REDEFINE THE SKYLINE

DETROIT WATERFRONT

MASTER-/DIPLOMARBEIT

Neudefinition der Skyline
Redefine the Skyline
Detroit Waterfront District

ausgeführt zum Zwecke der Erlangung
des akademischen Grades eines
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ABSTRACT

This master thesis deals with the design of a new complex of towers in the Downtown of Detroit. The topic originates from the architecture competition “Detroit Waterfront District”, which purpose is to define the future of the city`s Skyline. The project aims to boost the person`s desire for exploration, creating spaces for meeting, communication, leisure, privacy and business. By generating oblique and exciting transactions between the different functions, the design provokes emotions in the visitors and tenants, offering the needed comfort and a huge diversity of amenities.

ABSTRAKT

Diese Masterarbeit befasst sich mit dem Entwurf eines neuen Turmkomplexes in der Innenstadt von Detroit. Das Thema stammt aus dem Architekturwettbewerb „Detroit Waterfront District“, wo wird die Zukunft der Skyline der Stadt definiert. Das Projekt zielt darauf ab, die Besucher und Einwohner dieses Komplexes eine vielfalt von Athmosphären zu schaffen. Die moderne Mensch soll sich auch in Natur noch in Stadt wohlfühlen und diese wirken im Entwurf in Symbiose. Durch die Erzeugung von schrägen und aufregenden Transaktionen zwischen den verschiedenen Funktionen wurden Emotionen bei den Besuchern und Mietern provoziert, gleichzeitig werden erforderlichen Komfort und eine große Vielfalt an Annehmlichkeiten angeboten.

РЕЗЮМЕ

Във фокуса на тази дипломна магистърска работа е проектирането на нов комплекс от кули в центъра на Детройт. Темата произхожда от архитектурния конкурс „Detroit Waterfront District" (Детройтски крайбрежен район), чиято основна цел е да положи основите на един нов, модерен и емблематичен облик на градския силует. Проектът провокира желанието на човека за изследване, създавайки пространства за срещи, комуникация, отдих, личен живот и бизнес. Чрез генериране на косвени и вълнуващи транзакции между различните функции, дизайнът предизвиква емоции у посетителите и жителите, предлагайки необходимия комфорт и огромно разнообразие от удобства и функции.

ABSTRACTO

Esta tesis de máster trata sobre el diseño de un nuevo complejo de torres en el centro de Detroit. El tema tiene su origen en el concurso de arquitectura "Detroit Waterfront District", cuyo propósito es definir el futuro del Skyline de la ciudad. El proyecto tiene como objetivo impulsar el deseo de exploración de la persona, creando espacios de encuentro, comunicación, ocio, privacidad y negocios. Al generar transiciones oblicuas y excitantes entre las diferentes funciones, el diseño provoca emociones en los visitantes y residentes, ofreciendo confort y una enorme diversidad de comodidades.

CONSPECT

I

INTRODUCTION

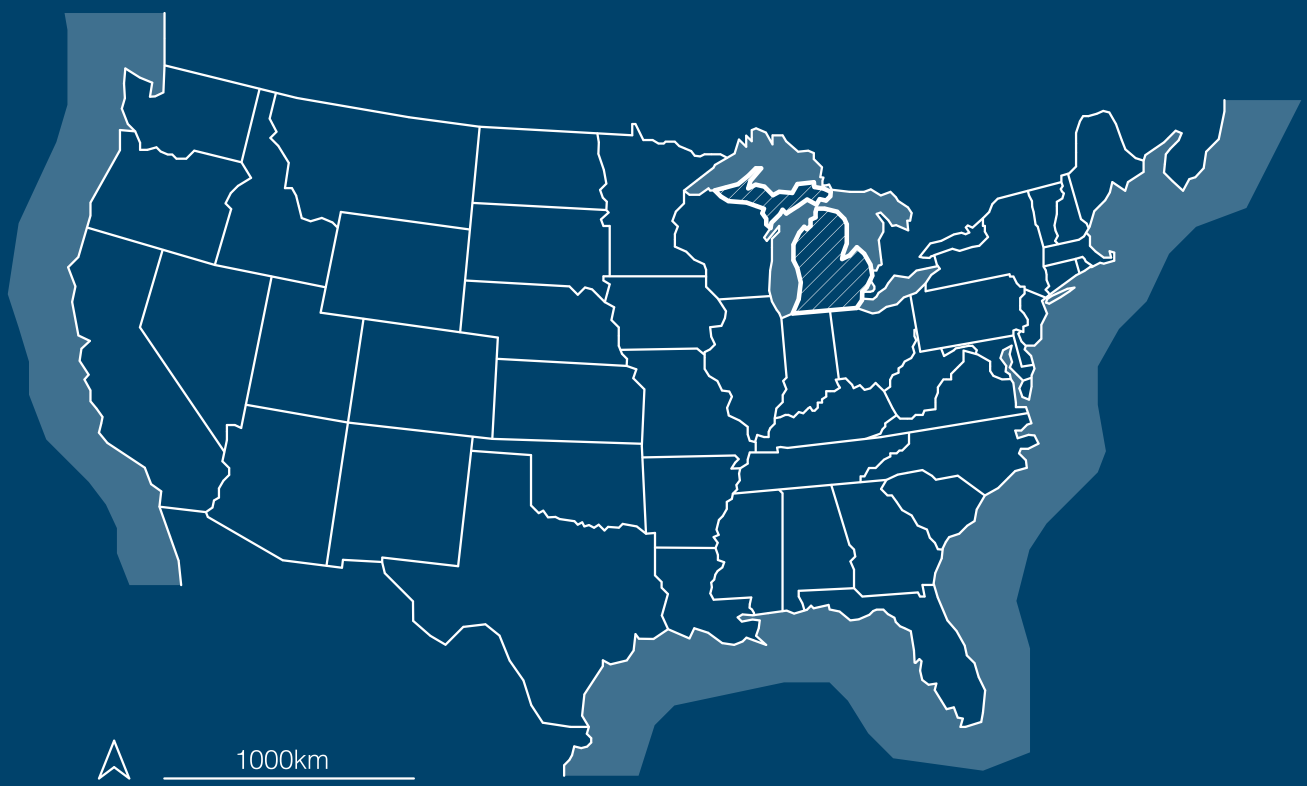
The reason why I chose this topic is the insterest I have in solving modern social, architectural and structural problems. I am looking to give answer to issues, where the solutions will embody my creativity and intellect. The scale of this project has pushed me to balance between general and specific, trying to generate good spaces for the whole community, while answering the specific desires of various groups.

No one can define how Detroit, known as "the arsenal of democracy" in the early 1940s, transformed into the largest modern-day ghost city. Empty streets and abandoned buildings scar the city of Detroit. After half a century of decay, this unfortunate town sees a silver lining and is looking forward to its own resurrection.

As a result, many of the voids of the city – created by economic crisis and depopulation - turned into new epicenters of urban regeneration. Detroit Waterfront District precisely focuses on the most fascinating canvas of all: the downtown skyscrapers overlooking the river, reflecting into the water mirror and offering fascinating views to its Canadian neighbours of Windsor. The newly generated architecture masterpieces are to become the symbol of the revival of one of the most iconic and controversial cities of the history of the United States of America.

II

SITUATION ANALYSIS



Pln.1: USA & State of Michigan

Pln.2: State of Michigan & Detroit

II. 1 Hystorical overview

II. 1 . 1 Birth of Detroit

At the beginning of the 18th century, the french trader Antoine de la Mothe Cadillac landed on the northern side of the strait between the lakes St. Clair and Erie. There he found the perfect place for the settlement of a new community. This is where the roots of the city`s name originate from - reffering to the Detroit river, meaning the strait of lake Erie (le détroit du lac Erie in French) Until 1815, French, British, Native Americans and eventually independents fought for the city. In that year, the city became part of the United States of America permanently. Simultaneously established on the other bank of the Detroit Rivier, its sibling city - Windsor(established by French, the current name given in the 19th century by the English) is nowadays Canadian territory.

After the American Civil War – that the State of Michigan proudly contributed to the Union and fought at President Lincoln's side - the city lived remarkably prosperous years. Due to the city's splendors and majestic architectures, Detroit was referred by many as the "Paris of the West".

Detroit's population grew drastically between 1850 and 1950. The city's industrial growth was a magnet for migrants, at first mainly European immigrants and later African Americans from the South.

Fig.1: General Motors Building

II. 1 . 1 Flourishing of the city

Fig.2: Ford Motor Company Plant

The real turning point for Detroit was in 1896. At a car rental office on a main Avenue, the 33-year-old Henry Ford built his first car. Inspired by his major innovations three giants in automobile manufacturing were found in the city: Ford, Dodge, Chrysler. From that moment on Detroit took the lead in an unprecedented economic boom that seemed unstoppable at the time. The city`s connection with the automotive industry was the city's key to success. In the 20th century, the name Detroit became synonymous with the American automotive industry.

II. 1 . 3 Decay and Revival

Detroit's economy remains unusually dependable to the automotive industry. Therefore, economic depressions have been felt more heavily in Detroit than in most areas of the country. When the city expanded, and its center got overpopulated, the companies moved to the suburbs and surrounding cities, so the city slowly got emptier. Economic and social tensions broke causing one of the bloodiest periods of American history - "the 1967 Detroit riot".

Since that moment, there were many unsuccessful attempts of recovering the city. In 2013 bankruptcy was rather a need than a failure. Since then a rapid economic recovery is being observed. Many new property investments are giving Detroit new hope for its so desired resurrection.

Detroit Waterfront District will head this new beginning of the city. It will generate a powerful international interest and create the new face of Detroit - symbolizing its revival.

Fig.3: Ghost House in Downtown Detroit

II.2 YAC Architecture Competition

II.2.1 Brief

The plot of the design is the area where stood the Joe Louis Arena. Participants should design a building complex to re-define the city skyline. They shall generate superb architecture masterpieces to become the symbol of the revival of one of the most iconic and controversial cities of the history of the United States of America.
The complex of towers should provide a real international entertainment center pulsating with scenes and lights reflected on the Detroit River. It will be an essential element for the composition of the city skyline, being an everyday view for its neighbor city - Windsor, Canada.

The project shall not only create architectures and common spaces to enjoy the views, but they also shall think of an expression that can be admired from the other bank in mirror-like reflections in the Detroit River.
The neighboring plot is taken since the mid 20th century by Detroit's Cobo Center - Michigan's largest and one of the USA`s first convention centers. According to tradition, its site was where the first French colonists, who founded Detroit at the beginning of the 18th century, landed.
For the design of the new complex steel and glass constructions are prefered. The maximum allowed height is 125m (to the last slab).

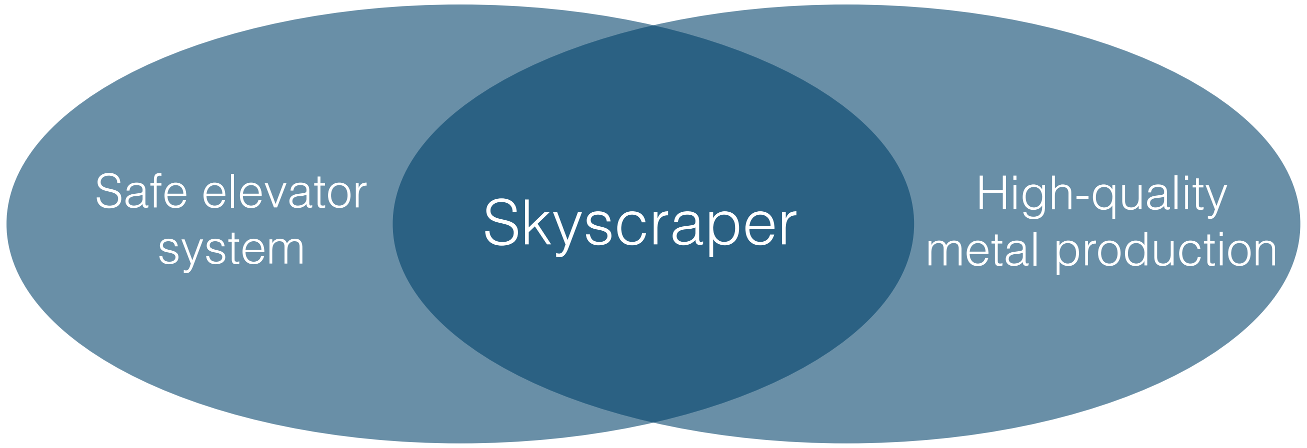
II.2.2 Criterias

Leisure	Residential	Hotel	Office
mall 15000m^2	3 Lofts (500m^2)	500 bedrooms	25 floors
in the lower floors	100 luxury ap.(200m^2)	swimming pools	1000m^2 per floor
restaurants	100 business ap.(70m^2)	iconic architecture	free floor arrangement
shops	green terraces	restaurants	
cafés	glass walls	gym	
park			

Fig.4: Detroit

II.3 Evolution of the Skyscrapers

II.3.1 Prehistory



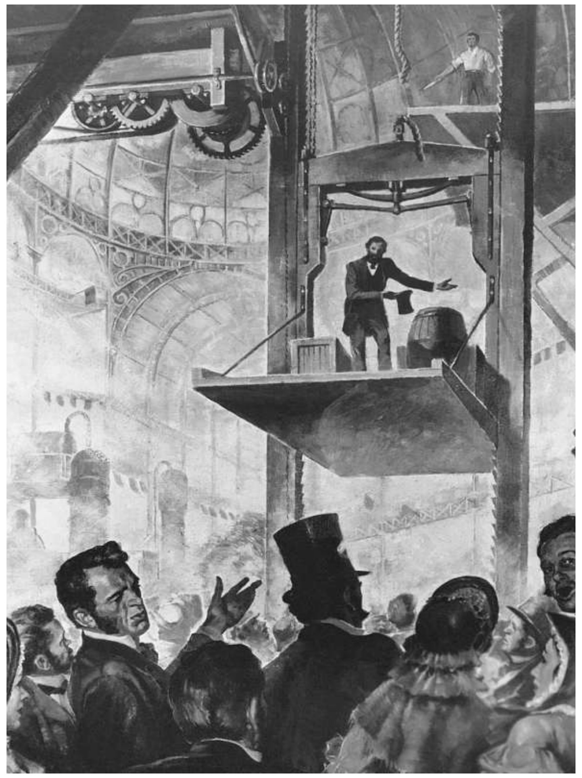


Fig.5: Otis free-fall safety demonstration in 1853

Elevators

Elisha Otis (founder of the Otis Elevator Company) was the inventor of a safety device that prevents elevators from falling if the hoisting cable fails. Back in time higher floors in buildings were less desired for tenants, due to the effort required to climb up the stairs. Firstly Otis and his sons created a safety locking mechanism for personal needs. In the NY exhibition in Chrystal Palace the invention was shown by Elisha Otis to a greater audience in a dramatical performance. Since that moment people, seeing the safety working system, gained greater willingness to ride in traction elevators. These elevators quickly became the type in most common usage and were the cornerstone in making present-day skyscrapers possible.

Iron to Steel

The industrial revolution played a crucial role in the development of high-rise buildings. An English industrialist John Wilkinson ("Iron-Mad") pioneered the manufacture and use of cast iron, inventing blast furnaces for generating high temperatures and boring machine for boring cast-iron cylinders. Another English pioneer was Sidney Gilchrist Thomas, a metallurgist who discovered a method in 1875 for eliminating phosphorus from iron ores. The development of iron led to the creation of steel. This evolution in chemistry gave more freedom to engineers and architects, allowing them to create longer spans and achieve greater heights in their works.


Fig.6: The first Cast Iron Bridge, Coalbrookdale


Fig.7: Eiffel Tower

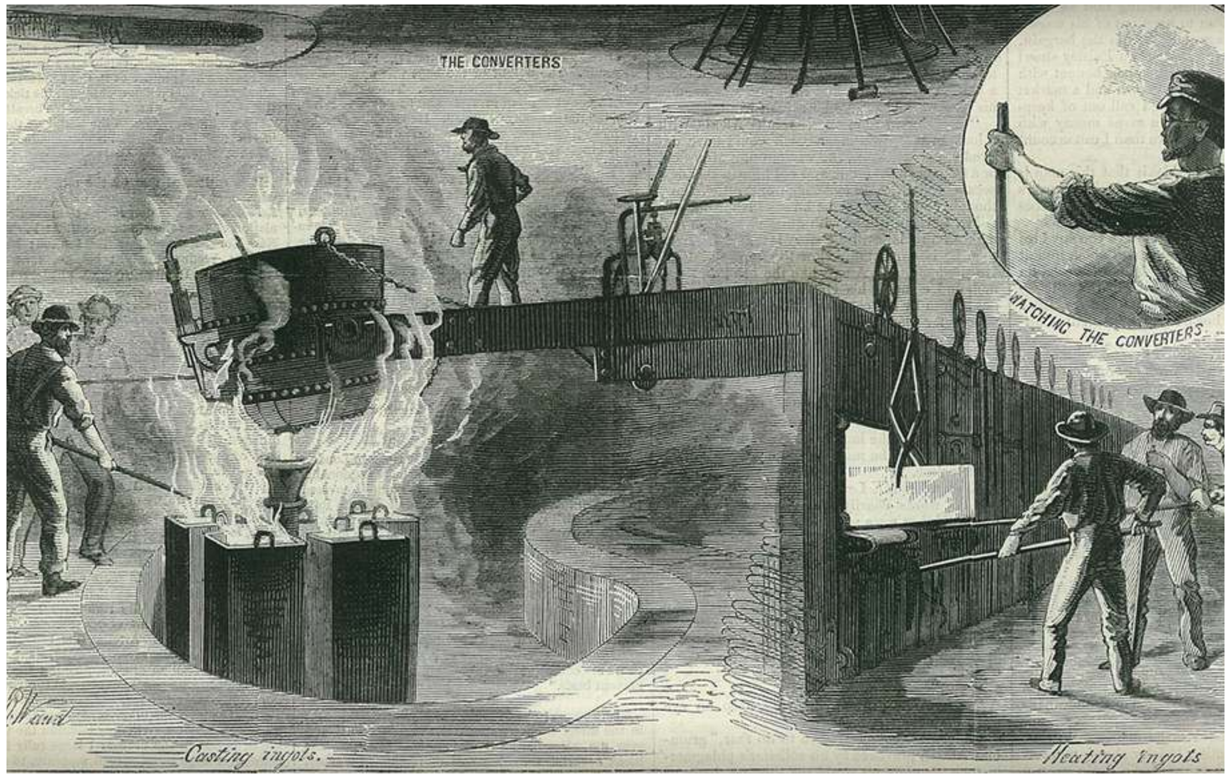


Fig.8: Production of Iron and Steel during the Industrial Revolution

II.3.2 Early Skyscrapers

Chicago School

The early skyscrapers were tall commercial buildings built between 1884 and 1945, mainly located in the American cities of New York City and Chicago. Recent inventions such as the elevator, electric lighting and other technological improvements enabled the construction of mega-high fireproofed iron-framed structures with deep foundations. The American architect Louis Henry Sullivan, considered by many the “father of skyscrapers” and the “father of modernism”, was an influential architect of the Chicago School and a mentor to Frank Lloyd Wright. The phrase “Form follows function”, for which he credited the ancient Vitruvius, gained popularity in modern architecture thankfully to Sullivan.

Fig.9: Home Insurance Building, Chicago, 1894

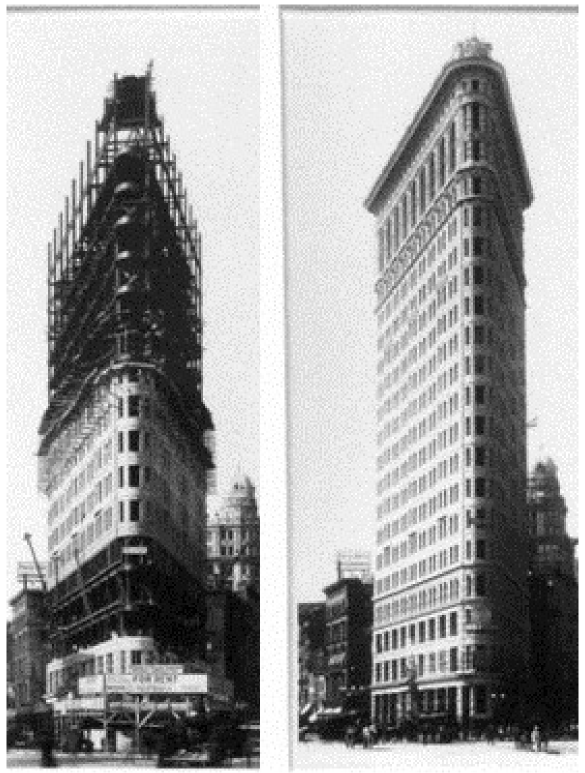


Fig.10: Flatiron Building, NY, 1902

First Skyscrapers

Considered the world’s first skyscraper The Home Insurance Building was built in 1885 in Chicago(existed until 1931). Originally ten stories, with a height of 42.1 m, it was designed by William Le Baron Jenney a year prior to completion. A few years later two more floors were added, bringing it to 54.9 meters. It is noted as the first tall building to be supported both inside and outside by a fireproof structural steel and metal frame, which included reinforced concrete.

The Flatiron Building, originally the Fuller Building, was designed by Daniel Burnham and Frederick Dinkelberg. It was one of the tallest buildings in the city of New York upon its 1902 completion, at 20 floors high and is considered as an architectural icon of the city.

II.3.3 Late Modern Skyscrapers

John Hancock Center

The tube is a structural engineering system where, in order for a building to resist lateral loads, it is designed to act like a hollow cylinder, cantilevered perpendicular to the ground. This system was introduced by Fazlur Rahman Khan in the Chicago office of Skidmore, Owings & Merrill (SOM). When topped out, John Hancock Center was the second-tallest building in the world. The 50 elevators are manufactured by Otis and the ones reaching the observation floor have a top speed of 9.1m/s, allowing them to reach from Ground level to the 95th floor for only 38 seconds.

Architects: SOM
Completion: 1969
Height: 343.7m (100 floors)
Floor Area: 260,126m²

Fig.11: John Hancock Center, Chicago, 1969

Fig.12: Turning Torso, Malmö, 2004

Turning Torso

An example of High-Tech Architecture is the Turning Torso from the Valencian architect Santiago Calatrava. Inspired by his own sculpture “Twisting Torso”, the building is regarded as the first twisted skyscraper in the world.

This mixed-use building is constructed in nine segments of six-story pentagons that twist relative to each other as it rises, making a total twist of 90 degrees. Each floor consists of an irregular pentagonal shape rotating around the vertical core, which is supported by an exterior steel framework. It consists of 10 office floors in the bottom and the top 7 segments house 147 apartments.

Architect: Santiago Calatrava
Completion: 2005
Height: 190m (54 floors)
Floor Area: 27,500 m²

II.3.4 Contemporary References

Torre Glòries

Formerly known as Torre Agbar, the 38-story skyscraper marks the gateway to the new technological district of Barcelona. The concrete structure is being covered with glass facade. A defining feature of the building is its nocturnal illumination -4,500 LED devices, generating luminous images on its facade. Furthermore, the outside of the tower has temperature sensors that regulate the opening and closing of the window blinds of the façade, reducing the consumption of energy for air conditioning.

Architect: Jean Nouvel
Completion: 2005
Height: 144m
Diameter: 39m
Floor Area: 50,693m^2
Cost: €130 million

Fig.13: Torre Glòries, Barcelona

Fig.14: Bosco Verticale, Milan

Bosco Verticale

"Vertical Forest" is a pair of green residential towers in Milan, Italy. The buildings contain more than 900 trees on their terraces. Having more than 90 species, the buildings biodiversity is expected to attract new bird and insect species to the city. The grenery also helps to moderate temperatures in the building in the summer, by shading the interiors from the sun and in winter, by blocking harsh winds. The vegetation also prevents noise pollution and dust from street-level traffic.

Architect: Boeri Studio
Completion: 2014
Height: 111m & 76m
Floor Area: 360,000m^2
Cost: €87.5 million

Tao Zhu Yin Yuan

Also known as Agora Garden, is a residential high-rise building completed in 2018 in Taipei, Taiwan. The twisting tower was designed by the Belgian architect Vincent Callebaut . The building has an architectural height of 93.2 m with 21 floors above ground. There are seven elevators inside, one of which can carry cars and ambulances to the upper/residential floors.
Aiming to reduce the carbon footprint of Taipei, the building is covered with approximately 20,000 trees and shrubs. The twisting design of the building is inspired by a DNA strand. The rotation of the building is 90 degrees from up to bottom, with each floor rotating 4.5 degrees from the previous.

Fig.15: Tao Zhu Yin Yuan Project

Fig.16: Structure concept

The structure consists of a round composite core, each two floors are bound together with steel Vierendeel trusses and cantilevered to the core. Additionally on the outer side of the facade steel megacolumns are pulling all the cantilevered sections up, where these columns are attached to a the main truss, carrying the forces towards the core. This structure allows the twist of the building to be performed and additionally every second floor is column-free.

Fig.17: Construction process

II.4 Situation

Detroit is the largest US city on the US–Canada border and bigest and most-populous city in the U.S. state of Michigan.
The city and the river are named after the French word Détroit, lit. ‘strait’.
Its neighboring city on the other bank - Windsor - is similarly knows as “Automotive Capital of Canada”. Detroit and Windsor are connected through a highway tunnel, railway tunnel, and the Ambassador Bridge, which is the second busiest international crossing in North America, after San Diego–Tijuana.

Detroit`s population: 670,000 people
Metro Detroit`s population: 3,5million
Windsors`s population: 234,000 people

Pln.3: Road Map of Detroit and Windsor

Pln.4: Plan of Waterfront District

Fig.18: Waterfront District

III

OBJECTIVE

The topic of this master thesis is a competition organized by YAC in order to design a complex of skyscrapers, including Office, Residential and Hotel towers, and commercial center on the lower floors of the complex. The project should give a new vision to the skyline of the city and define its future look - bright and prosperous times coming after few very decades full of struggle and decay.

Taking into consideration the history and location of Detroit, the concept`s main inspirations are the revival of the city and the water, therefore the complex, laying on the bank of the Detroit River, should express fluidity in height.

My work aims to generate expressions for visitors and tenants, where comfort and design are balanced. The complex should offer mixed functions of privacy and openness, where safety is a priority and borders are existing, but hidden. Green areas, huge, open spaces and different levels are some of the tools to create a better environment for all.

The first steps of finding a solution are done by the means of hand sketches, experimenting with shapes, volumes, program. Afterwards, calculations are done to figure out the necessary space in each building taken by elevators, as in skyscrapers elevators have an immense footprint, therefore their optimal solution is vital. Then structural solutions are observed in order to create free-floor arrangement. Furthermore, proposals for optional internal distributions are being shown in ground plans.

Fig.19: Visualisation

IV METHODOLOGY

IV. 1 Methods

In search of shapes

As the competition's criteria are to generate towers with the three particular functions and the commercial center is meant to be on the lower floors, additionally considering the concept of the author of this work "revival and fluidity", this hand sketch was the results of many experiments and analyses of hand drawings and the basis for the 3D-Design.

Big Three (automobile manufacturers)

Distribution of the functions: hotel, office and residential areas are done in three different towers, symbolizing the three founders of the giant automobile manufacturers. The shopping center unites them as a basis - reference to the citizens of Detroit and that without their hard work and unity these manufacturers wouldn`t have achieved worldwide success.

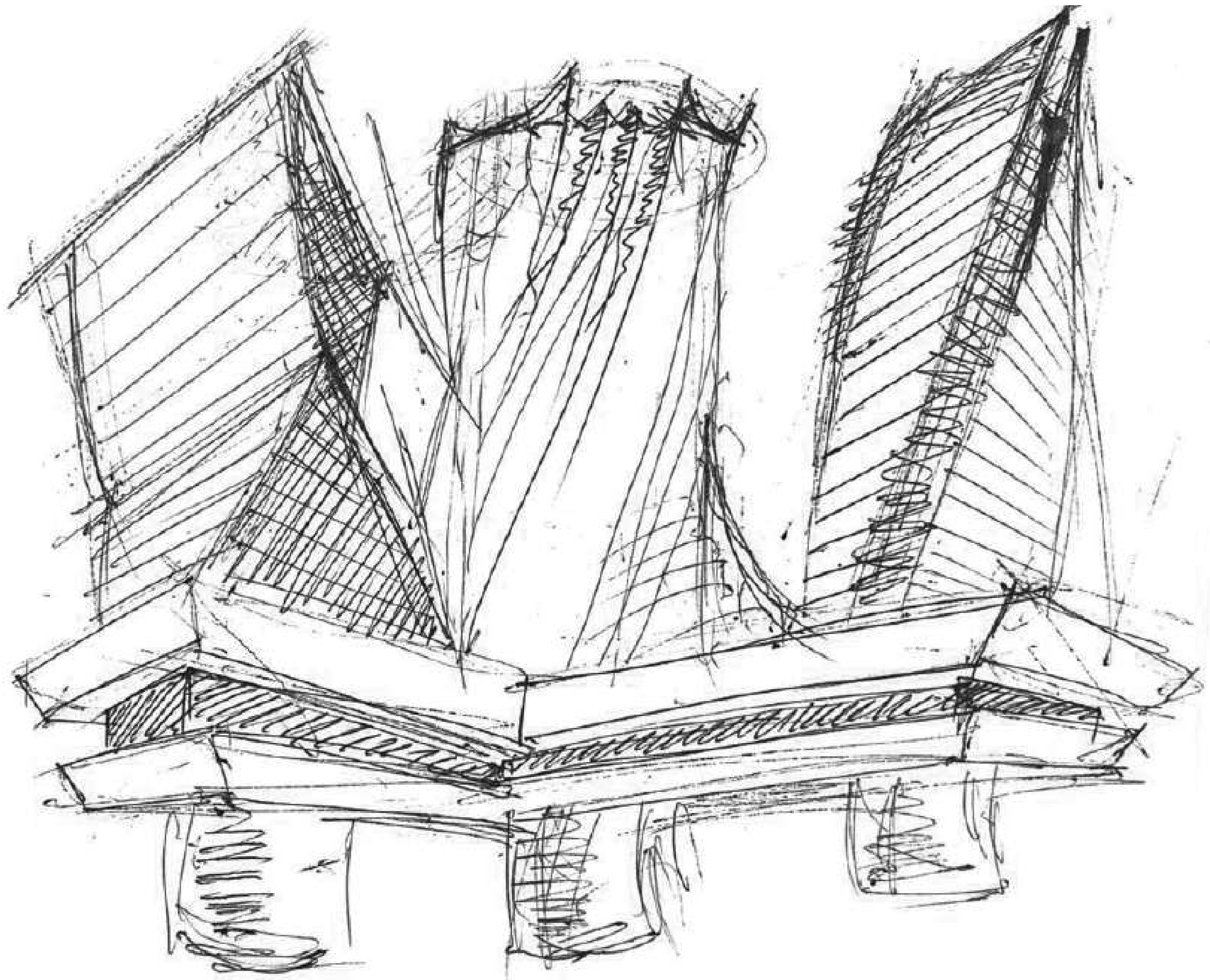
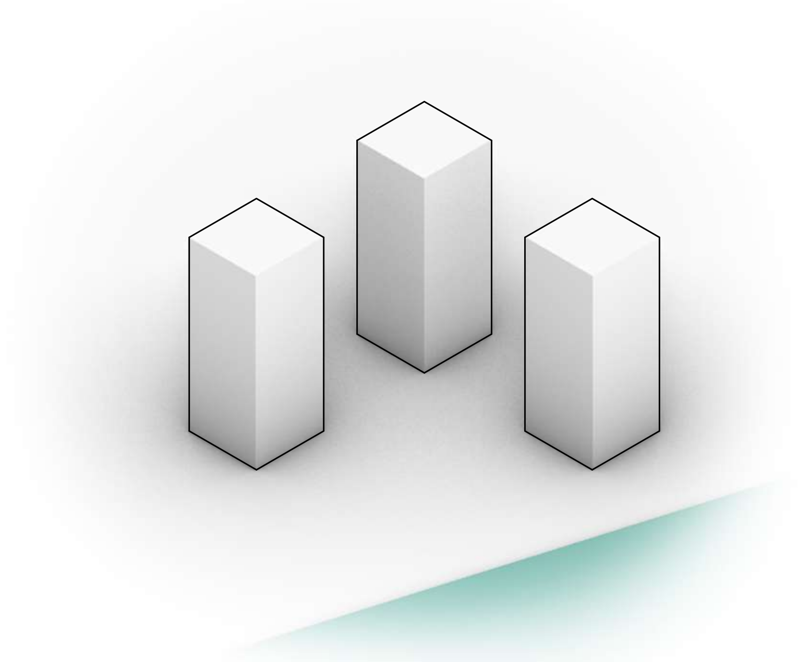


Fig.20: Hand sketch

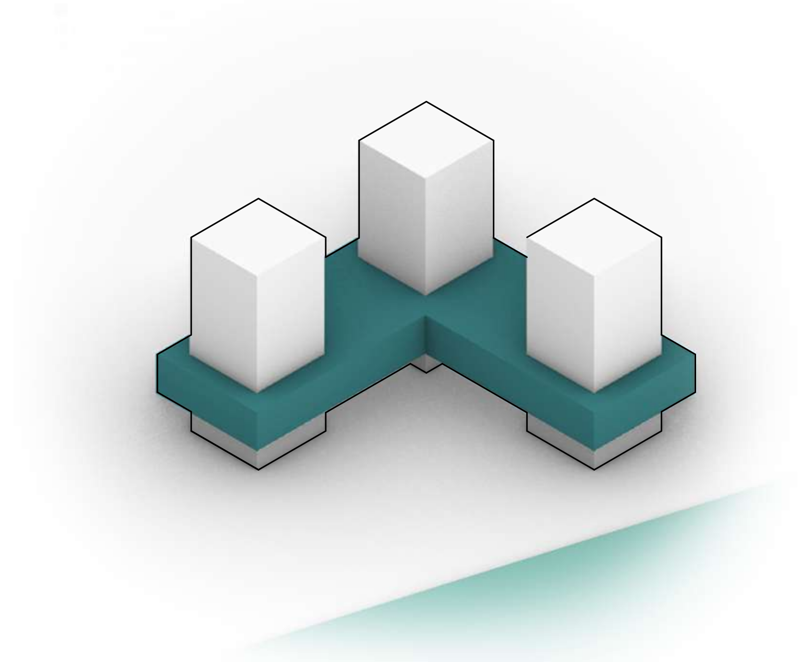
Though similar by style and materials (steel and glass), the three towers should generate different geometries, corresponding to each one's function. The skyscrapers are twisted in height, having expressional roof designs, giving the sense of evolution and prosperity - corresponding to the upcoming waves of economic prosperity and the positive views towards a bright future for Detroit.

The uplifting of the commercial area, being also a reference to the many overground passages of Detroit, gives more free space and openness to the square. Another benefit of this "flying complex" is the opportunity for an exciting oblique approach to the commercial area. The entrance should be hidden behind riddles of stairs and a "forest of columns" and the visitor should find the way to it.

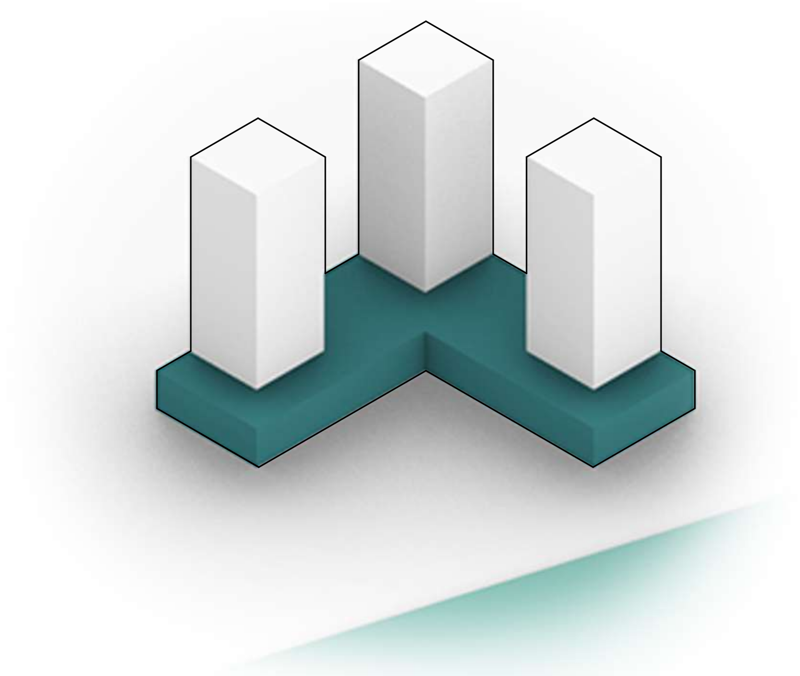
II.2 Concept diagrams



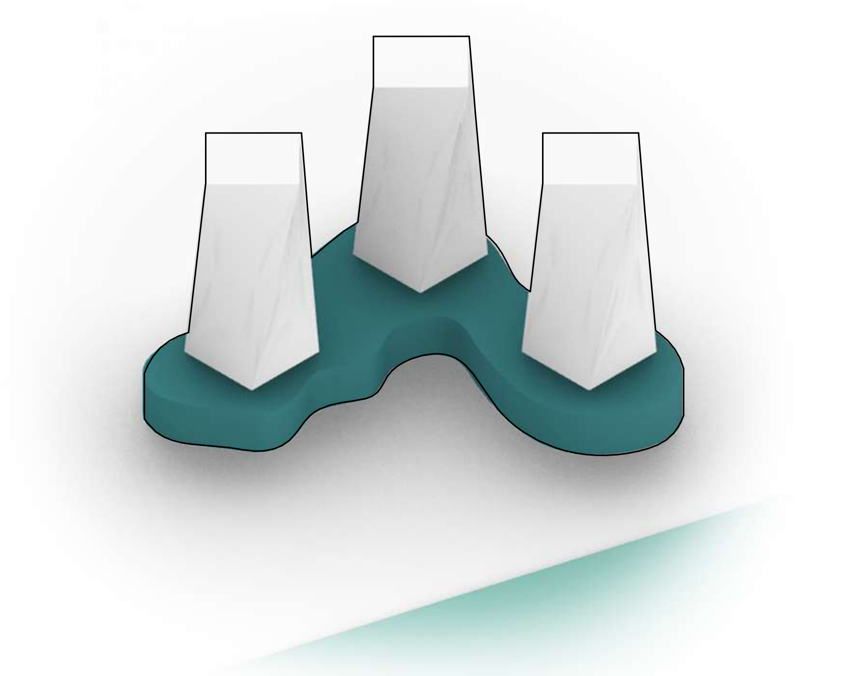
THREE
TOWERS FOR
3 FOUNDERS



UNITING
CITYZENS THROUGH
PASSAGES



LEVITATION
REPRESENTING
THE NEW REVIVAL



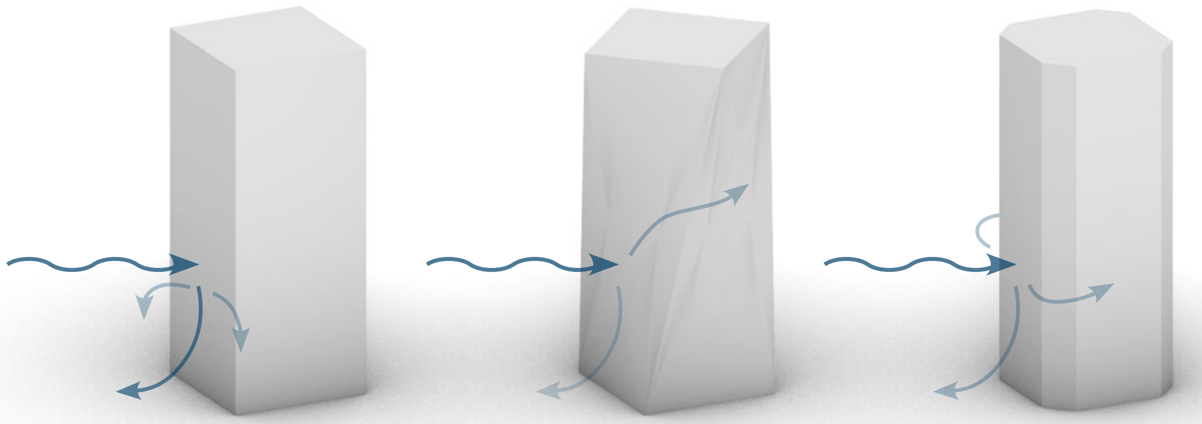
PICTURESQUE
FORMS AND
OBLIQUE APPROACH

Fig.21: Concept Diagram

Fig.22: Functions

II.4 Aerodynamics

Analysis:



Flat-fronted Twisted Mitigated corners

Wind observations

As the building is not directly located next to other tall towers, wind pressure on the higher floors will be stronger than (for example) the wind forces on a tower in the middle of the Downtown Detroit.
Lateral wind forces against a flat-fronted skyscraper are redirected down the building where the pressure is low, because of the “shelter” from surrounding buildings, and creates a windier microclimate for the surrounding area/street level, which is to be avoided.
Detroit`s average wind speed in January (10m height): 22km/h.

In search of shapes

Twisted skyscrapers and corner mitigations allow for the easier flowthrough of the wind, reducing its pressure on the facade and minimizing the horizontal forces on the main construction.This solution helps creating better environment for the pedestrians on the streets/square/base levels of skyscraper.
Therefore for this project both techniques are being used in all three towers. Beside the aerodynamical advanceds, it gives aesthetical quality and modern vision to the whole complex.

Solutions:

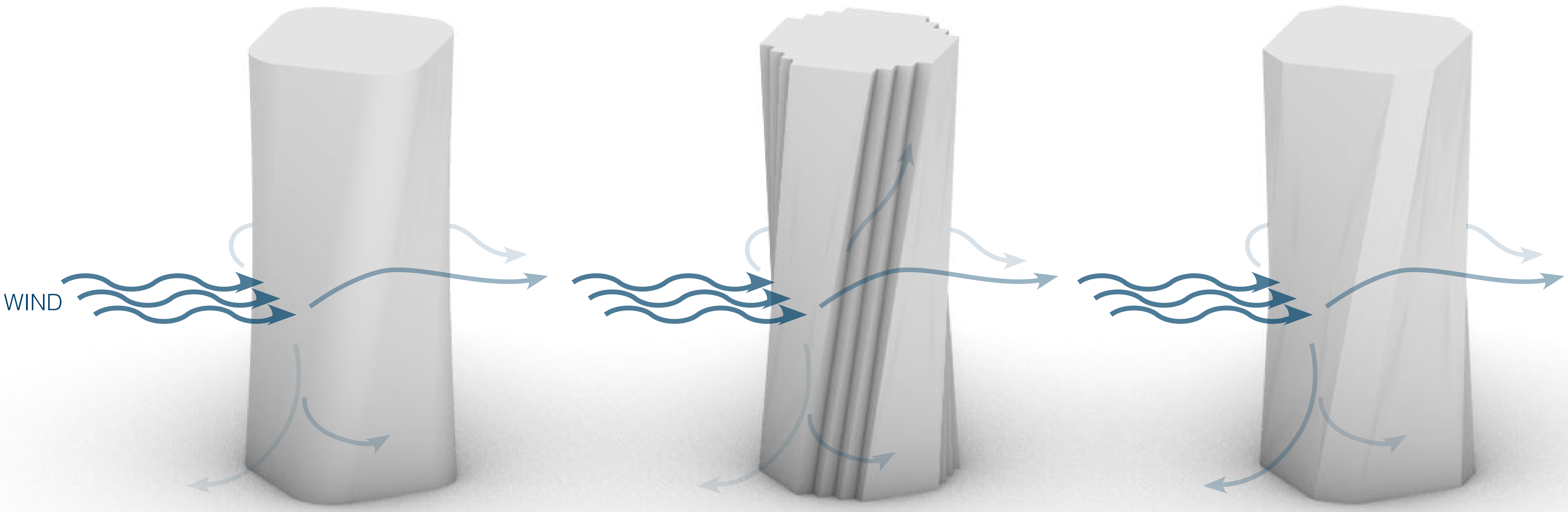


Fig.23: Aerodynamics Diagram

II.5 Structure and Timelapse

In order to redefine the skyline of Detroit, as well as to give the buildings flexible functions, some structural proposals are being developed. The structure of the three vertical bodies is proposed to be consisting of a concrete core surrounded by steel framing. Construction is performed from bottom to top, with the core and megacolumns on the facade bringing all the vertical forces to the ground. Steel vierendeel trusses are attached to the core, in order to avoid diagonal beams. The spans of the beams vary between 7-12m, allowing huge column-free indoor spaces.

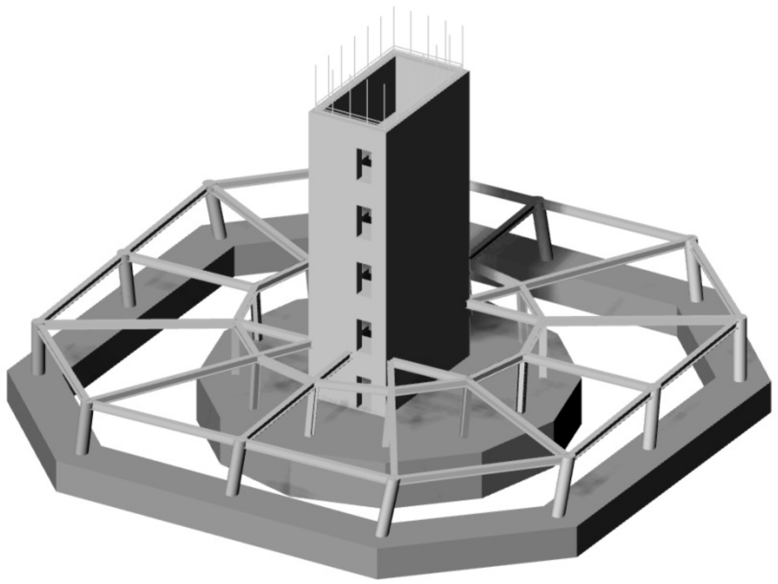


Fig.24: Construction

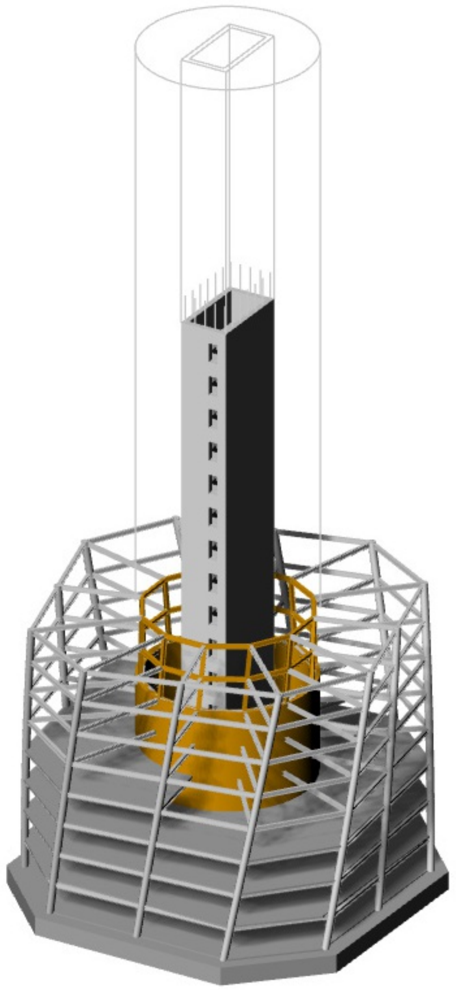


Fig.25: Construction process

The construction process begins with laying the concrete foundations - one slab foundation under the concrete core and linear foundations under the columns, which are bearing some of the load of the skyscrapers and the loads from the commercial center. Once the inner concrete core reaches few levels above, the cantilevered steel structures are being consequently mounted.
Afterward, the internal circle of steel frames is stiffed with concrete walls to give additional stability to lateral loads. The structure of each floor consists of the same parts, for the parts to be prefabricated and fasten the building process.

Due to the twist, the megacolumns are rotating around the structure, enhancing the stability to lateral loads (winds, earthquakes). These columns also hold all cantilevered floor structures as one. This reduces the weight of the normal loads taken by the columns and transmits the percentage of it to the concrete core. After the main structure has been developed few floors above, placement of slabs, walls, facade and installations can be started. Once the secondary structure is finished, furnishing can be started. The interior of the premises is free of columns, giving the tenants complete freedom of arrangement.

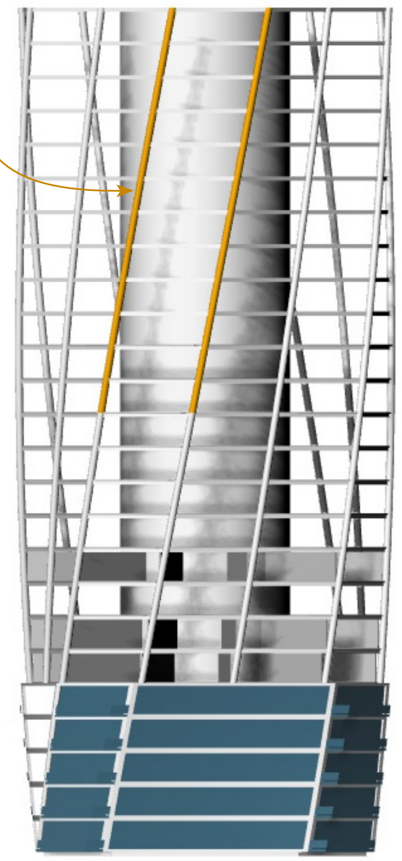


Fig.26: Structure and facade

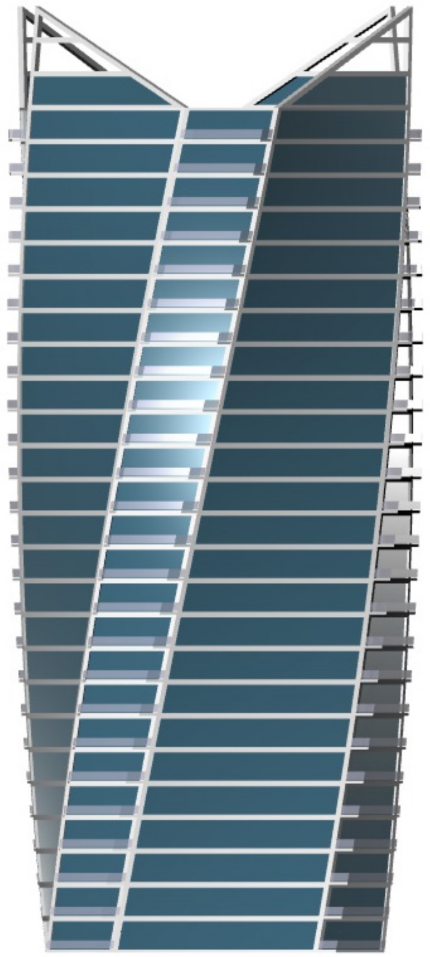


Fig.27: Facade of Hotel

The twist of the buildings (2 degrees per floor) is giving them additional aerodynamic and resistance to wind loads. The rooftop is also covered on the side by the facade to reduce the wind power and make the use of the rooftop possible and comfortable. In these four particular drawings (Fig.25-28) we observe the conceptual construction process of the Hotel Tower, taking into account that the rest two skyscrapers (Office and Residential) are designed in a similar method, where only dimensions and slab-geometries are different than the described one.

II.6.1 Office elevator system

Demand assumptions:
- Office occupied floors 5-29
- 100 people per floor; presence factor 90% => 90p/floor
- 15% of the people arrive within the peak 5min
- Average Waiting Time (AWT) <30sec
- Average Time to Destination <70s Good, max 90s
- office elevator optimal capacity = 80%

Assumptions:
- passengers get in = p * 1.2s
- passengers get out = p * 1.2s * 50%
- 4 elevators for each group; 18p, 1350kg, 4m/s
- 2.5sec elevator acceleration + deceleration per stop
– 4.5 seconds door wait per stop (door open – 1.8s; door close – 2.7s)
– stops*one-way trip = (k-1)(1-((k-2)/(k-1))n)

(k-floors, n-passengers)

ZONE A - Levels 1-13

stops per one-way trip:	8	
Average Transit Time (ATT):	57.7s <60s	
Round Trip (RT):	110s <120s	
=> for max.AWT	30s	=> 4 elevators
Average Waiting Time (AWT) :	27.5s <30s	
Average Time to Destination:	85.2s <90s	
=>13.5 passangers per cabin	< 14 p/elevator(80% *capacity)	

ZONE B - Levels 1, 3, 14-22

stops per one-way trip:	7.2	
Average Transit Time (ATT):	57s <60s	
Round Trip (RT):	119s <120s	
=> for max.AWT	30s	=> 4 elevators
Average Waiting Time (AWT) :	29.8s <30s	
Average Time to Destination:	86.8s <90s	
=>12.2 passangers per cabin	< 14 p/elevator(80% *capacity)	

ZONE C - Levels 1, 3, 23-29

stops per one-way trip:	6.4	
Average Transit Time (ATT):	55.9s <60s	
Round Trip (RT):	120s =120s	
=> for max.AWT	30s	=> 4 elevators
Average Waiting Time (AWT) :	30.1s ~30s	
Average Time to Destination:	85.9s <90s	
=> 9.6 passangers per cabin	< 14 p/elevator(80% *capacity)	

Summary:

12 passanger elevators in 3 groups
1 service elevator
additionally 2 TWIN elevators

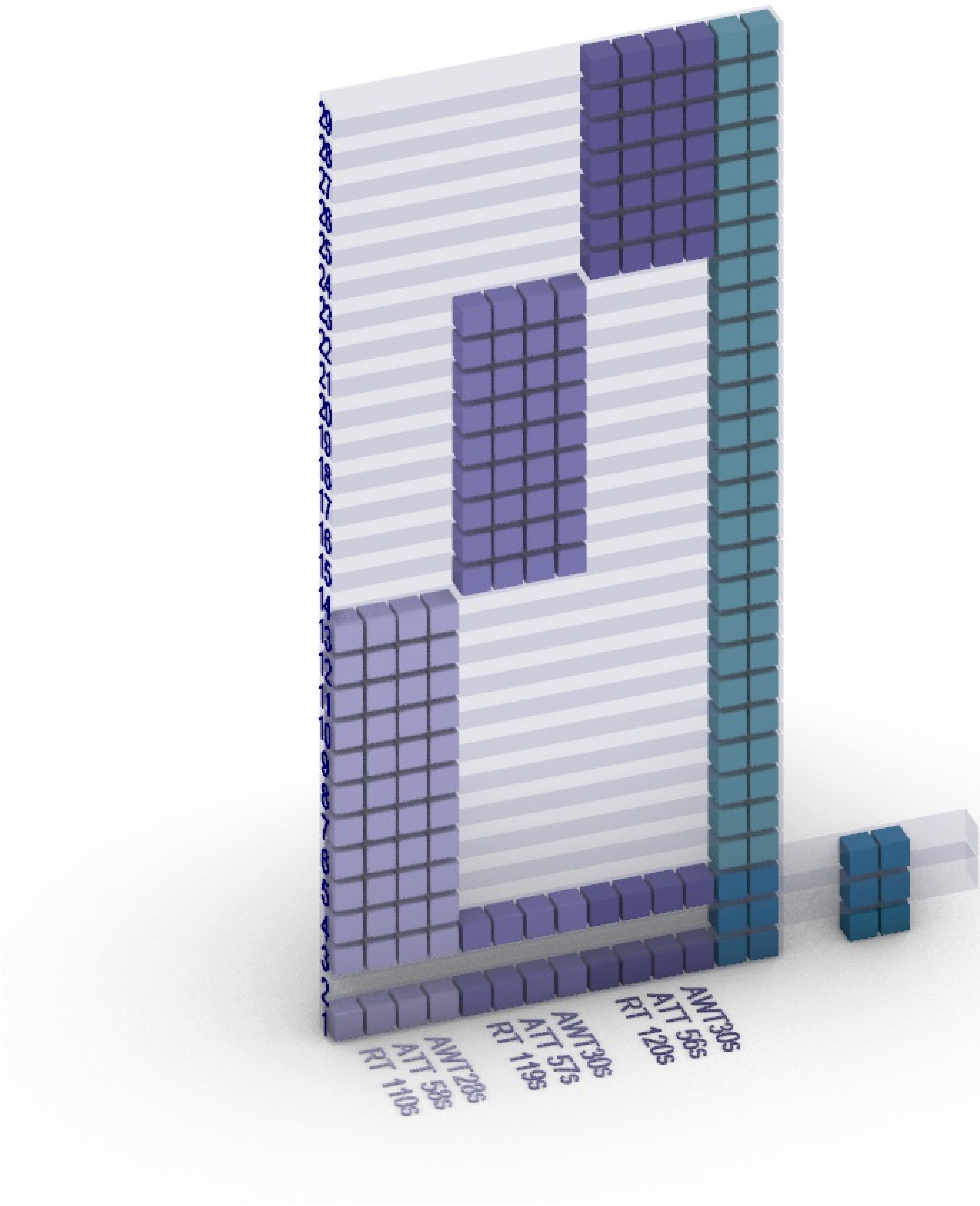


Fig 28: Diagram of Office Elevator System

II.6.2 Residential elevator system

Demand assumptions:
- Floors with appartments 6-15, 17-31
- 24 people per floor (4 luxury*4.2p + 4 business apartments*1.8p)
- 7.5-10% of the people arrive within the peak 5min
- Average Waiting Time (AWT) 30-60s
- Average Time to Destination <120s
- office elevator optimal capacity = 80%

Assumptions:
- passengers get in = p * 1.2s
- passengers get out = p * 1.2s * 50%
- 4 elevators for each group; 18p, 1350kg, 4.5m/s
- 2.5sec elevator acceleration + deceleration per stop
– 4.5 seconds door wait per stop (door open – 1.8s; door close – 2.7s)
– stops*one-way trip = (k-1)(1-((k-2)/(k-1))n)

(k-floors, n-passengers)

ZONE A - Levels 1-16

stops per one-way trip:	4.7	
Average Transit Time (ATT):	42s	<60s
Round Trip (RT):	74s	<120s
=> for max.AWT	40s	
Average Waiting Time (AWT) :	37s	<40s
Average Time to Destination:	79s	<90s

=> 2 elevators

ZONE B - Levels 1-5, 16-24

stops per one-way trip:	3.4	
Average Transit Time (ATT):	36.2s	<60s
Round Trip (RT):	76.6s	<120s
=> for max.AWT	40s	
Average Waiting Time (AWT) :	25.6s	<40s
Average Time to Destination:	61.8s	<90s

=> 3 elevators

ZONE C - Levels 1-5, 24-31

stops per one-way trip:	3.3	
Average Transit Time (ATT):	37.6s	<60s
Round Trip (RT):	85.1s	=120s
=> for max.AWT	40s	
Average Waiting Time (AWT) :	28.4s	<40s
Average Time to Destination:	66s	<90s

=> 3 elevators

Summary:

8 passanger elevators in 3 groups
1 service elevator

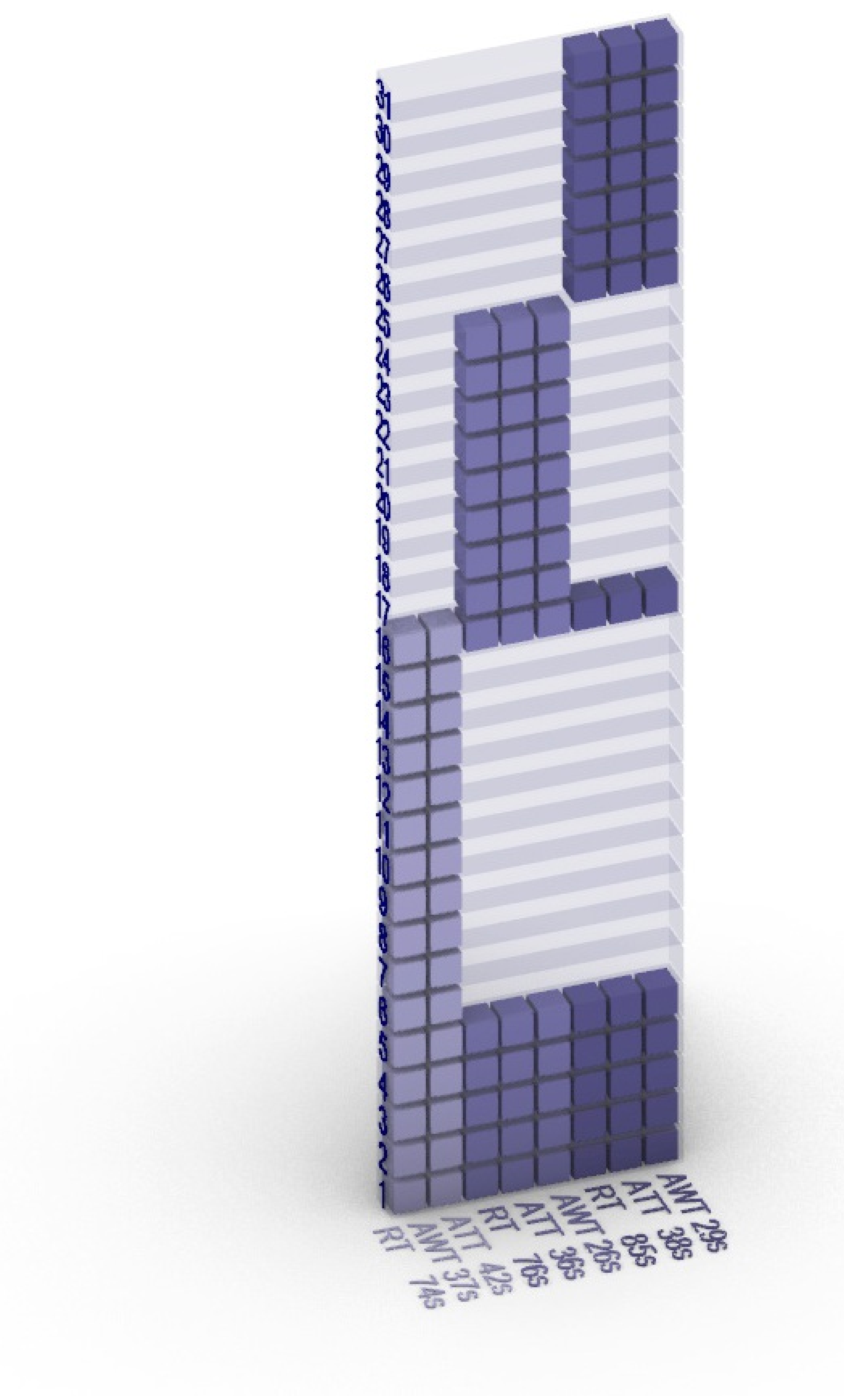


Fig.29: Diagram of Residential Elevator System

II.6.3 Hotel elevator system

Demand assumptions for 5-star Hotel:
- Rooms on floors: 6-16, 19-28
- 43 people per floor(24 rooms * 1.8 occupancy factor for 5-star Hotel)
- 12% of the people move within the peak 5min
- Average Waiting Time (AWT) <40sec
- Average Time to Destination <110s
- office elevator optimal capacity = 60%

Assumptions:
- passengers get in = p * 1.2s
- passengers get out = p * 1.2s * 50%
- 4 elevators for each group; 18p, 1350kg, 4m/s
- 2.5sec elevator acceleration + deceleration per stop
– 4.5 seconds door wait per stop (door open – 1.8s; door close – 2.7s)
– stops*one-way trip = (k-1)(1-((k-2)/(k-1))n)

(k-floors, n-passengers)

ZONE A - Levels 1-18

stops per one-way trip:	7		
Average Transit Time (ATT):	49s	<60s	
Round Trip (RT):	97s	<120s	
=> for max.AWT	40sec		=> 3 elevators
Average Waiting Time (AWT) :	32s	<40s	
Average Time to Destination:	81s	<110s	
=> 8.7 passangers per cabin	< 14 p/elevator(80% *capacity)		

ZONE B - Levels 1, 3, 14-22

stops per one-way trip	6.5		
Average Transit Time (ATT):	55s	<60s	
Round Trip (RT):	111s	<120s	
=> for max.AWT	40sec		=> 3 elevators
Average Waiting Time (AWT) :	37s	<40s	
Average Time to Destination:	92s	<110s	
=> 8 passangers per cabin	< 14 p/elevator(80% *capacity)		

Summary:

6 passanger elevators in 2 groups
2 service elevators

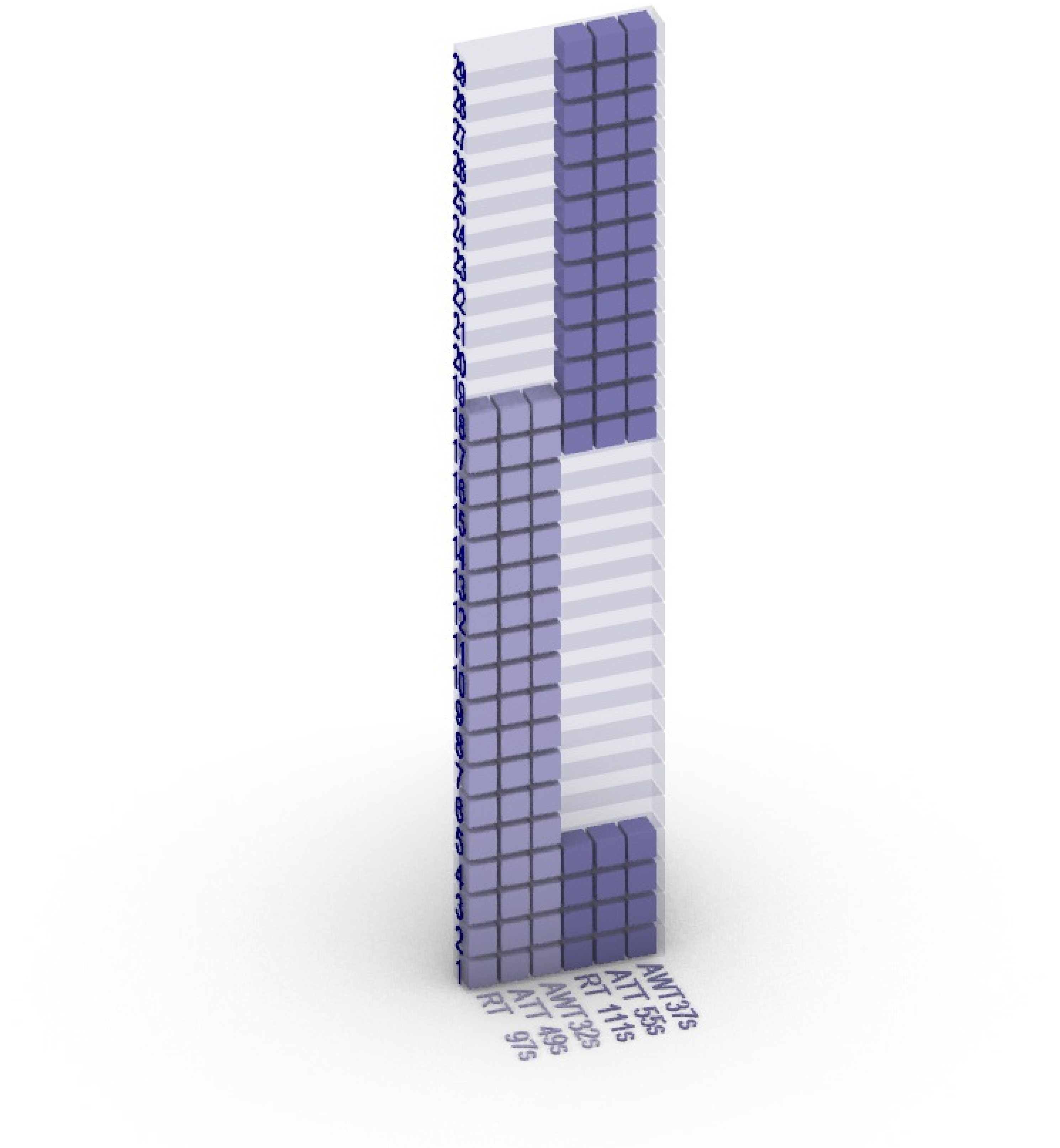


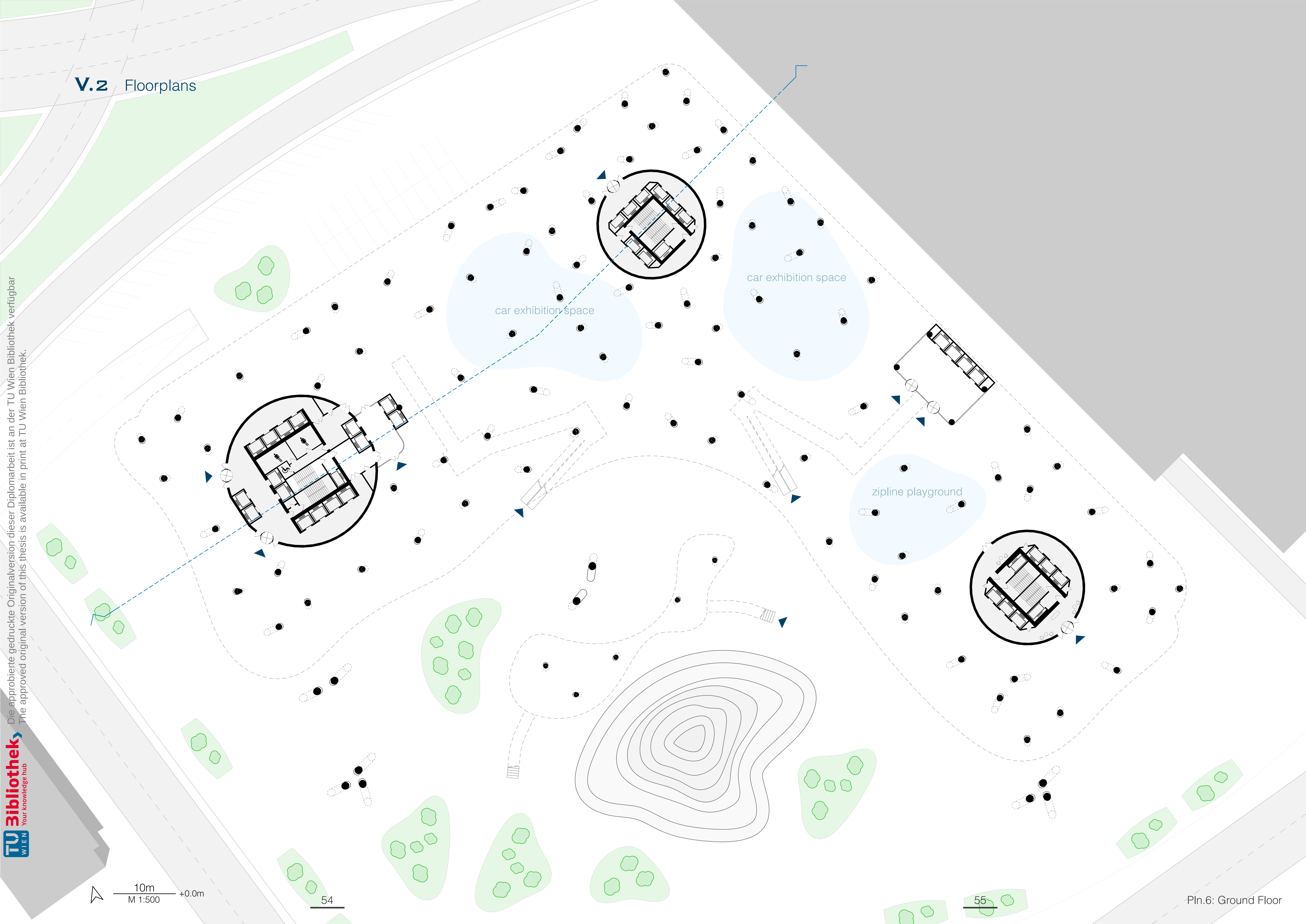
Fig.30: Diagram of Hotel Elevator System

V

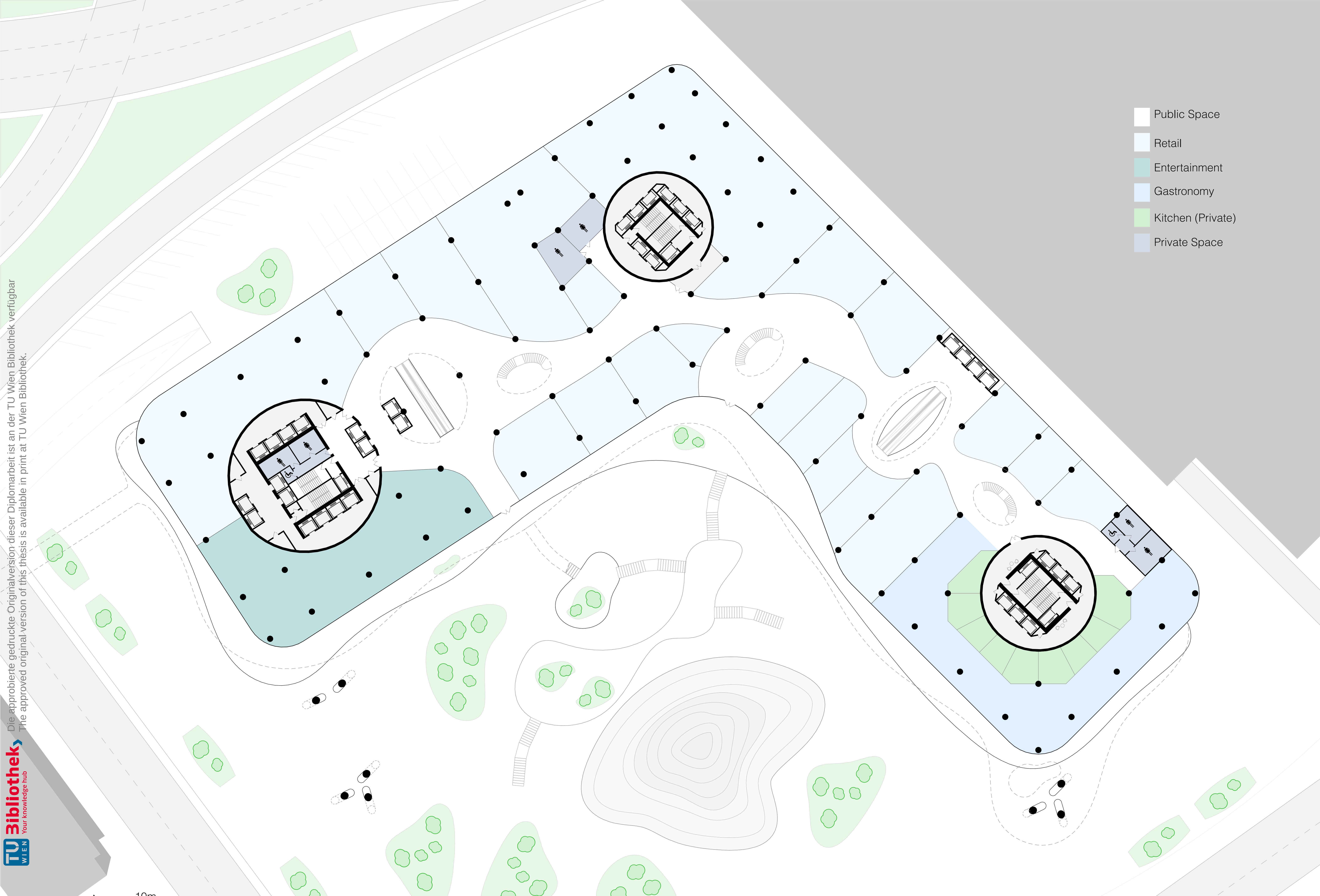
RESULT

Fig.31: Visualisation

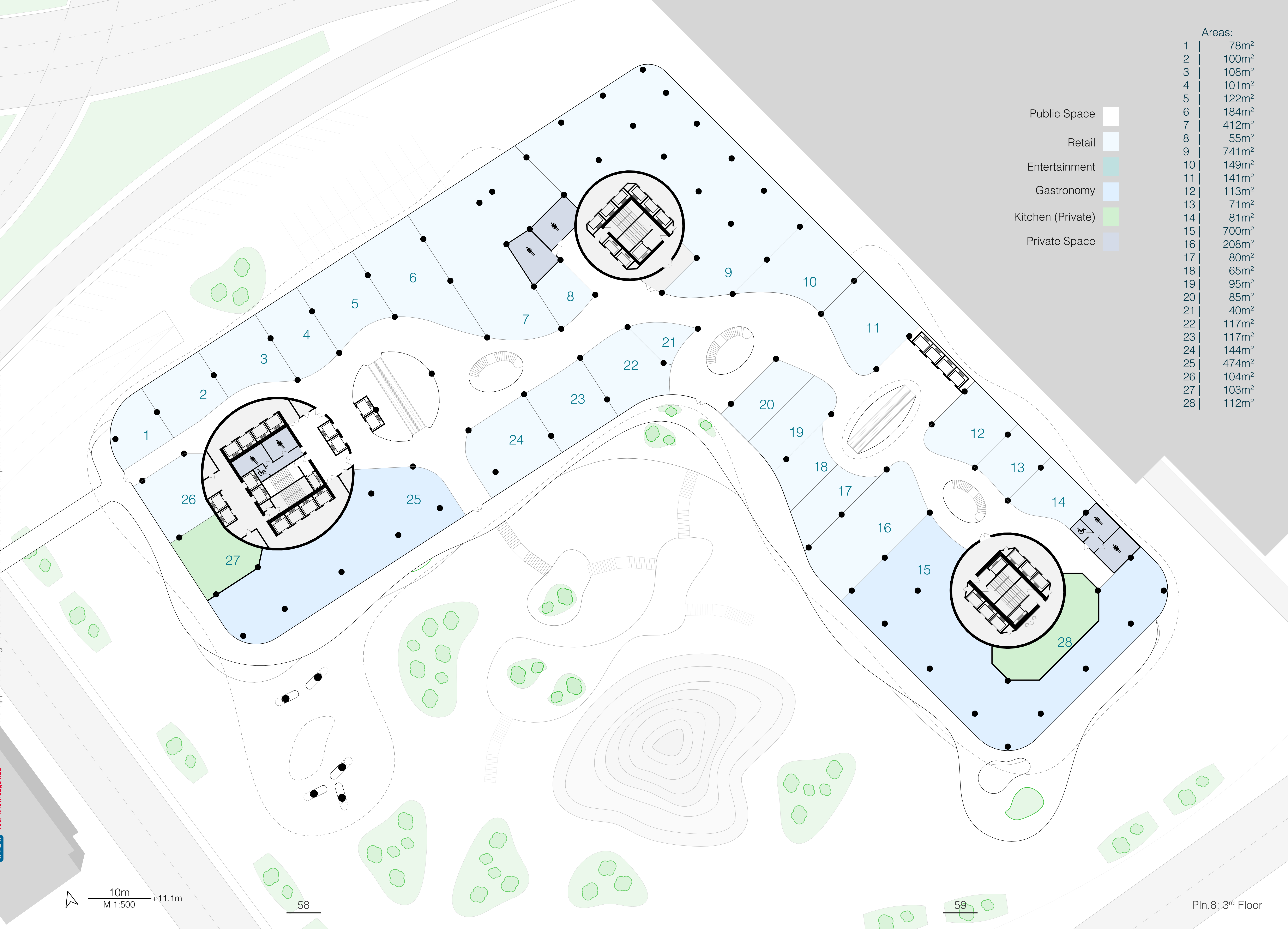
V. 1 Siteplan



Pln.6: Ground Floor



Pln.7: 2nd Floor

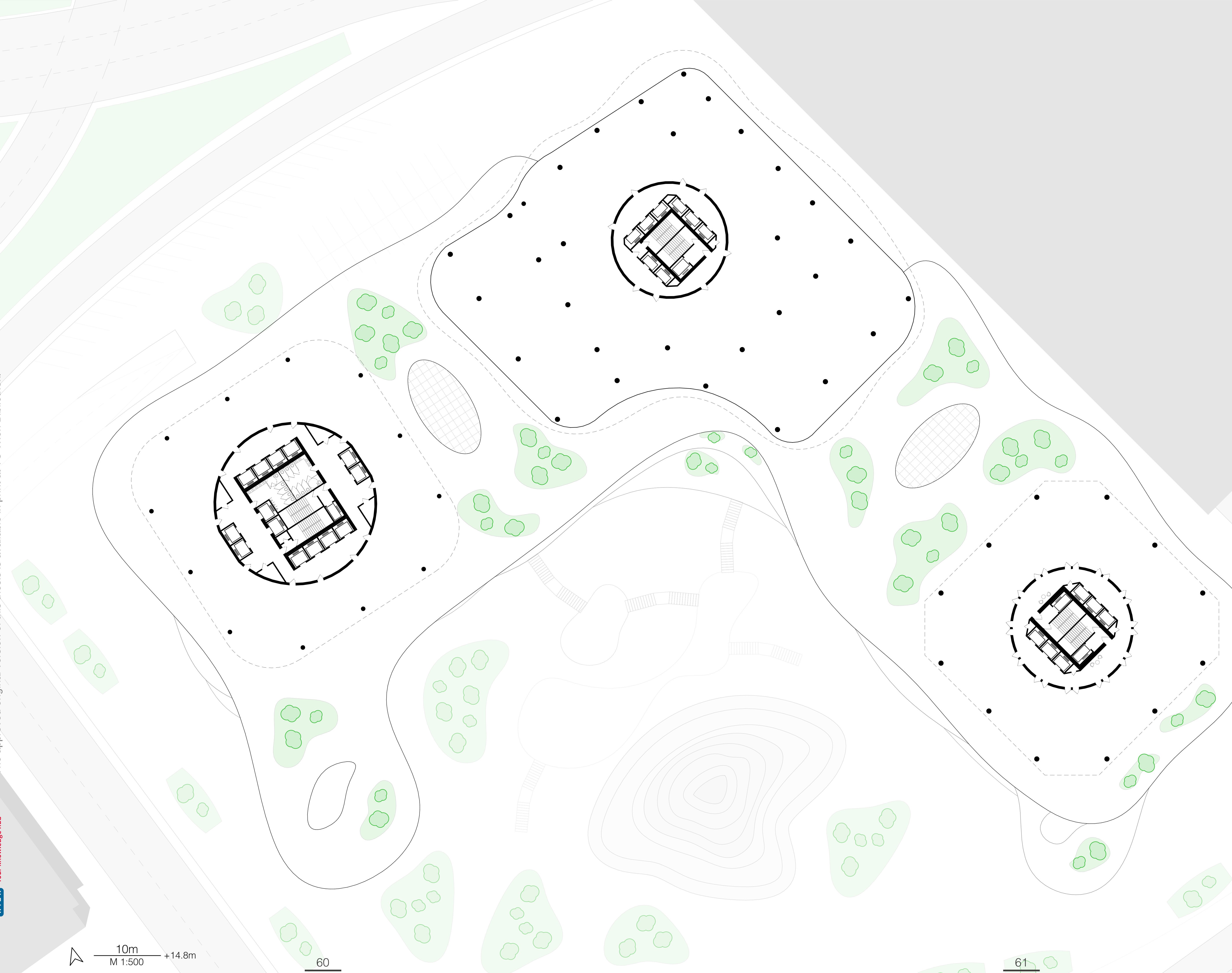


Public Space
Retail
Entertainment
Gastronomy
Kitchen (Private)
Private Space

Areas:

1	78m²
2	100m²
3	108m²
4	101m²
5	122m²
6	184m²
7	412m²
8	55m²
9	741m²
10	149m²
11	141m²
12	113m²
13	71m²
14	81m²
15	700m²
16	208m²
17	80m²
18	65m²
19	95m²
20	85m²
21	40m²
22	117m²
23	117m²
24	144m²
25	474m²
26	104m²
27	103m²
28	112m²

Pln.8: 3rd Floor



Areas:

OFFICE

Core 468m²
Office Area 1036m²

RESIDENTIAL

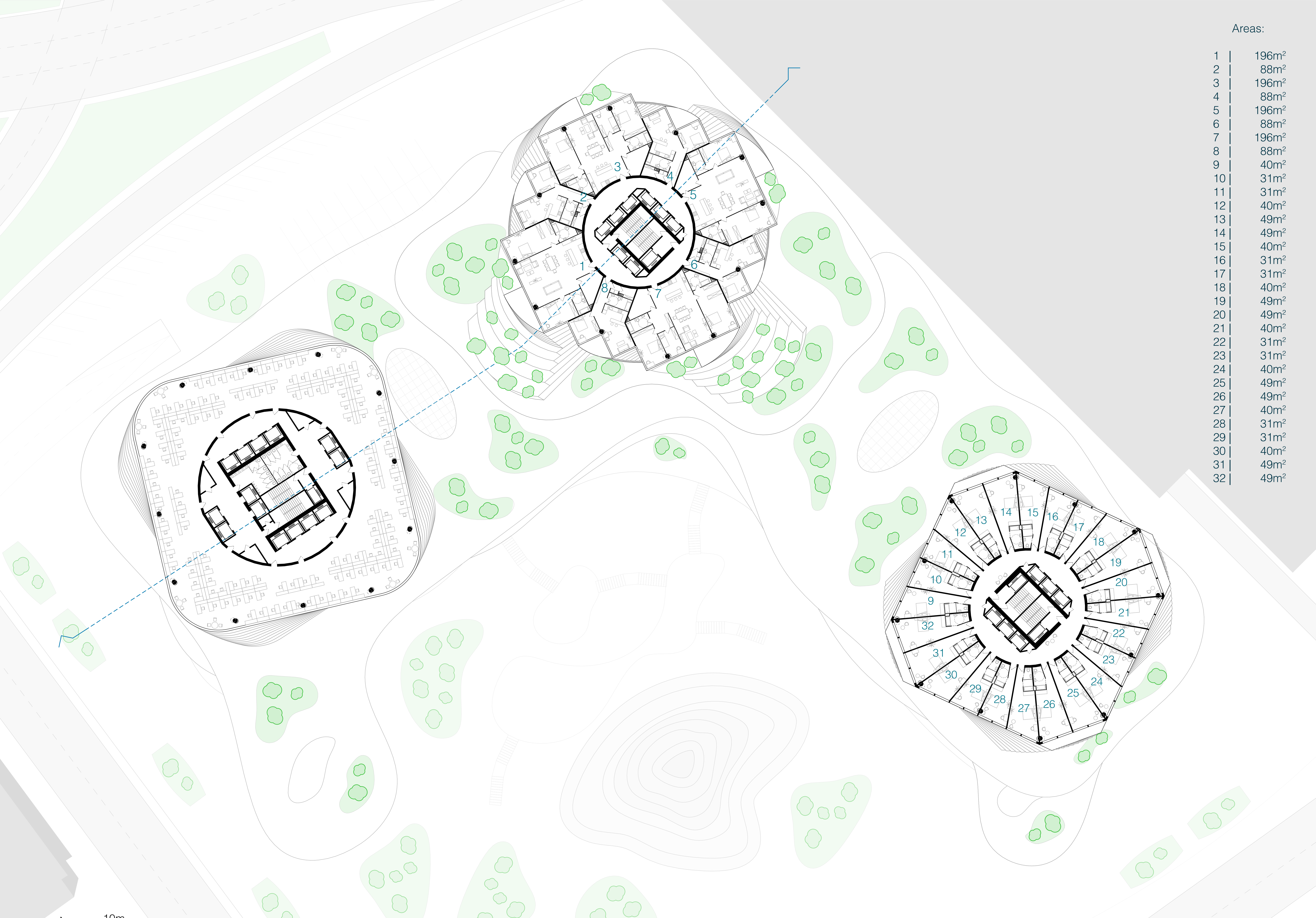
Core 245m²
Living Area 970m²
Balconies 180m²

HOTEL

Core 272m²
Rooms Area 970m²
Balconies 58m²

Pln.9: 4th Floor

Pln.10: 5th Floor

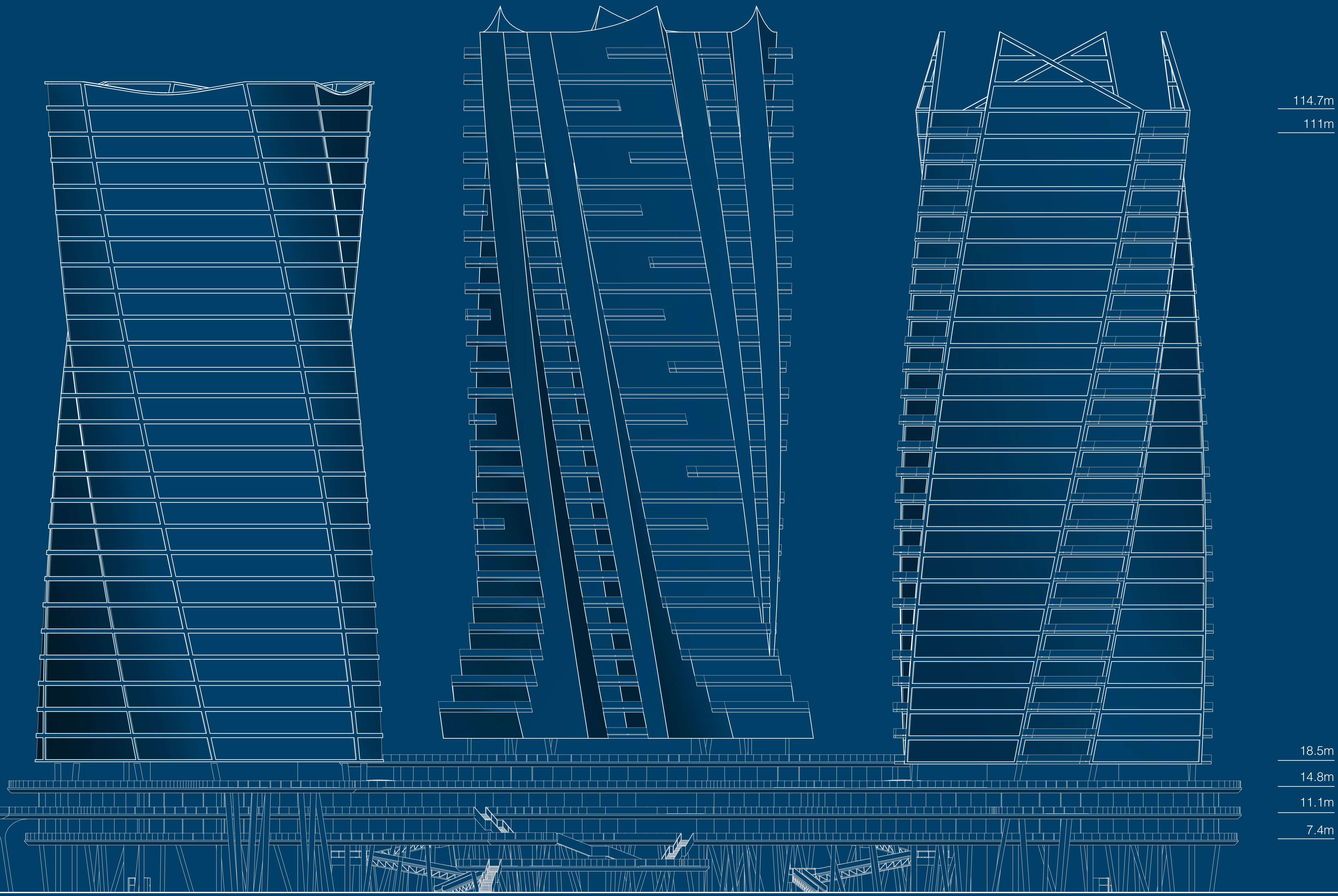


Areas:

1	196m²
2	88m²
3	196m²
4	88m²
5	196m²
6	88m²
7	196m²
8	88m²
9	40m²
10	31m²
11	31m²
12	40m²
13	49m²
14	49m²
15	40m²
16	31m²
17	31m²
18	40m²
19	49m²
20	49m²
21	40m²
22	31m²
23	31m²
24	40m²
25	49m²
26	49m²
27	40m²
28	31m²
29	31m²
30	40m²
31	49m²
32	49m²

Pln.11: 16th Floor

10m
M 1:500



10m
M 1:500

Pln.13: Elevation South

Pln.14: Elevation East

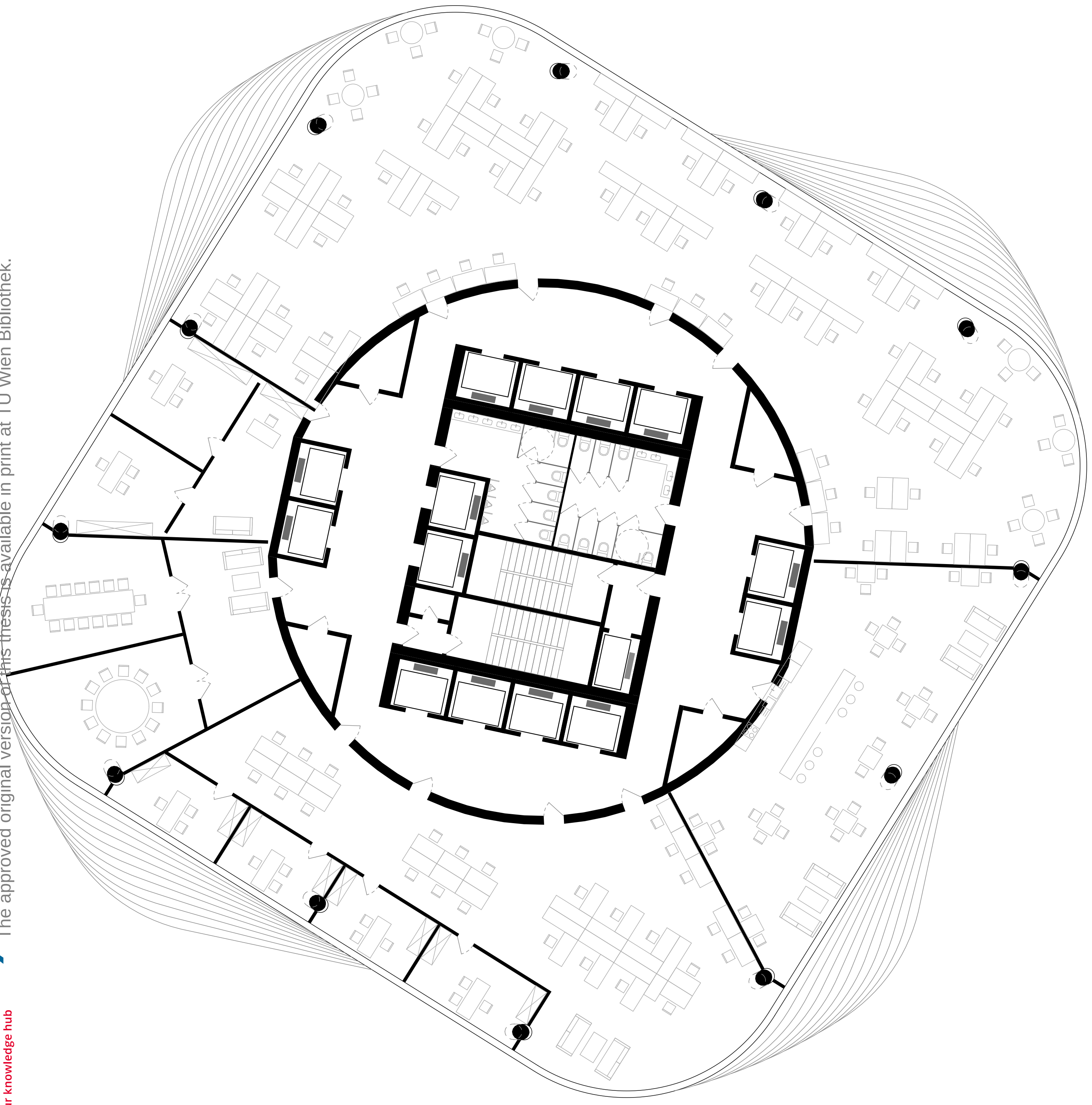
V.4 Detailed Floorplans

OFFICE TOWER

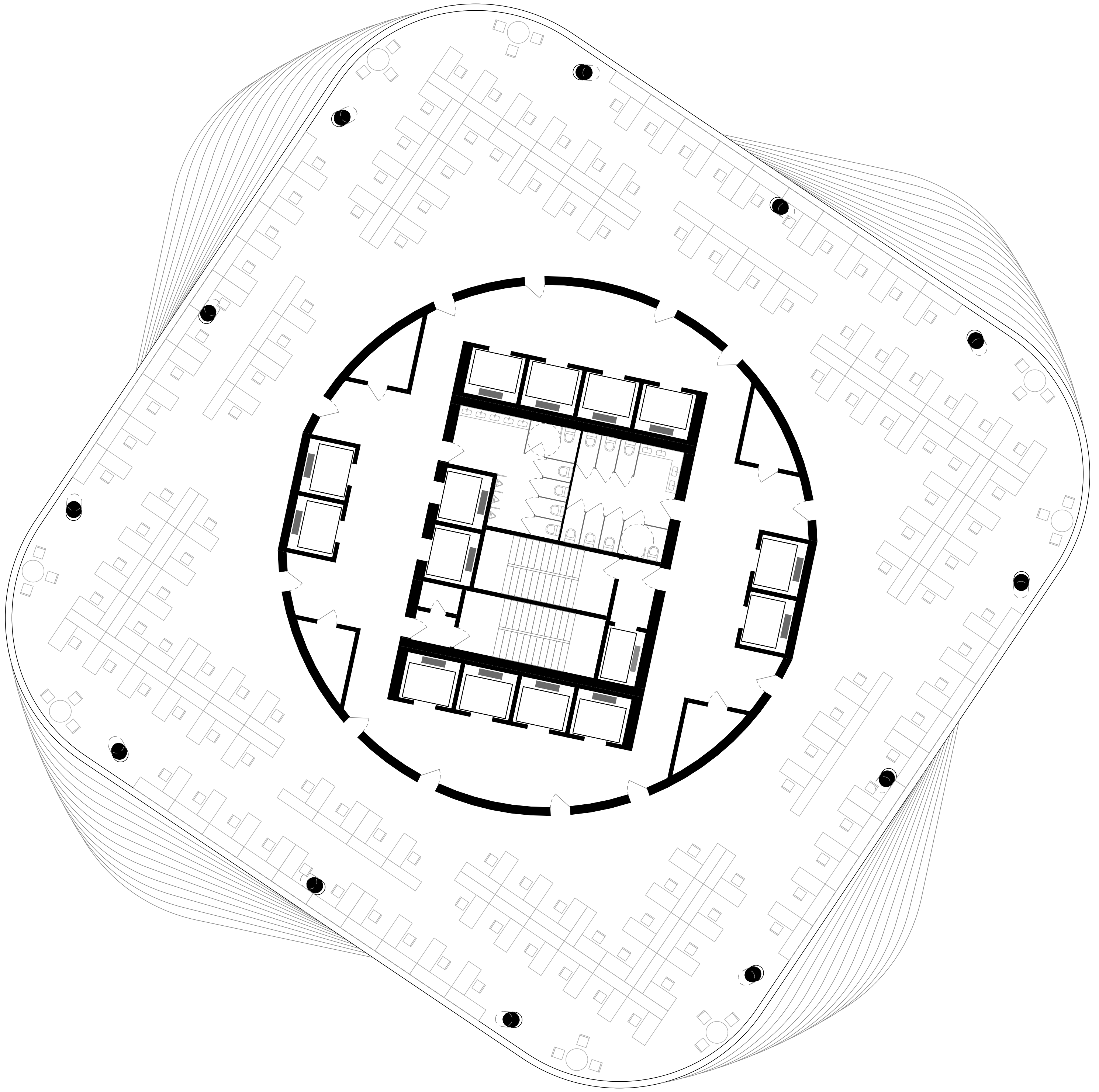
Data:

Netto Office space	-	1036m²
Core Area	-	468m²
Height per floor	-	3.7m
Ceiling height	-	3.2m
Cantilevered floors	-	13
Columns-free floors	-	12

Due ti the column-free plan (except the 12 megacolumns close to the facade), these floors have the flexibility of containing different functions with diverse layouts. On these floors will be fitnesses, lobbys, restaurants, common areas and some of the apartments.



Floor layout with multiple functions and individual spaces



Open floor arrangement

10m
M 1:250

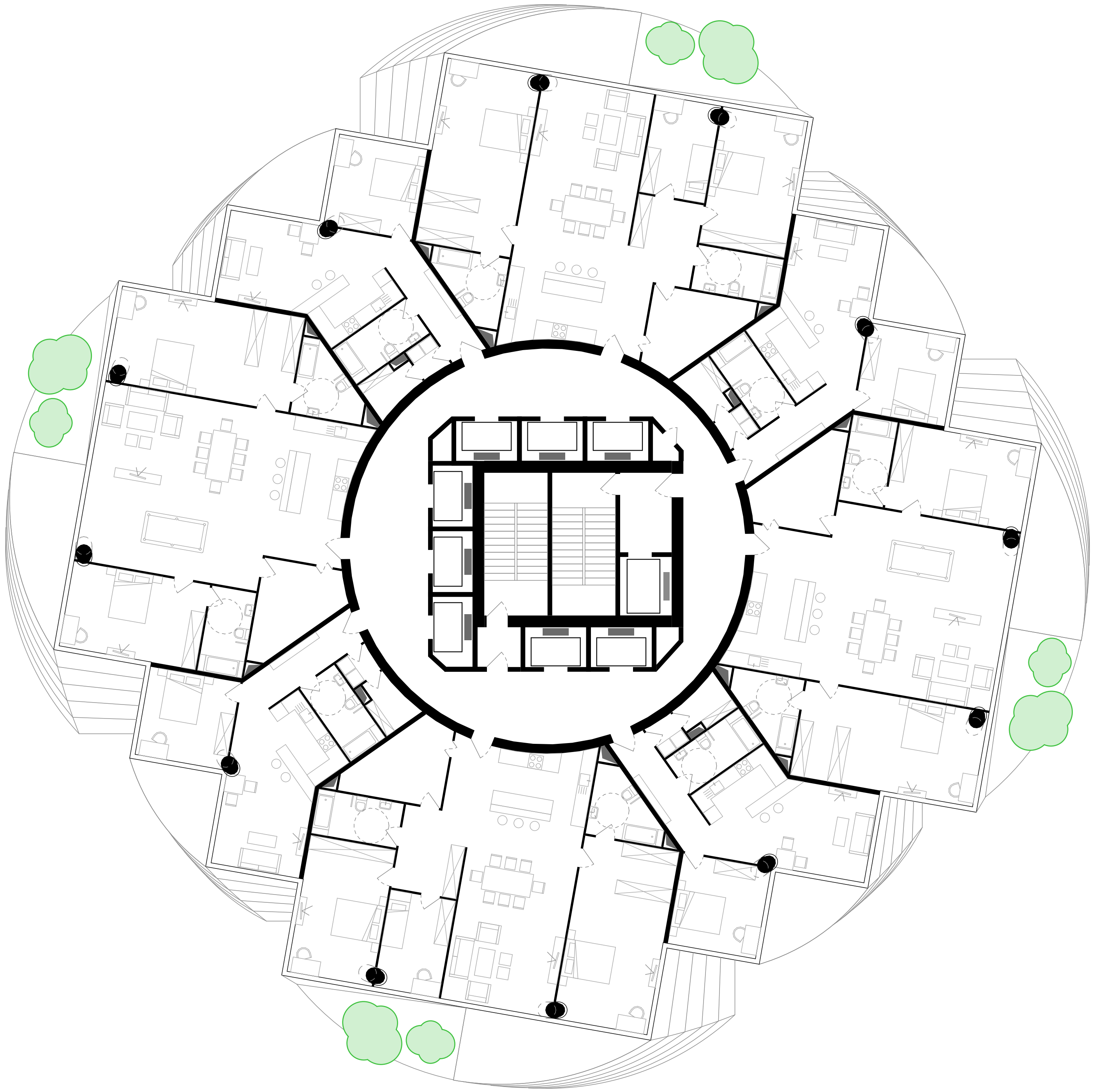
RESIDENTIAL TOWER

On the column-free floors are planned the fitnesses, lobbies, restaurants, common areas and some of the apartments and lofts. On the plan are visible Business apartments (70m²) and Luxury apartments (190m²). Each flat has a private balcony varying 9-36m².

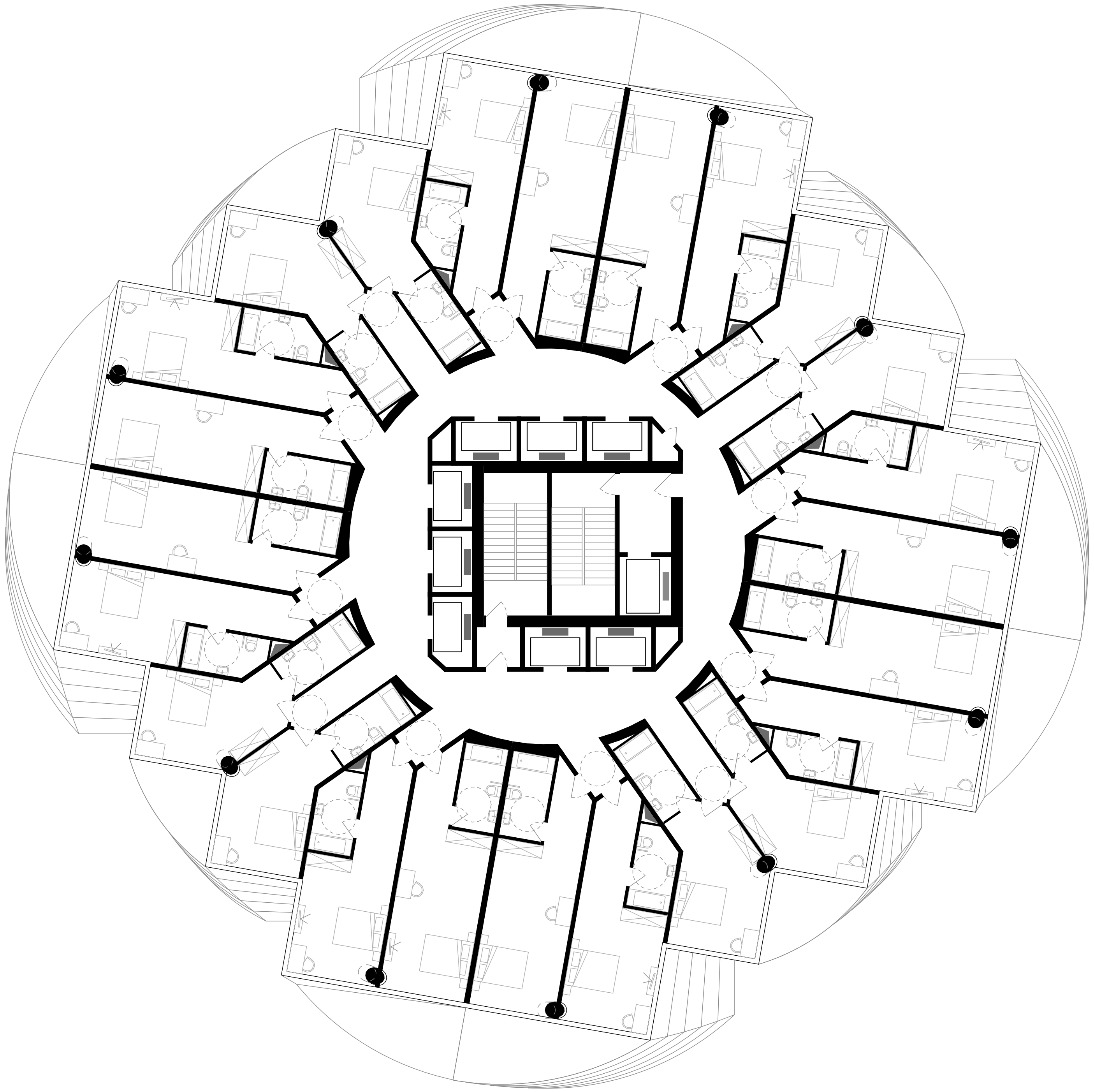
Data:

Netto Interior space -	1150m²
Core Area -	245m²
Height per floor -	3.7m
Ceiling height -	3.2m
Cantilevered floors -	14
Columns-free floors -	13

Considering a possible future change in the demands for dwellings, alternative residential distribution for the hotel tower is proposed. In this case outlines of the ex-residential apartments are being preserved, generating hotel rooms with different layouts.



Arrangement of residential floor



Arrangement of alternative function as Hotel

Pln.16: Ground plans of Residential Tower

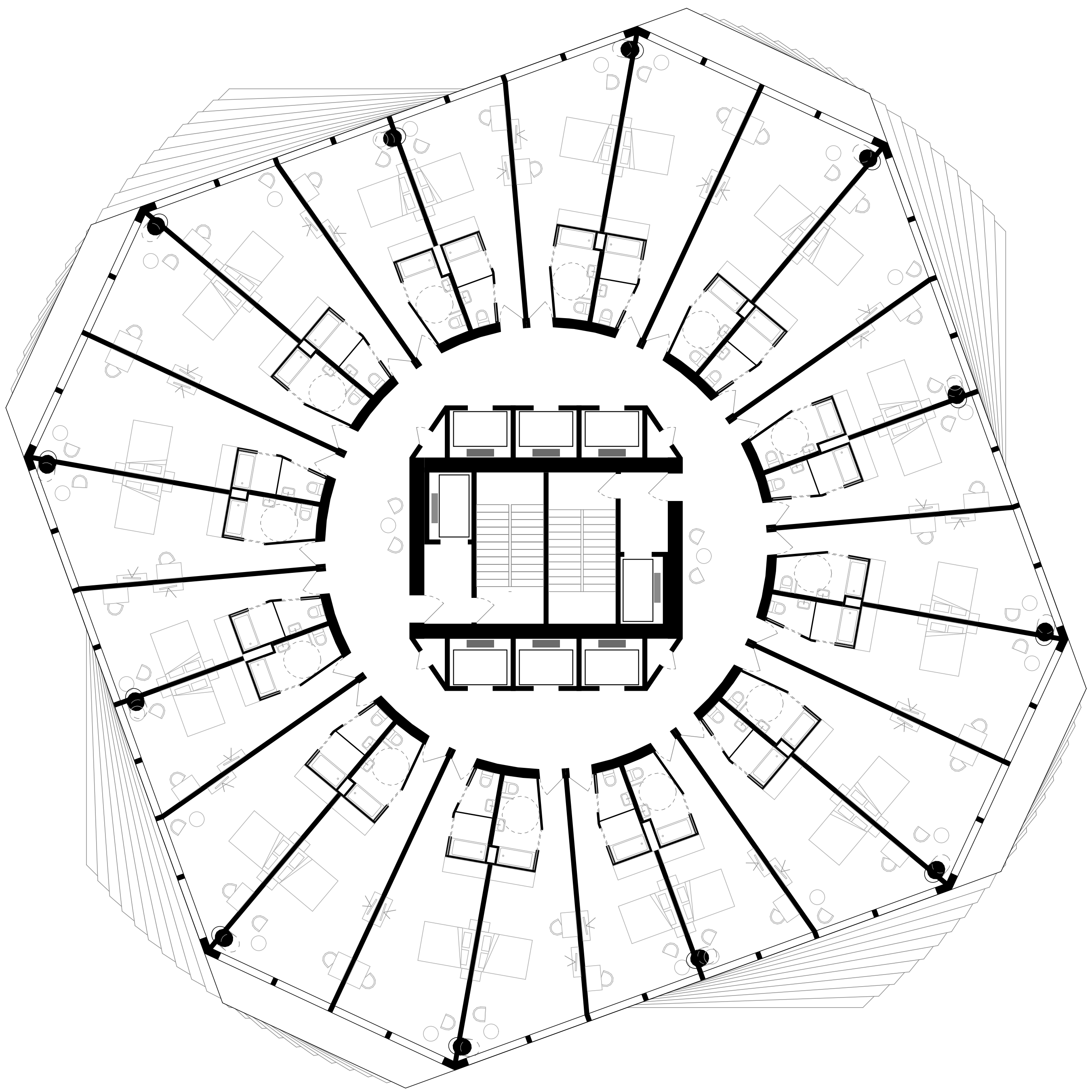
10m
M 1:250

HOTEL TOWER

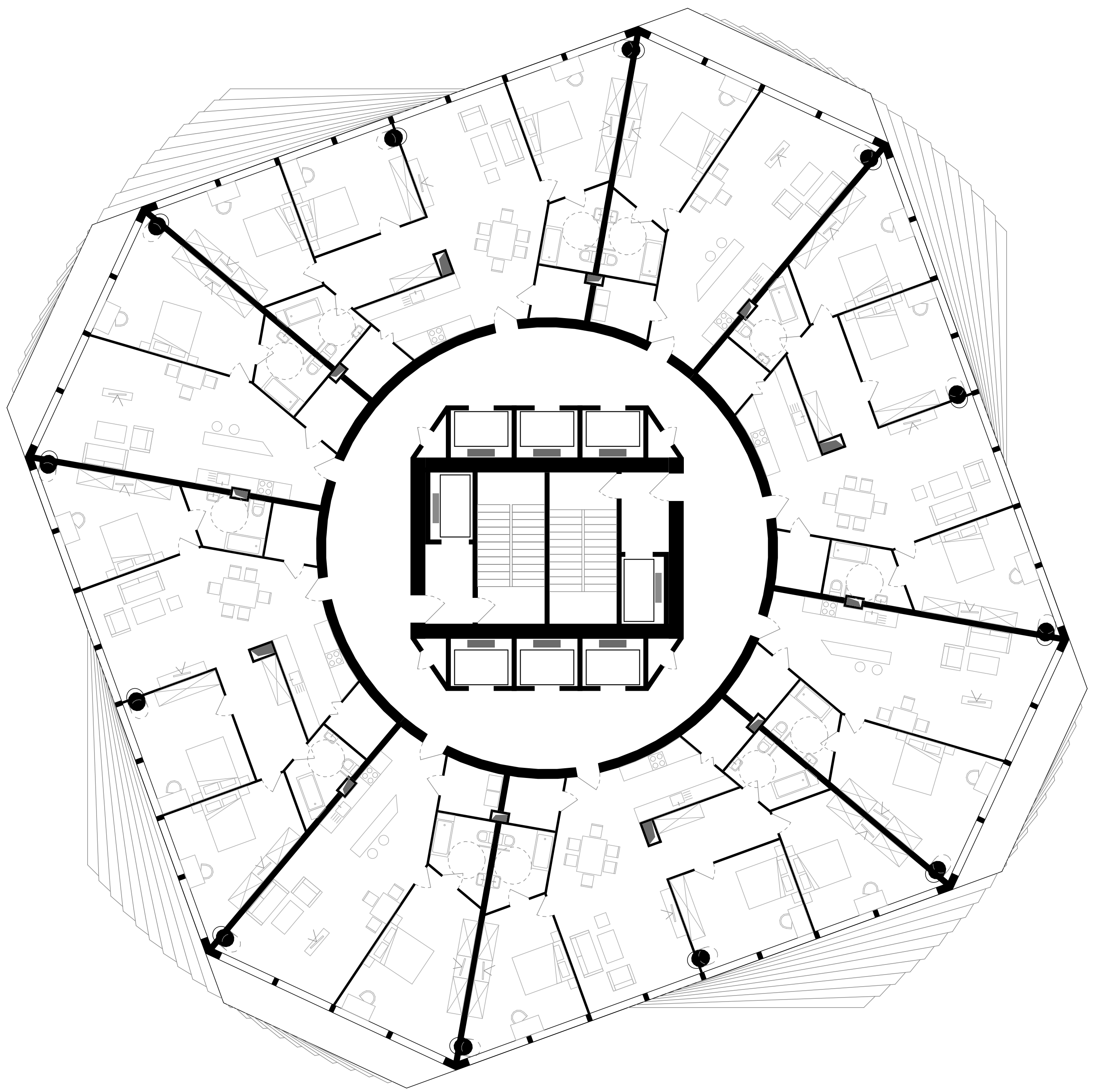
The standart hotel rooms have sizes of 30-38m². Each second room is completely accessible for disabled. On each floor are planned two small common spaces. One out of three rooms has a balcony, offering wider diversity in the price range of the rooms. On few floors are planned common spaces, fitnesses, restaurants, lobbies and SPA.

Data:

Netto Interior space	-	1031m²
Core Area	-	272m²
Height per floor	-	3.7m
Ceiling height	-	3.2m
Cantilevered floors	-	13
Columns-free floors	-	12



Floor with Hotel rooms



Arrangement of alternative function as residential building

10m
M 1:250

Pln.17: Ground plans of Hotel Tower

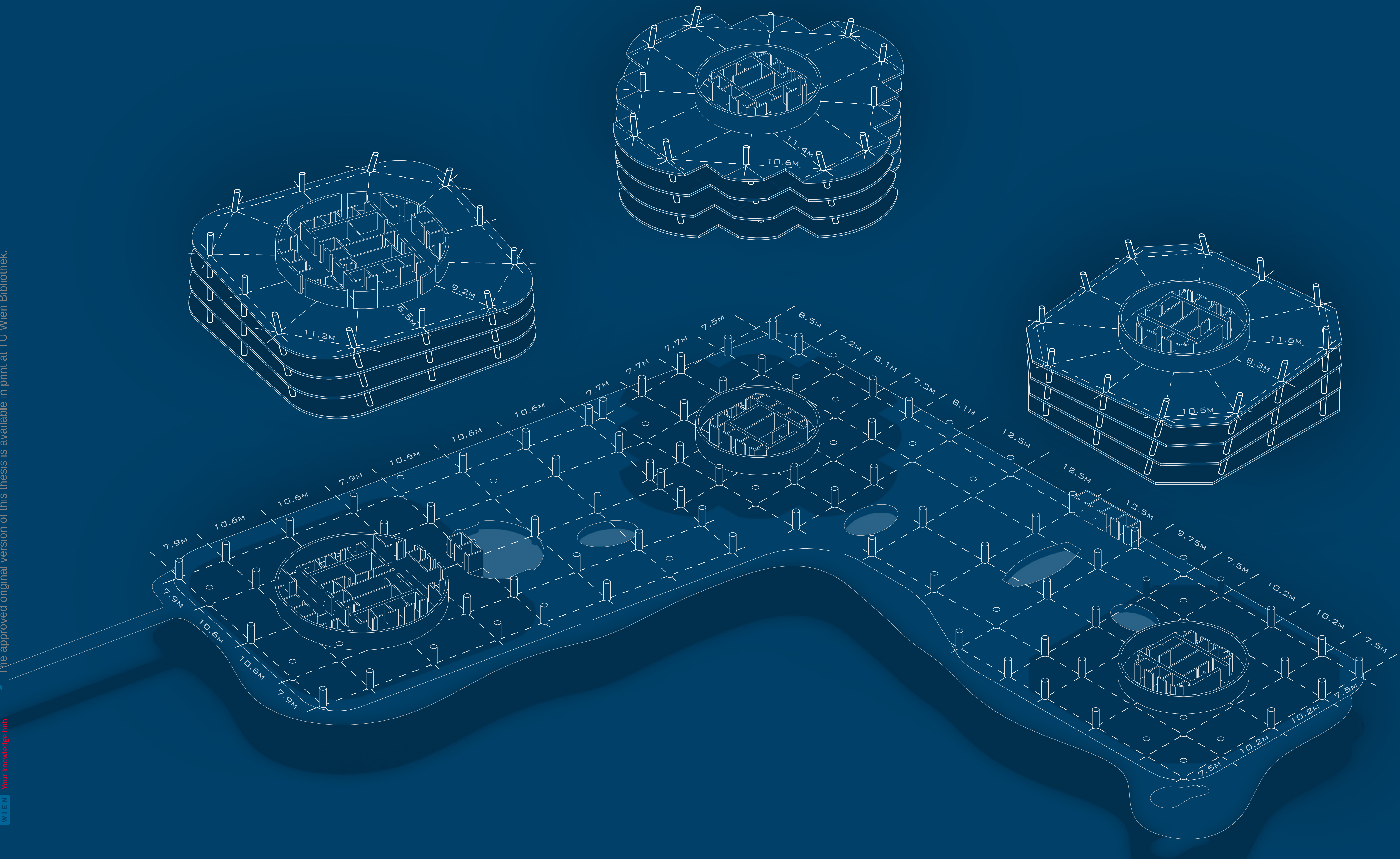


Fig.32: Structure Axes

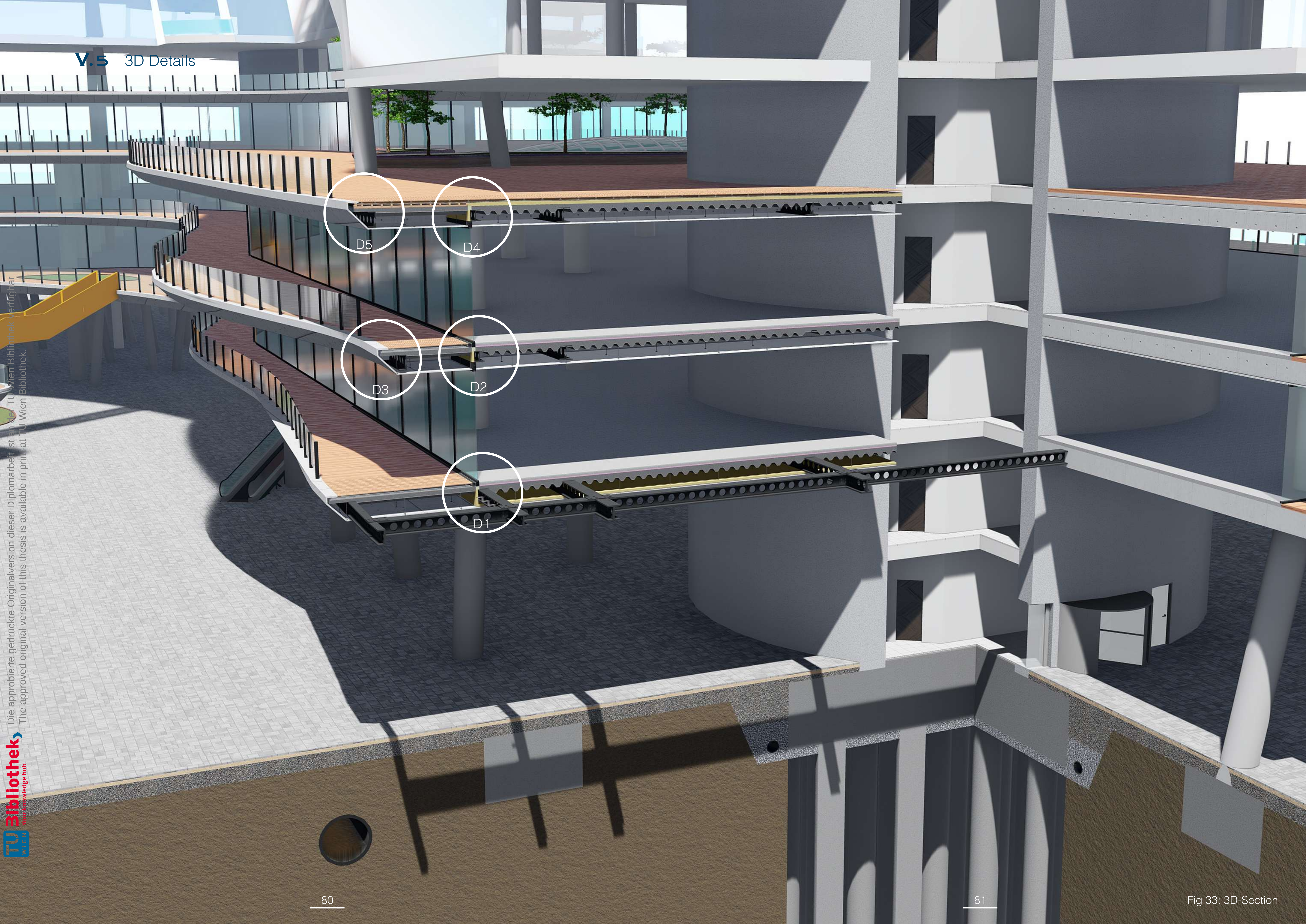


Fig.33: 3D-Section

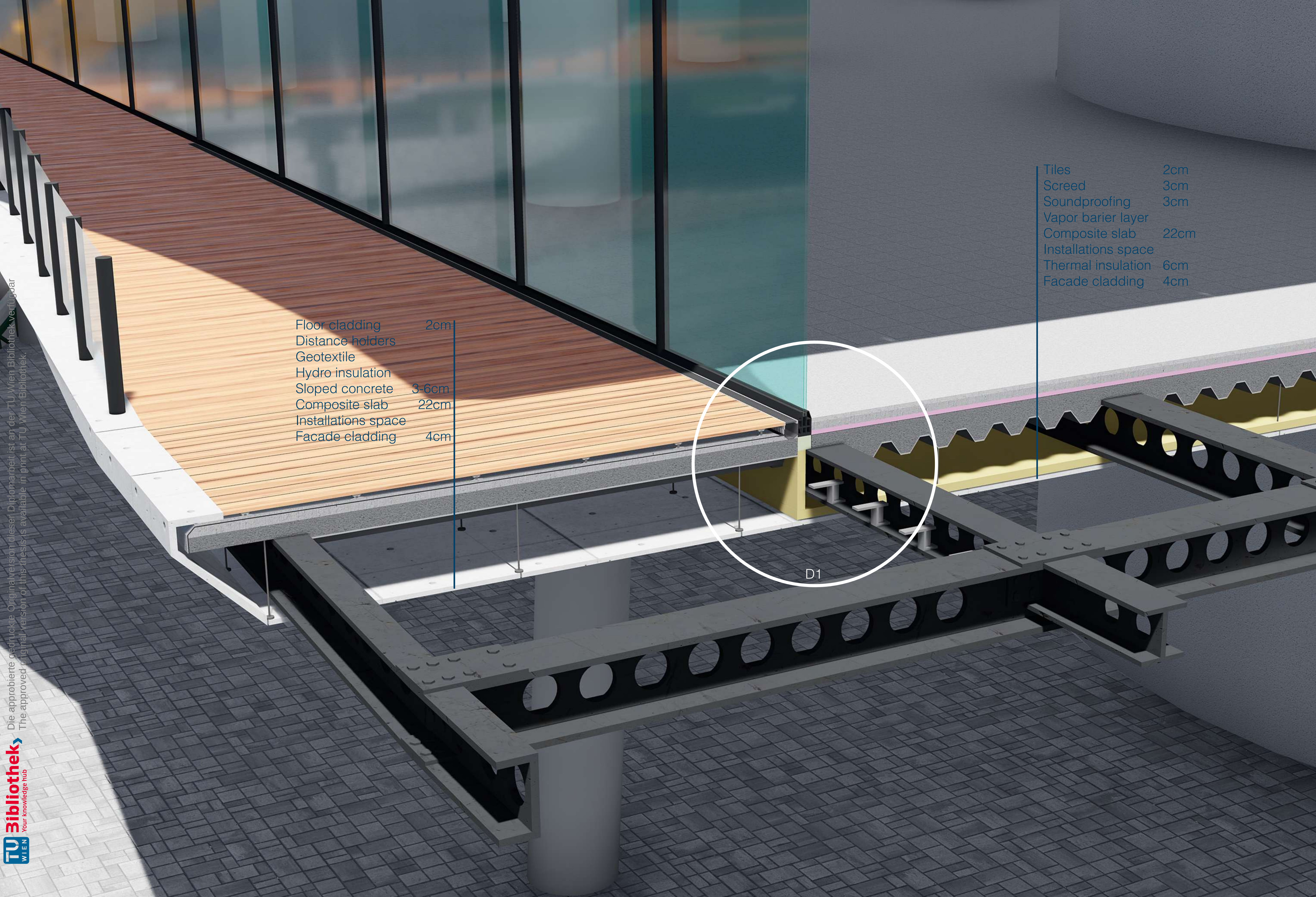


Fig.34: 3D-Details

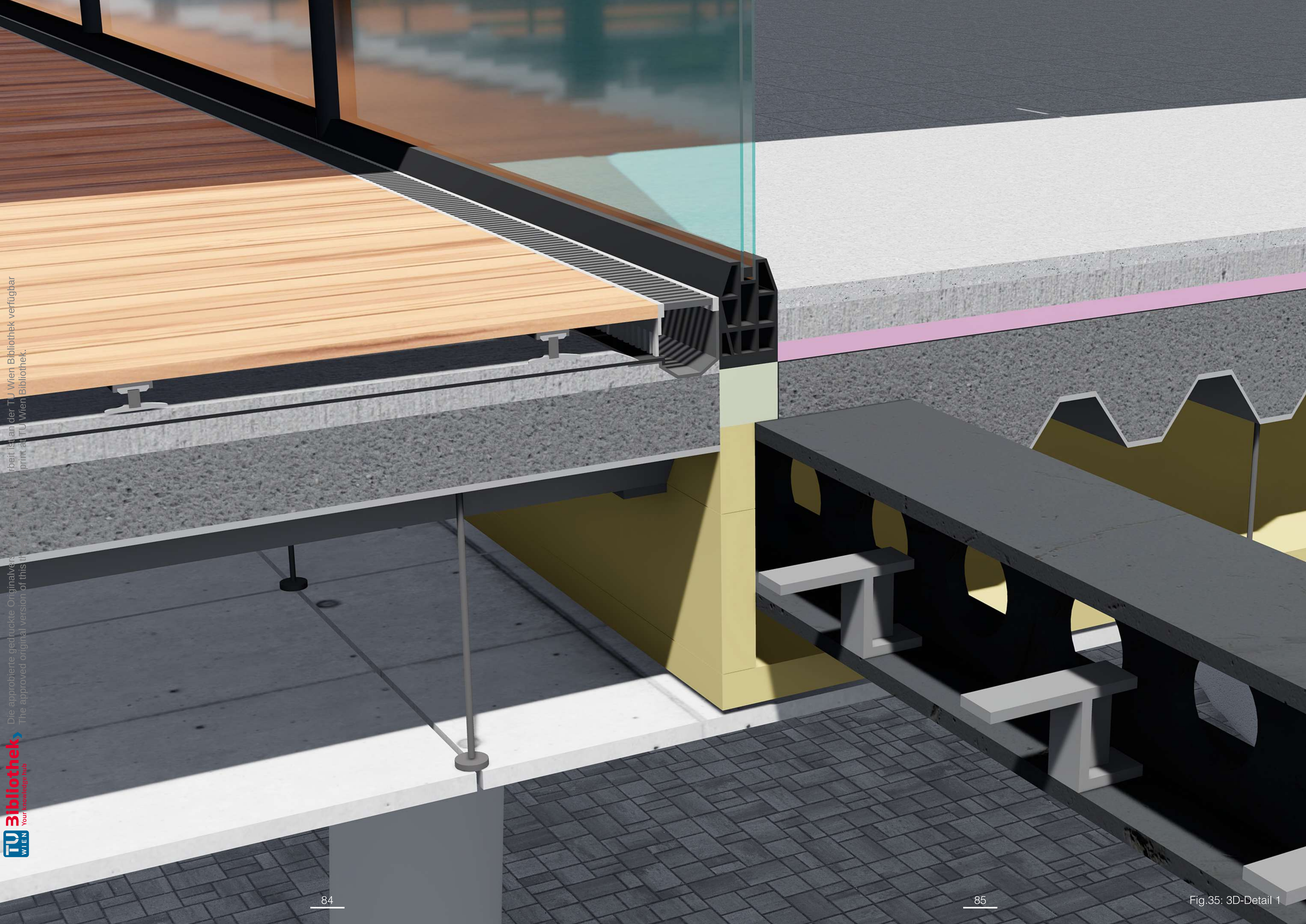


Fig.35: 3D-Detail 1

Fig.36: 3D-Detail 1

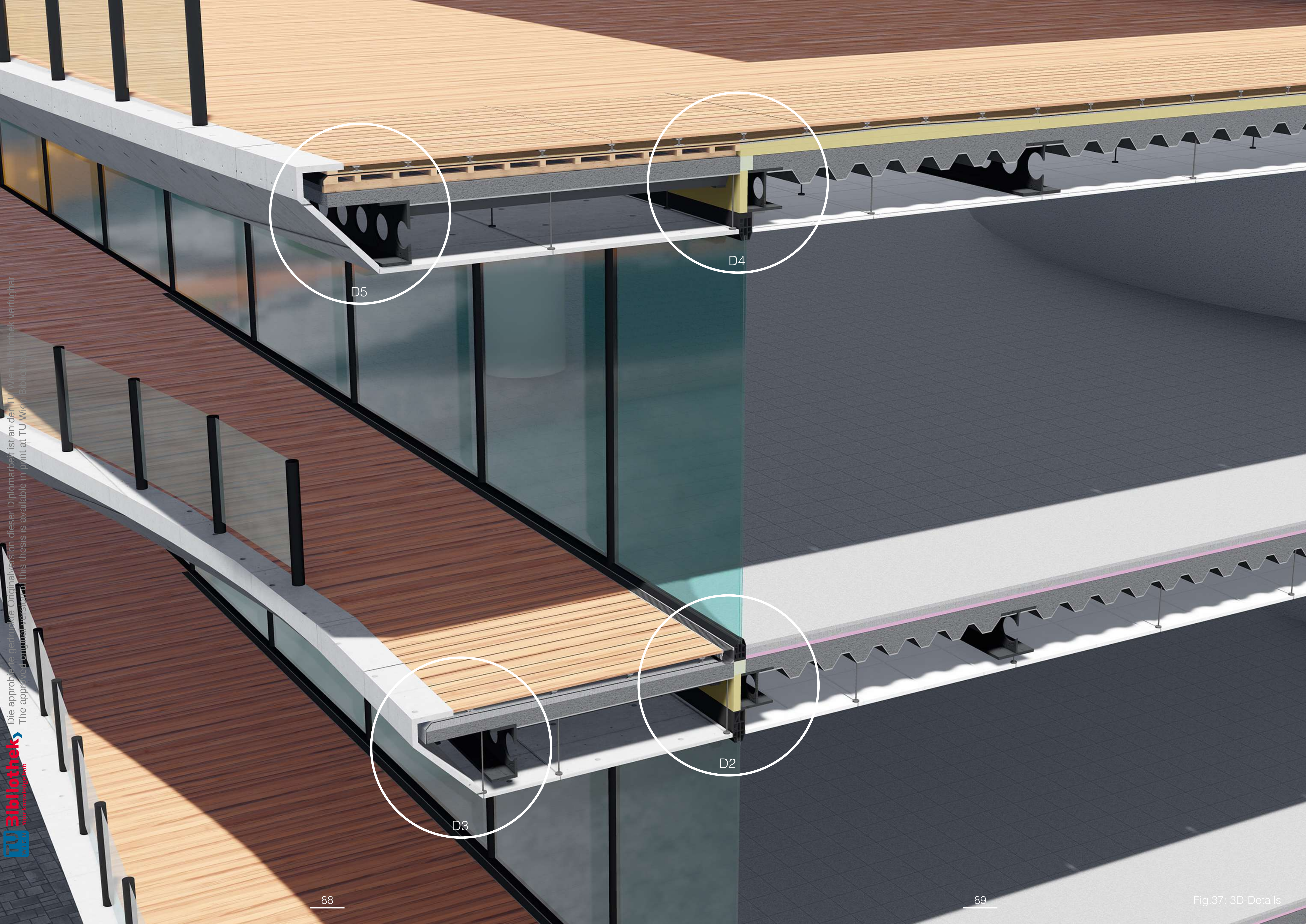


Fig.37: 3D-Details

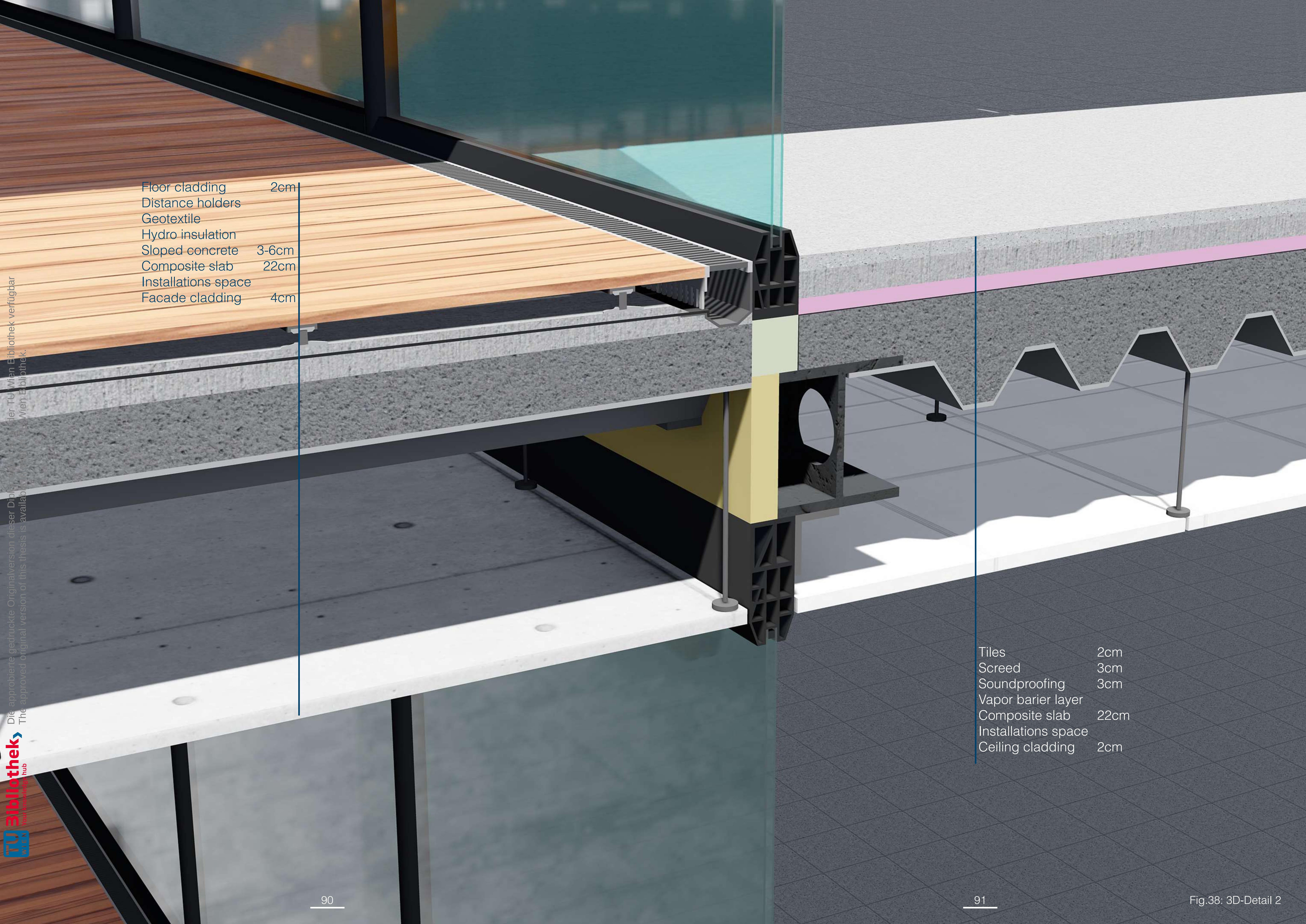


Fig.38: 3D-Detail 2

Fig.39: 3D-Detail 3

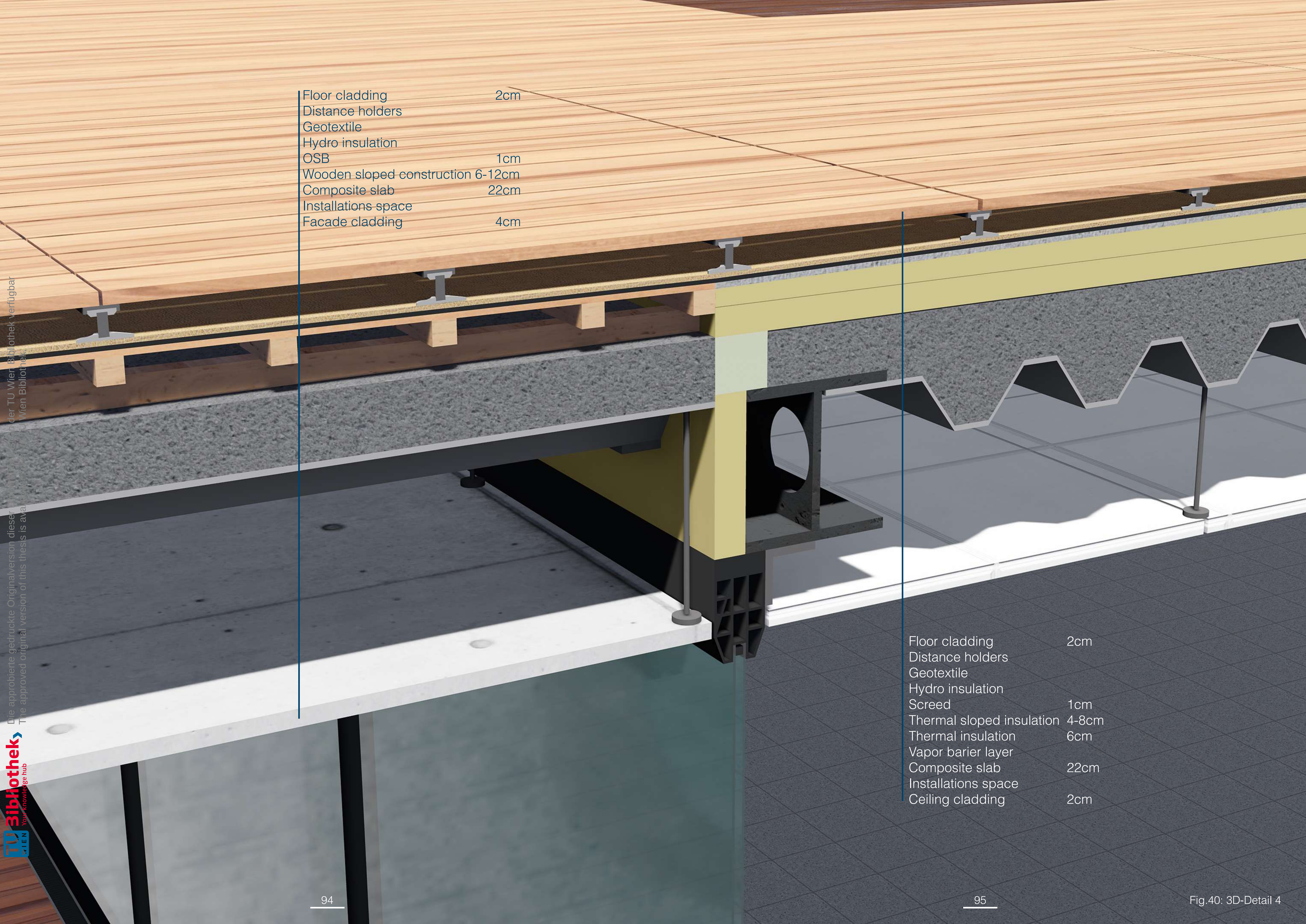


Fig.40: 3D-Detail 4

Fig.41: 3D-Detail 5

V.6 3D Section

Fig.42: 3D Isometric Section

Fig.43: Visualisation

Fig.44: Visualisation

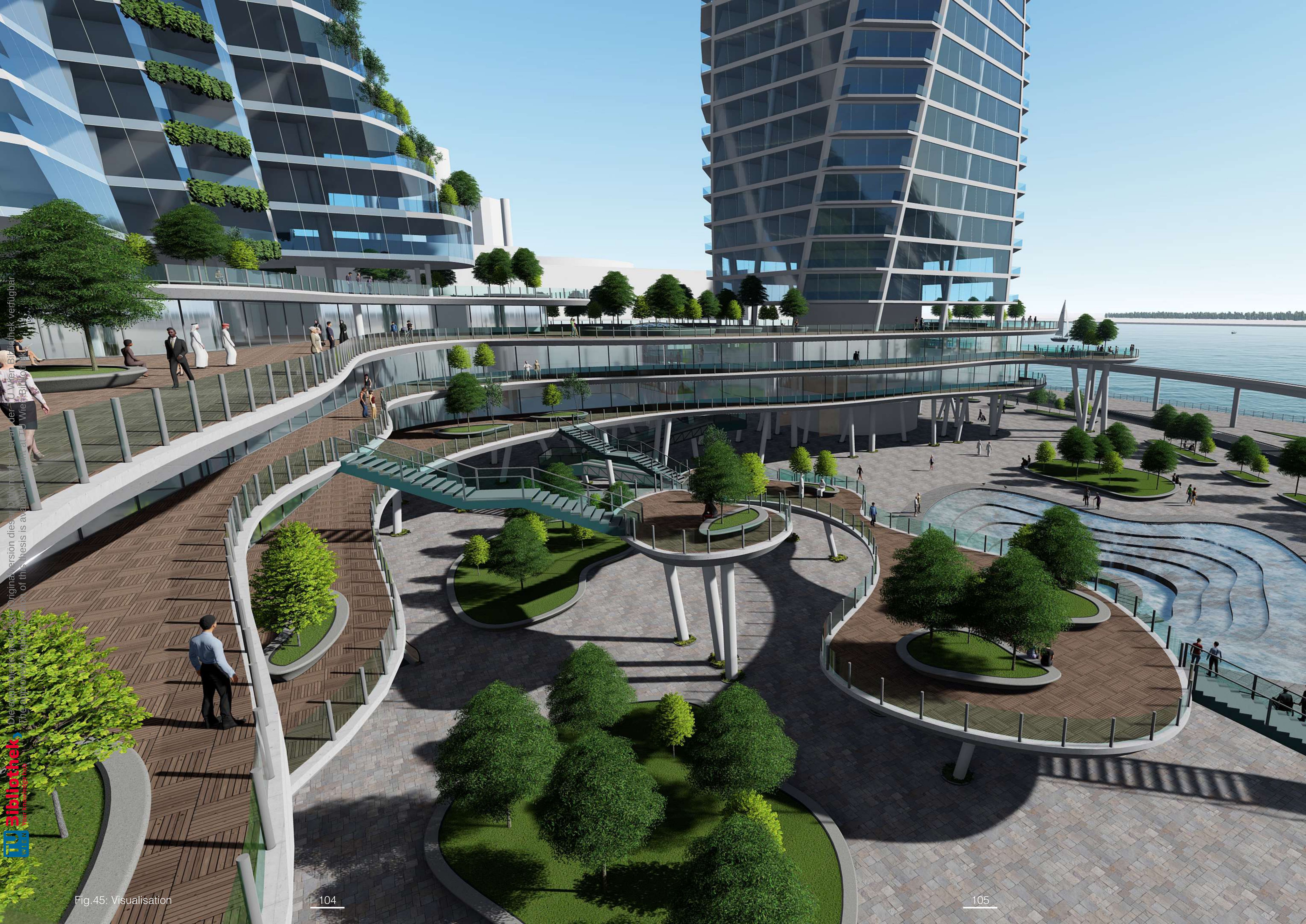


Fig.45: Visualisation

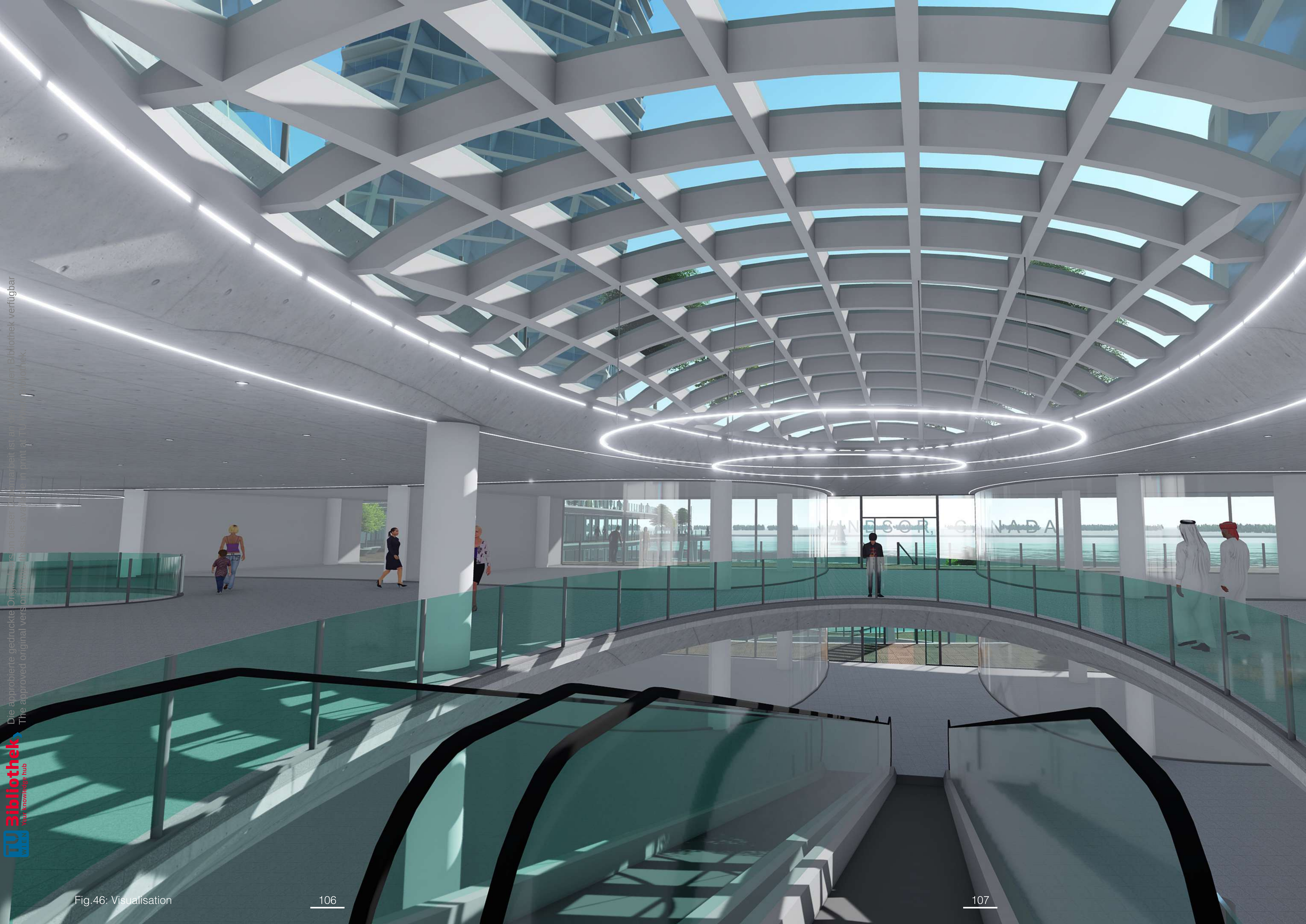


Fig.46: Visualisation

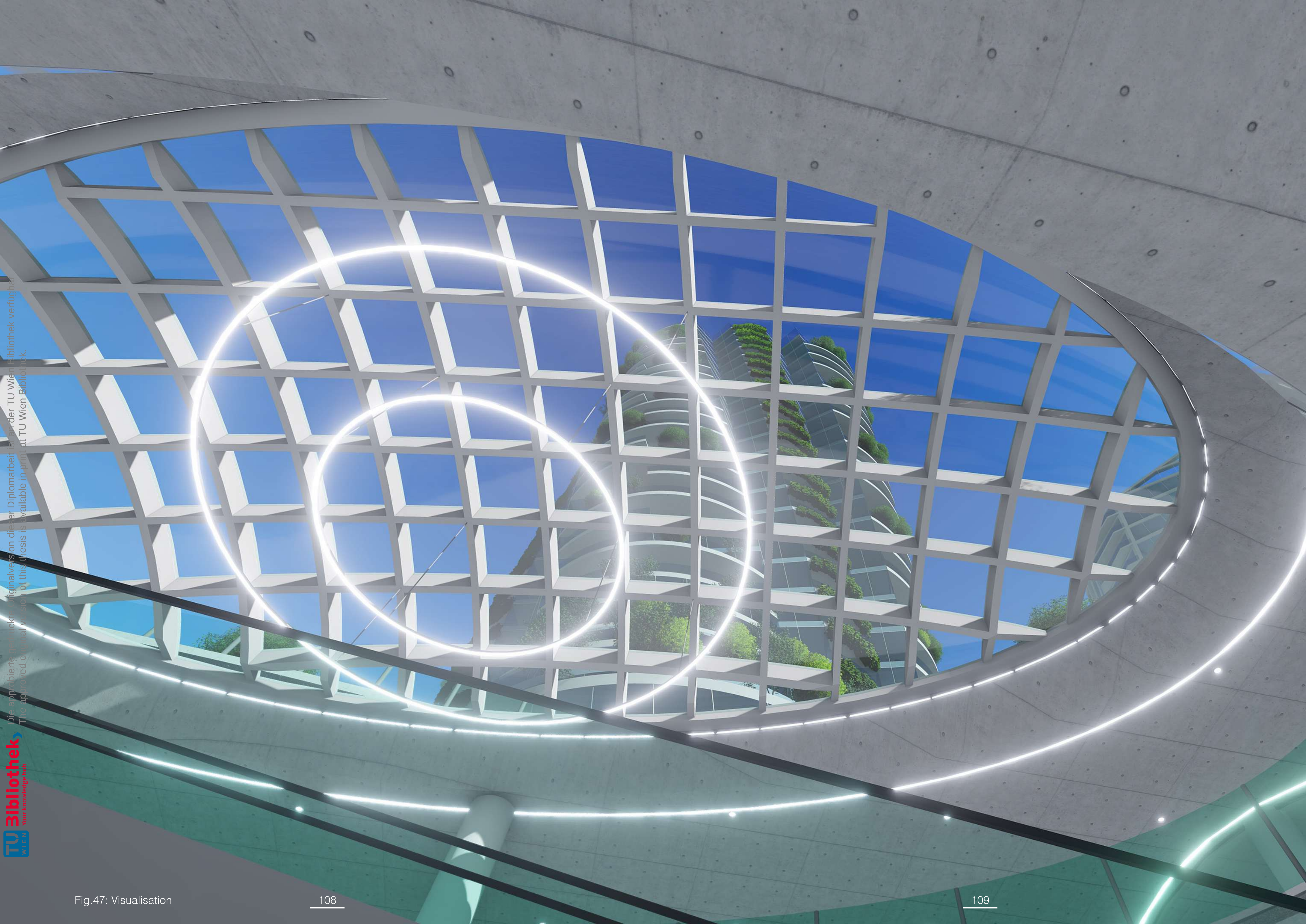


Fig.47: Visualisation

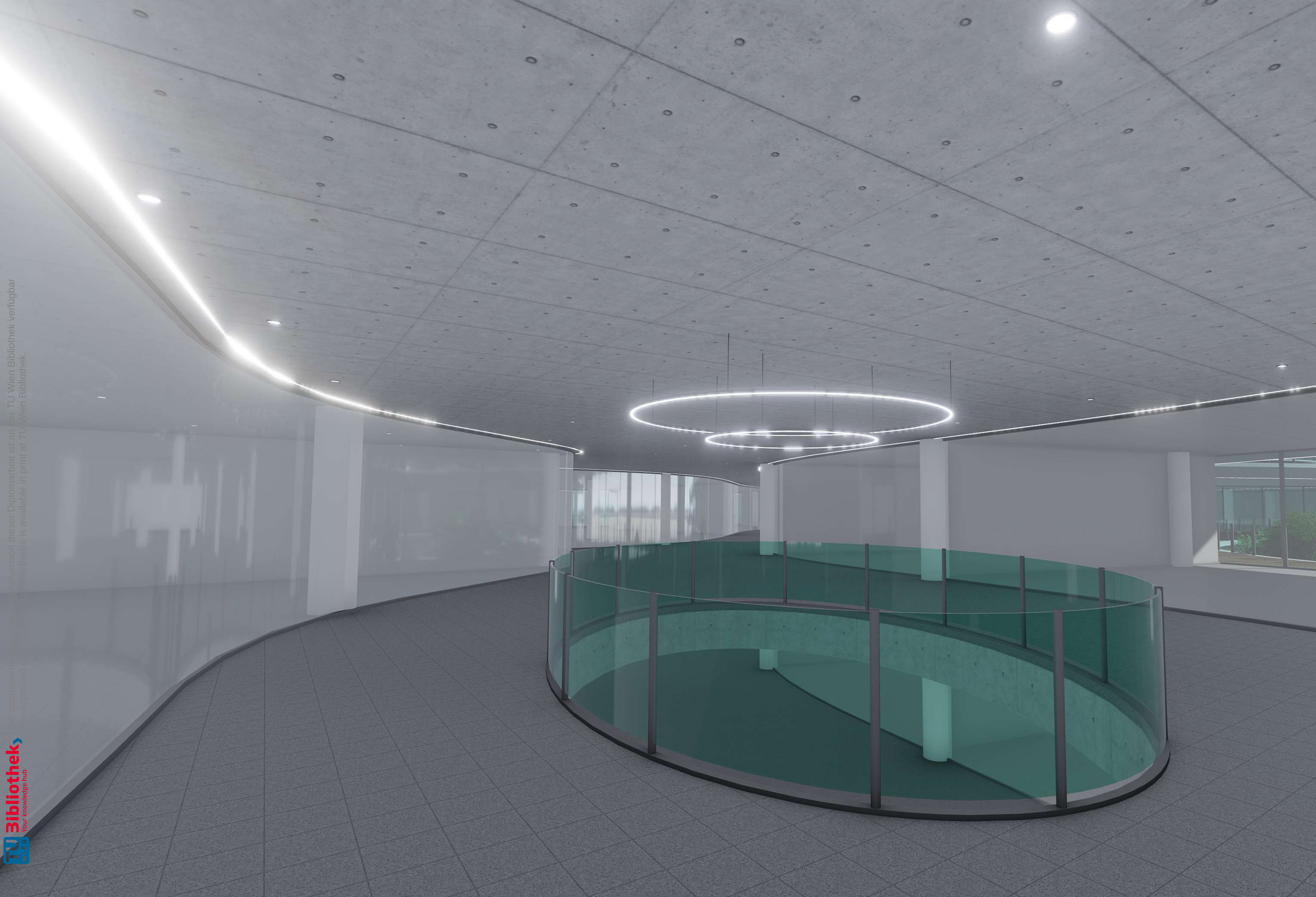


Fig.48: Visualisation

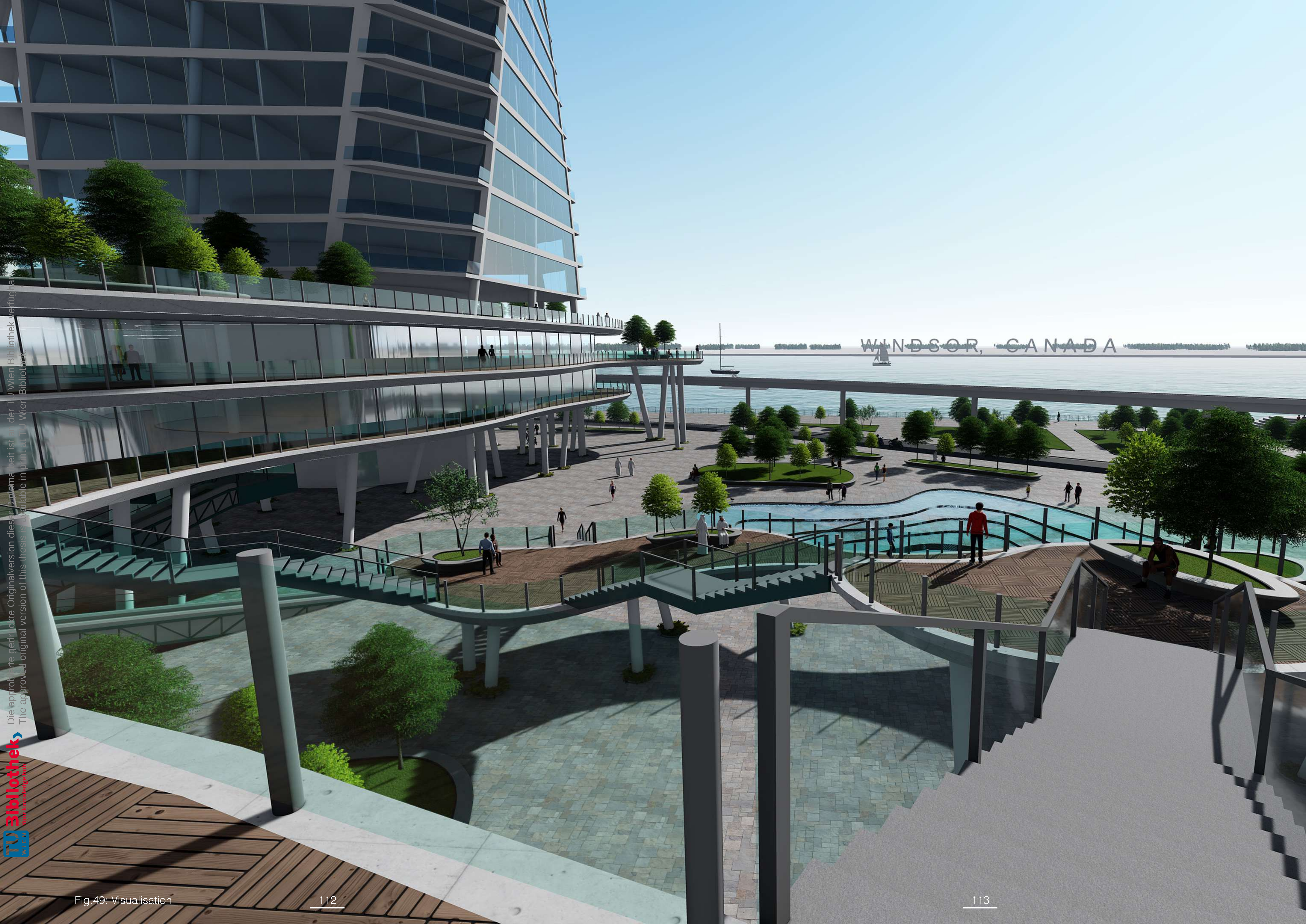


Fig.49: Visualisation

Fig.50: Visualisation

Fig.51: Visualisation

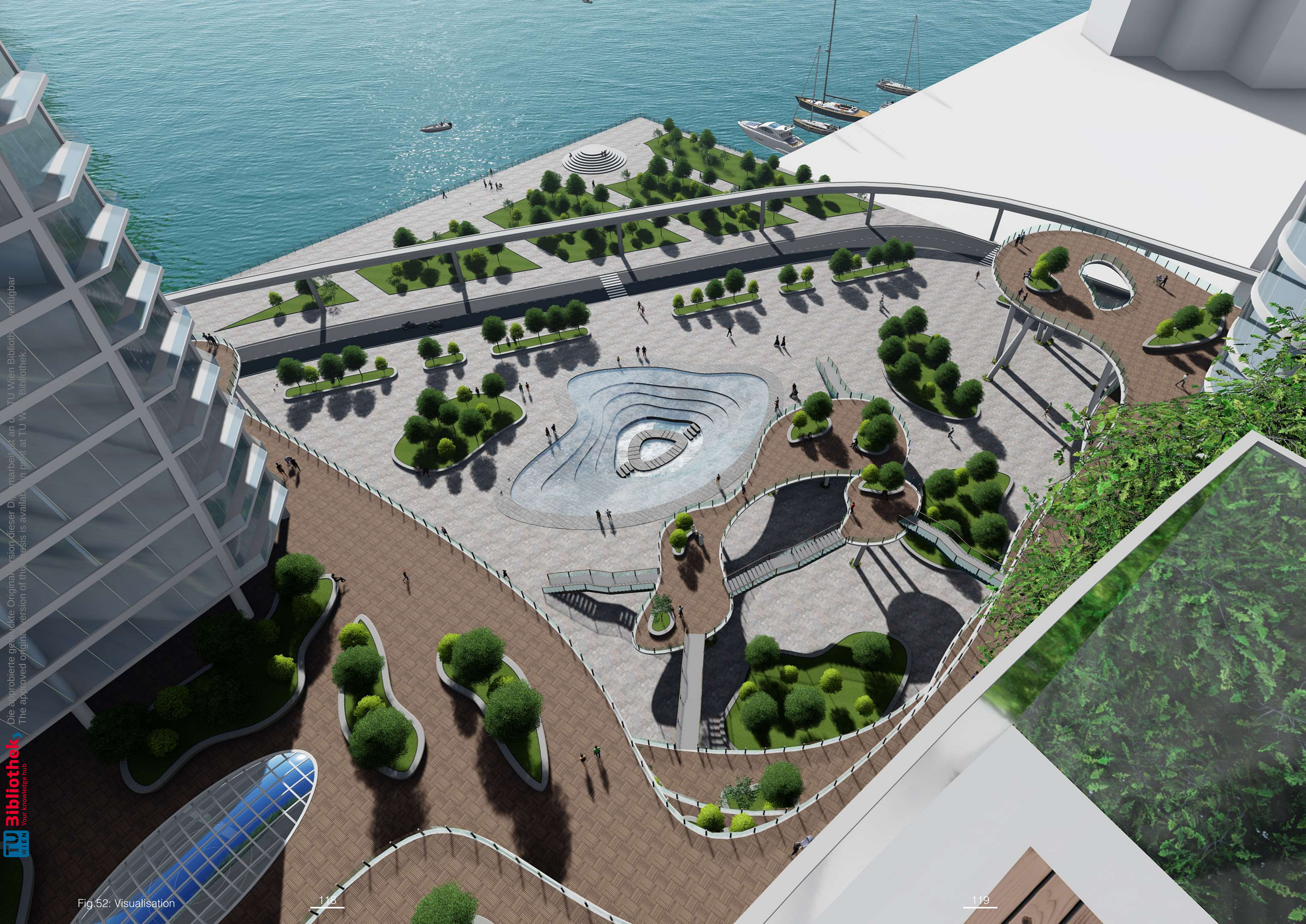


Fig.52: Visualisation

Fig.53: Visualisation

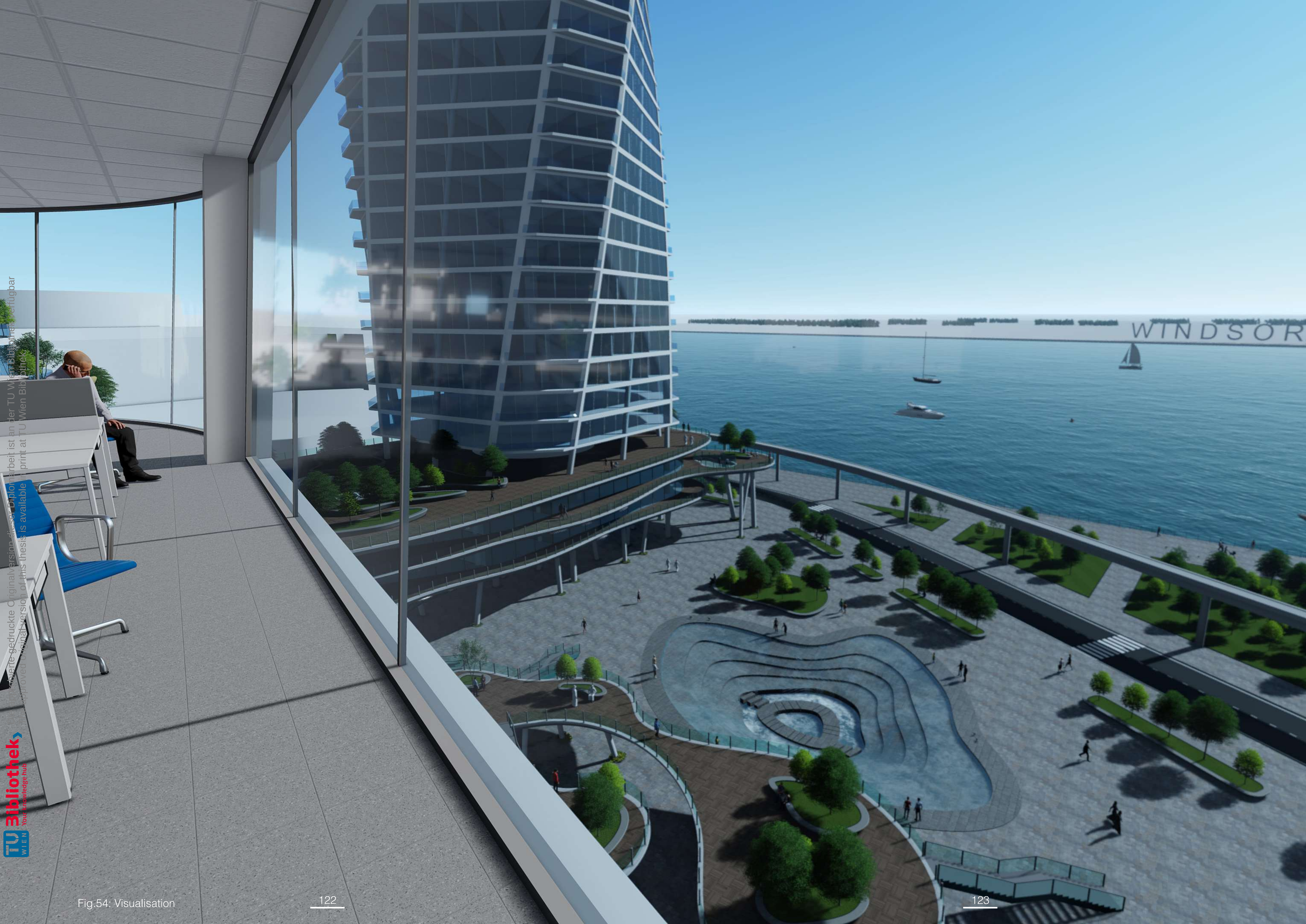


Fig.54: Visualisation

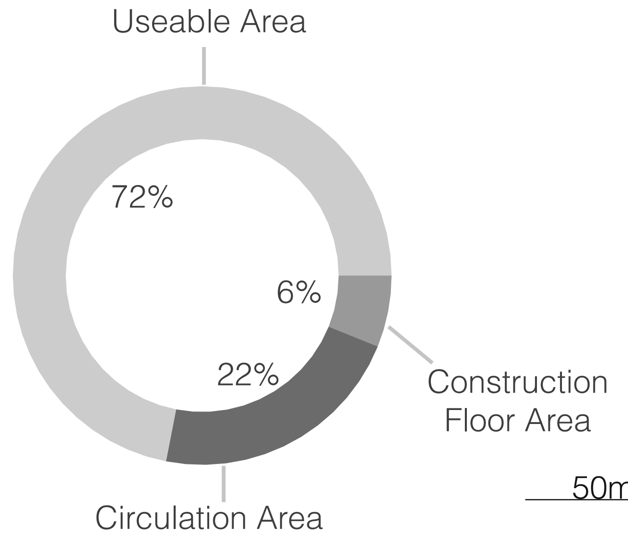
Fig.55: Visualisation

Fig.56 Visualisation

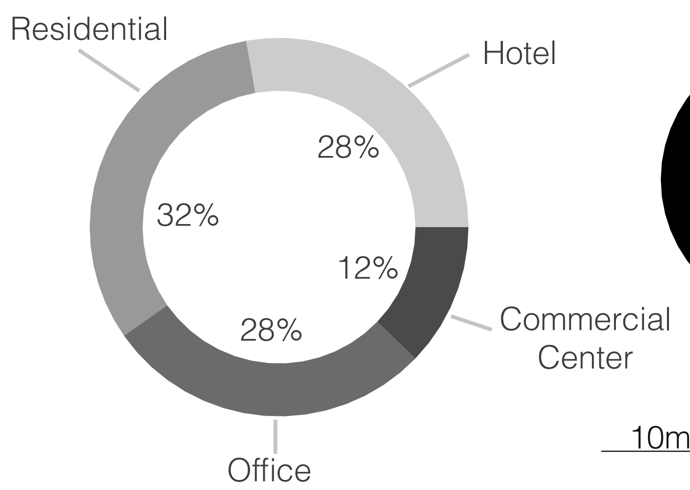
VI AREA CALCULATION

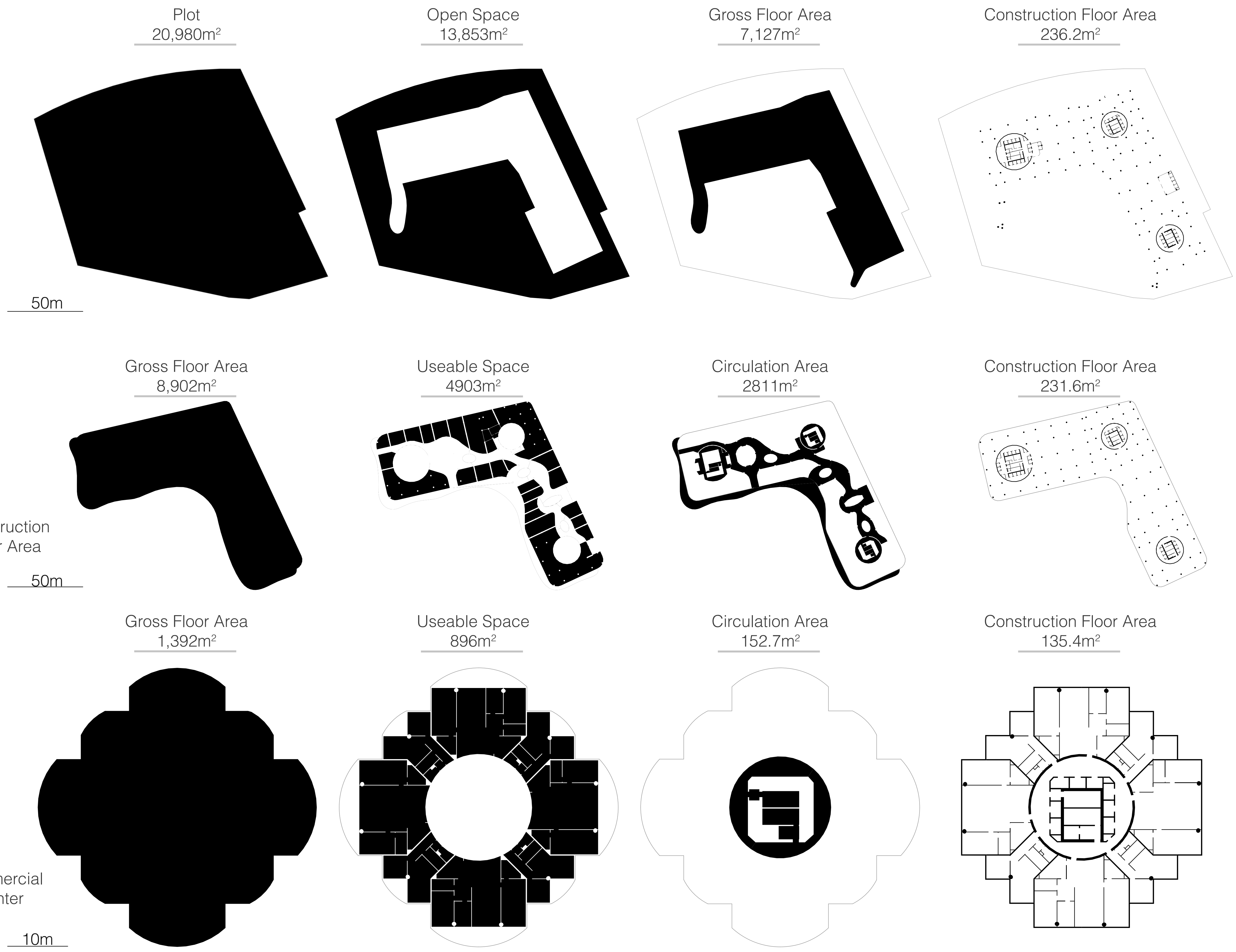
Total Gross Area = 126,902m²

Development Density = 6.04



Useable Area per function





Pln.18: Area Calcualtions

VII

CONCLUSION

The designed complex should define the future look of Detroit`s skyline. The unfortunate faith of the city has brought much poverty, crime and depopulation. Now that Detroit is reviving, in a decade of economic prosperity, many Contractors are attracted by the city and specifically its Waterfront District. In the proposed design are added much symbolism and many references unique for the city.

The design intends to find contextualized, modern, sustainable, fluid, greener and flexible architectural solution to the expectations and cultural needs of the society of this globalized era. The twisted and mitigated forms of the complex should benefit not only the esthetical quality but offer more comfort and look for advanced technical solutions, reducing the lateral loads and giving more stability.

The proposal offers mixed functions, where privacy and public spaces co-exist. To satisfy the needs of the public, green areas, huge, open spaces and different levels are generated. The stories of the towers offer a lot of space, due to the lack of interior columns and walls, giving freedom of functions and distribution for the tenants. Prefabricated parts are a priority for the construction, which will allow a more economical, environmental and time favorable building process.
The Elevator’s optimal solution is vital for the development of such project, as in skyscrapers lifts have an immense footprint. Therefore different complex systems are implemented as groups of elevators serving specific floors or multiple cabins in a single shaft.

It was Important for the design to give the towers freedom of space use, allowing the tenants a future change of functions.

The design was driven by the motivation that the building of tomorrow should be able to adapt to the rapid changes of our globalized civilization, by the dream of redefining the skyline of our future cities for a better quality of life.

VIII

TABLE OF CONTENTS

VIII. 1 List of Figures

VIII.2 List of Plans

VIII.3 Bibliography

Kheir Al-Kodmany | 2015 | Tall Buildings and Elevators: A Review of Recent Technological Advances

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Softwares

●●●●○ AutoCAD
●●●●◐ ArchiCAD
●●●●● Rhino
●●●●○ Lumion
●●●●● Photoshop
●●●●○ InDesign
●●○○○ Keyshot
●●◐○○ MS Office

Hobbies

Travelling
Guitar
Camping
Photography
Football
Jogging

Driving Licenses

Languages

●●●●● Bulgarian
●●●●○ German
●●●●◐ English
●●○○○ Spanish

Personal Statement

Motivated
Adaptable
Leader
Good time management
Energetic
Balanced

Education

ARCHITECTURE

2019-2021 Technical University of Vienna
Masters of Science

2019-2021 Polytechnical University of Valencia
Masters of Science (Exchange Year)

2014-2019 Technical University of Vienna
Bachelor of Science

2012 Callan School of English
London, UK

2002-2014 Nikolay Katranov School
Svisthov, Bulgaria

Work Experience

2020 - 2021
Koev SD

2018
Markan Project