

CTBUH - Sustainable High-rise Construction: The Nordic Perspective

Case: MIRAI high-rise, Dhaka/Bangladesh

ARCO
ARCHITECTURE COMPANY



LOCATION

Bangladesh is the home of the world's largest river delta, most of its territory is less than 12 m above sea level. Climate change has caused already today major impacts on the country, include sea level rise, temperature rise, food crises, droughts, floods, and cyclones.

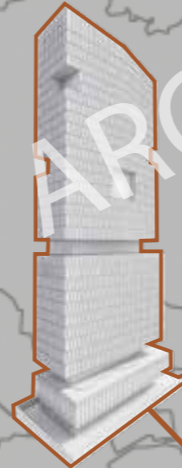


148 500 km²
half the size of Finland

170 mill.
30 x more than Finland

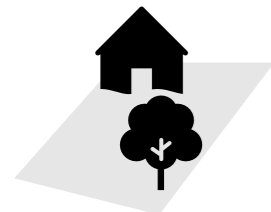
It is also the eighth-most populous and most densely populated country in the world.

Sustainable Development Goals are a global call to action therefore the UN is currently pushing to implement 178 key activities during the ongoing programme cycle. We as architects should do the same!



DHAKA

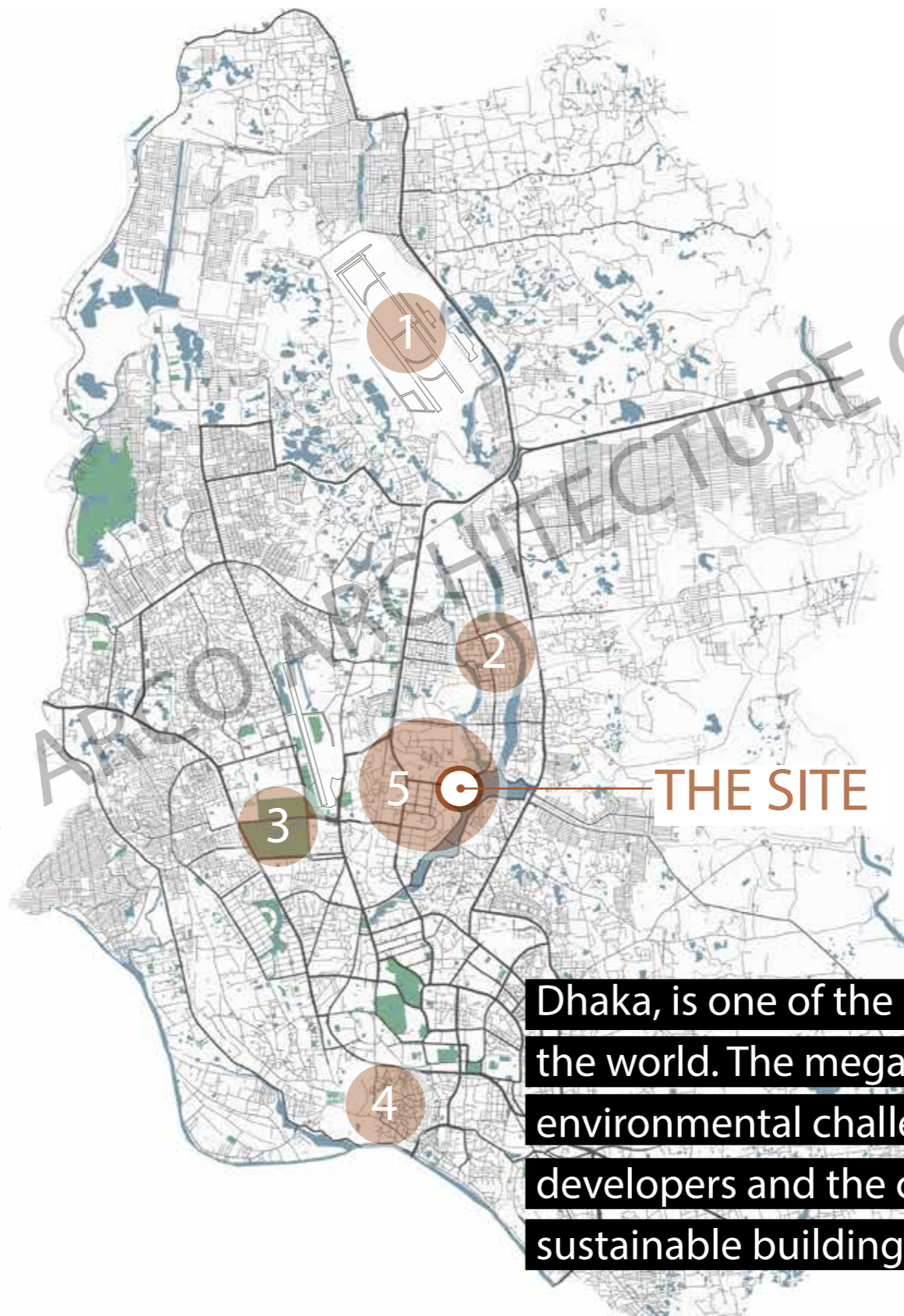
Today 41 % of the population lives
in urban areas 20 years ago
it was only 24%



270 km²
smaller than Helsinki Region



22 mill.
15 times more than Helsinki



- 1 INTERNATIONAL AIRPORT
- 2 GULSHAN RESIDENTIAL AND BUSINESS DISTRICT
- 3 NATIONAL PARLAMENT BUILDING
- 4 OLD DHAKA
- 5 TEJGAON BUSINESS DISTRICT

Dhaka, is one of the most densely populated cities in the world. The megacity is facing major environmental challenges whilst local property developers and the city itself start implementing sustainable building standards.

DHAKA

A

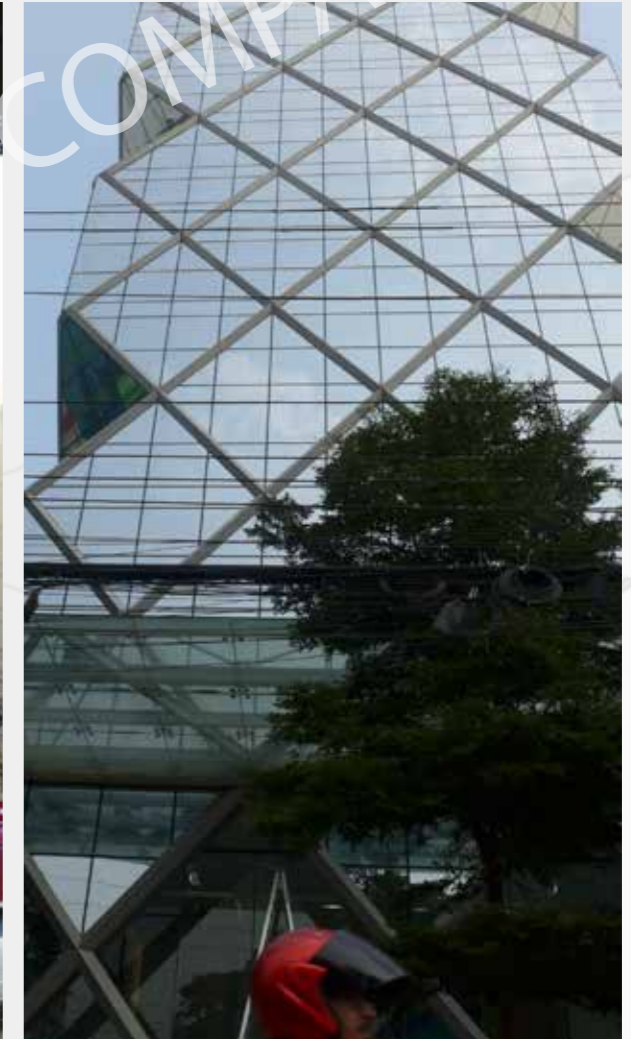


In 2021 Dhaka was the 4th least liveable city in the world. Although some lakes and green spaces relieve the overall set up.

Air pollution threatens booming Bangladesh Megacity. Dhaka's air quality is among the world's worst, due to traffic, construction, and industrial pollution

DHAKA

A



The streetscapes are full of contrast between poverty and business world, low and high-tech. A vigorous ambition to create a modern and better place to live can be seen.

DHAKA

A



source: ARCO



source: ARCO

The site is located adjacent to one of the city's most attractive waterbodies - in the last years some of them have been restored towards a revitalized ecosystem.

DHAKA

TEJGAON
DISTRICT

199, Bir Uttam Mir Shawkat Sarak

GULSHAN/
HATIRJHEEL LAKE

TEJGAON is undergoing a massive transformation to become Dhaka's most important business district attracting major HQ's from financial and media market

TEAM



NIRMAN

- client
- land-owner
- developer
- construction firm
- local design team

ARCO

ARCHITECTURE COMPANY

- Principal architectural design
- Landcape design
- Interior design
- BIM coordination

MEIN-HARDT

- MEP
- Structural design
- Facade consultant
- Vertical transport
- Traffic design

(SD, DD, Tender)

RAMBOLL

- MEP
- Structural design
- Vertical transport

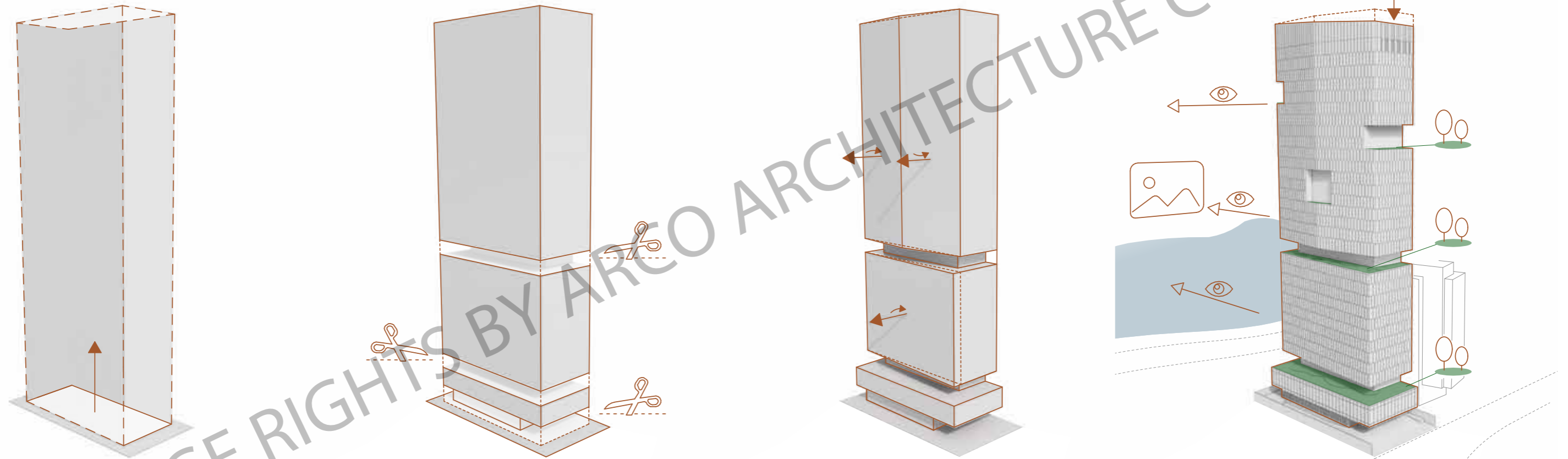
(Concept Design)

archetype
group



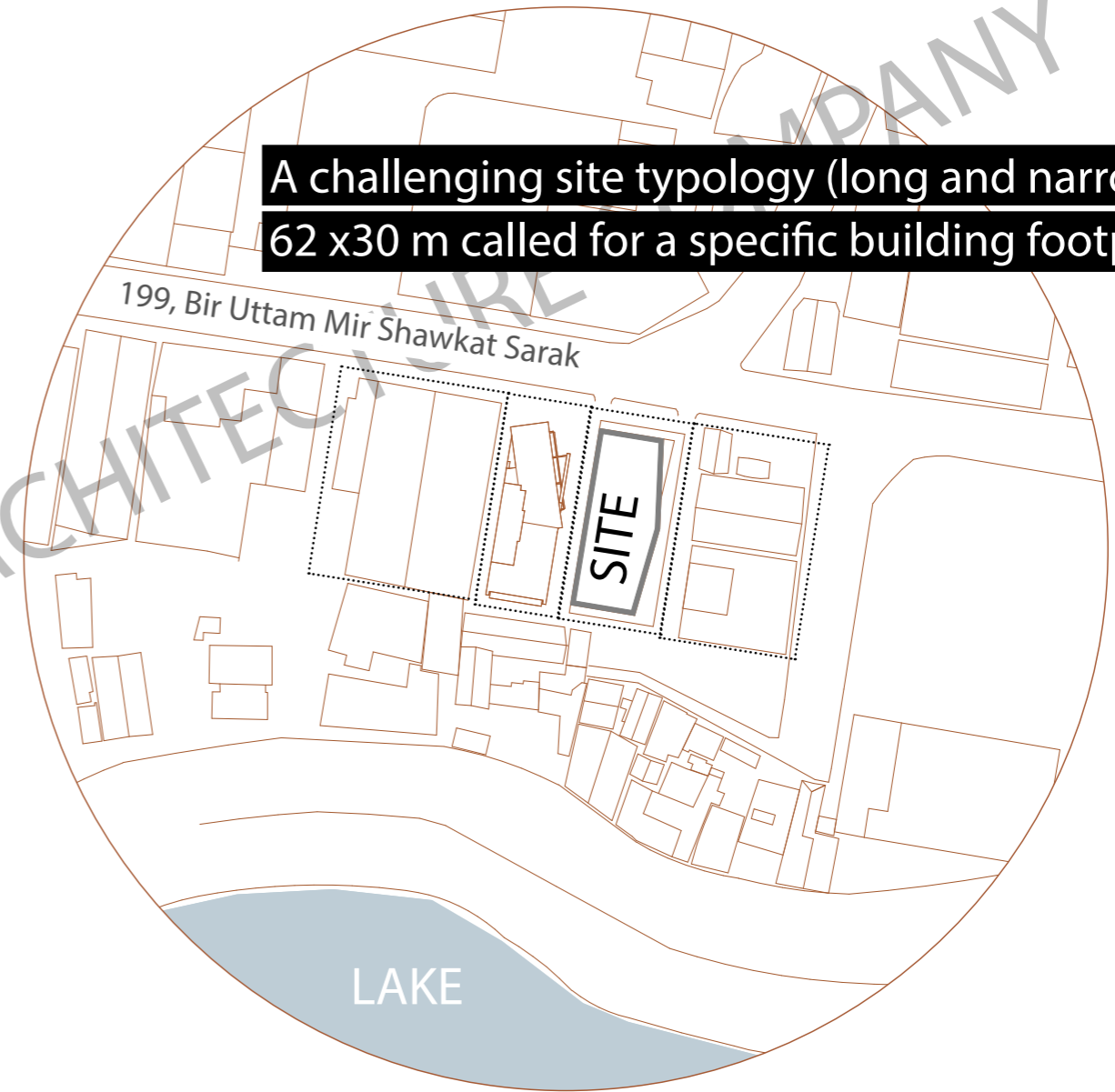
ARCHITECTURAL CONCEPT

A



With three building volumes stacked on top of each other, the architecture feels simple and timeless, but also playful

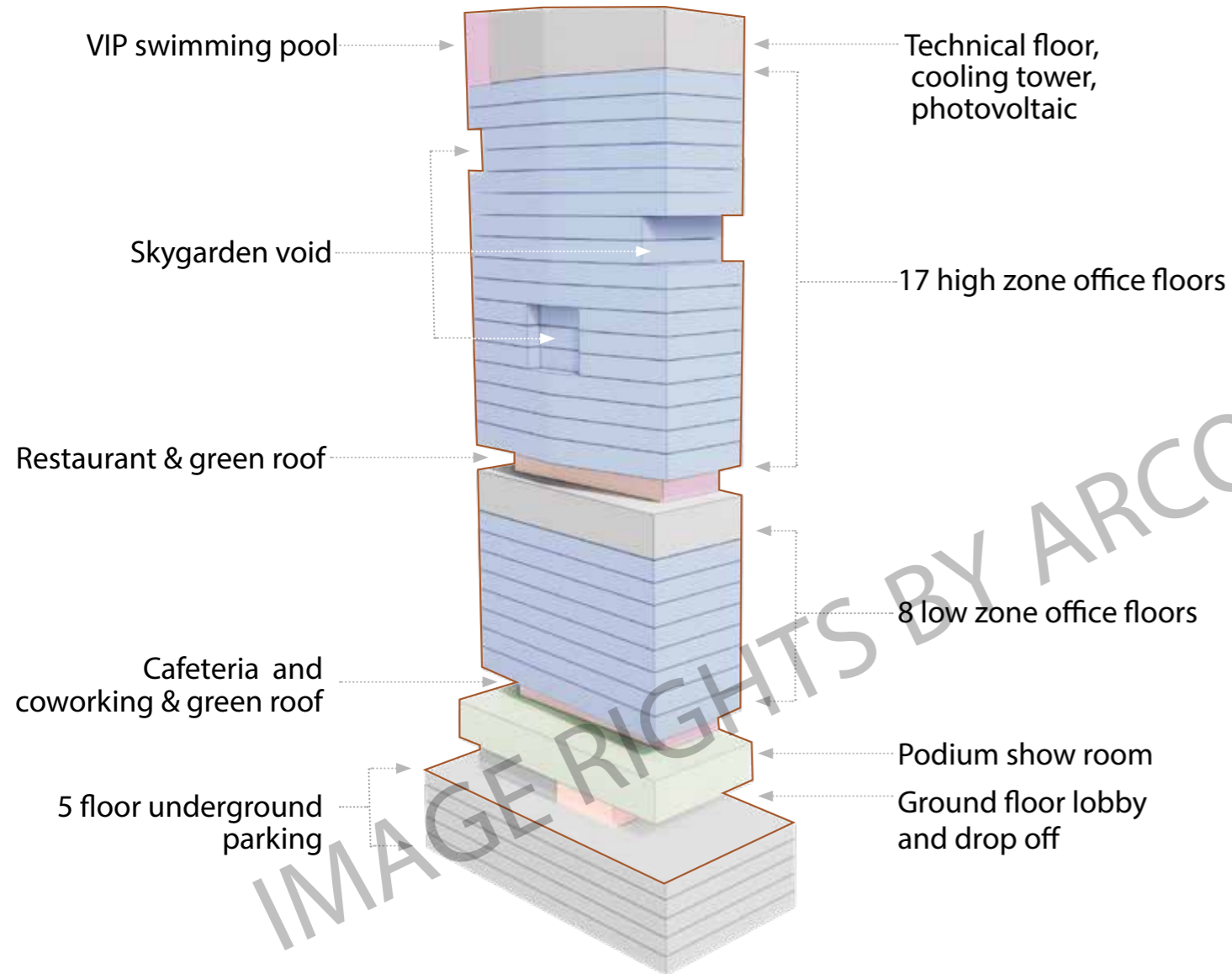
We tried to create a building shape that balances between an efficient floor plate design and maximum views towards the lake



A challenging site typology (long and narrow)
62 x30 m called for a specific building footprint

Angled facades guarantee views towards the lake
and city even if both neighboring sites would be
developed with tall buildings in the future

PROGRAM



"Mirai by Nirman" is an international-grade office high-rise, standing 138 meters tall across 30 floors

Status: under construction

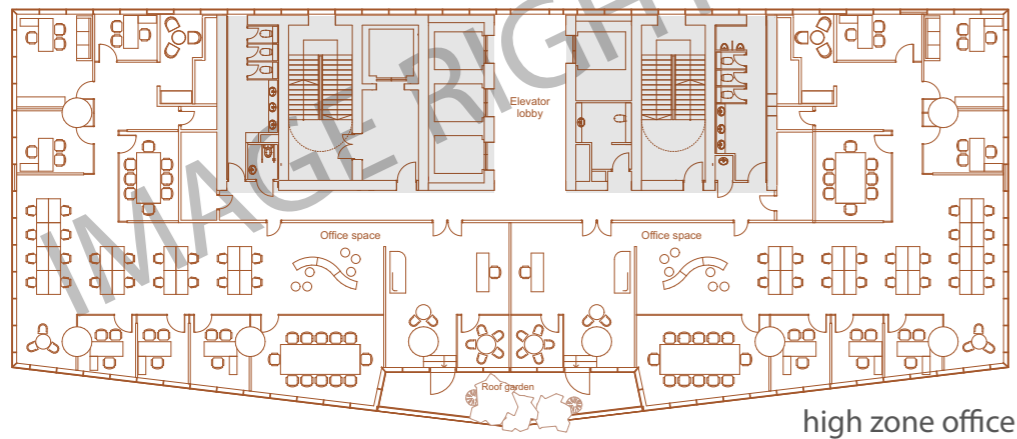
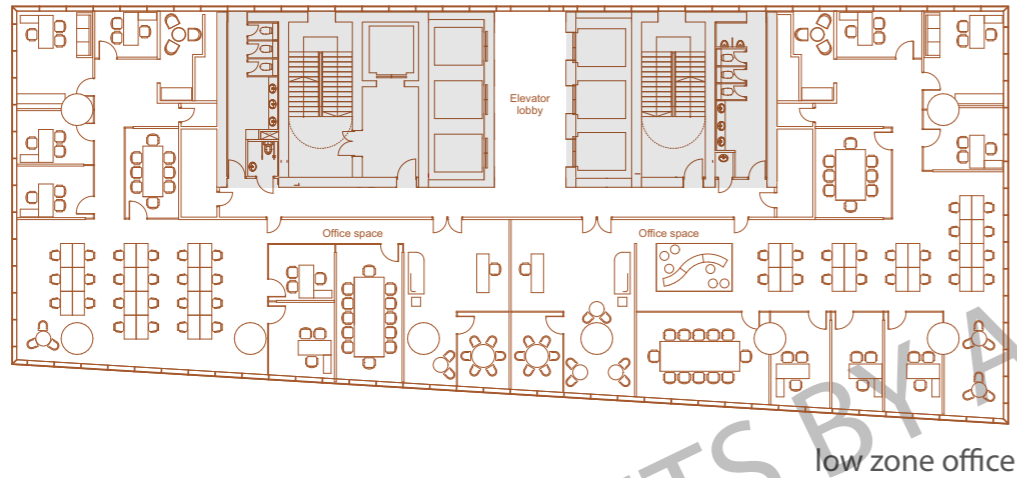
Size: 36,000 m² (GFA)

Height: 138 m



PROGRAM

The adjacent mid-rise office building "AKIJ House" will have an impact on the natural daylight and views of MIRAI's low zone office volume, with that in mind the core was placed alongside the west facade



Generic office layouts with the core aligned on the west facade provide sufficient natural daylight and flexibility



APPROACH



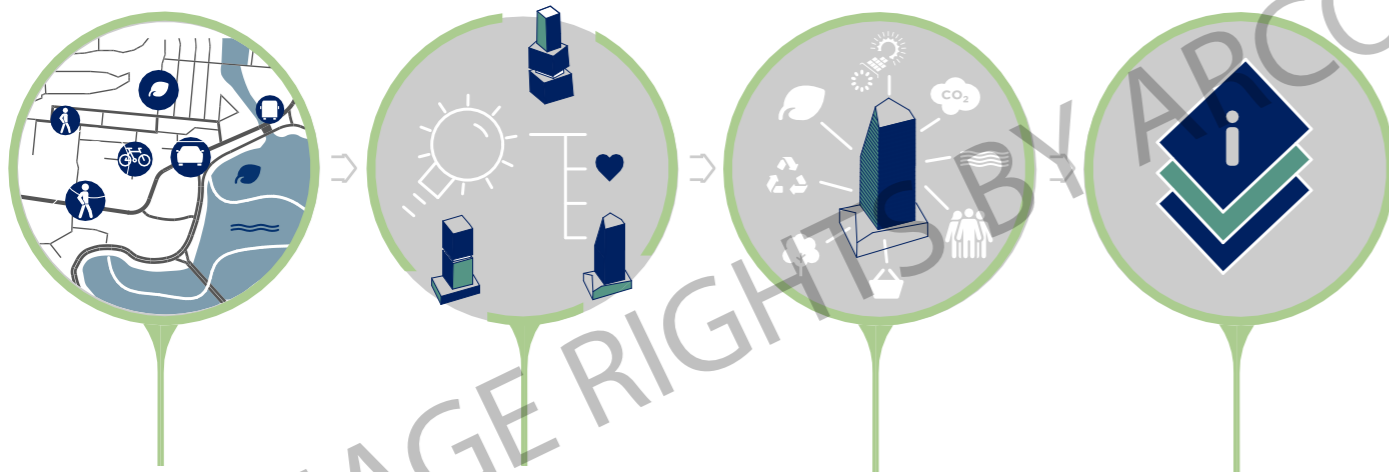
As architects, it's our responsibility to create ecological and socially sustainable environments. We believe that sustainable high-rise buildings can represent a promising solution for our rapidly urbanizing world.



APPROACH

BIM coordination and global collaboration is one of the interesting parts of the Mirai project. ARCO is located in Scandinavia, working on a site in Bangladesh, consulting with engineers in Thailand, engaging experts in central Europe and Italy

We aim for a holistic sustainability approach that that considers the interconnectedness of various aspects.

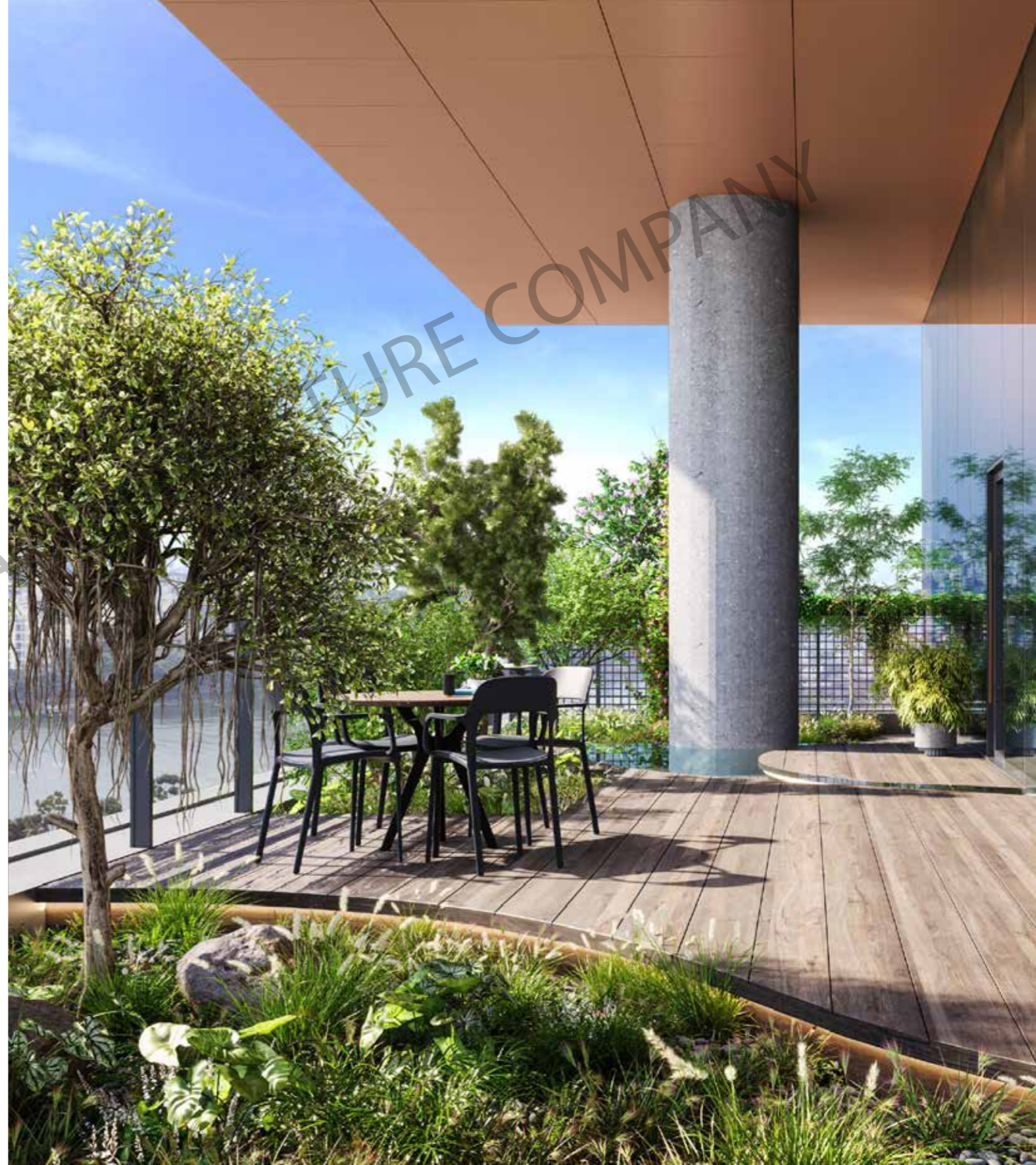


- site visit
- urban analysis
- climate analysis

- volume studies
- performance test of multiple design solutions
- client involvement

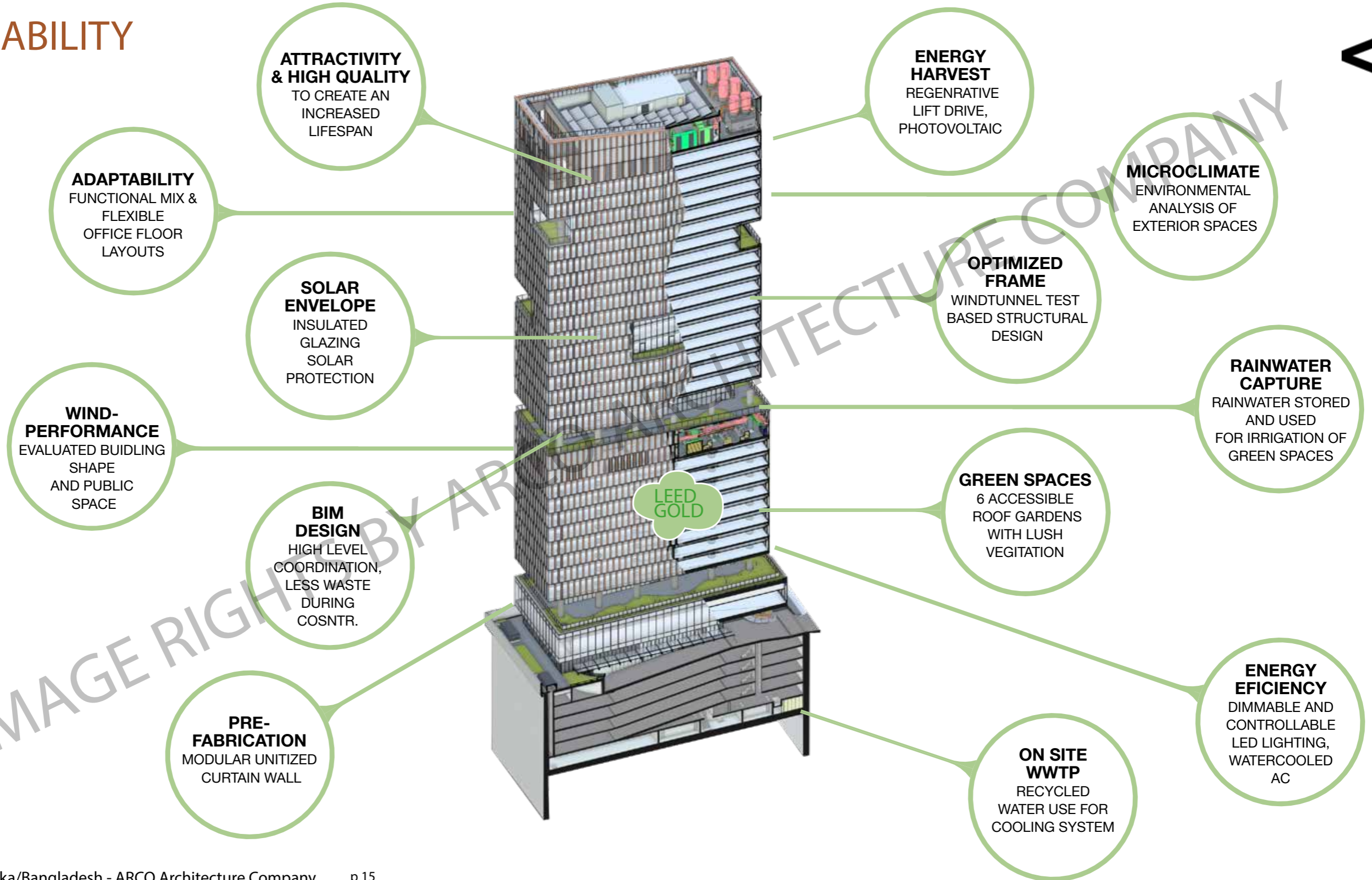
- further development of the preferred design
- net-gross efficiency
- material efficiency

- strong collaboration with multidisciplinary experts
- detail design stage
- high level coordination using BIM



SUSTAINABILITY

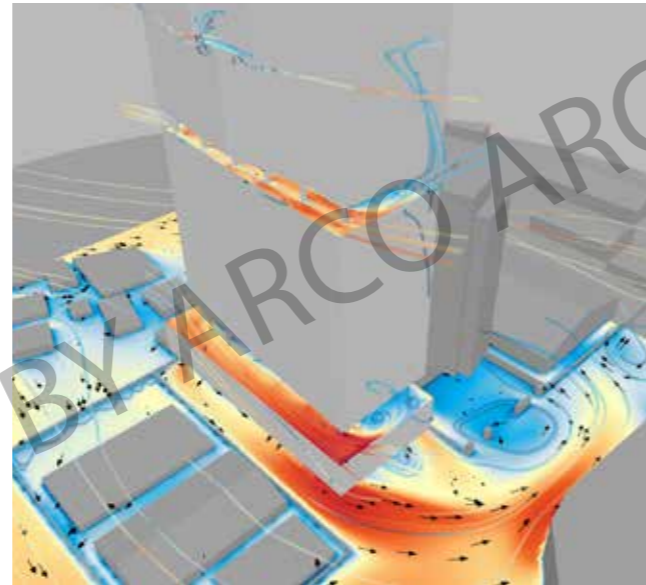
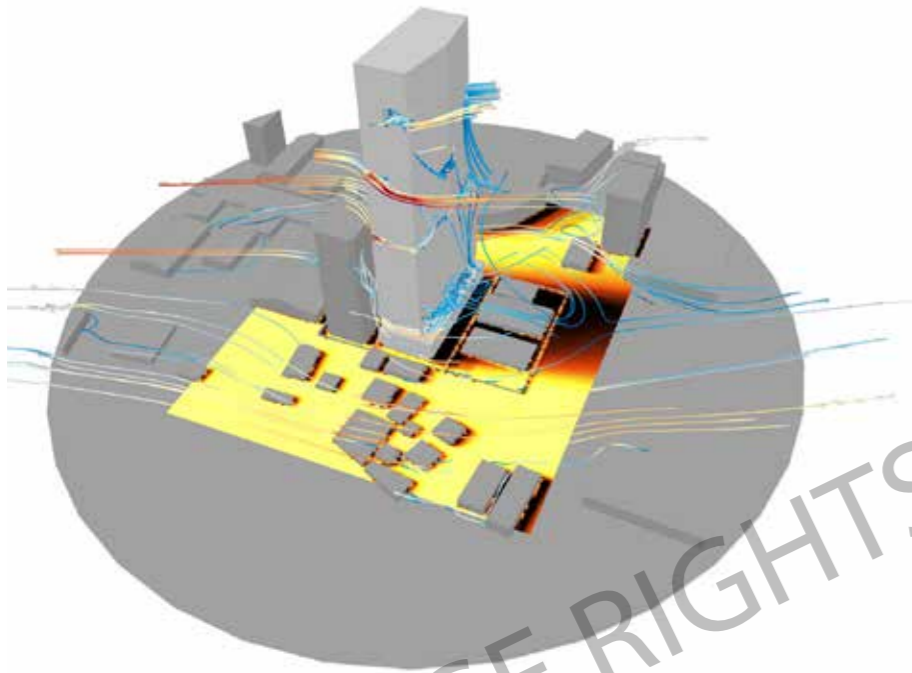
A



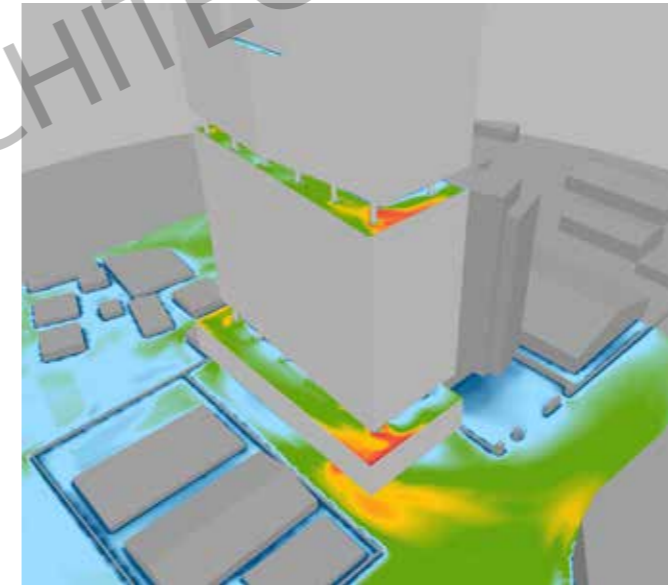
CLIMATE ANALYSIS

A

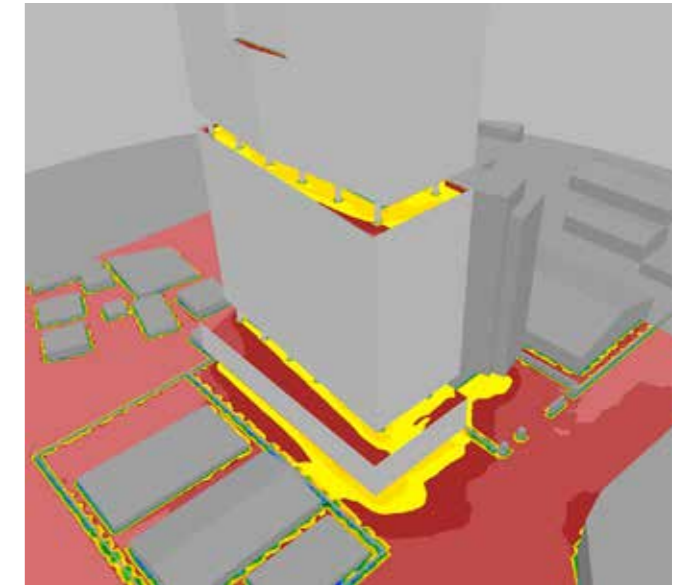
ARCO's 3D model was used to run in-house environmental analysis to evaluate the building geometry regarding: micro climate, thermal comfort on the public exterior areas and green roofs, shading and solar impacts on facades



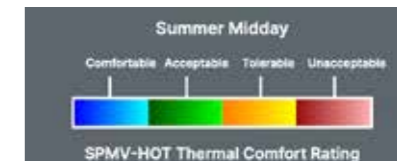
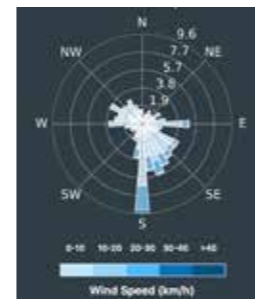
Directional wind (mean wind 180 degree)



Pedestrian wind comfort - wet season



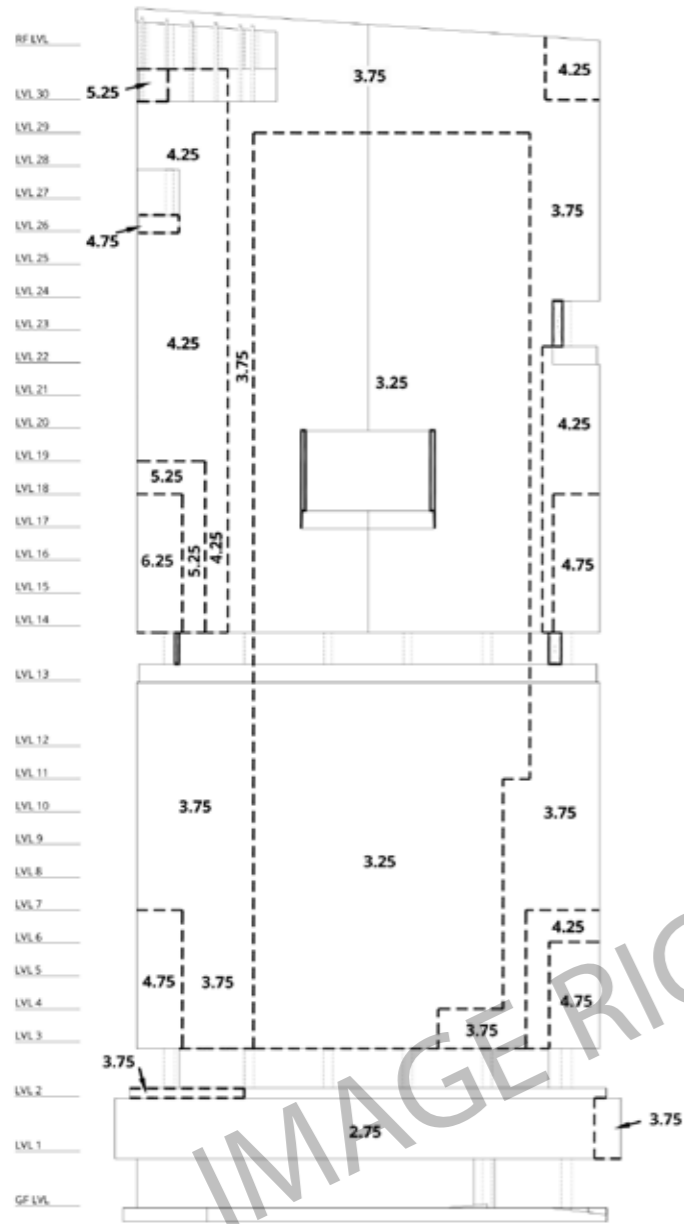
Thermal comfort - summer - mid day



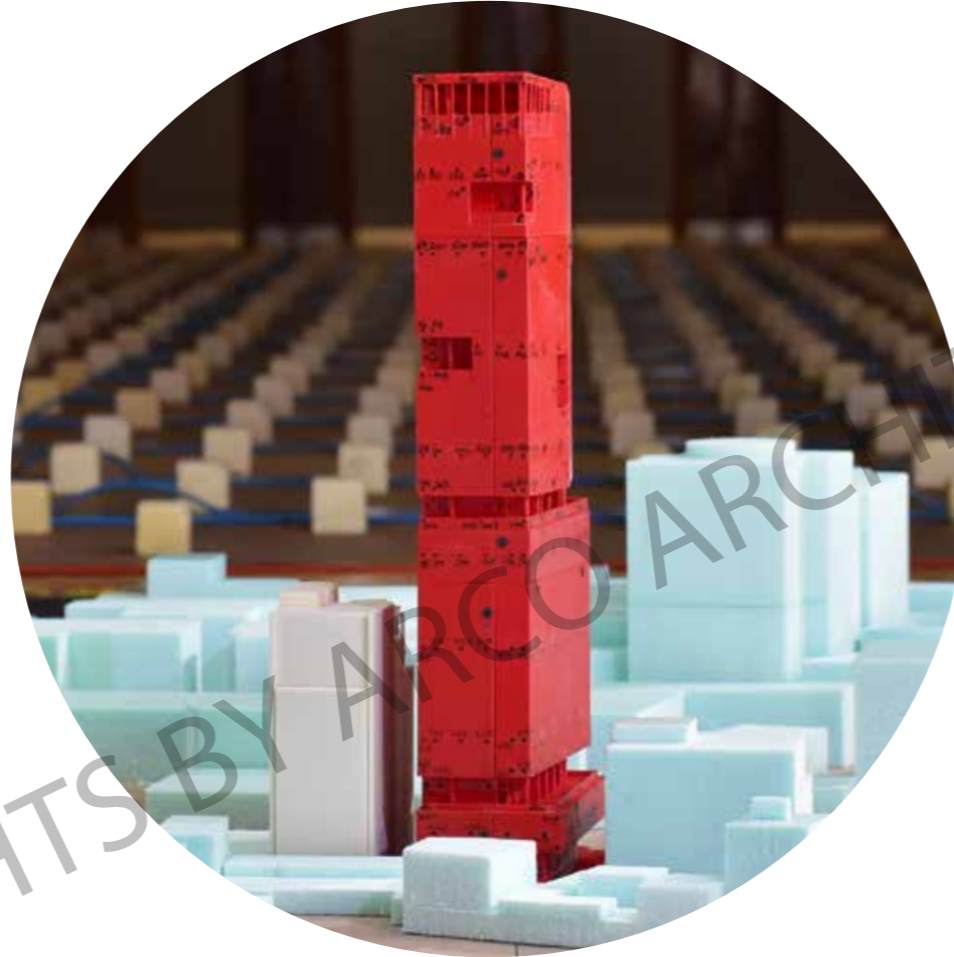
Analysis and illustration by
Orbital Stack-AI Engine

OPTIMIZED FRAME

A



RECOMMENDED WINDLOADS FOR CLADDING DESIGN kPa (RWDI)



WIND TUNNEL MODEL WITH 50 SENSORS BOTH FOR FACADE AND GREEN GARDEN AREAS (RWDI)



Wind Speed (km/h)	Probability (%)	
	Summer	Winter
Calm	30.1	12.7
1-10	40.8	34.6
11-20	25.9	44.4
21-30	3.0	7.8
31-40	0.2	0.4
>40	0.0	0.1

DIRECTIONAL DISTRIBUTION OF WIND (RWDI)

The results of the wind tunnel test created the based for the structural design of the building frame & claddings. Peak values could be reduced significantly compared to local code

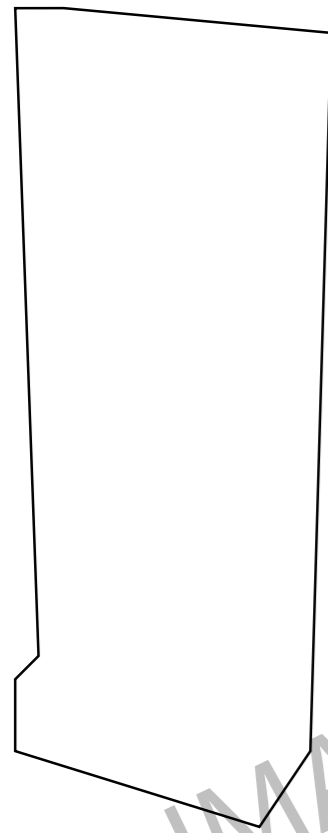
OPTIMIZED FRAME

CONCEPT STAGE STRUCTURAL SYSTEM COMPARISON

A material optimization process through structural design calculation tool was started in the conceptual phase by RAMBOLL – their design results reduced weight, loads and embodied carbon

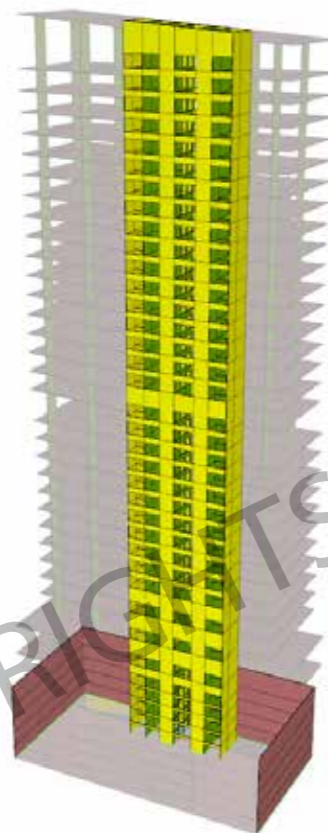


VERSION "0"
based on local code ...



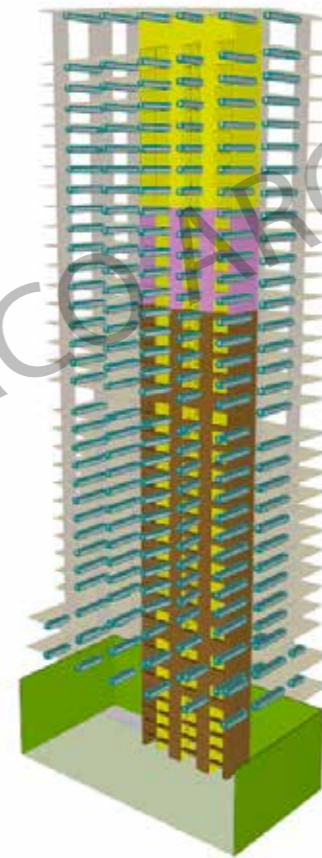
< 73% NET-TO-GROSS EFFICIENCY

VERSION 1
Core walls



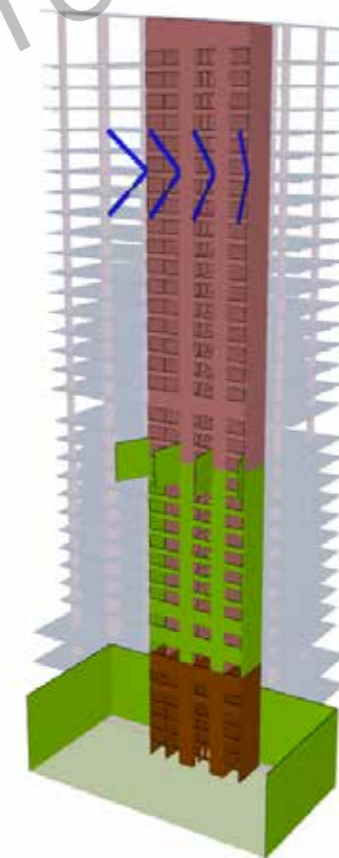
77% NET-TO-GROSS EFFICIENCY

VERSION 2
Core walls & Beams



79%

VERSION 3
Core and double outrigger
(steel/concrete)



82%

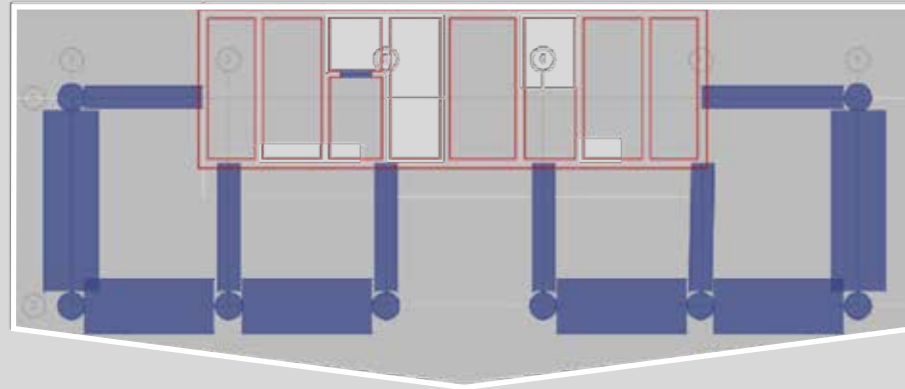
VERSION 4
Core and double outrigger
(concrete)



81% NET-TO-GROSS EFFICIENCY

OPTIMIZED FRAME

CONVENTIONAL RC SLAB / BEAM SYSTEM

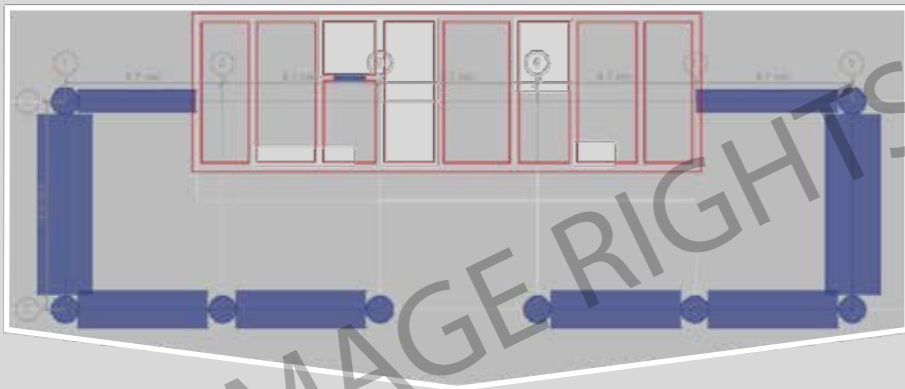


RC Band Beam Depth:
550-600 mm

RC Slab Thk.
300 mm

RC Shear Wall Thk:
500 mm

OPTIMIZED PT SLAB / BEAM SYSTEM



RC Band Beam Depth:
350-400 mm

PT Slab Thk.
200 mm

RC Shear Wall Thk:
500 mm

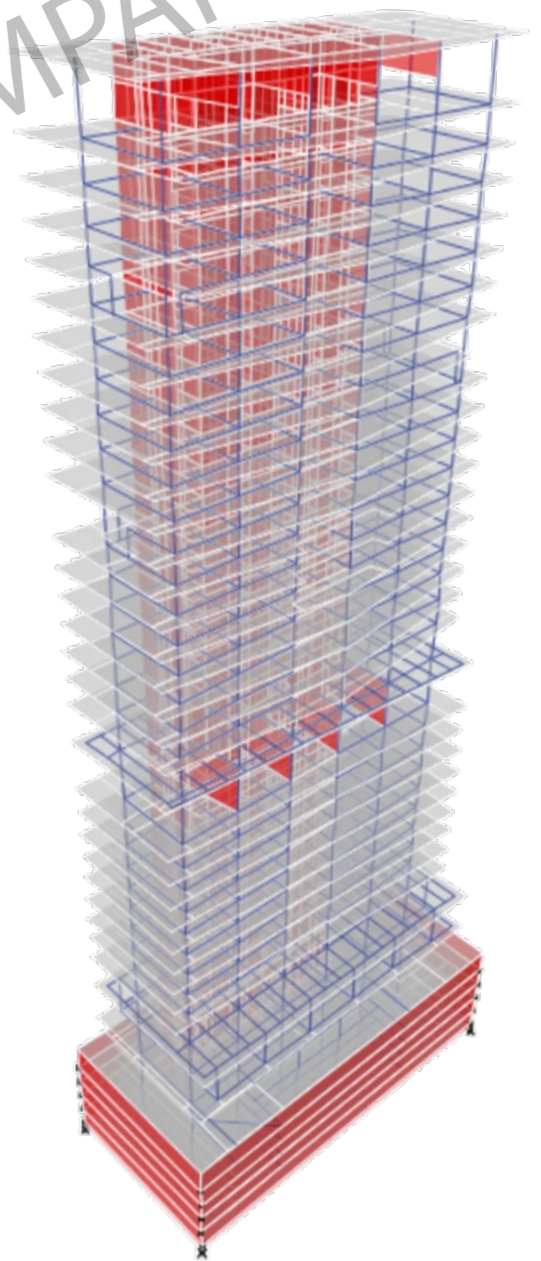
During DD stage Meinhardt continued the optimization and reviewed the impacts of using 200mm post-tensioned slab in lieu of 300mm RC slabs at typical floors

ACHIEVED EMISSION BENEFITS

A POST-TENSION SLAB SYSTEM BRINGS SIGNIFICANT EMISSION SAVINGS AND HAS BEEN CHOSEN TO BE IMPLEMENTED



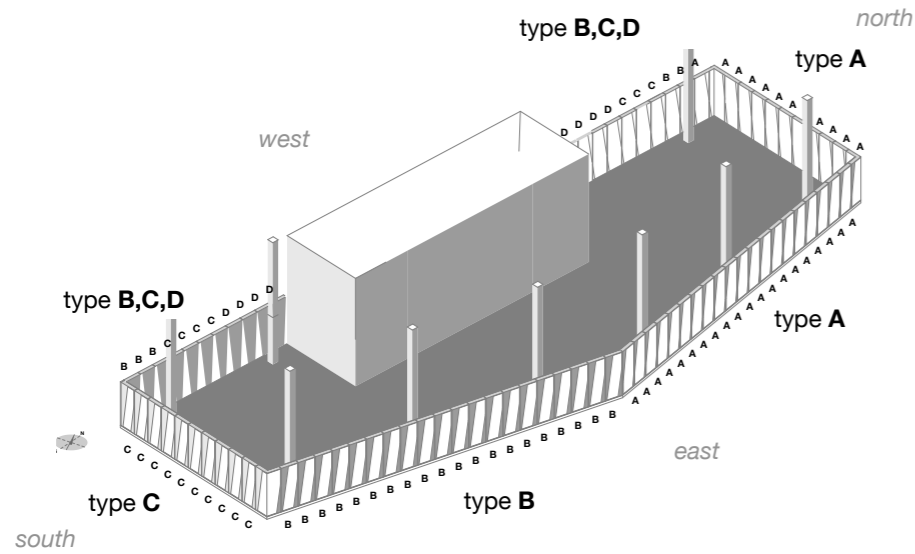
- ↓ 29% less reinforcement in columns
- ↓ 11% less reinforcement in core
- ↓ 28% less reinforcement in slab and beam
- ↓ 42% less concrete in slab and beams
- ↑ 200 mm more free height enables reduction in floor to floor height



A

ENVELOPE # 1

A

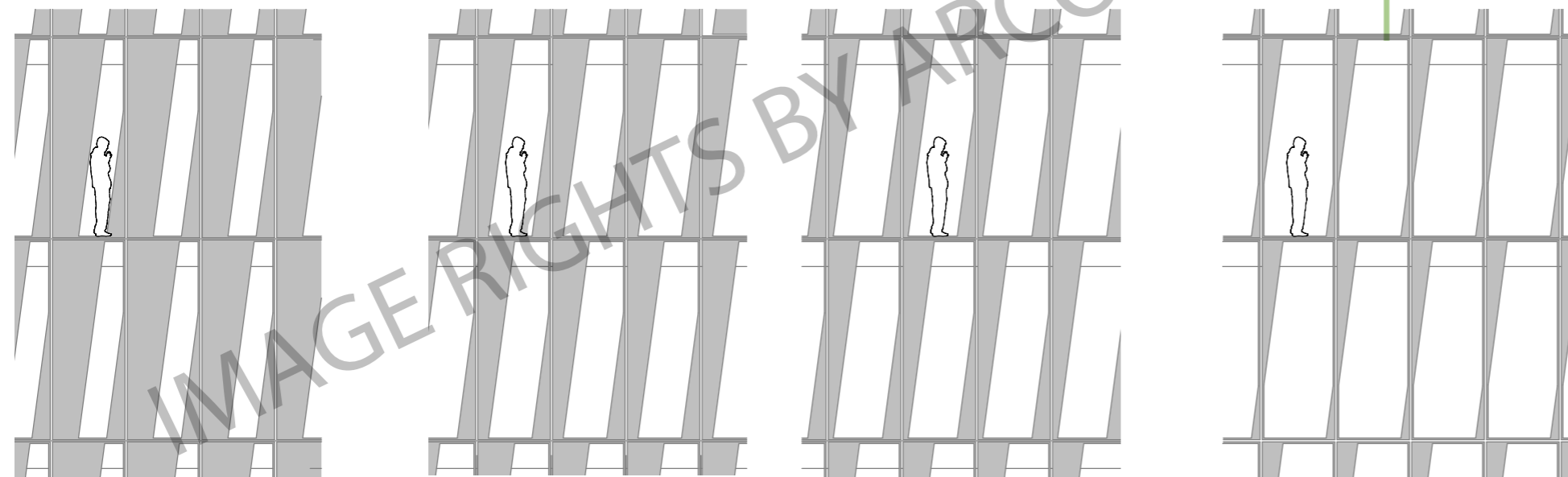


CONCEPT 1 CLIMATE RESPONSIVE FACADE

MODULAR INSULATED UNITIZED CURTAIN WALL FACADE WITH 4 GRADES OF OPENESS (CLEAR VISION / METAL CLADDING) TO REACT ON DIFFERENT SOLAR EXPOSURE

LOW MATERIAL EFFICIENCY
DUE TO POLYGONAL SHAPES:
GLASS AND METAL CUT OFF

DRAWBACK

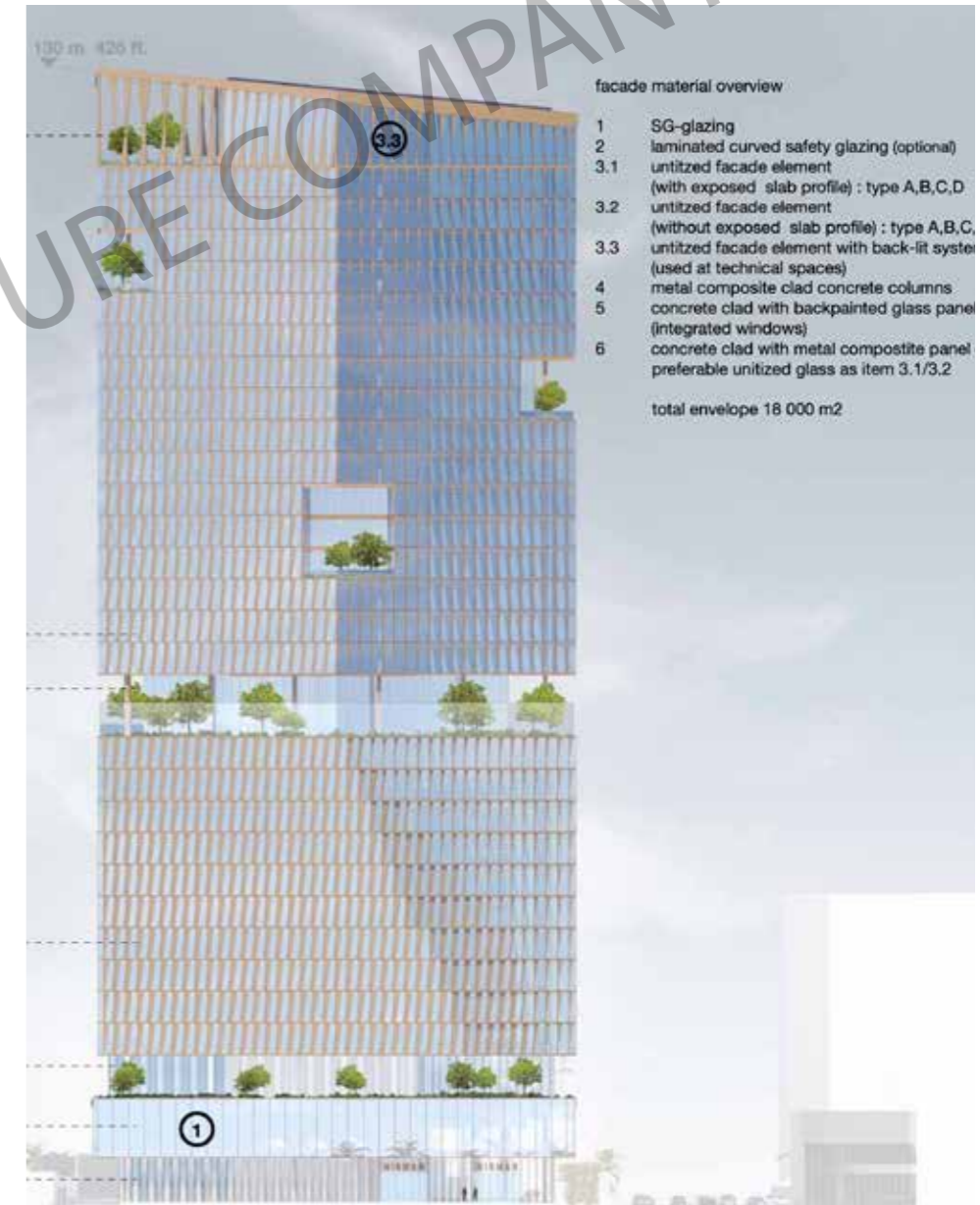


D
facade west
30 % openess

C
facade s/e & south
48 % openess

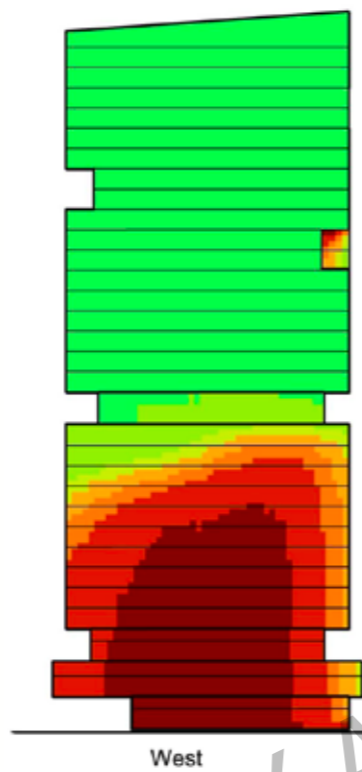
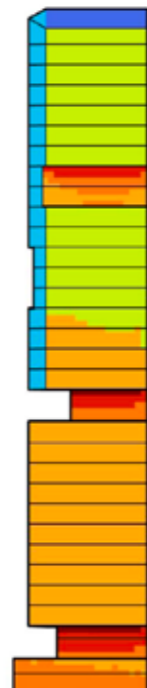
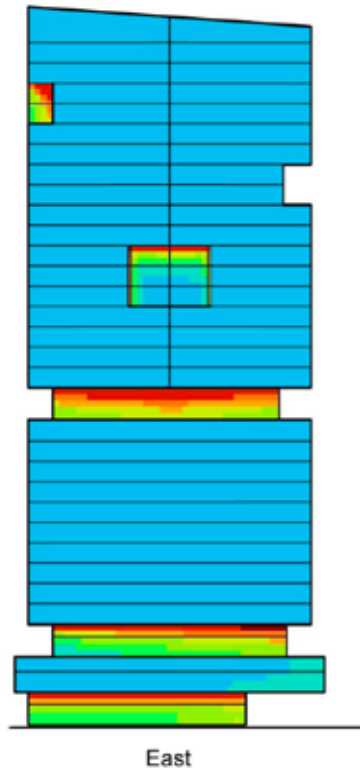
B
facade n/e
55 % openess

A
facade north
70 % openess



ENVELOPE # 2

A



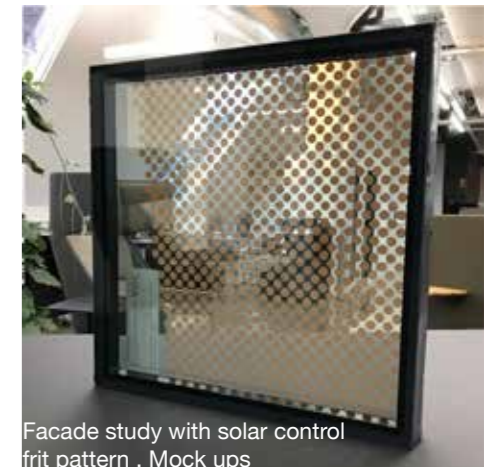
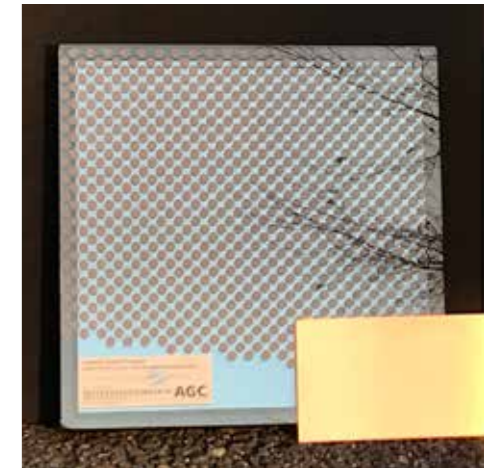
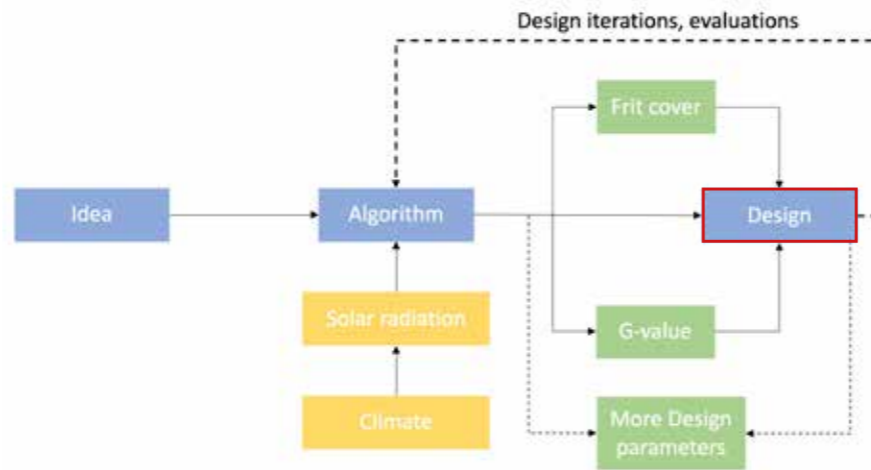
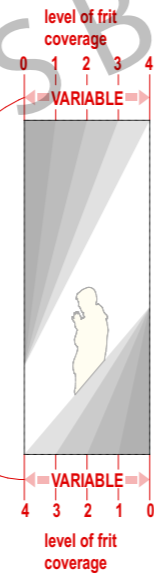
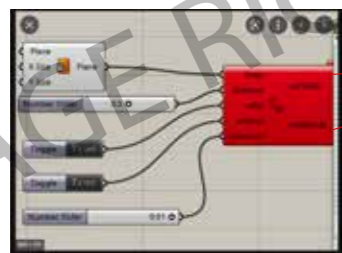
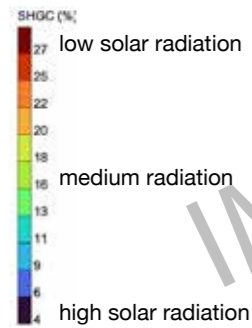
CONCEPT 2 CLIMATE RESPONSIVE FACADE

MODULAR INSULATED UNITIZED
CURTAIN WALL FACADE
WITHOUT METAL CLADDING
BUT CERAMIC FRIT

DATA-DRIVEN
DESIGN:

USING CLIMATE
INFORMATION
DIRECTLY FOR
FACADE DESIGN

AND TO REDUCE
COOLING LOAD



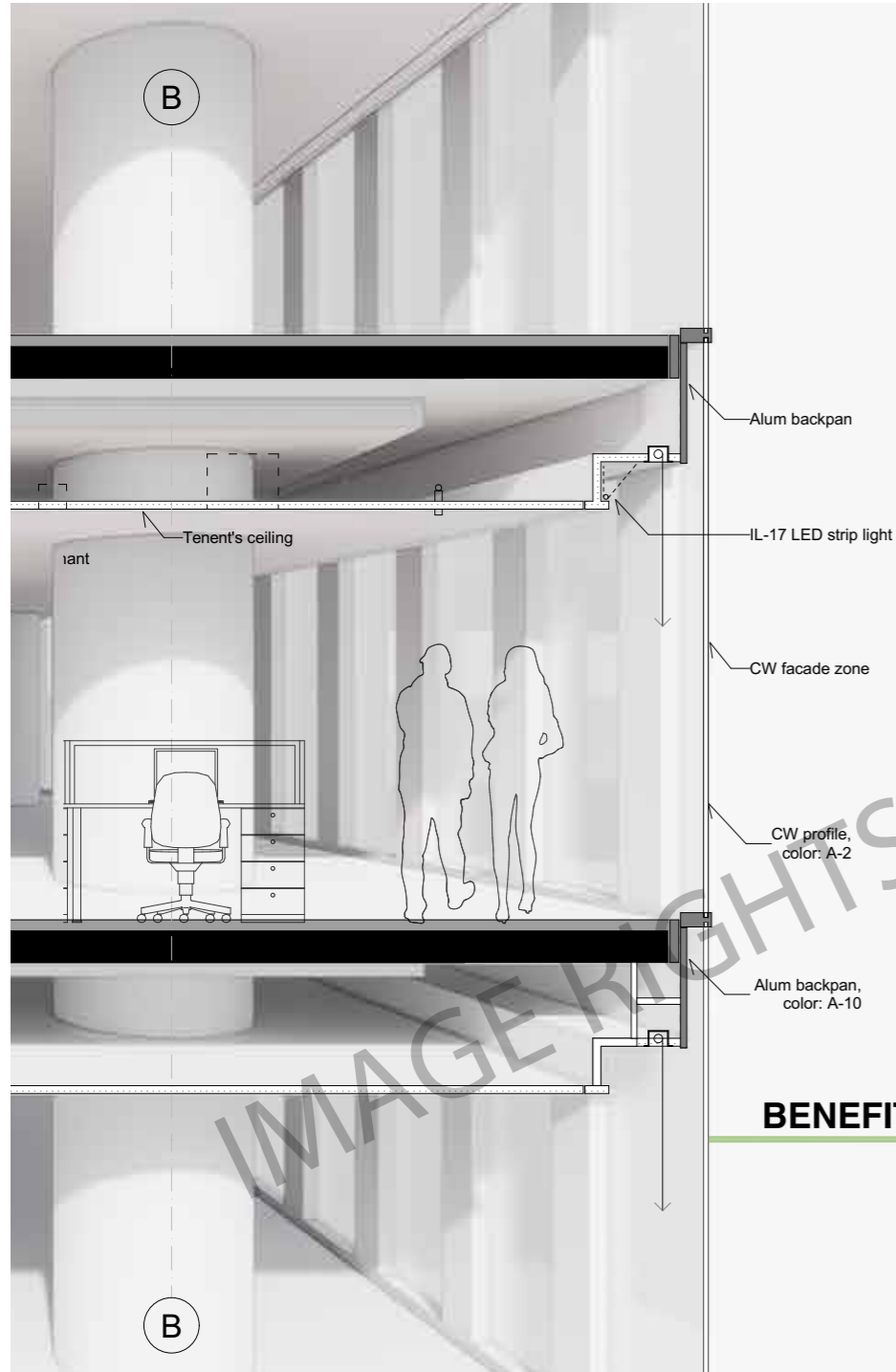
ENVELOPE # 2

A



ENVELOPE # 3

A



CONCEPT 3 ENERGY AND MATERIAL EFFICIENT FACADE

MODULAR INSULATED UNITIZED
CURTAIN WALL FACADE
WITH A RECTANGULAR CLEAR VISION
AND
COPPER LOOK METAL CLADDING

FLOOR TO FLOOR
DOUBLE GLAZED INSULATED
1352 X 3700 MM
SOLAR PROTECTION
NOISE PROTECTION
PREFABRICATED
MODULAR

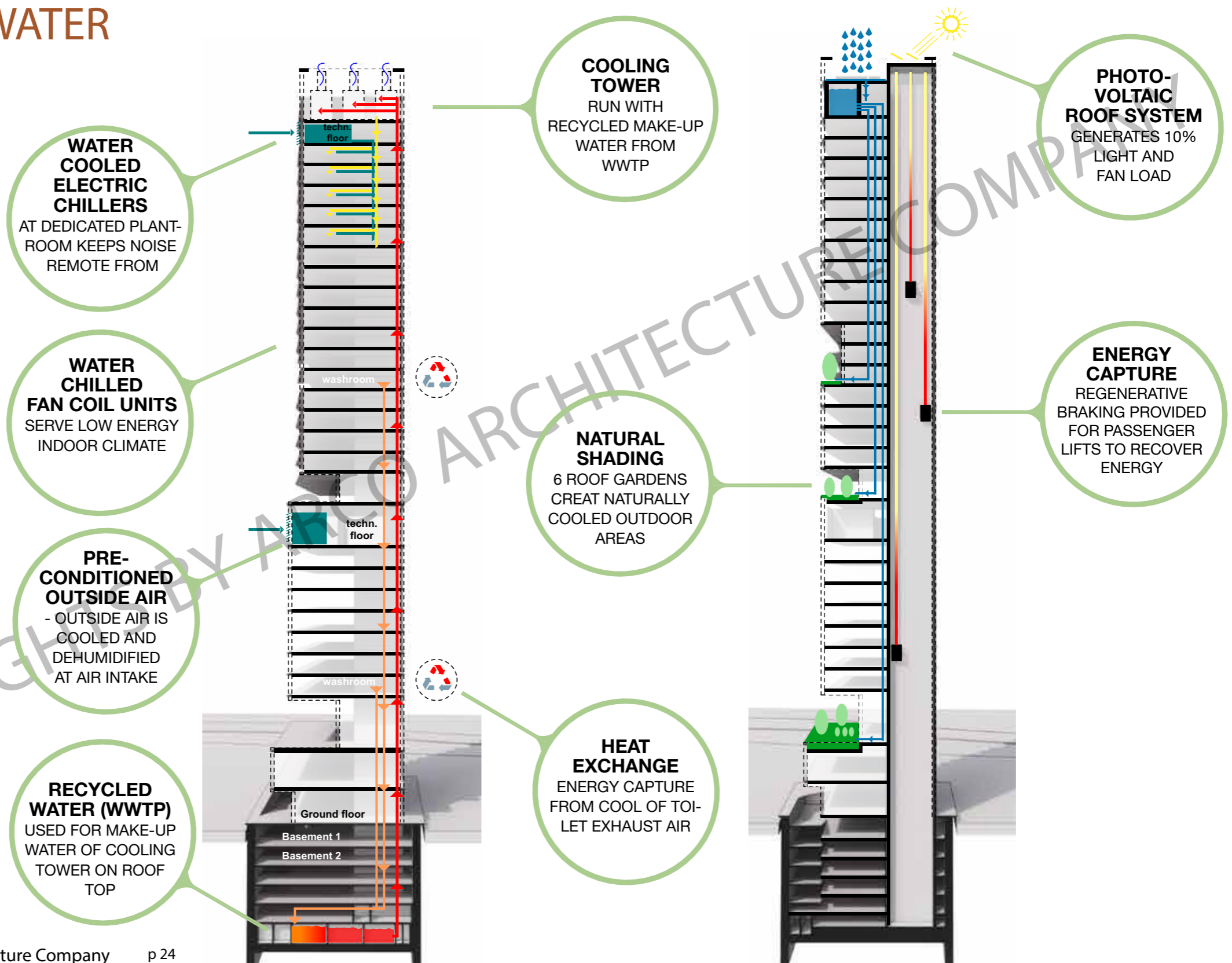
BENEFIT

**HIGH
MATERIAL
EFFICIENCY**
DUE TO SIMPLIFIED
RECTANGULAR
SHAPE



MEP - ENERGY AND WATER

The MEP design goes beyond the typical regional standards to fulfill LEED Gold targets of the client.



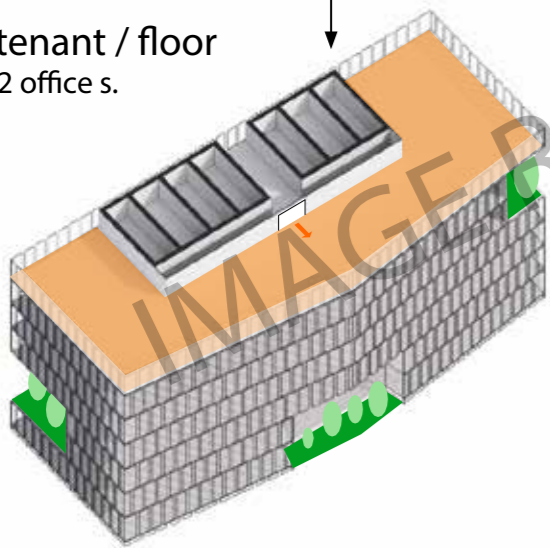
ADAPTABILITY = SUSTAINABILITY

Mirai is multifunctional high-rise:
delivering international-grade offices, high-end restaurants,
retail showrooms, green spaces and more. But it's also a
building designed for adaptability.

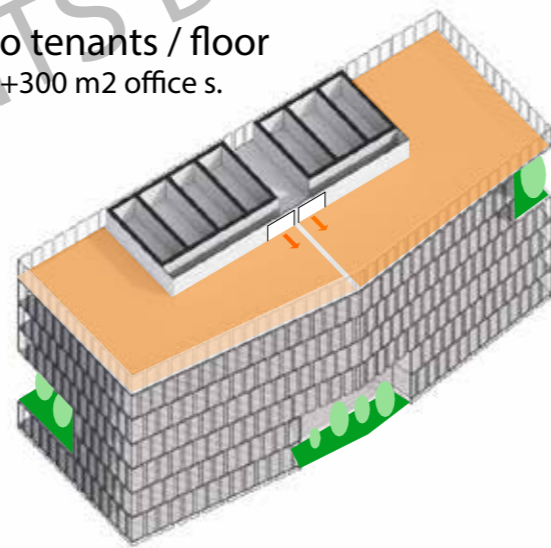
Flexible floorplan layouts allow for various user
scenarios which increase the building lifespan a main
driver for sustainability.

Strategically located compact core allows a
wide range of future interior developments

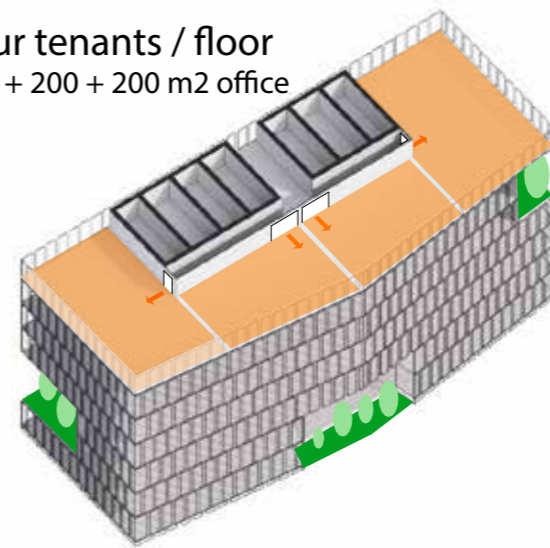
One tenant / floor
600 m2 office s.



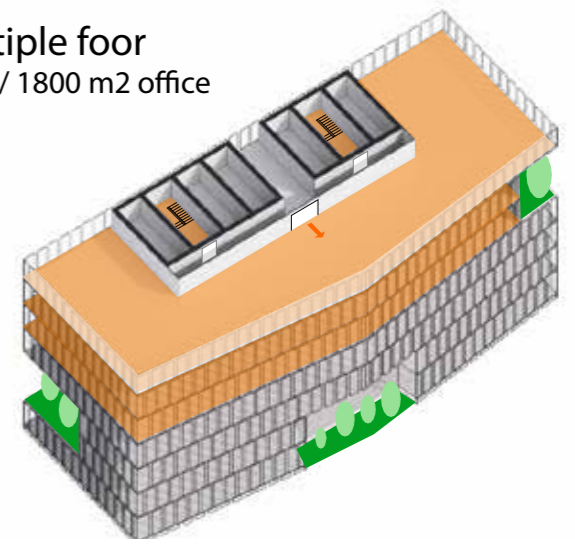
Two tenants / floor
300+300 m2 office s.



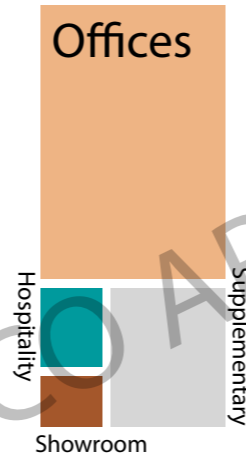
Four tenants / floor
200 + 200 + 200 m2 office



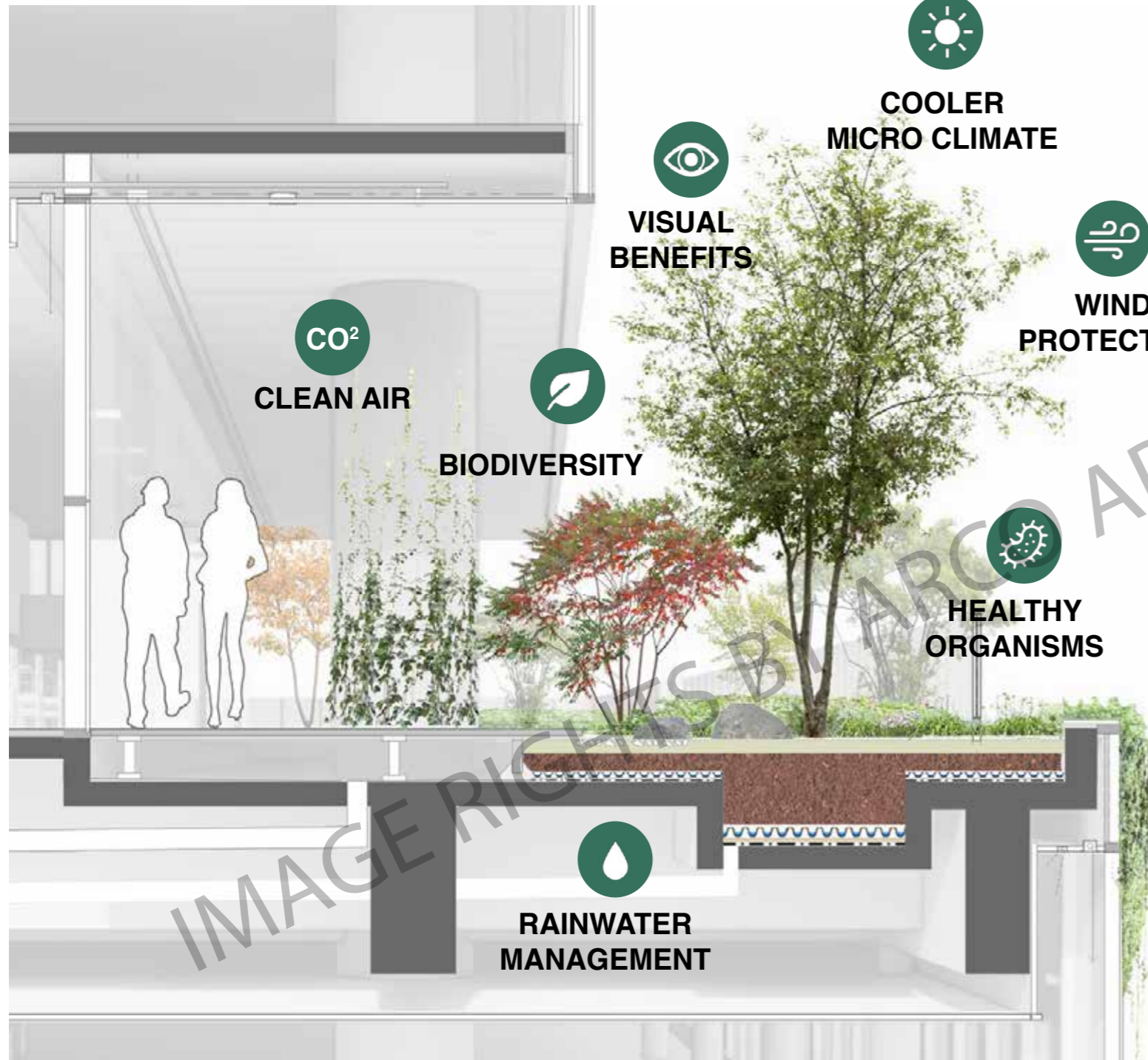
Multiple floor
1200 / 1800 m2 office



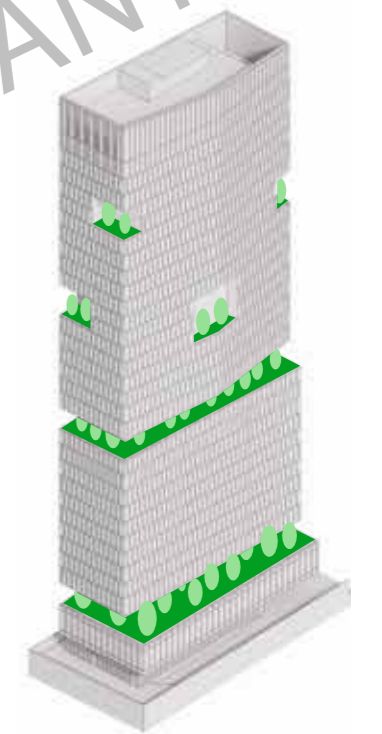
Functional mix allows for a
24/7 user activity



GREEN SPACES

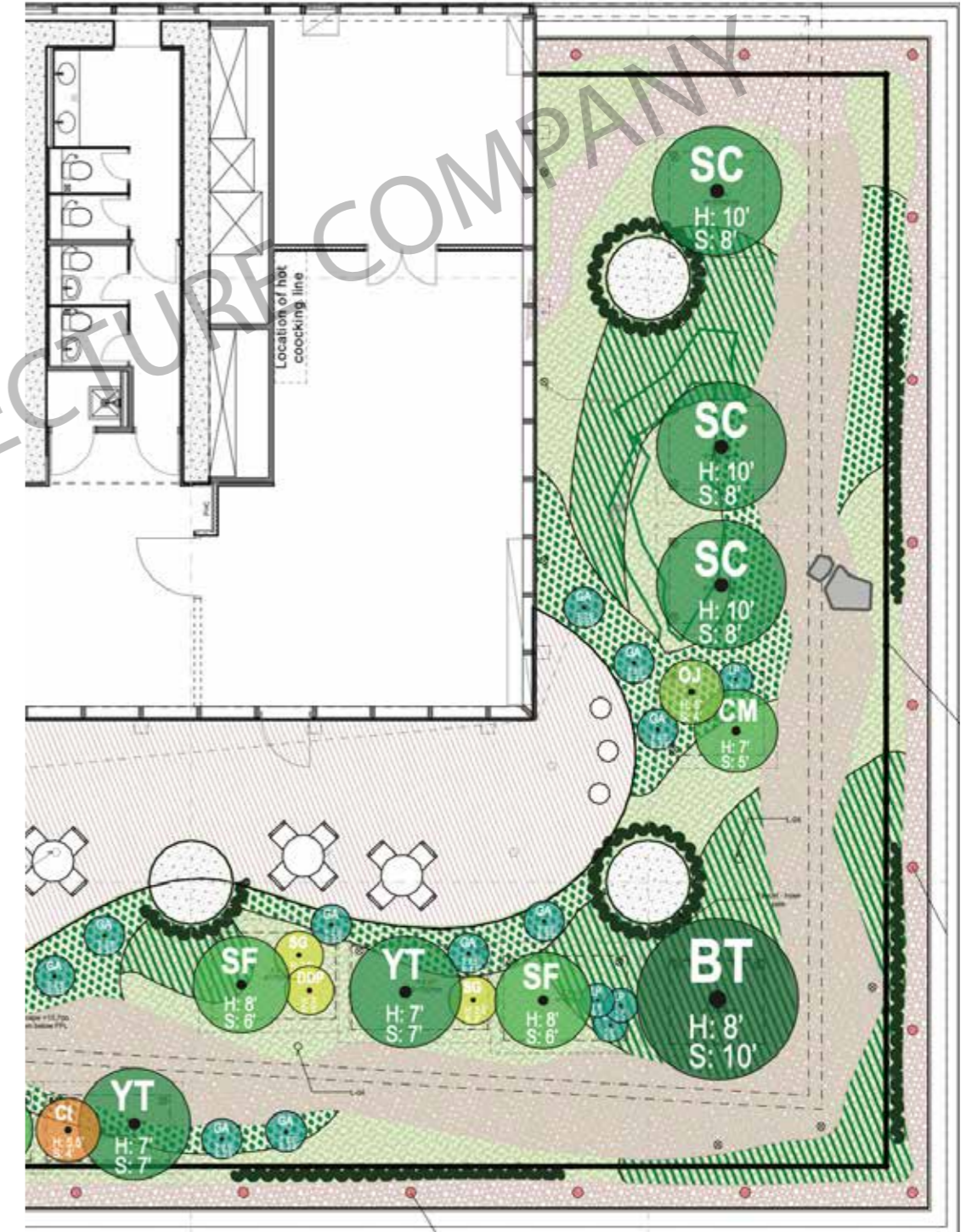


Green rooftops and pocket gardens are an important design element of MIRAI. The goal is to create lush green environments by using drought tolerant local vegetation to boost natural shading element and biodiversity



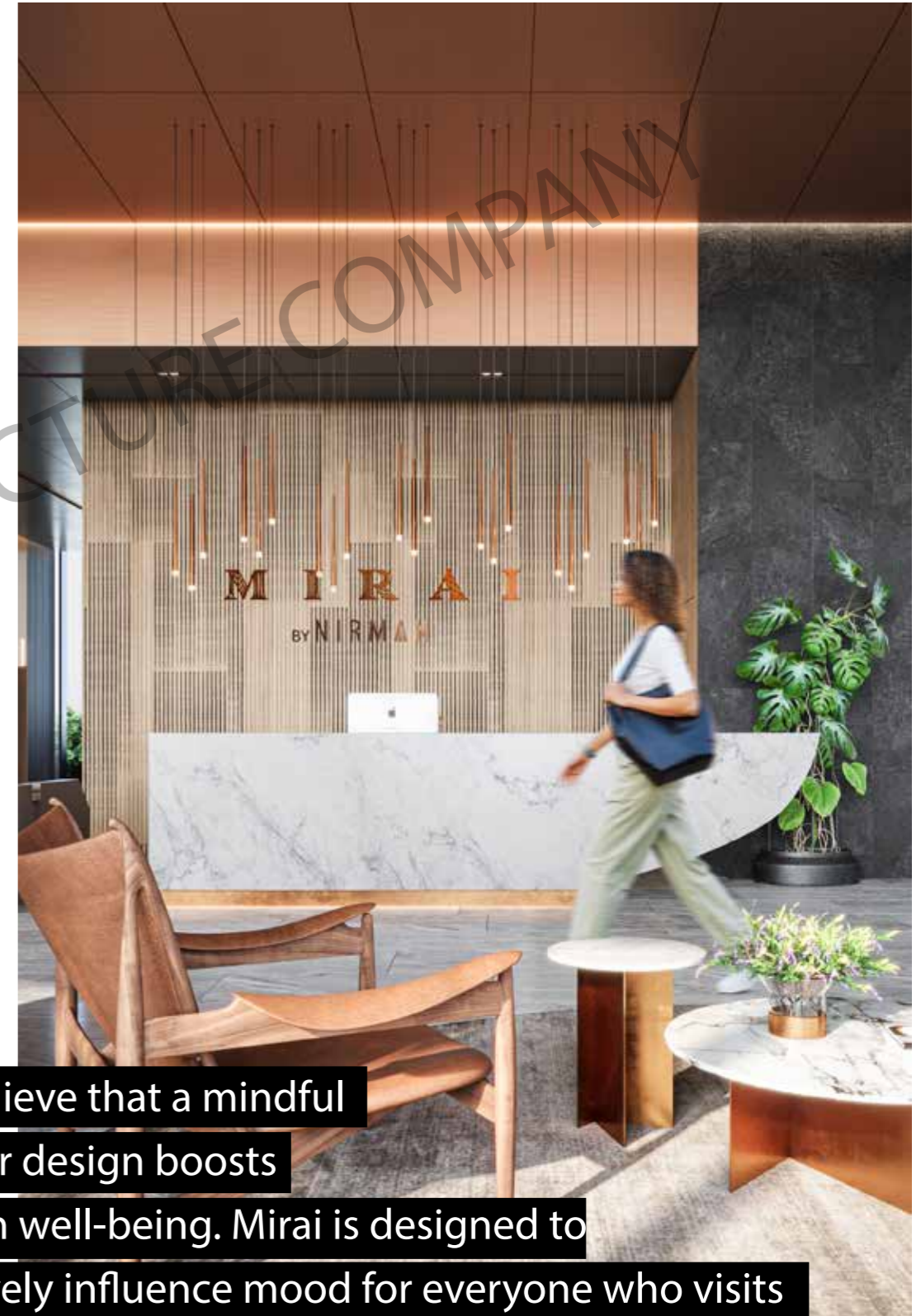
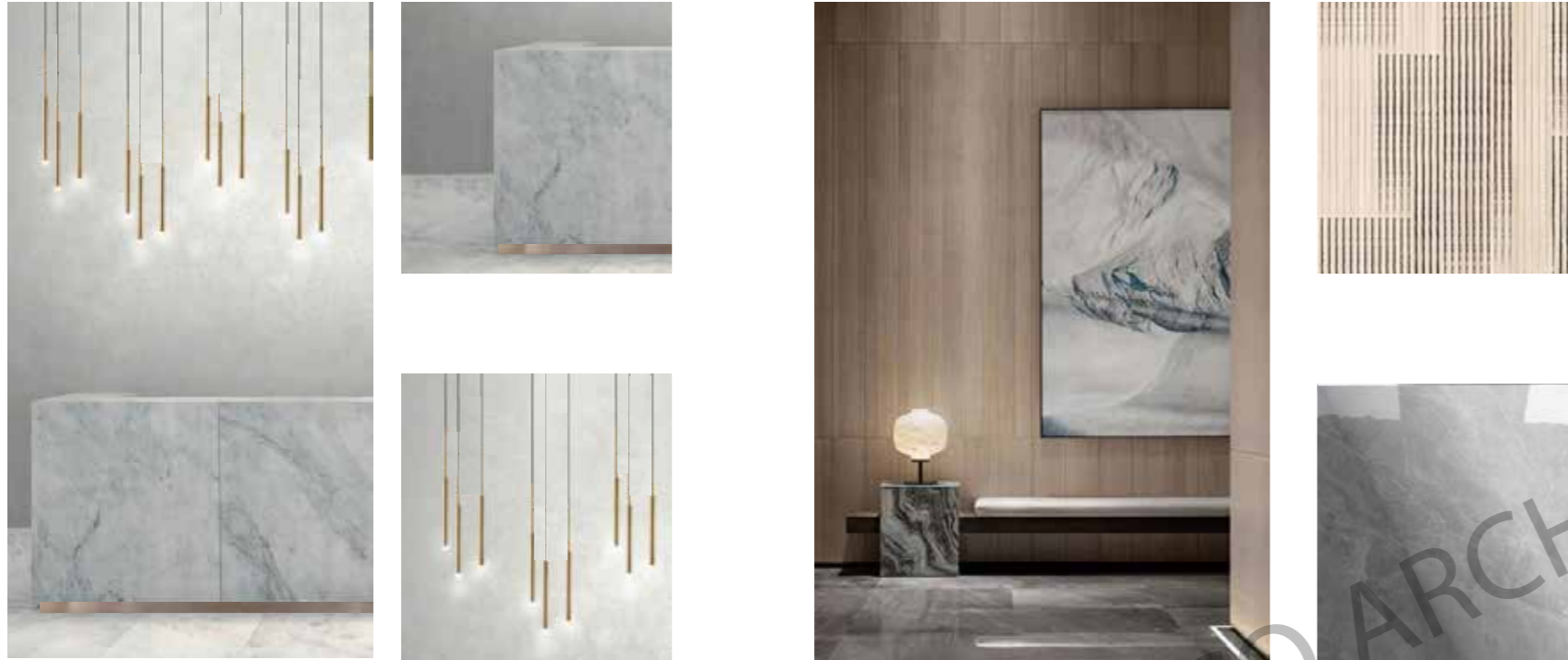
GREEN SPACES

Accessible exterior spaces with green environments will add a notable value for the user. In addition to that it highlights the green ambition within overall look of the building



plantation layout by IKEBANA-LANDSCAPE

HUMAN WELL-BEING



We believe that a mindful interior design boosts human well-being. Mirai is designed to positively influence mood for everyone who visits

ARCO

Helsinki

Salomonkatu 17 A
00100 Helsinki

Tampere

Satakunnankatu 18 A
33210 Tampere

Turku

Eerikinkatu 12 B
20100 Turku

Oulu

Kauppurienkatu 24 A2
90100 Oulu

CONTACT

Stefan Ochsner, Senior Architect

stefan.ochsner@arco.fi

+358 45 638 7017

