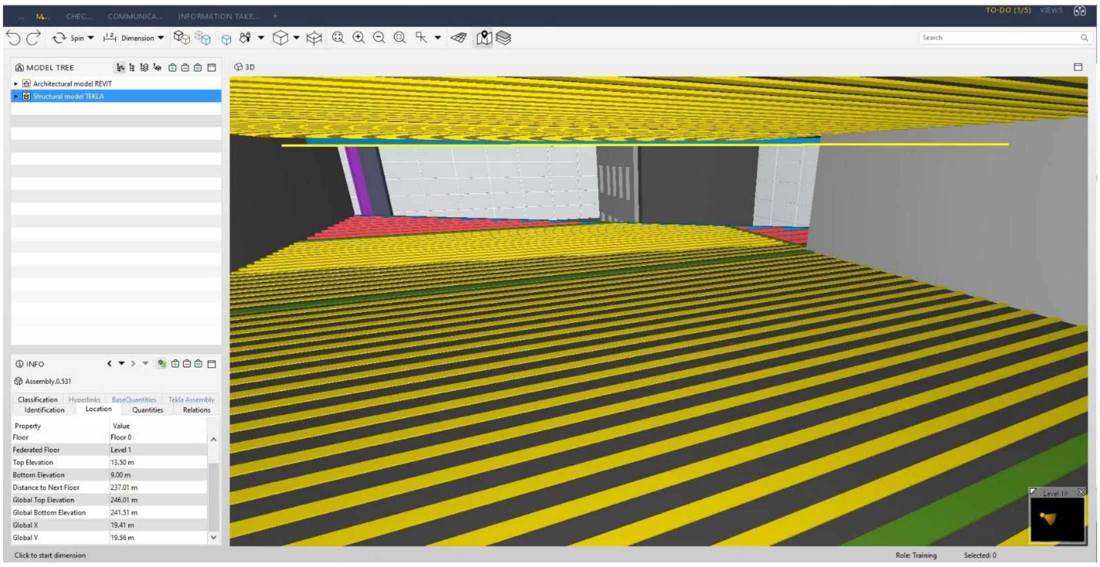
Daylight analysis, Velux



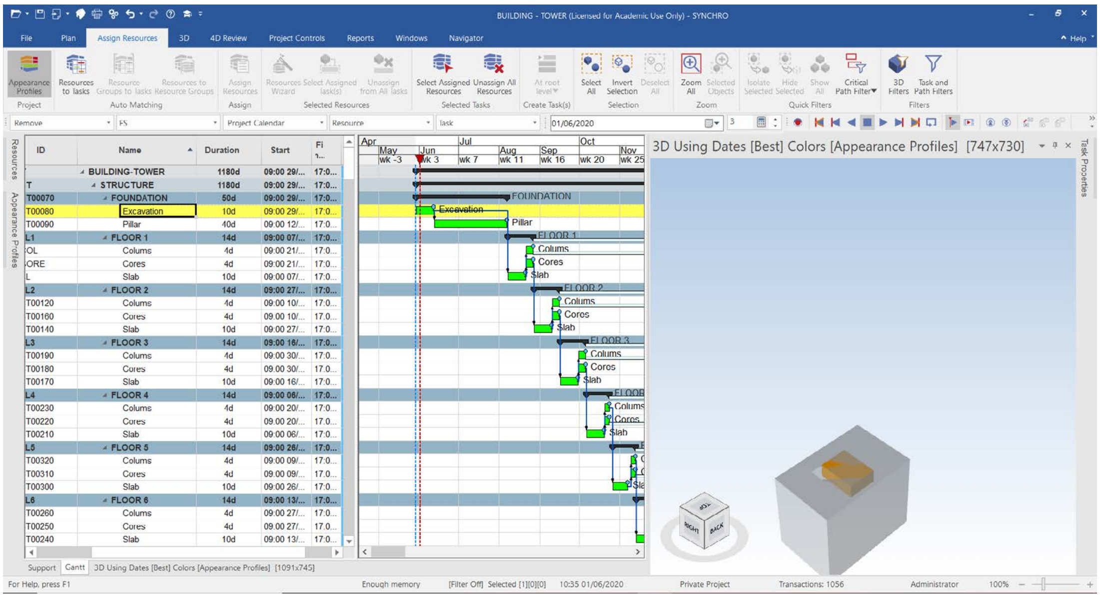


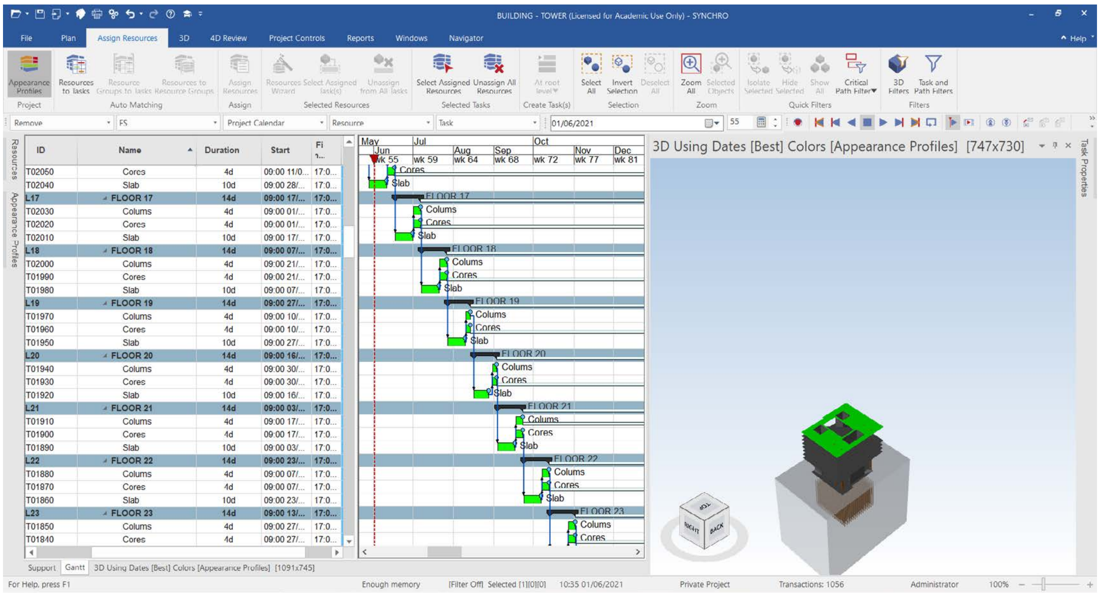
Sun analysis, Ladybug





Solibri model check


BUILDING - TOWER (Licensed for Academic Use Only) - SYNCHRO
File
Plan
Assign Resources
3D
4D Review
Project Controls
Reports
Windows
Navigator
3D Using Dates [Best] Colors [Appearance Profiles] [747x730]
ID
Name
Duration
Start
BUILDING-TOWER
STRUCTURE
FOUNDATION
Excavation
Pillar
FLOOR 1
Colums
Cores
Slab
FLOOR 2
FLOOR 3
FLOOR 4
FLOOR 5
FLOOR 6
Support
Gantt
3D Using Dates [Best] Colors [Appearance Profiles] [1091x745]
For Help, press F1
Enough memory
Private Project
Transactions: 1056
Administrator

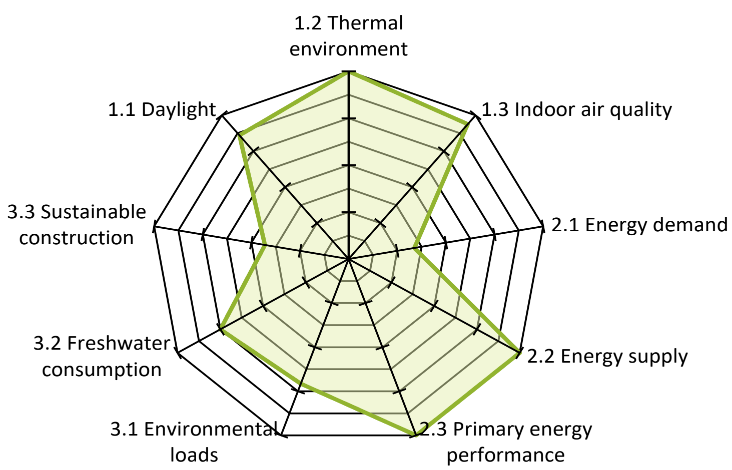

BUILDING - TOWER (Licensed for Academic Use Only) - SYNCHRO
File
Plan
Assign Resources
3D
4D Review
Project Controls
Reports
Windows
Navigator
3D Using Dates [Best] Colors [Appearance Profiles] [747x730]
ID
Name
Duration
Start
FLOOR 17
FLOOR 18
FLOOR 19
FLOOR 20
FLOOR 21
FLOOR 22
FLOOR 23
Colums
Cores
Slab
Support
Gantt
3D Using Dates [Best] Colors [Appearance Profiles] [1091x745]
For Help, press F1
Enough memory
Private Project
Transactions: 1056
Administrator

Synchro

Main calculation - New building		
Comfort	Value	Category
1.1 Daylight:	4.5 %	1.6
1.2 Thermal environment:	best level	1.0
1.3 Indoor air quality:	≤ 750 ppm	1.3
Classification		
Energy	Value	Category
2.1 Energy demand:	105.8 kWh/m²	3.6
2.2 Energy supply:	315.0 kWh/m²	1.0
2.3 Primary energy:	-240.0 kWh/m²	1.0
Classification		
Environment	Value	Category
3.1 Environmental loads:	Good level	2.2
3.2 Freshwater:	30 % savings	2.0
3.3 Sustainable construction:	Better level	3.3
Classification		

Radar

Project



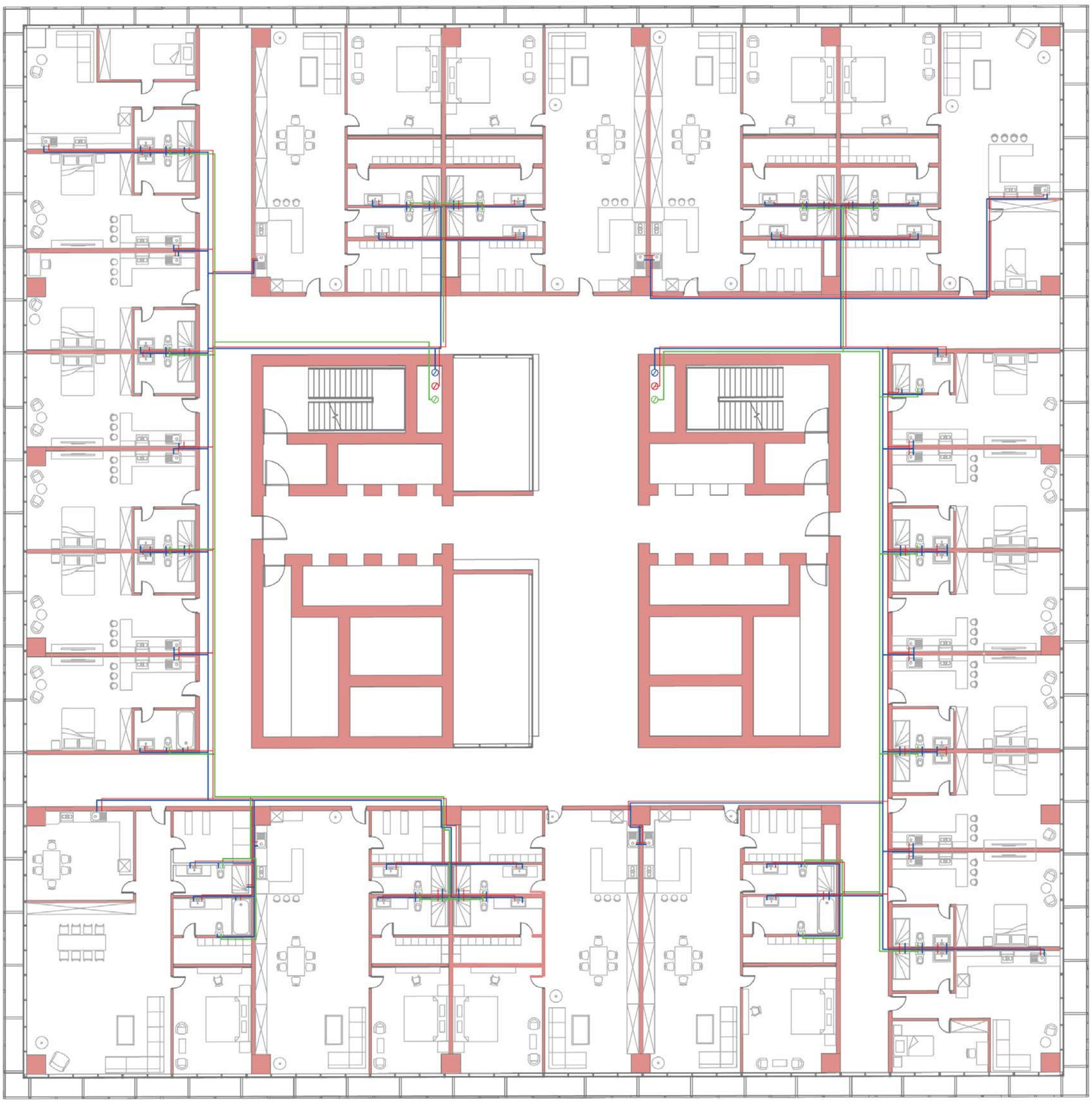
Active House

09. BUILDING SERVICES

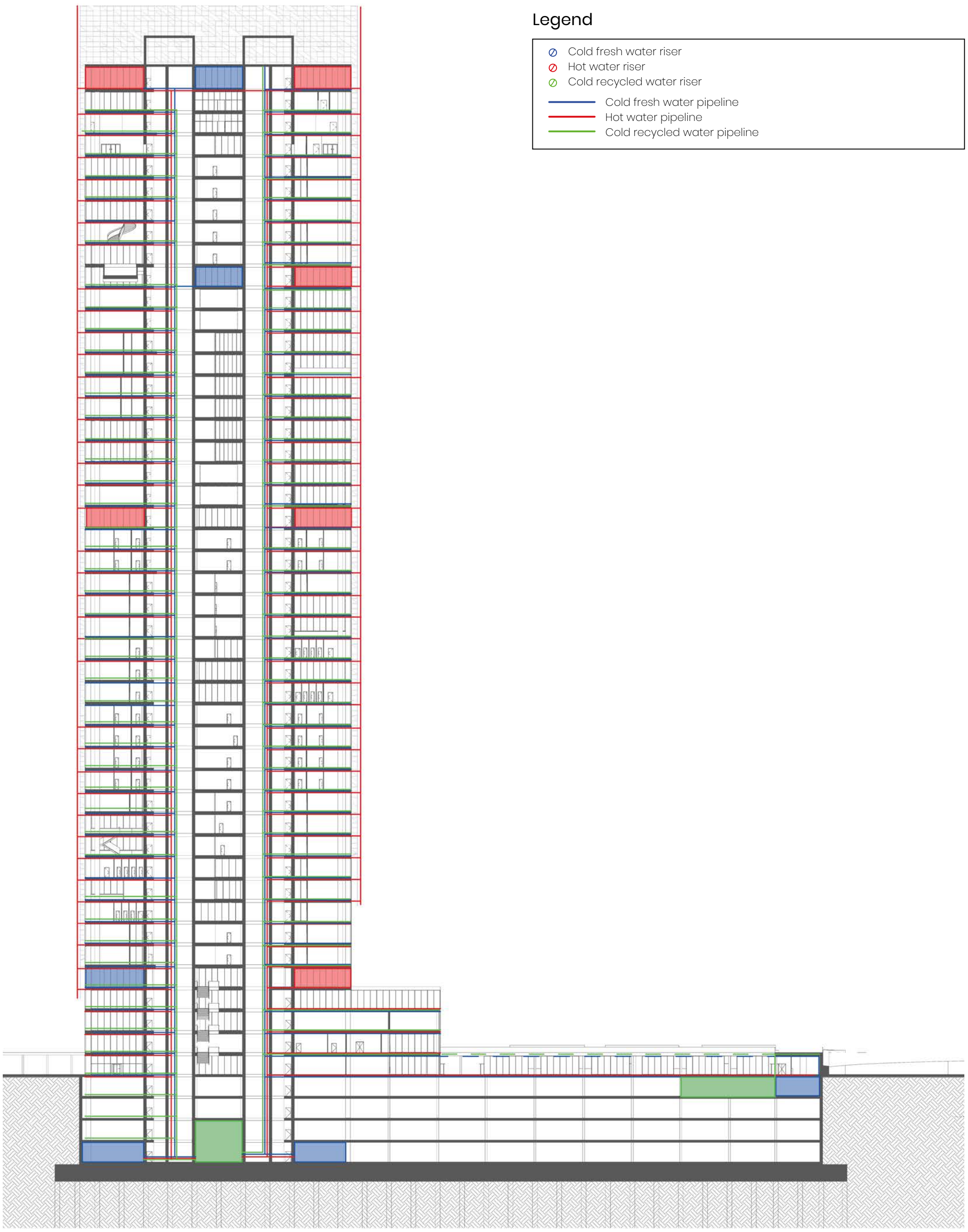
The complex has one underground floor where all the technical rooms for climatization, storage, machinery needed for complete and successful work of the buildings are located. The floor is -4.5 meters below the marked 0, that is, the carriageway of the city. Also on this floor, there is a parking lot, which is connected with each part of the complex, that allows achieving excellent distribution of the flow of visitors, employees, cars.

Majority of the services are distributed in the basement with the exception of a few. The water tank for rainwater storage, Domestic use, and Fire fighting are also located in the basement.

SERVICE ORGANIZATION



WATER SUPPLY SISTEM



Most buildings' water supply systems combine three types of systems: direct supply, indirect supply, and sump and pump supply.
Fresh water is delivered directly from the public water mains to lower-floor residences by hydraulic pressure within the mains in the direct delivery system.
A water pump is used in the indirect supply system to pull water from the ground-level storage tank, and fresh water drawn into the rooftop water tank is then carried to each household through a network of sub-mains.
Water is conveyed to the receiving end of the sump and pump supply system by attaching a pressure pump to the supply: a fire main is an example of this. Water pumps, risers, storage tanks, automated float switches, and submains are all vital aspects of a water supply system that should be examined and maintained on a regular basis. For quality control, all water storage tanks should be sanitized on a regular basis.

Draw-off point	Q_A	Q_{min}	Loading units
	l/s	l/s	
Washbasin, handbasin, bidet, WC-cistern	0,1	0,1	1
Domestic kitchen sink, -washing machine [a], dish washing machine, sink, shower head	0,2	0,15	2
Urinal flush valve	0,3	0,15	3
Bath domestic	0,4	0,3	4
Taps /garden/garage)	0,5	0,4	5
Non domestic kitchen sink DN 20, bath non domestic	0,8	0,8	8
Flush valve DN 20	1,5	1,0	15
[a] For non domestic appliances check with manufacturer.			

Table 3.8 — PEX/AL/PE-HD resp. PE-MD/AL/PE-HD

Max. load	LU	3	4	5	6	10	20	55	180	540	1 300
Highest value	LU			4	5	5	8				
d_a x s	mm	16 x 2,25/16 x 2,0			18 x 2	20 x 2,5	26 x 3	32 x 3	40 x 3,5	50 x 4	63 x 4,5
d_i	mm	11,5/12,0			14	15	20	26	33	42	54
Max length of pipe	m	9	5	4							

WATER SUPPLY SISTEM

COLD WATER (Apartements)	N. Left cluster	N. Right cluster	LU	Max LU Left cluster	Max LU Right cluster
Sink	17	13	2	34	26
Toilet	17	13	4	34	26
Shower head	17	13	2	34	26
Kitchen sink	10	12	2	20	24
Tot LU				122	102
Pipe size				40 x 3,5	40 x 3,5

HOT WATER (Apartements)	N. Left cluster	N. Right cluster	LU	Max LU Left cluster	Max LU Right cluster
Sink	17	13	2	34	26
Shower head	17	13	2	34	26
Kitchen sink	10	12	2	20	24
Tot LU				88	76
Pipe size				40 x 3,5	32 x 3

COLD WATER (Facilities)	N. Left cluster	N. Right cluster	LU	Max LU Left cluster	Max LU Right cluster
Sink	4	4	2	**8**	8
Toilet	3	3	4	12	12
Tot LU				20	20
Pipe size				26 x 3	26 x 3

HOT WATER (Facilities)	N. Left cluster	N. Right cluster	LU	Max LU Left cluster	Max LU Right cluster
Sink	4	4	2	8	8
Tot LU				8	8
Pipe size				20 x 2,5	20 x 2,5

A1	N.	LU	Max LU
Sink	2	2	4
Toilet	2	4	8
Shower head	2	2	4
Tot LU			16
Pipe size			26 x 3

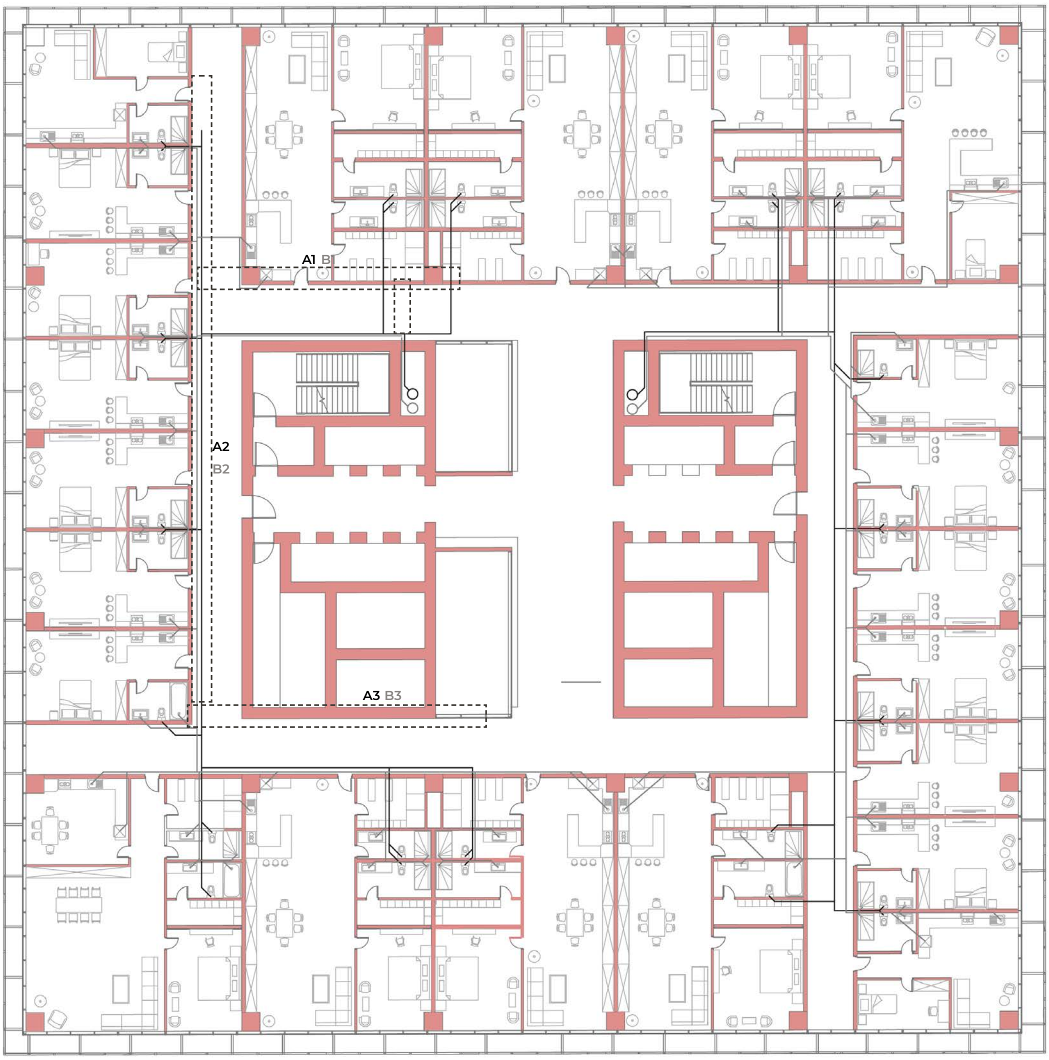
B1	N.	LU	Max LU
Sink	2	2	4
Shower head	2	2	4
Tot LU			8
Pipe size			20 X 2,5

A2	N.	LU	Max LU
Sink	2	2	4
Toilet	0	2	0
Shower head	2	2	4
Tot LU			8
Pipe size			20 x 2,5

B2	N.	LU	Max LU
Sink	1	2	2
Shower head	2	2	4
Tot LU			6
Pipe size			18 x 2

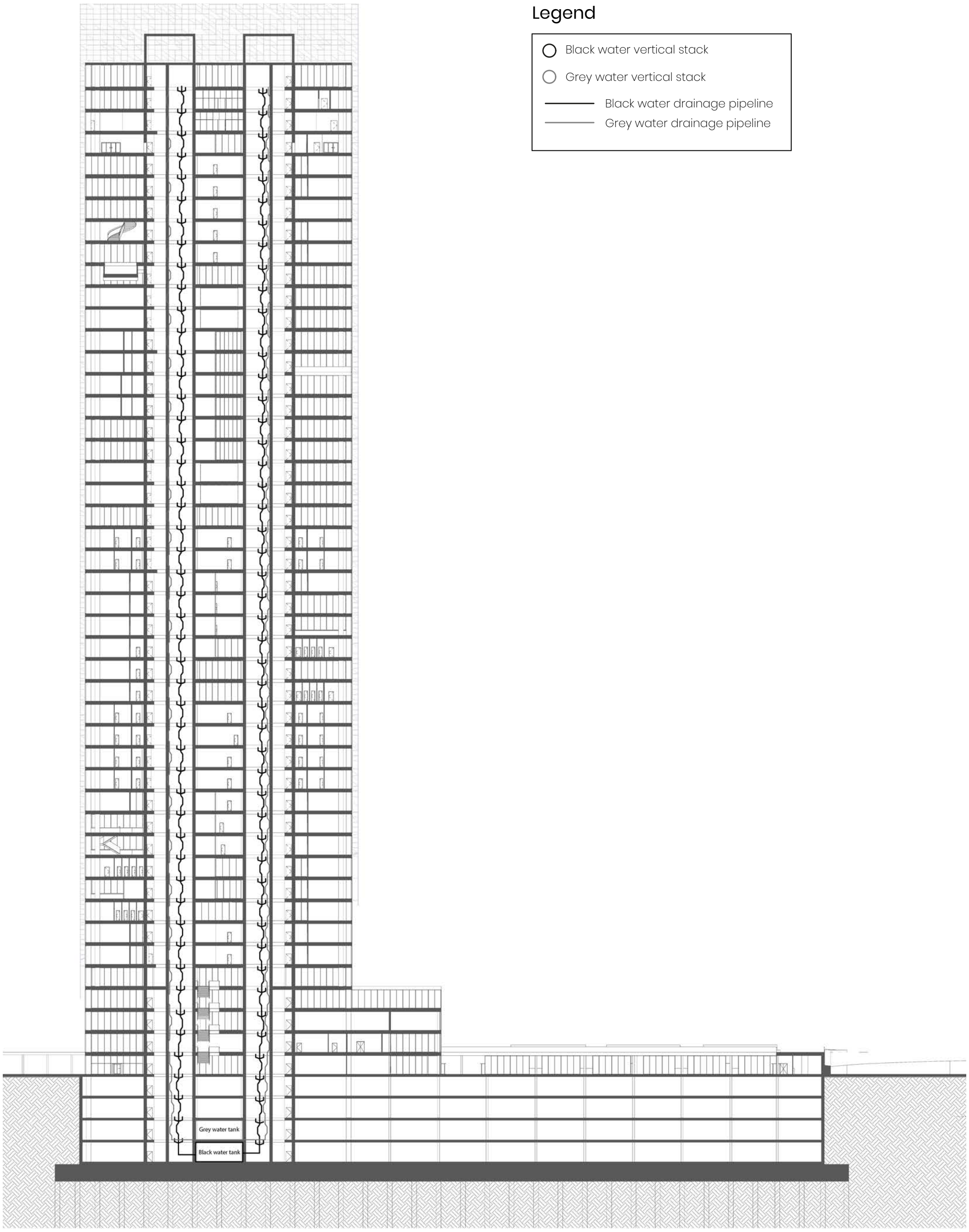
A3	N.	LU	Max LU
Sink	1	2	2
Toilet	0	2	0
Shower head	2	2	4
Tot LU			6
Pipe size			18 x 2

B3	N.	LU	Max LU
Sink	0	2	0
Shower head	2	2	4
Tot LU			4
Pipe size			16 x 2,25



Drainage distribution

DRAINAGE SYSTEM



Legend

- ○ Black water vertical stack
- ○ Grey water vertical stack
- —— Black water drainage pipeline
- —— Grey water drainage pipeline

Rain-water pipe systems and sewage pipe systems are two types of drainage systems. Drain pipes, traps, and manholes are all essential components of a drainage system. Drain pipes should never be connected incorrectly, for example, sewage from sinks should never be poured into a rain-water pipe. Drainage outlets should be kept clean or equipped with gratings to prevent trash from clogging the pipes. All drain pipes, including soil, waste, ventilating, and subterranean drain pipes, should be kept in good operating order and free of faults. All such pipelines should be inspected on a regular basis, and any leaks, blockages, or faults should be addressed right away.

Appliance	System I DU l/s	System II DU l/s	System III DU l/s	System IV DU l/s
Wash Basin, Bidet	0,5	0,3	0,3	0,3
Shower without Plug	0,6	0,4	0,4	0,4
Shower with Plug	0,8	0,5	1,3	0,5
Single Urinal with Cistern	0,8	0,5	0,4	0,5
Urinal with Flushing Valve	0,5	0,3	-	0,3
Slab Urinal	0,2*	0,2*	0,2*	0,2*
Bath	0,8	0,6	1,3	0,5
Kitchen Sink	0,8	0,6	1,3	0,5
Dishwasher (Household)	0,8	0,6	0,2	0,5
Washing Machine up to 6 kg	0,8	0,6	0,6	0,5
Washing Machine up to 12 kg	1,5	1,2	1,2	1,0
WC with 4,0 l Cistern	**	1,8	**	**
WC with 6,0 l Cistern	2,0	1,8	1,2 to 1,7***	2,0
WC with 7,5 l Cistern	2,0	1,8	1,4 to 1,8***	2,0
WC with 9,0 l Cistern	2,5	2,0	1,6 to 2,0***	2,5
Floor Gully DN 50	0,8	0,9	-	0,6
Floor Gully DN 70	1,5	0,9	-	1,0
Floor Gully DN 100	2,0	1,2	-	1,3

* per person
** not permitted
*** depending upon type (valid for WC's with siphon flush cistern only)
\- not used or no data

Q_{max} l/s	System I DN	System II DN	System III DN	System IV DN
0,40	*	30	see table 6	30
0,50	40	40		40
0,80	50	*		*
1,00	60	50		50
1,50	70	60		60
2,00	80**	70**		70**
2,25	90***	80****		80****
2,50	100	90		100

* not permitted
*** not more than two WC's and a total change in directions of not more than 90°
** no WC's
**** not more than one WC

Usage of appliances	*K*
intermittent use e.g. in Dwelling, Guesthouse, Office	0,5
frequent use e.g. in Hospital, School, Restaurant, Hotel	0,7
congested use e.g. in Toilets and/or Showers open to Public	1,0
special use e.g. Laboratory	1,2

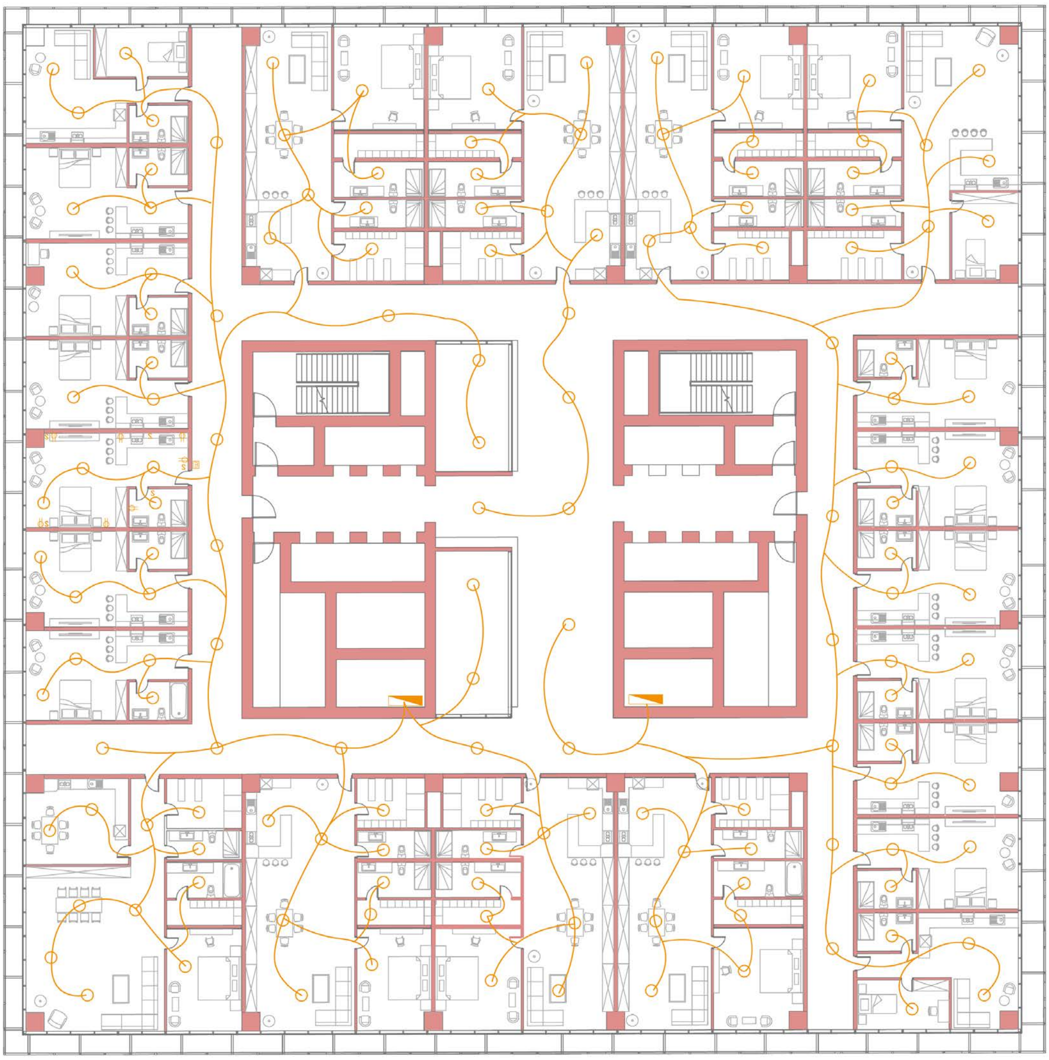
Stack and stack vent	System I, II, III, IV Q_{max} (l/s)	
DN	Square entries	Swept entries
60	0,5	0,7
70	1,5	2,0
80*	2,0	2,6
90	2,7	3,5
100**	4,0	5,2
125	5,8	7,6
150	9,5	12,4
200	16,0	21,0

* minimum size where WC's are connected in system II
** minimum size where WC's are connected in system I, III, IV

System IV Separate discharge stack system
Drainage systems type I, II and III may also be divided into a black water stack serving WC's and urinals and a grey water stack serving all other appliances.

DRAINAGE SYSTEM

DISCHARGE BRANCHES						DISCHARGE STACKS	
(Cluster 1)						(Cluster 1)	
Grey water	N.	DU	Max DU	Frequency factor (K)	Qww		
Sink	12	0.5	6	0.5	1.22		
Shower head	17	0.5	8.5	0.5	1.46	16.56088328	(Qww*4 floors)
Kitchen sink	17	0.5	8.5	0.5	1.46		
					4.14		
DN					60	150	
Black water	N.	DU	Max DU	Frequency factor	Qww		
Toilet	17	2	34	0.5	2.92	11.66190379	(Qww*4 floors)
DN					100	125	
A1	N.	DU	Max DU	Frequency factor (K)	Qww		
Toilet	17	2	34	0.5	2.92		
DN					100		
A2	N.	DU	Max DU	Frequency factor (K)	Qww		
Toilet	13	2	26	0.5	2.55		
DN					60		
A3	N.	DU	Max DU	Frequency factor (K)	Qww		
Toilet	6	2	12	0.5	1.73		
DN					50		
B1	N.	DU	Max DU	Frequency factor (K)	Qww		
Units	18	0.5	9	0.5	1.50		
DN					60		
B2	N.	DU	Max DU	Frequency factor (K)	Qww		
Units	46	0.5	23	0.5	2.40		
DN					60		
B3	N.	DU	Max DU	Frequency factor (K)	Qww		
Units	18	0.5	9	0.5	1.50		
DN					60		



Electrical distribution

ELETTRICAL SYTEM

Legend

In the human body, the electrical system is comparable to the neurological system. It provides power to various portions of the building and aids in the control and communication systems.

The transformer, power distribution panels, light fixtures, telephones, and security devices are all examples of primary electrical assemblies. Different aspects of the electrical system are depicted in the images to the right.

Attributes

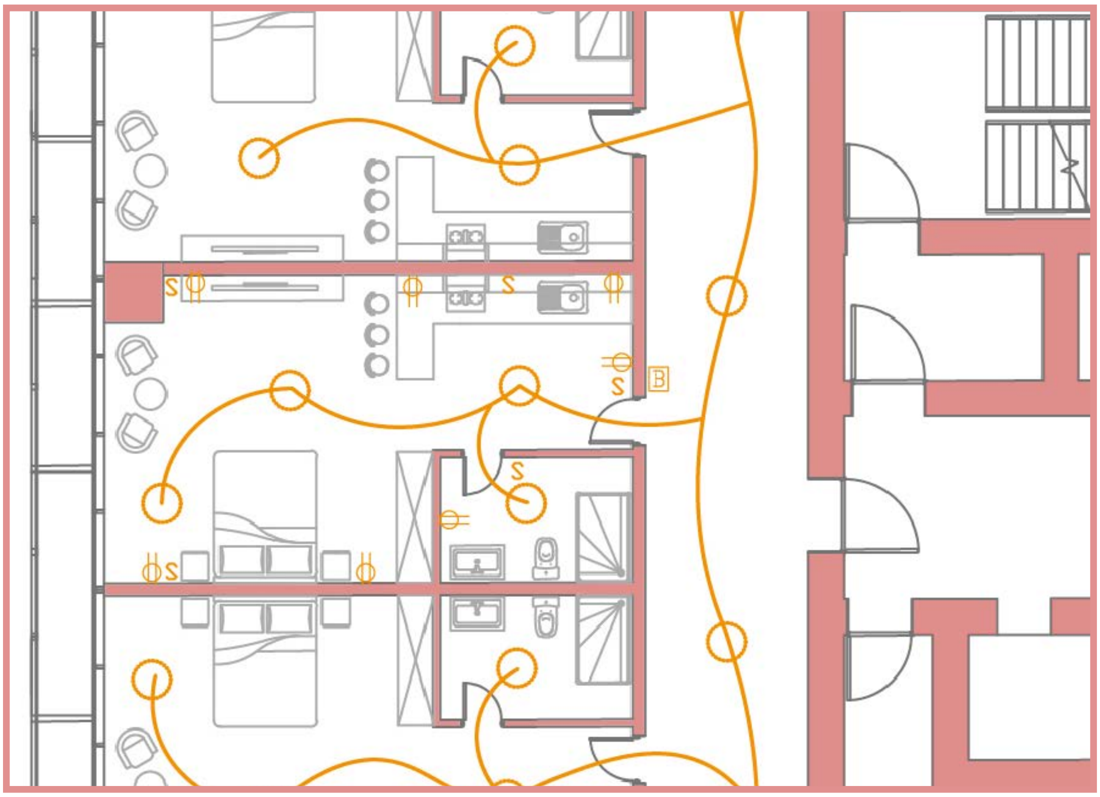
Some of the electrical system's characteristics are listed below.

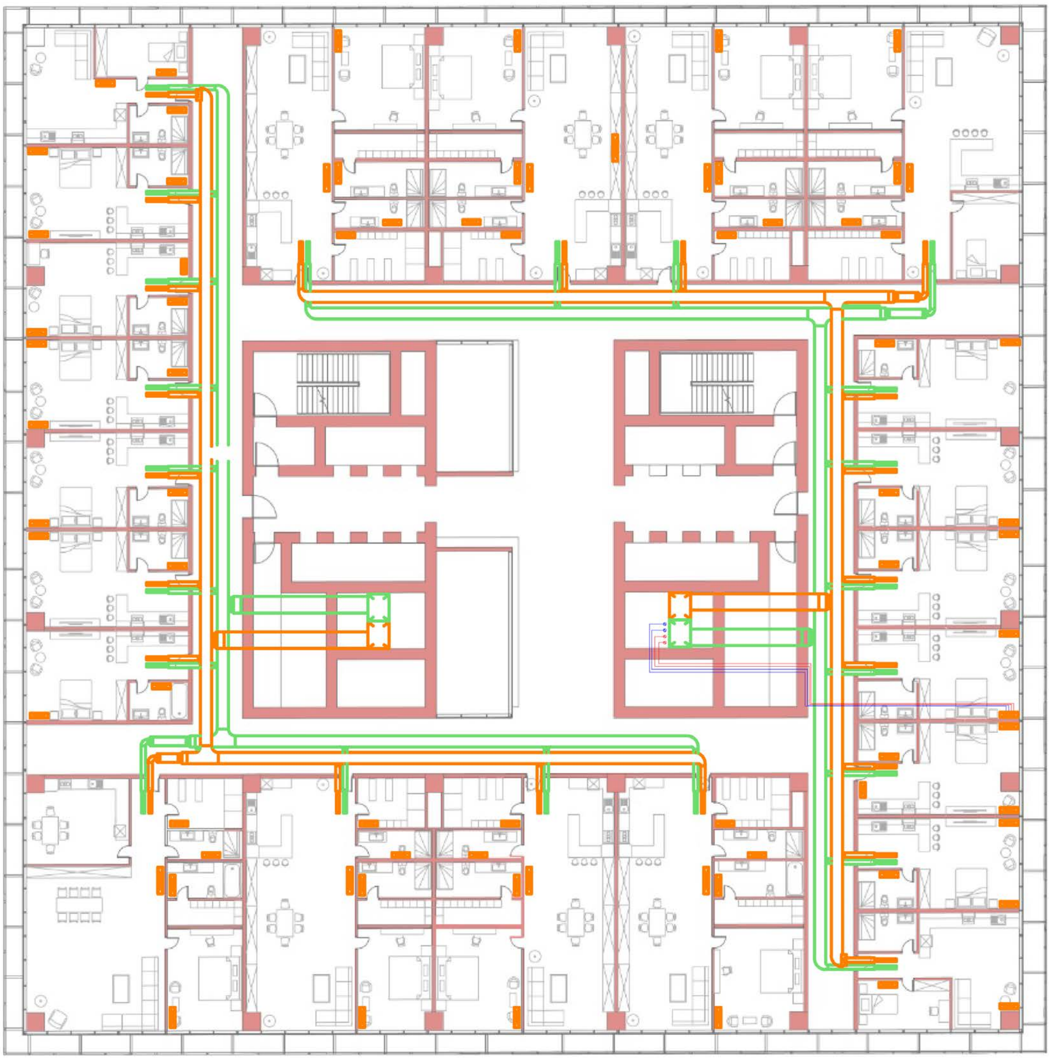
Because mechanical equipment requires a lot of power and control, the electrical system and the mechanical system are inextricably linked. The electrical system is mostly inaccessible, with the exception of light fixtures, power receptacles, and panel boards. As a result, the inaccessible elements' estimated useful service life (such as wiring) is frequently planned to be throughout the life of the structure or for very extended periods of time.

Periodic inspection, maintenance, and renewals are required for accessible components. Many of the assets are considered long- or medium-term investments.

Because the assets are sturdy and do not require much maintenance, the maintenance-to-replacement ratio (MRR) is often low.

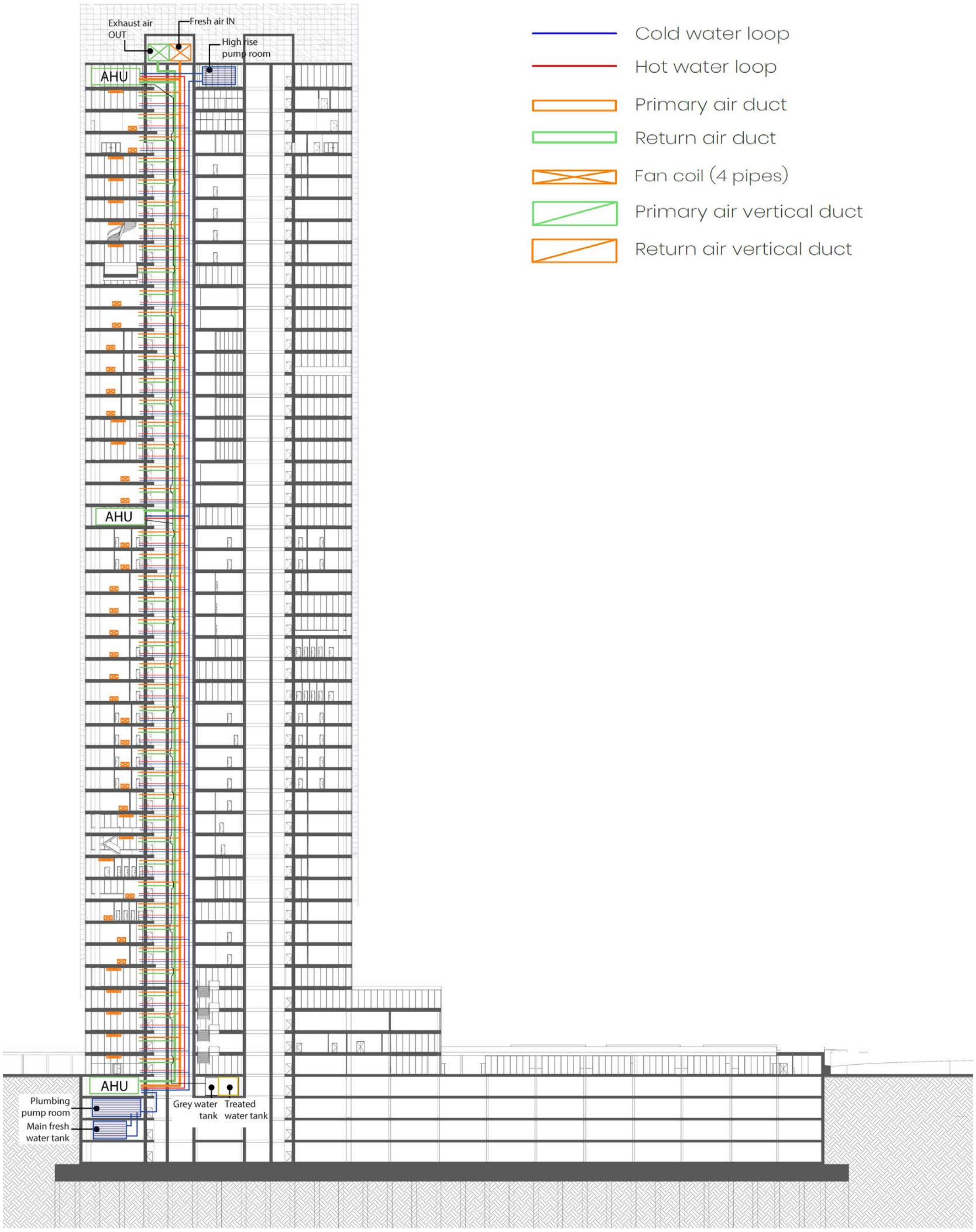
ELETTRICAL SYTEM





HVAC distribution

HVAC SYSTEM


Exhaust air OUT
Fresh air IN
High rise pump room
AHU
AHU
AHU
Plumbing pump room
Main fresh water tank
Grey water tank
Treated water tank
Cold water loop
Hot water loop
Primary air duct
Return air duct
Fan coil (4 pipes)
Primary air vertical duct
Return air vertical duct

H.V.A.C

Surface water based heat exchange system

To utilize the presence of Huangpu River in the vicinity of the project, a Surface water-based heat exchange system has been implemented in the project. The core idea is that surface water has always a temperature difference, this difference can be utilized sustainability to exchange the heat from the building.

To better define the services the Building has been divided into blocks. These core are served by the system throughout the shafts, these are they connected to the basement where the majority of the HVAC equipment are kept.

An Open Water Heat Pump system works by recovering the solar energy stored naturally in river water or open water. The water then passes through heat pumps to yield its low-grade heat before being returned to the river with a temperature change of 3°C.

Heating/ Cooling Loads

To do the heating and cooling loads of the project Hourly analysis program was used. This software is based on ASHRAE standard 62.1-2010

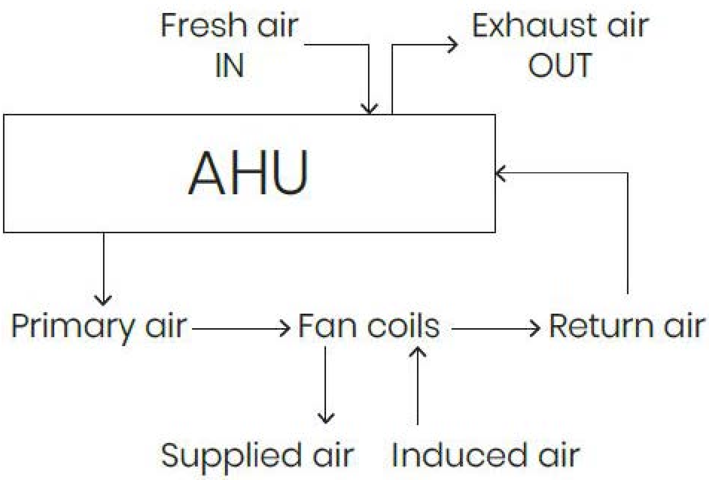
The following steps were done in the software. Location, and climate data were inserted.

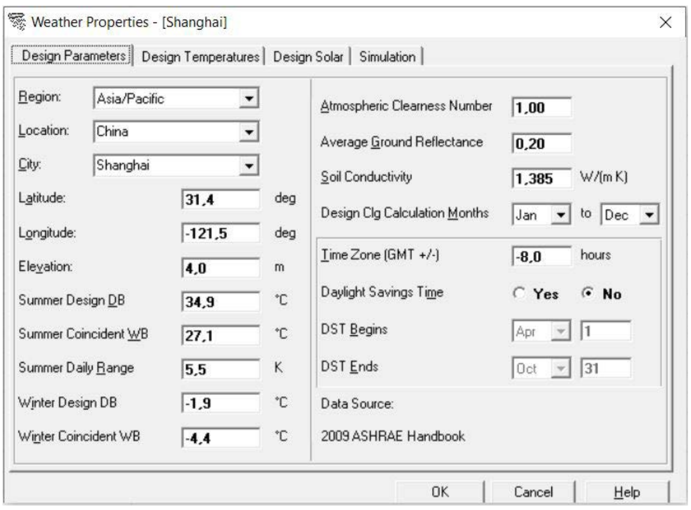
To run the analysis, we split the building in 5 zones, then only one was used for the simulation. The zone was divided by floor and the floor in block to better manage the space inside. The U-values of wall, roof, windows and doors, based on the curtain system, were defines.

Once all the information about the space were defined, we proceeded to insert the data about the power supply.

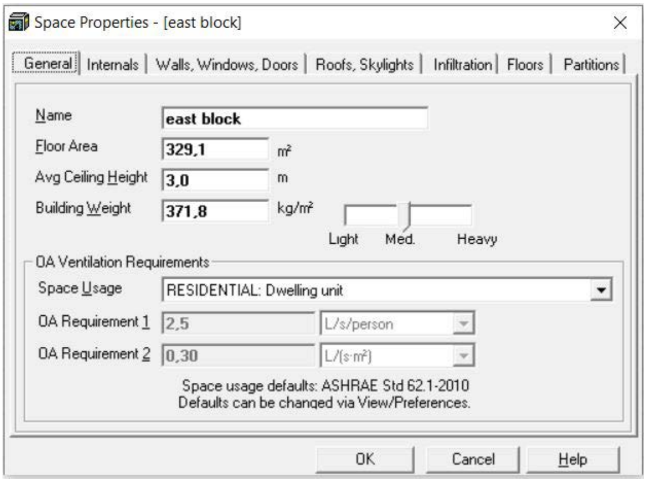
At this point the data corresponding to the spaces was assigned, specification of the system was assigned.

After these steps, design analysis was ran.

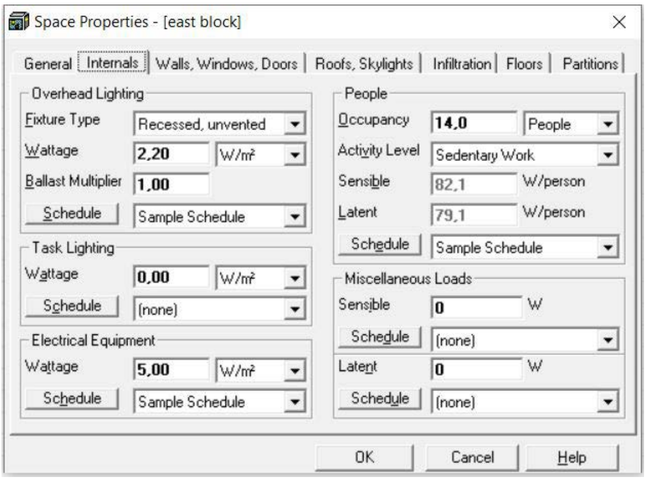




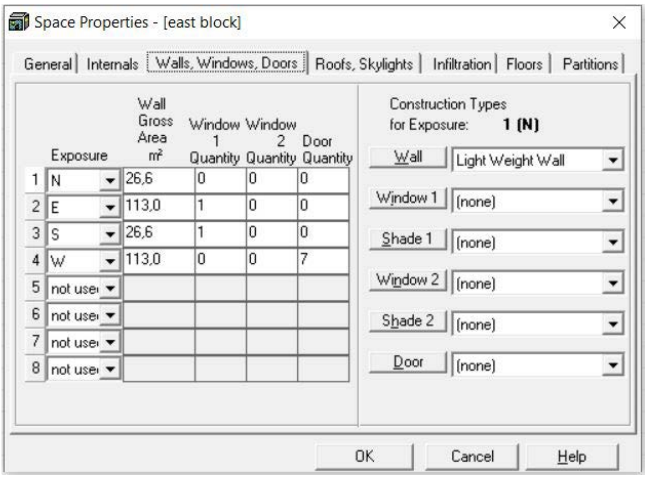
HAP Heating cooling calculation, weather properties



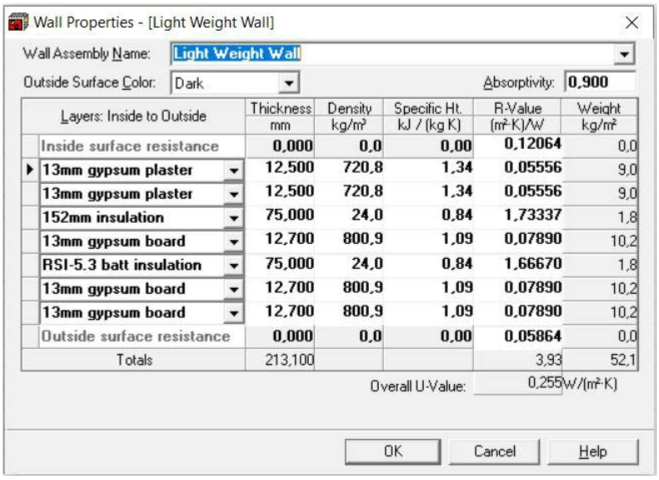
HAP Heating cooling calculation, space properties



HAP Heating cooling calculation, space properties



HAP Heating cooling calculation, space properties


Wall Properties - [Light Weight Wall]

Wall Assembly Name: Light Weight Wall

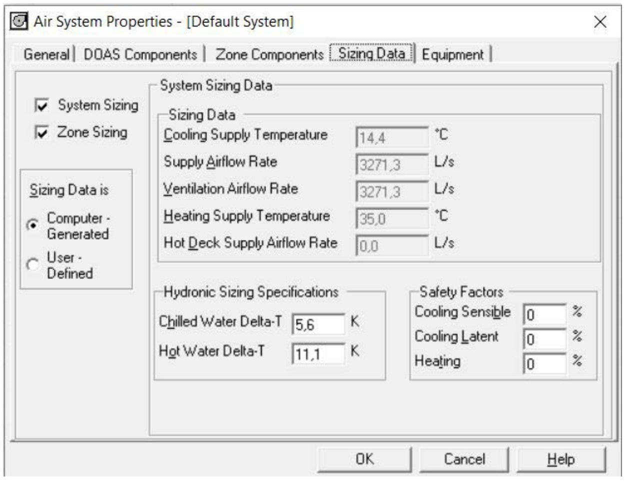
Outside Surface Color: Dark Absorptivity: 0,900

Layers: Inside to Outside	Thickness mm	Density kg/m³	Specific Ht. kJ / (kg K)	R-Value (m²-K)/W	Weight kg/m²
Inside surface resistance	0,000	0,0	0,00	0,12064	0,0
13mm gypsum plaster	12,500	720,8	1,34	0,05556	9,0
13mm gypsum plaster	12,500	720,8	1,34	0,05556	9,0
152mm insulation	75,000	24,0	0,84	1,73337	1,8
13mm gypsum board	12,700	800,9	1,09	0,07890	10,2
RSI-5.3 batt insulation	75,000	24,0	0,84	1,66670	1,8
13mm gypsum board	12,700	800,9	1,09	0,07890	10,2
13mm gypsum board	12,700	800,9	1,09	0,07890	10,2
Outside surface resistance	0,000	0,0	0,00	0,05864	0,0
Totals	213,100			3,93	52,1

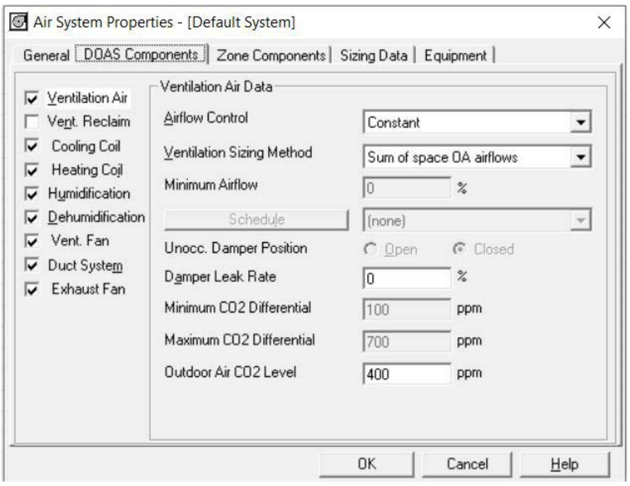
Overall U-Value: 0,255 W/(m²-K)

OK Cancel Help

HAP Heating cooling calculation, wall properties



HAP Heating cooling calculation, system properties



HAP Heating cooling calculation, system properties

Dedicated Outdoor Air System (DOAS) Sizing Summary for Default System

Project Name: shanghai tower — 06/27/2022
Prepared by: PoliMi — 12:48

Air System Information

Air System Name	**Default System**		Number of zones	**1**	
Equipment Class	**TERM**		Floor Area	**9071,0**	m²
Air System Type	**PKG-FC**		Location	**Shanghai, China**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone L/s Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space L/s Sizing	**Individual peak space loads**

Cooling Coil Sizing Data

Total coil load	**157,3**	kW	Load occurs at	**Jun 1500**	
Total coil load	**20,8**	L/(s kW)	OA DB / WB	**34,3 / 27,1**	°C
Sensible coil load	**74,1**	kW	Entering DB / WB	**34,3 / 27,1**	°C
Coil L/s at Jun 1500	**3271**	L/s	Leaving DB / WB	**15,5 / 15,6**	°C
Max coil L/s	**3271**	L/s	Bypass Factor	**0,100**	
Sensible heat ratio	**0,471**				
Water flow @ 5,6 K rise	**N/A**				

Heating Coil Sizing Data

Max coil load	**91,0**	kW	Load occurs at	**Des Htg**	
Coil L/s at Des Htg	**3271**	L/s	Ent. DB / Lvg DB	**-1,9 / 21,1**	°C
Max coil L/s	**3271**	L/s			
Water flow @ 11,1 K drop	**1,96**	L/s			

Humidifier Sizing Data

Max steam flow at Des Htg	**43,13**	kg/hr	Air mass flow	**14141,83**	kg/hr
Airflow Rate	**3271**	L/s	Moisture gain	**,00305**	kg/kg

Ventilation Fan Sizing Data

Actual max L/s	**3271**	L/s	Fan motor BHP	**0,00**	BHP
Standard L/s	**3270**	L/s	Fan motor kW	**0,00**	kW
Actual max L/(s·m²)	**0,36**	L/(s·m²)	Fan static	**0**	Pa

Exhaust Fan Sizing Data

Actual max L/s	**3271**	L/s	Fan motor BHP	**0,00**	BHP
Standard L/s	**3270**	L/s	Fan motor kW	**0,00**	kW
Actual max L/(s·m²)	**0,36**	L/(s·m²)	Fan static	**0**	Pa

Outdoor Ventilation Air Data

Design airflow L/s	**3271**	L/s	L/s/person	**14,87**	L/s/person
L/(s·m²)	**0,36**	L/(s·m²)			

HAP Heating cooling calculation, Result

Zone Sizing Summary for Default System

Project Name: shanghai tower 06/27/2022
Prepared by: PoliMi 12:48

Air System Information

Air System Name .... **Default System**
Equipment Class .... **TERM**
Air System Type .... **PKG-FC**

Number of zones **1**
Floor Area .... **9071,0** m²
Location .... **Shanghai, China**

Sizing Calculation Information

Calculation Months .... **Jan to Dec**
Sizing Data .... **Calculated**

Zone L/s Sizing .... **Sum of space airflow rates**
Space L/s Sizing .... **Individual peak space loads**

Terminal Unit Sizing Data - Cooling

Zone Name	Total Coil Load (kW)	Sens Coil Load (kW)	Coil Entering DB / WB (°C)	Coil Leaving DB / WB (°C)	Water Flow @ 5,6 K (L/s)	Time of Peak Coil Load	Zone L/(s·m²)
Zone 1	454,1	415,7	24,2 / 19,4	17,4 / 17,0	-	Sep 1500	5,61

Terminal Unit Sizing Data - Heating, Fan, Ventilation

Zone Name	Heating Coil Load (kW)	Heating Coil Ent/Lvg DB (°C)	Htg Coil Water Flow @11,1 K (L/s)	Fan Design Airflow (L/s)	Fan Motor (BHP)	Fan Motor (kW)	OA Vent Design Airflow (L/s)
Zone 1	147,7	21,1 / 23,5	-	50853	0,000	0,000	3271

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (kW)	Time of Peak Sensible Cooling Load	Zone Heating Load (kW)	Zone Floor Area (m²)
Zone 1	462,3	Oct 1400	134,9	9071,0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Peak Sensible Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s·m²)
Zone 1							
east block	5	27,8	Aug 0900	2440	6,9	329,1	7,41
north block	5	17,3	Jun 1700	1517	6,6	578,0	2,62
west block	5	31,6	Jun 1600	2770	6,9	329,1	8,42
south block	5	39,2	Dec 1300	3443	6,6	578,0	5,96

HAP Heating cooling calculation, Result

Air System Design Load Summary for Default System

Project Name: shanghai tower 06/27/2022
Prepared by: PoliMi 12:48

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Sep 1500 COOLING OA DB / WB 33,8 °C / 26,5 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -1,9 °C / -4,4 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	2379 m²	312080	-	2379 m²	-	-
Wall Transmission	2397 m²	11415	-	2397 m²	14072	-
Roof Transmission	0 m²	0	-	0 m²	0	-
Window Transmission	2379 m²	16932	-	2379 m²	43879	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	1400 m²	12455	-	1400 m²	32278	-
Floor Transmission	0 m²	0	-	0 m²	0	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	9071 m²	0	-	9071 m²	0	-
Overhead Lighting	19956 W	19954	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	45355 W	45353	-	0	0	-
People	220	18061	17402	0	0	0
Infiltration	-	19160	31532	-	44671	9678
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	455411	48934	-	134901	9678
Zone Conditioning	-	428781	48934	-	147708	9678
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	3271 L/s	0	-	3271 L/s	0	-
Ventilation Load	3271 L/s	36790	63323	3271 L/s	91008	19717
Ventilation Fan Load	3271 L/s	0	-	3271 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	465571	112257	-	238716	29396
Cooling Coil	-	71941	75853	-	0	0
Heating Coil	-	-21943	-	-	91006	-
Terminal Unit Cooling	-	415666	38426	-	0	0
Terminal Unit Heating	-	0	-	-	147711	-
Humidification Load	-	-	0	-	-	29396
>> Total Conditioning	-	465664	114279	-	238717	29396
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

HAP Heating cooling calculation, Result

CONCLUSION

The project of Live on High on Shanghai, aims to illustrate a new way of living on the high rises with a much consderate design of user needs with reference of traditional Chinese architecture; and the aspects learned from city's urban transformation history. The design is made based on the researches on the existing urban patterns, the history of the city; having the goal to understand this mega metropolis city itself.

In between all the high rise buildings that are built, a different way of living concept formed by main two aspects: The first one to start the architectural role inside the traditional Chinese architecture and than the role it holds much of society and culture. Taking a deeper study on people's life, understanding the habits and forming the architectural program around this habits of living became the main idea to achieve. On traditional Chineese architecture, the research highlights the the courtyard it is seen that one element that had come through the history to todays' date is the element and the use of common spaces in different functions.

Applying the courtyard theme to a tower resulted on different loggia settlements dedicated to different functions that has been observed on daily lives at estimated user groups. The design of the galleries, with the role of gathering people and leasure, taking advantage of the geometry of the tower, they are placed in four different corners facing different orientations of the city. To accommodate such complexity of intent, the overall volume of the tower must be as clear and essential as possible. Thus, the choice of the column typology as the model for our project. It will take shape through the complex flexible spaces described so far, wrapped by a secondary skin that will define its limits; increasing and decreasing in intensity along with the development of the tower so as to highlight the salient spaces.

To conclude, the justification of any proposal of high rise in such part of the city which is under transformation is made by deep studies on the city, high rise buildings and traditional way of living. Learning from the conflicts of living on high, the unsuccessful trials that has been made, helped the proposal to have a different perspective, coureing mix of functions in strict divisions of the city, offering a possible alternative solution to life on high.

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