TU Delft | Architecture and the Built Environment
BK Bouwkunde

public building

Shared Grounds

a landscape of intergenerational learning and exchange!

Sanjana Habde | Graduation Project

Public Building Studio, Copenhagen

An exploration of re-adapting an existing building into an intergenerational public space!

01 Contextual study of Haraldsgade

COPENHAGEN

SYMBOLIC IDENTITIES

NYHAVEN

THE LITTLE MERMAID

CITY CENTER

HARALDSGADE NEIGHBORHOOD

COPENHAGEN'S INDUSTRIAL PAST TURNING RESIDENTIAL!

INDUSTRIAL PAST

TRANSFORMING THE PAST INTO HOUSING

STREETS GRID AND PATTERNS

MAPPING DIVERSE USER GROUPS
IN HARALDSGADE NEIGHBORHOOD

BOLSJEFABRIKKEN IS A CULTURAL CENTER FOR NON-PROFIT MUSIC AND EVENTS

YOUNGSTERS

CPH VILLAGE IS A STUDENT AND WORKING PROFESSIONALS HOUSING

STUDENTS

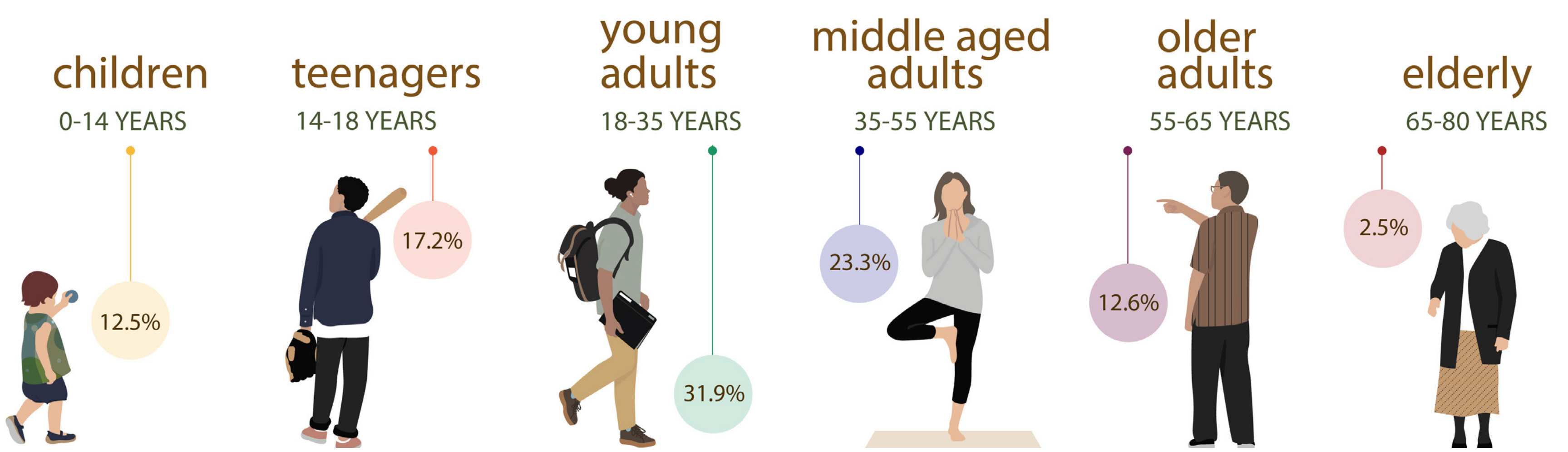
RORT IS A YOGA AND MOVEMENT COMMUNITY SPACE

FAMILIES

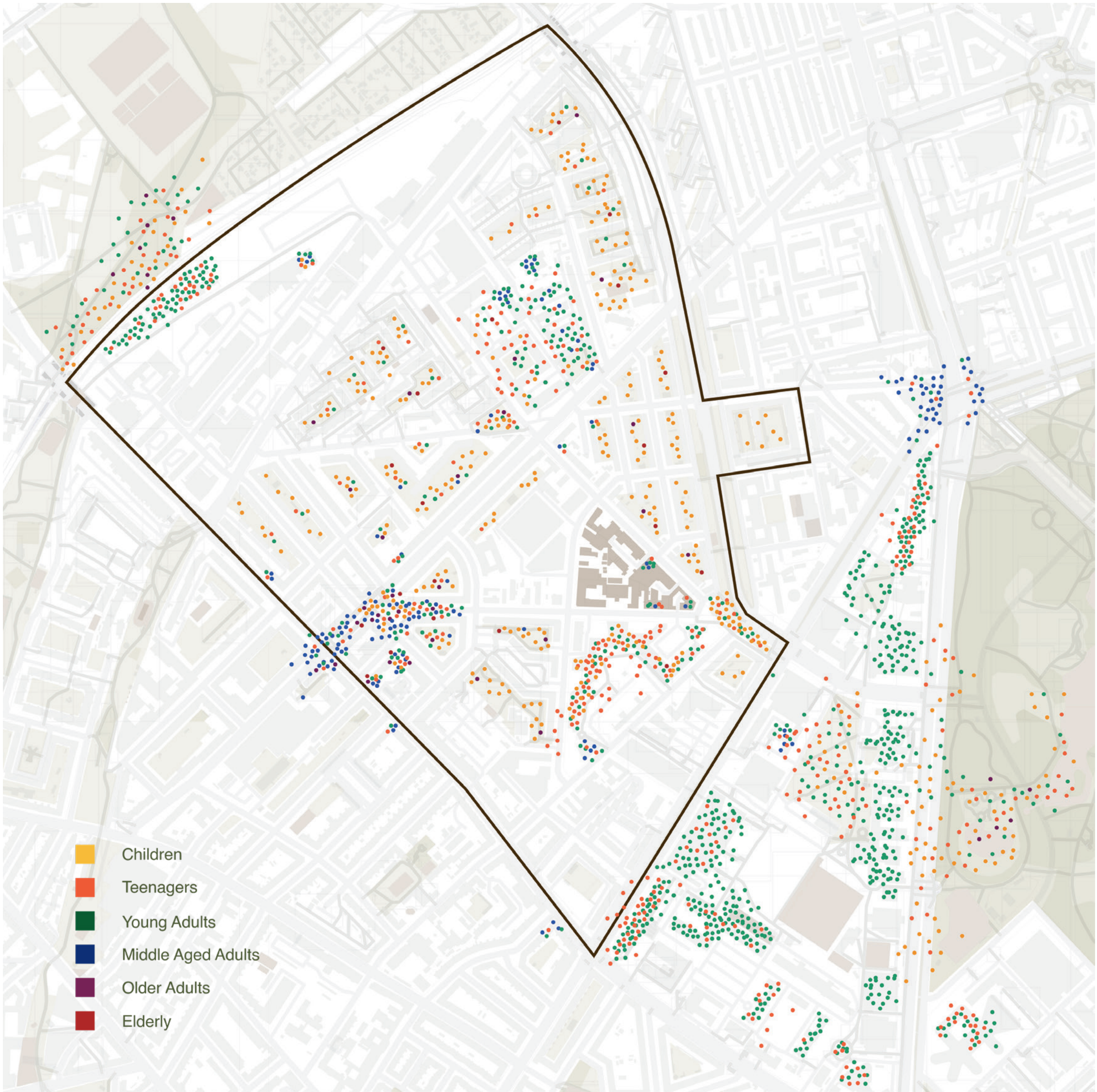
ELDERLY INDIVIDUALS SPENDING TIME WITH THIER KIDS IN THE PARK

ELDERLY

MAPPING DIVERSE USER GROUPS IN HARALDSGADE NEIGHBORHOOD

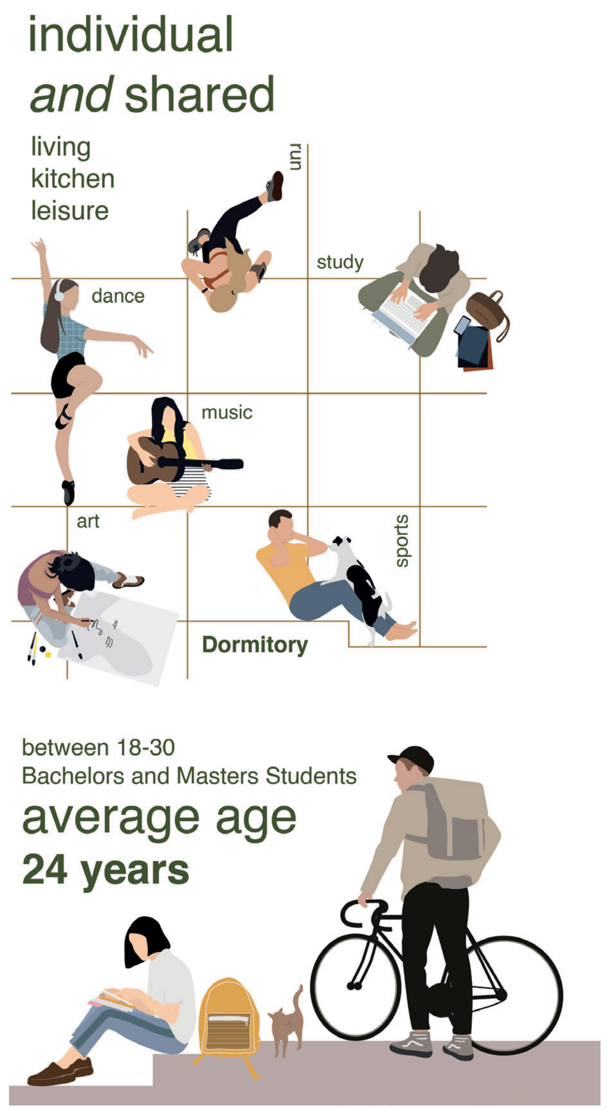


STATISTICS OF ALL USER GROUPS IN THE NEIGHBORHOOD



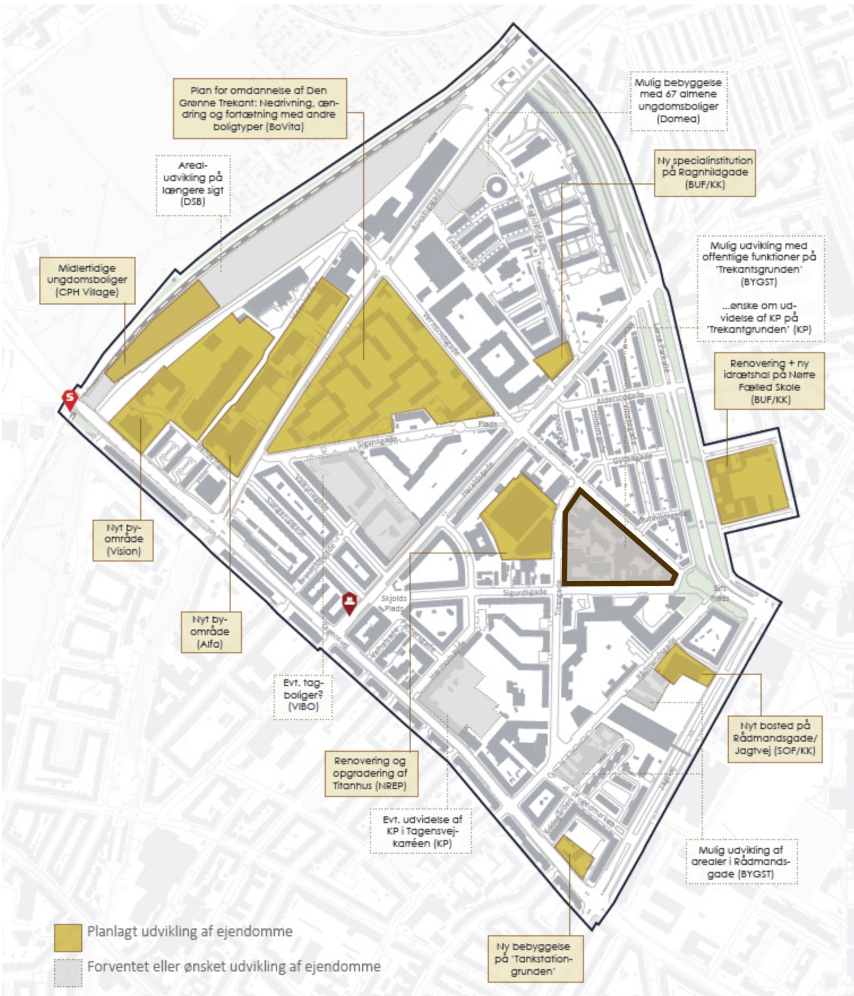
MAPPING MOVEMENT PATTERNS OF ALL USER GROUPS

ANALYZING THE RELATIONSHIP BETWEEN UNIVERSITY BUILDINGS AND STUDENT MOVEMENT



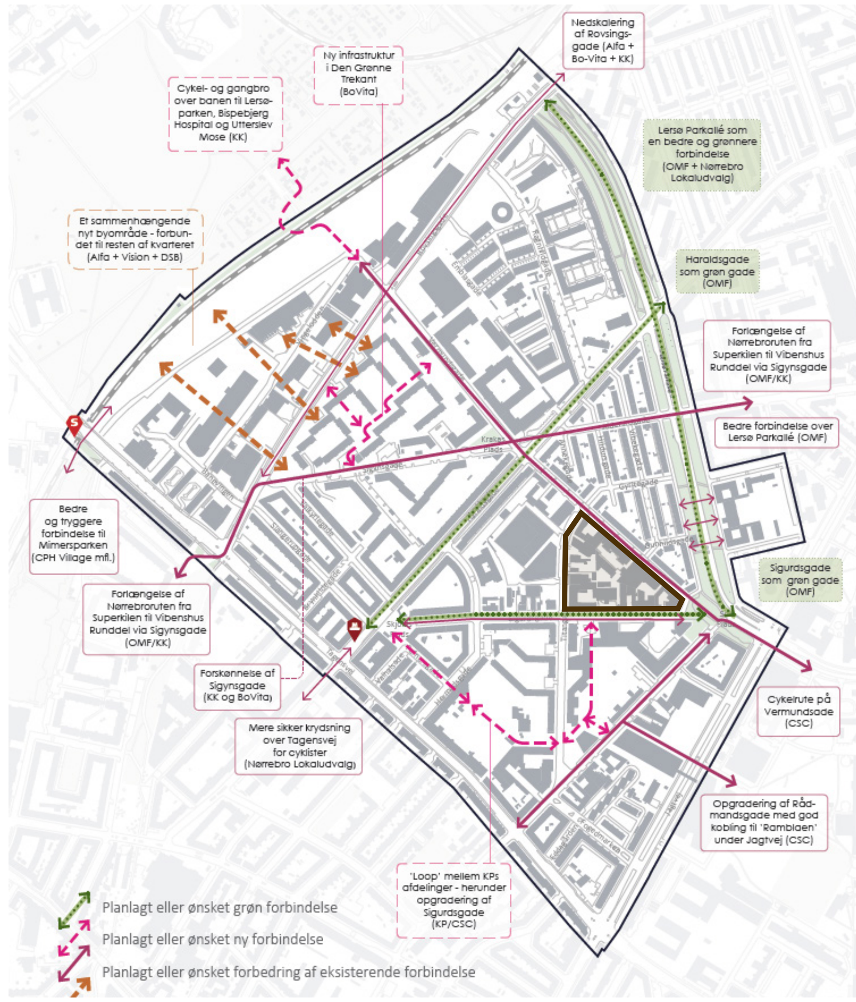
RESEARCH POSSIBILITY

NEIGHBORHOOD RENEWAL PLANS



UNDER DEMOLISION
“POSSIBLE DEVELOPMENTS WITH PUBLIC FUNCTION”
STUDY SPACE FOR STUDENTS + HOUSING + ACTIVITY ZONES

IMPROVED CONNECTIVITY TO THE GREEN



IMPROVED CONNECTIVITY OF THE JUNCTION +
NEW BUILDINGS TO OPEN UP TO THEIR SURROUNDING

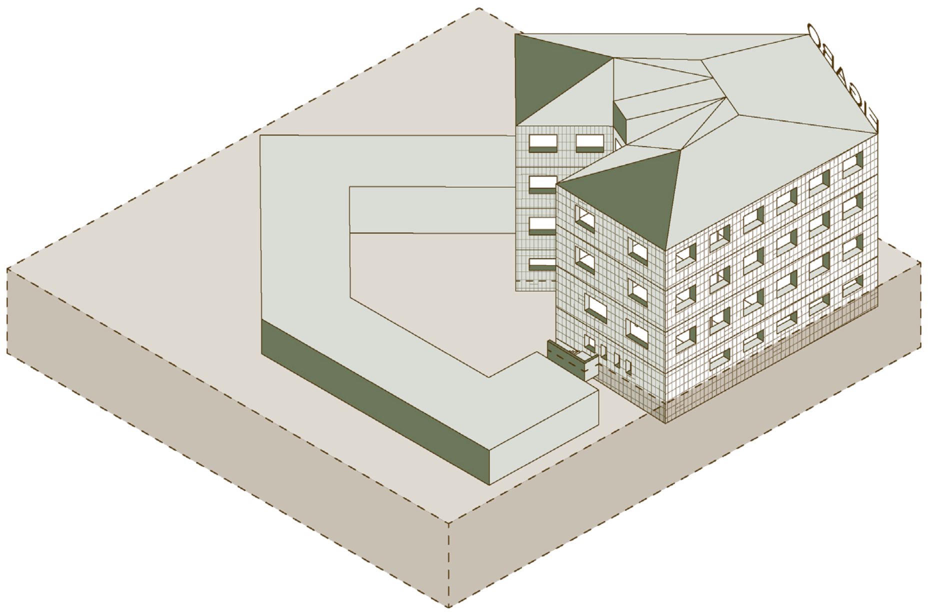
PROJECT SITE

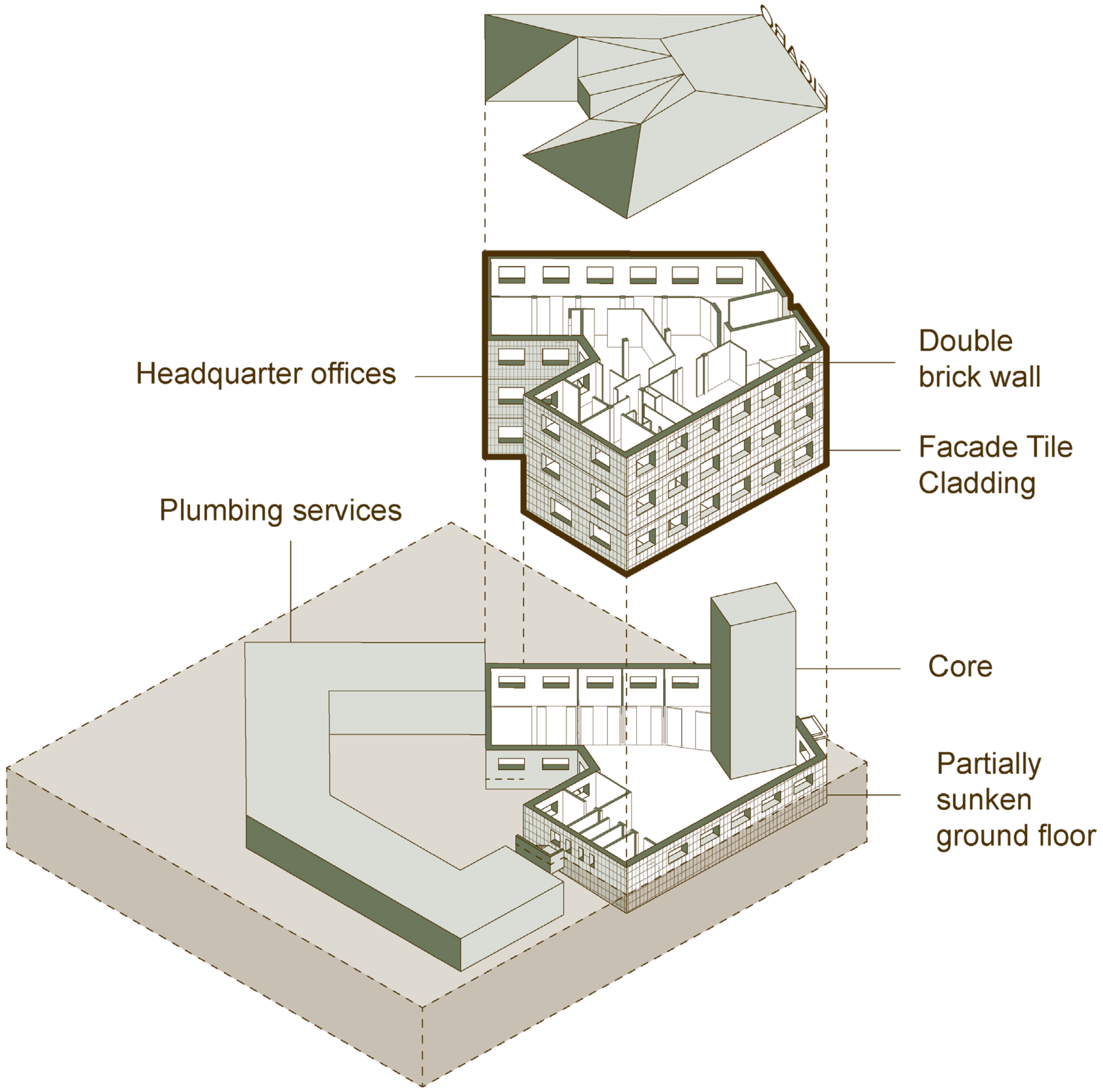
FIGARO IS CENTRALLY LOCATED WITH EDUCATIONAL INSTITUTIONS ON ONE HAND AND RESIDENTIAL ZONE TO THE OTHER

UNDERSTANDING FIGARO

Figaro, a factory and is the
Headquarter of the Danish Hair Dressers &
Cosmeticians Associations, 1935

In response to a conflict, the organization constructed an octagonal building resembling a fortress or castle, where Social Democrats and union activists gathered to have their hair cut.





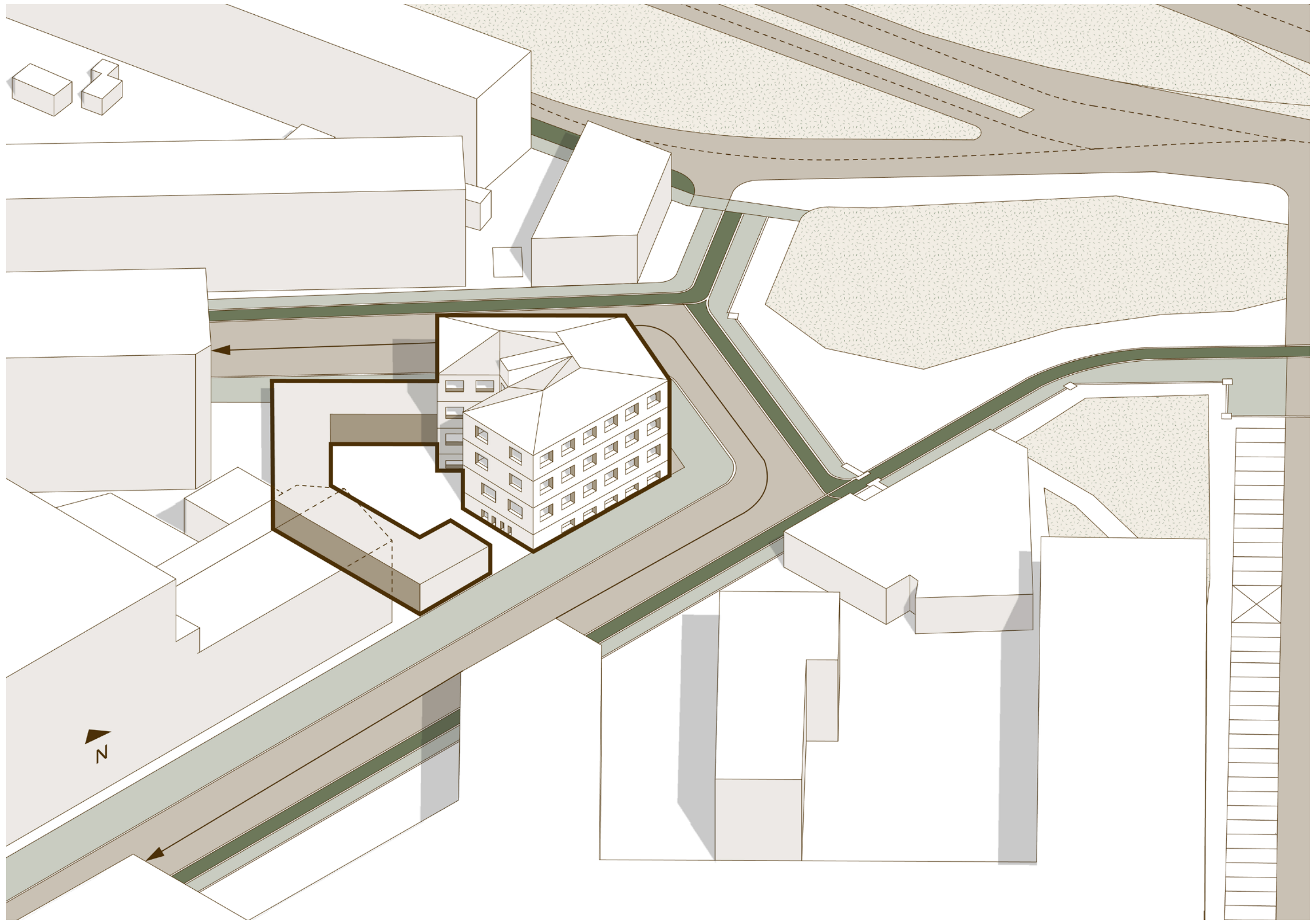
UNDERSTANDING FIGARO'S URBANSCAPE

FIGARO	ROAD ACCESS FOR CARS	PEDESTRIAN ZONE AND GREENSCAPES	CYCLE AND PEDESTRIAN PATHWAYS
RE USE?	A DIVISION?	ELEVATED? DOES IT HAVE ANY PURPOSEPOSE?	PERIPHERAL MOVEMENT?

How can a public building be designed by readapting Figaro to foster intergenerational learning and collaboration for the community of Haraldsgade?

02 Design Methodologies and Spatial Logic

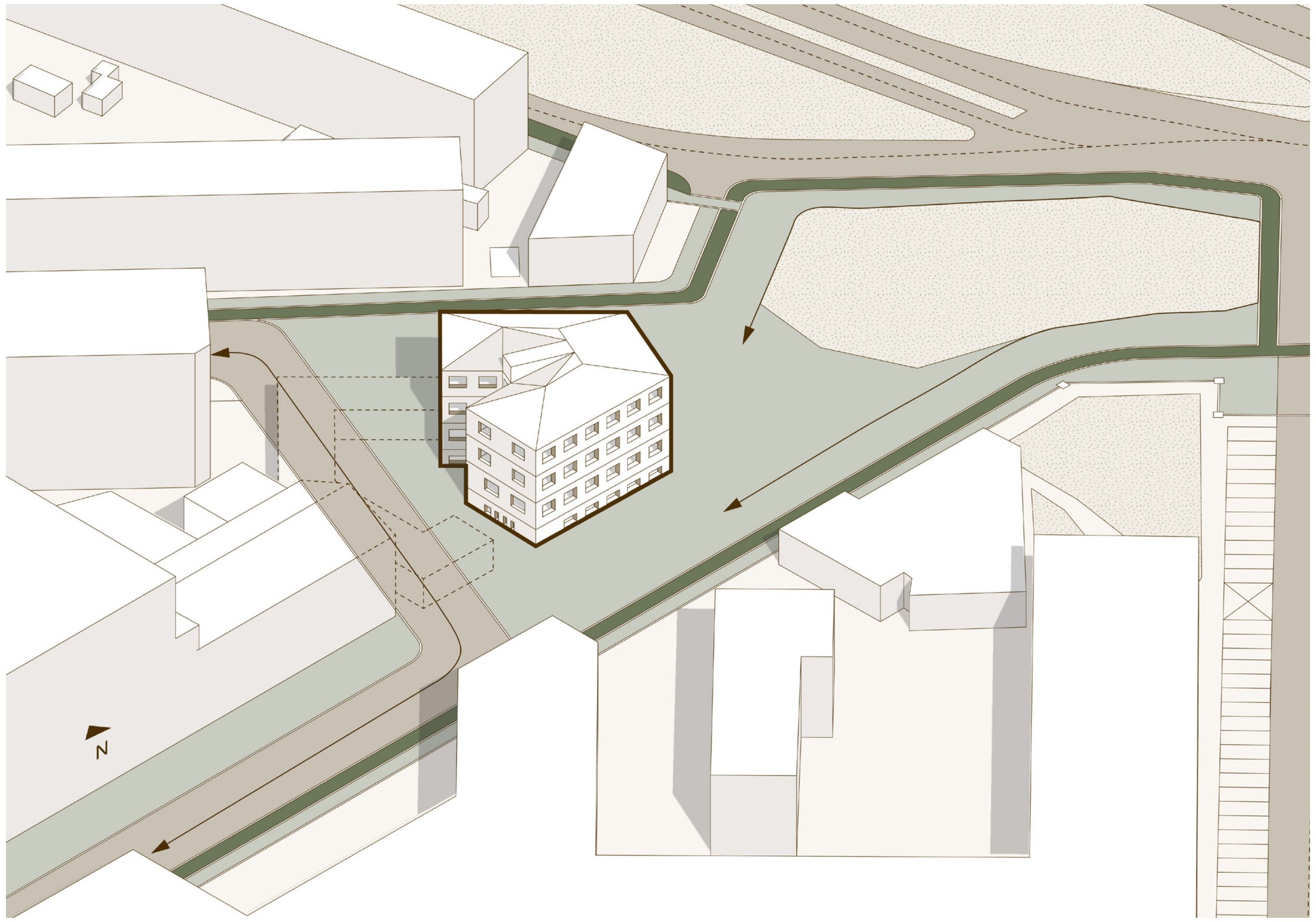
FORM STRATEGIES | 01 CLEAR MOVEMENT



EXISTING URBANSCAPE

existing road, cycle and
pedestrian access

- cycle access
- pedestrian access
- road access

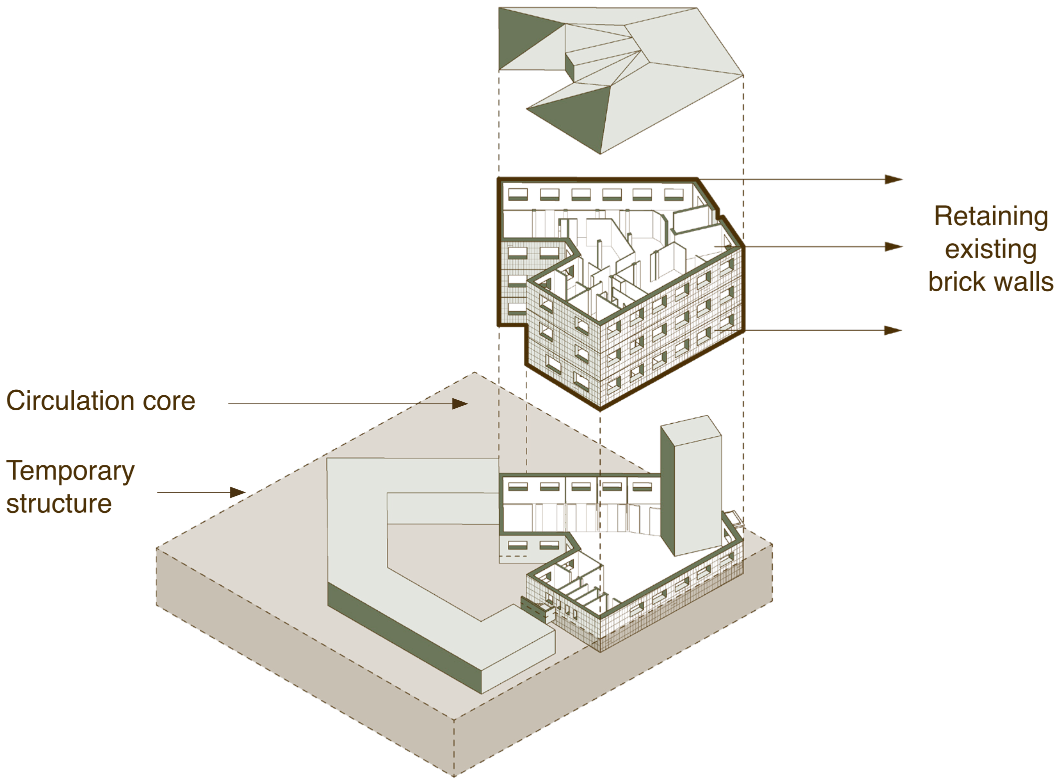


PROPOSED URBANSCAPE

shifting the road and opening up the
building front as a pedestrian zone

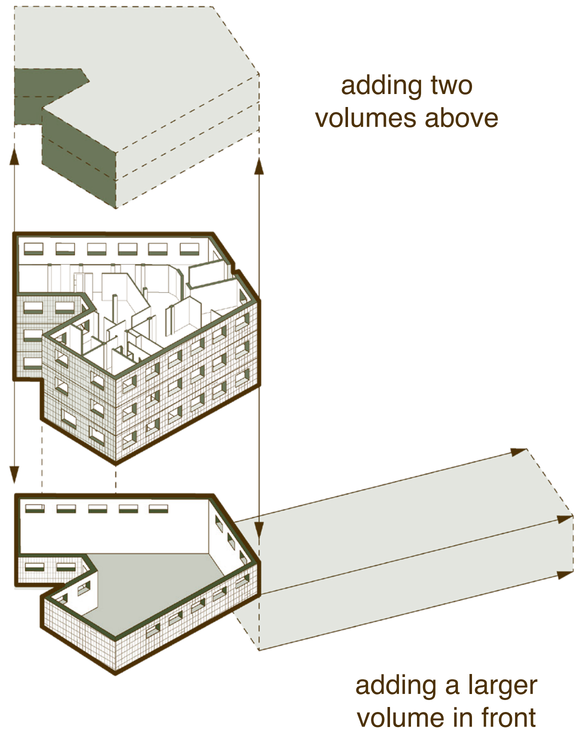
- cycle access
- pedestrian access
- road access

02 FORM TRANSFORMATION



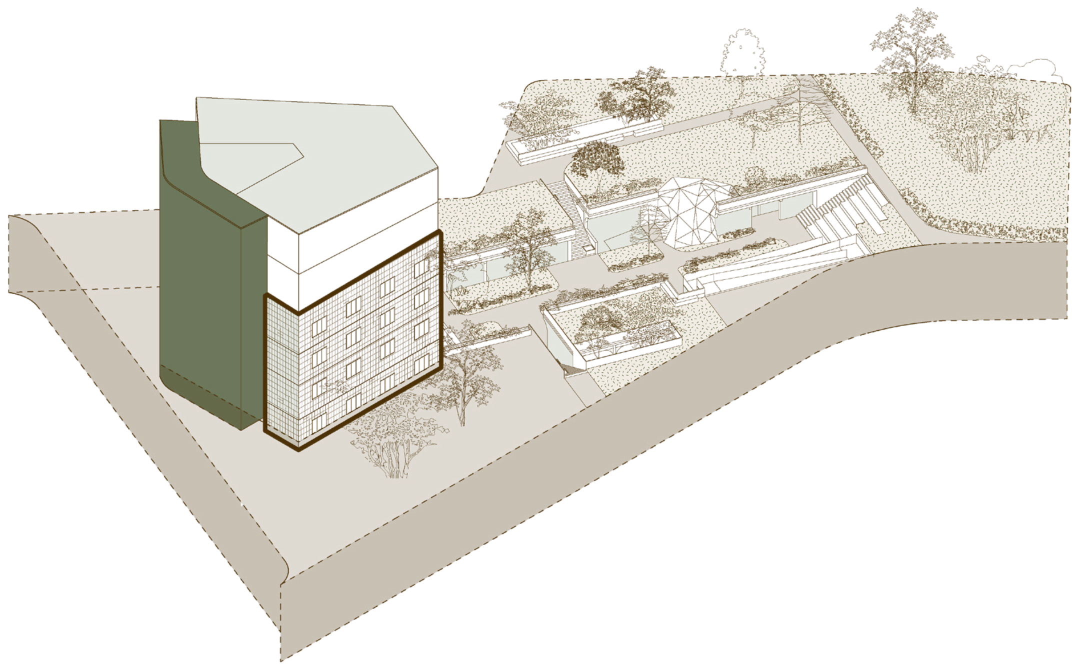
ELIMINATE

Eliminating the circulation core and the adjacent structure



ADD

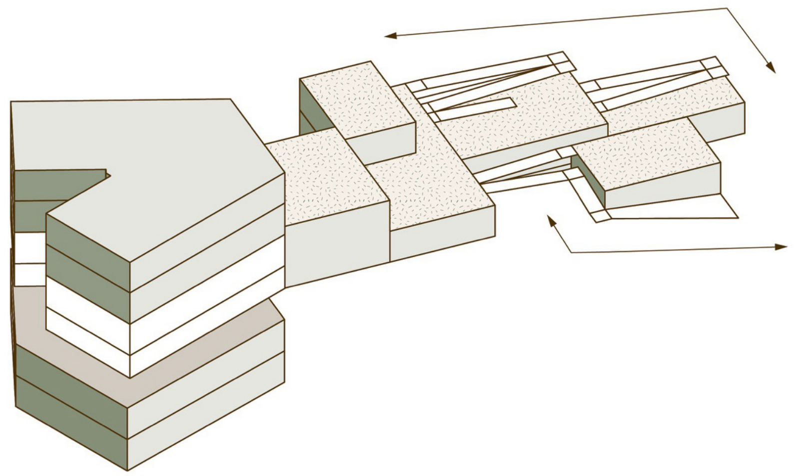
Adding volumes as per new programmatic needs



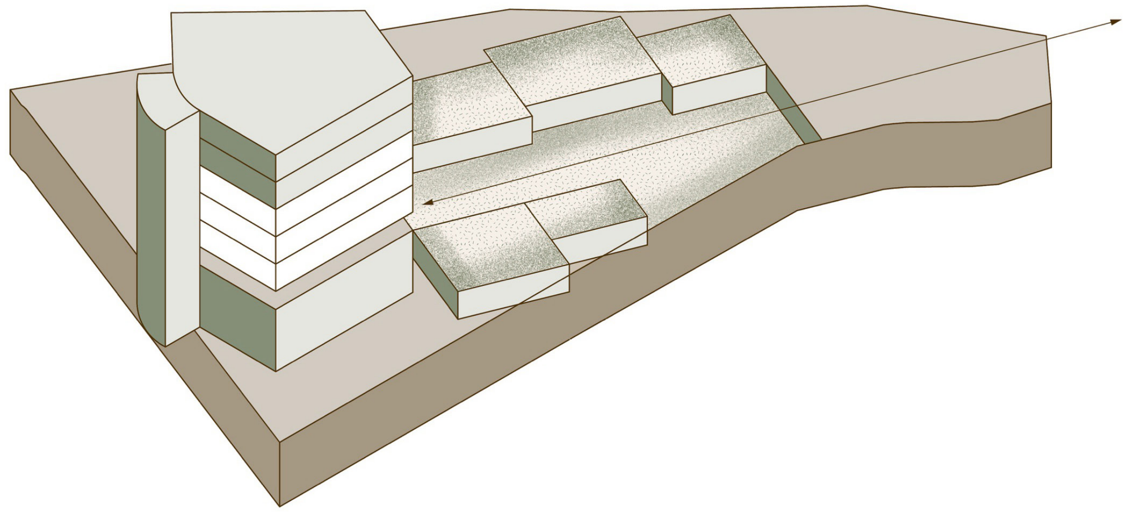
REIMAGINE

Reimagining the front edge as an extended green landscape and pedestrian zone, providing safe and accessible entry for all

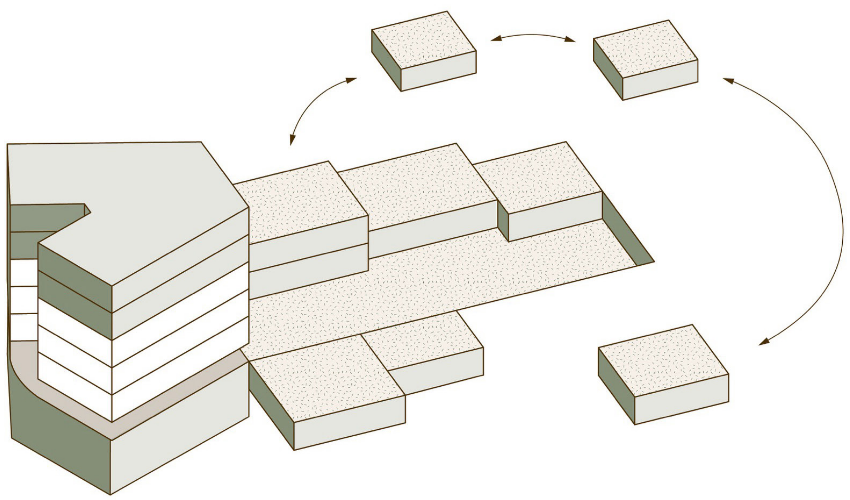
03 LANDSCAPE ITERATIONS



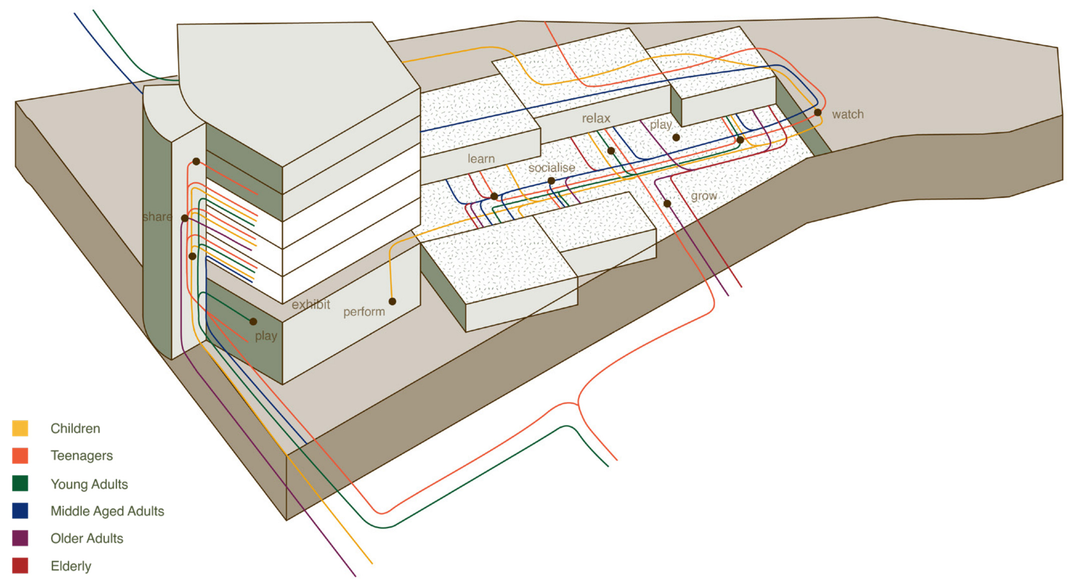
ON ONE SIDE



UNDERGROUND LINEAR FORM TO
MAXIMISE GREEN SPACE & ACCESSIBLITY

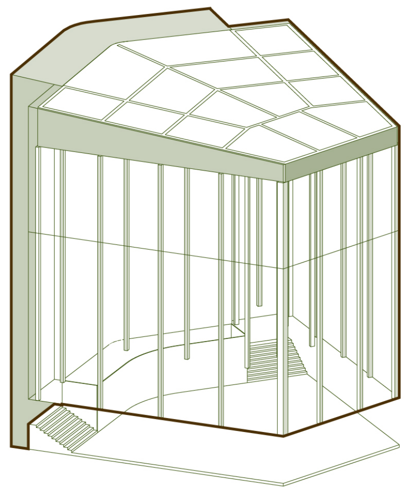


A SCATTERED LANDSCAPE

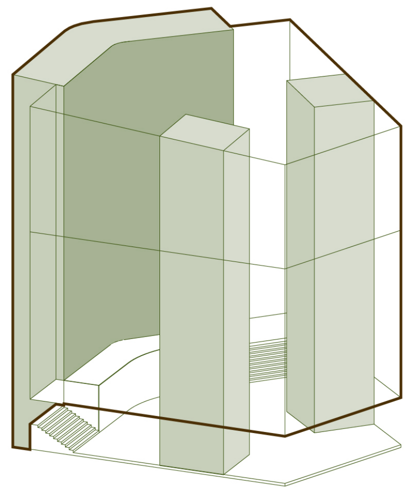


USER GROUP MOVEMENT PATTERN

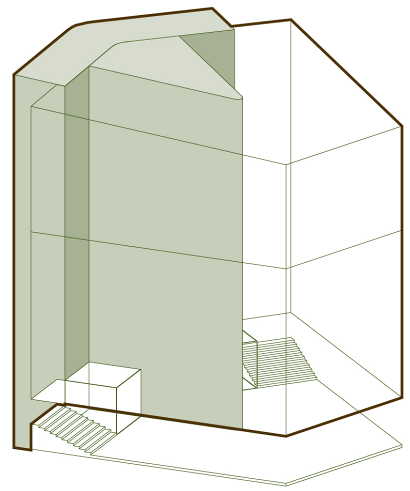
04 FIGARO STRUCTURAL ITERATIONS



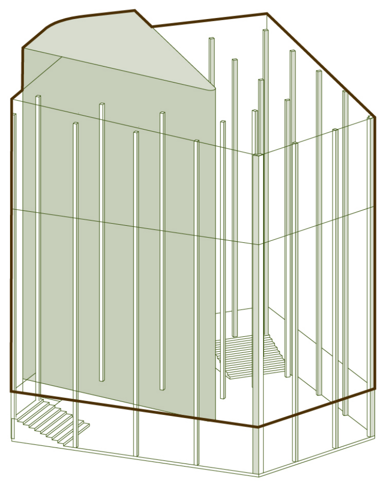
CANTILEVERED ON ONE CORE



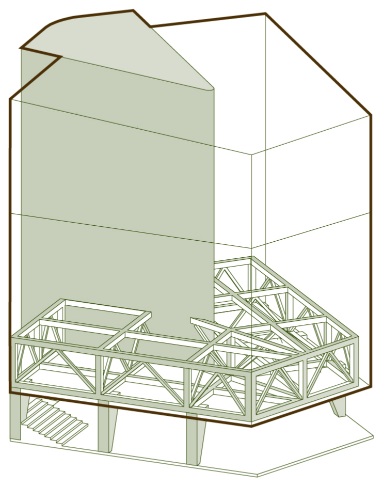
TWO CORES IN THE CENTRE



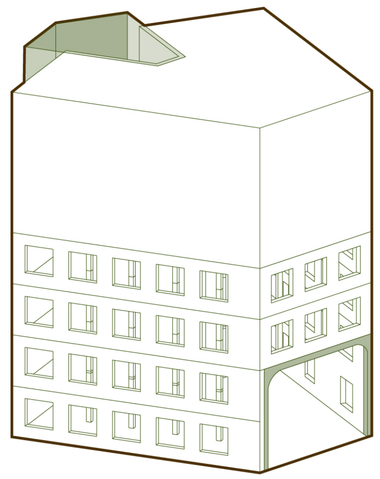
T SHAPED CORE TO
COVER MORE AREA



PERIPHERAL COLUMNS

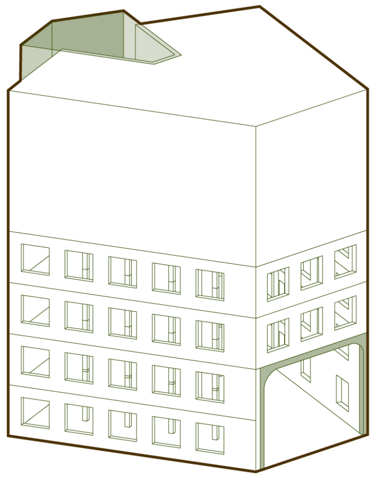


STEEL GIRDER TAKING THE LOAD

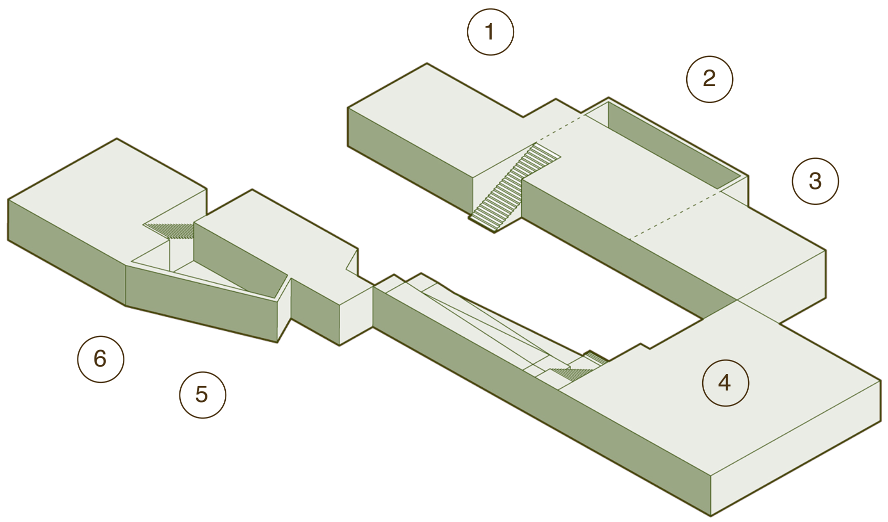


STEEL PORTALS

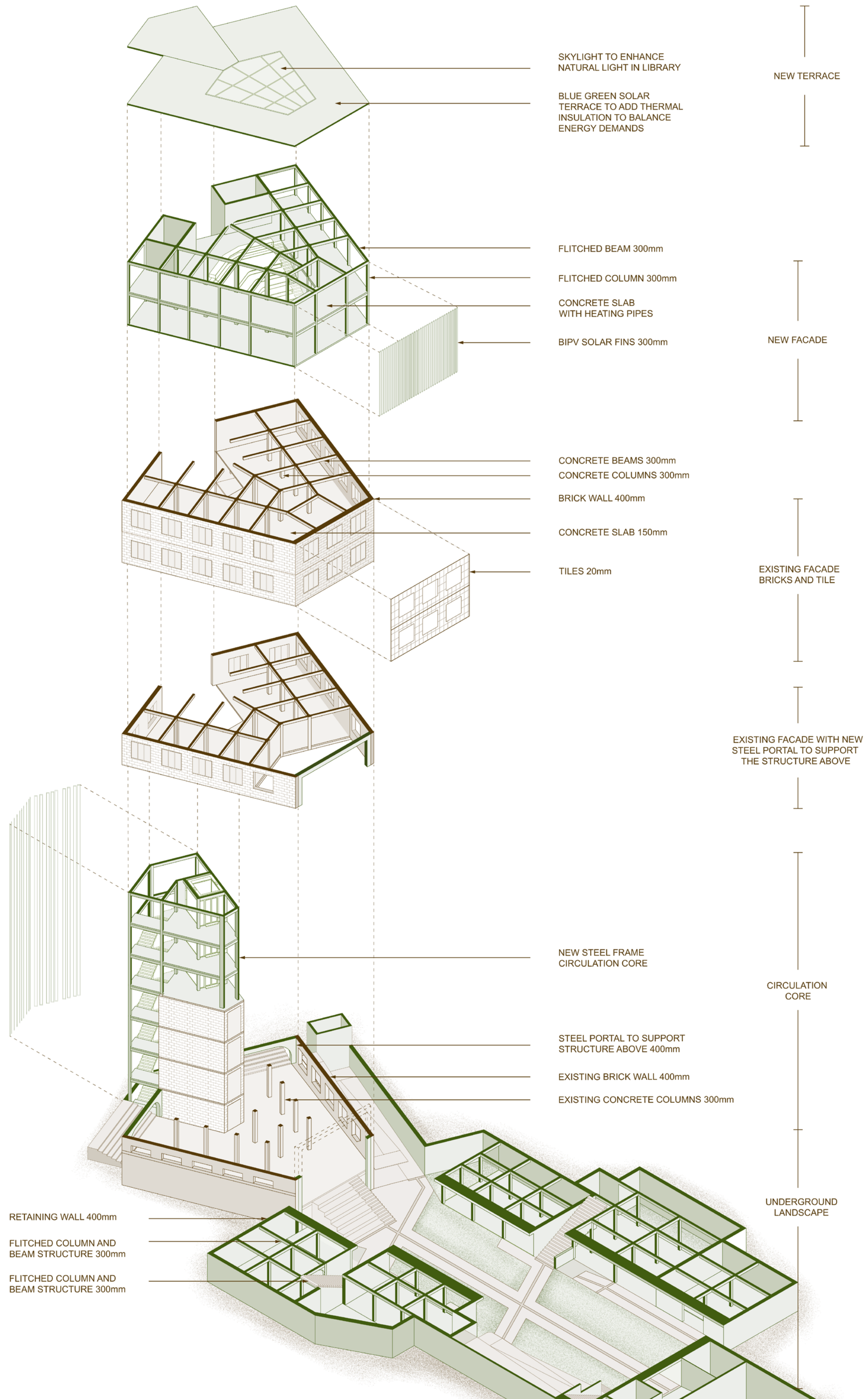
05 FINAL FORM



RETAINING FIGARO'S
EXISTING FACADE



AN INVITING LANDSCAPE WITH
PROGRAMS UNDERGROUND

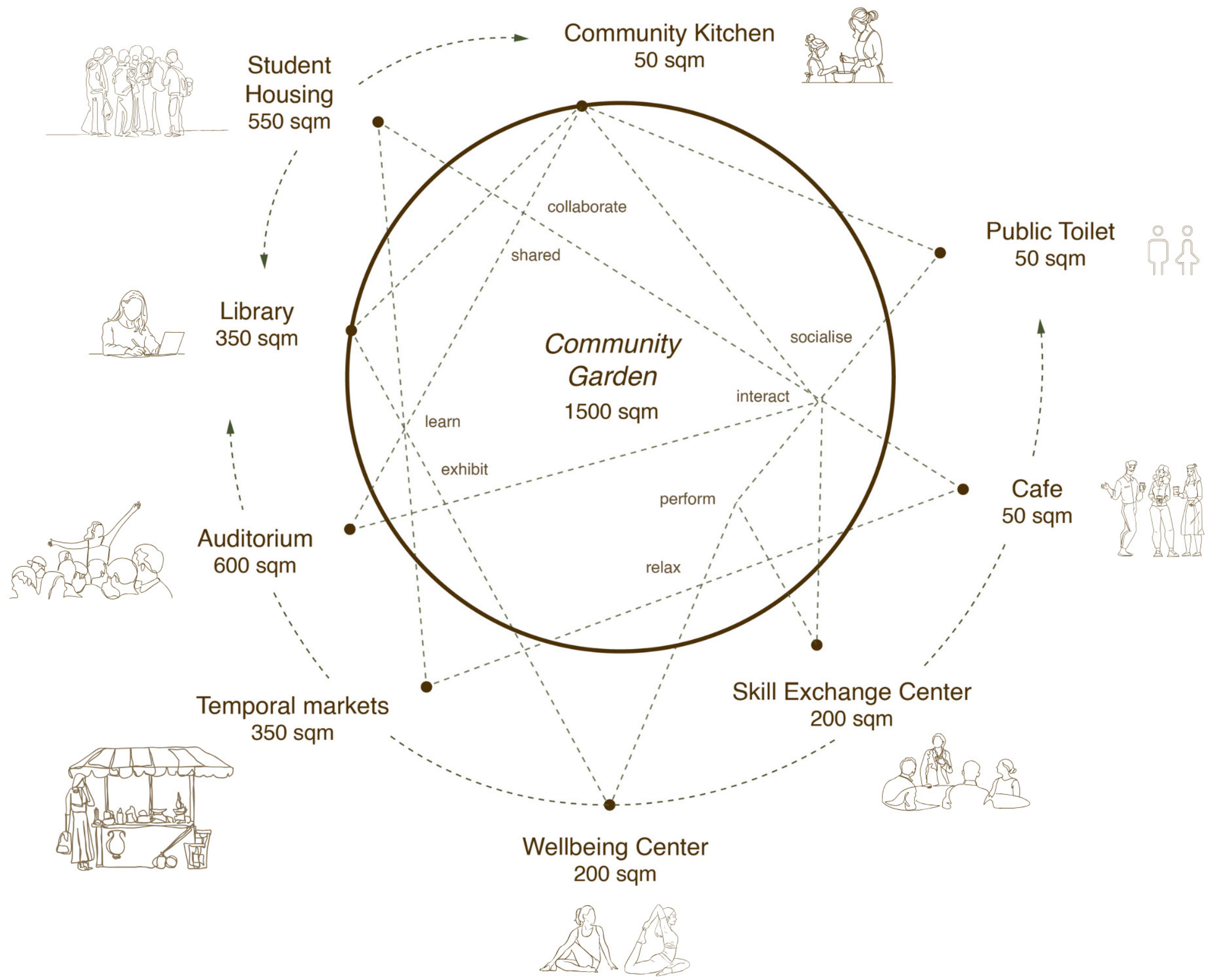


STRUCTURAL
ISOMETRIC

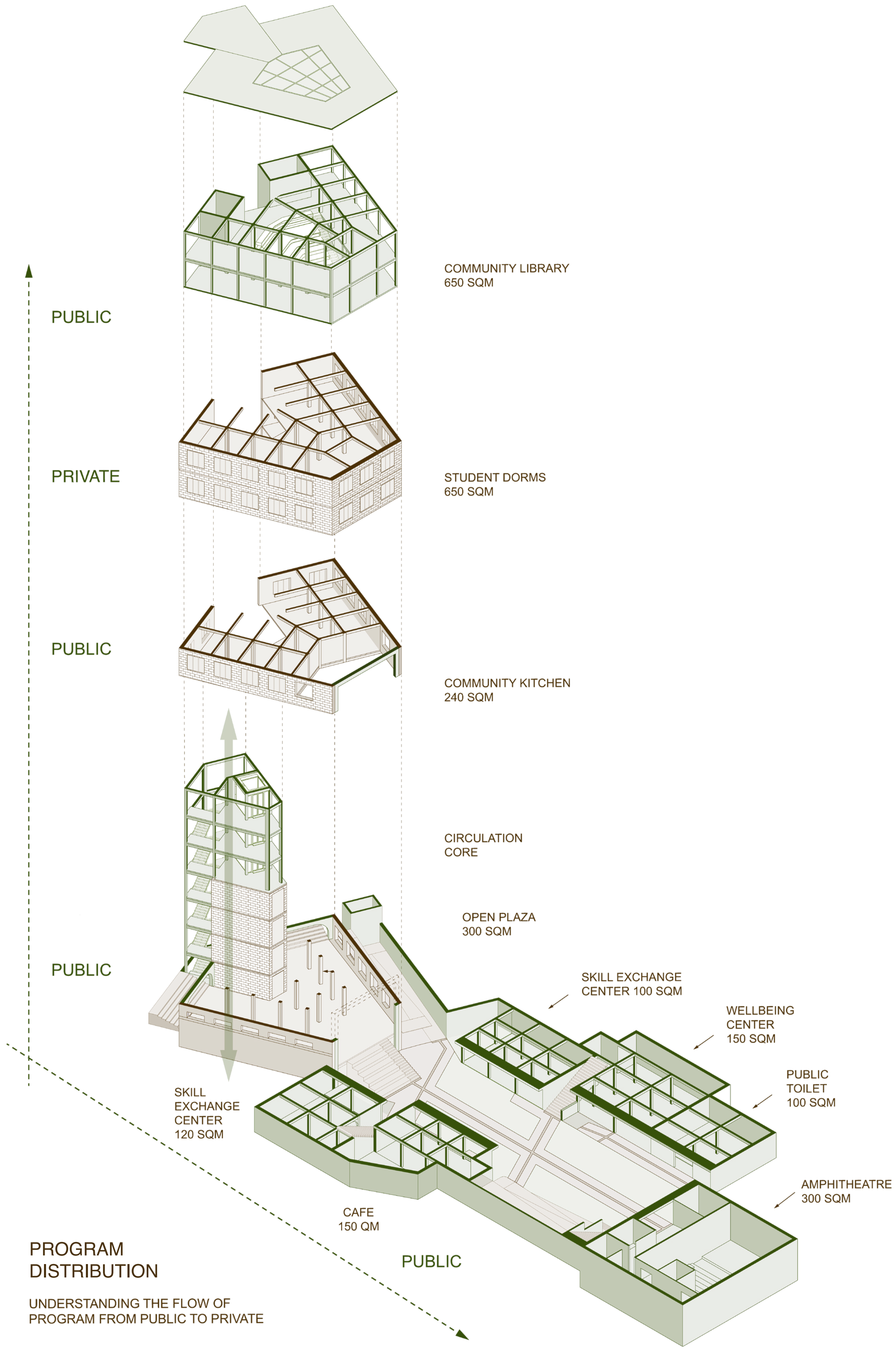
UNDERSTANDING EXISTING AND
NEW STRUCTURES AND FACADE

03 Flows and Functions

PROGRAM DIAGRAM



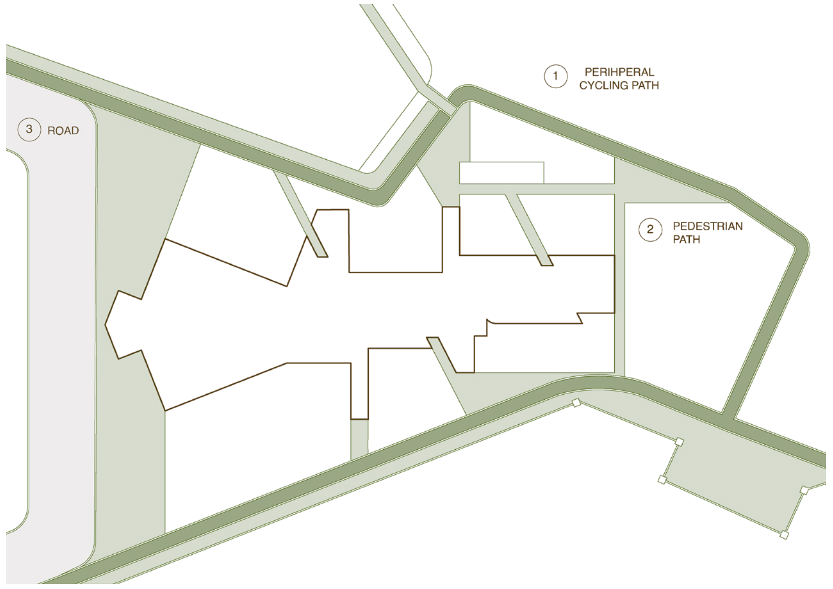
THE COMMUNITY GARDEN SERVES AS A CENTRAL MAGNET, ANCHORING AND CONNECTING ALL THE PROGRAMS OF THE BUILDING



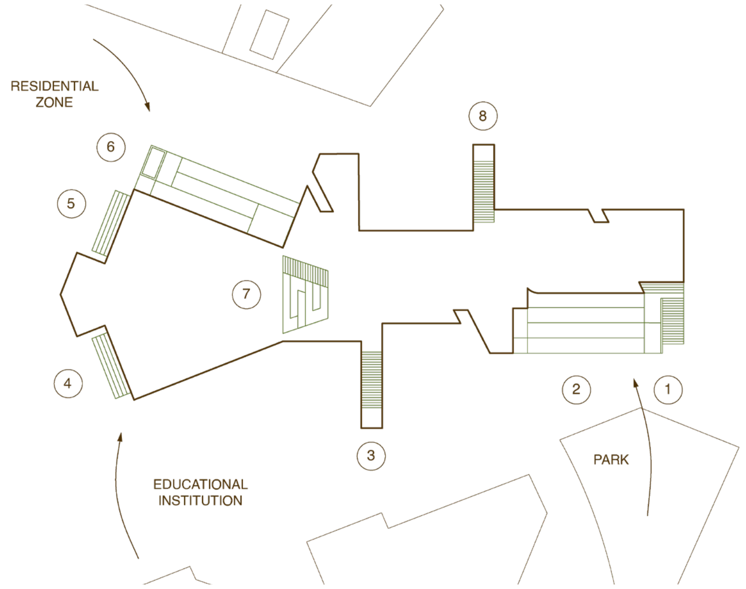
PROGRAM
DISTRIBUTION

UNDERSTANDING THE FLOW OF PROGRAM FROM PUBLIC TO PRIVATE

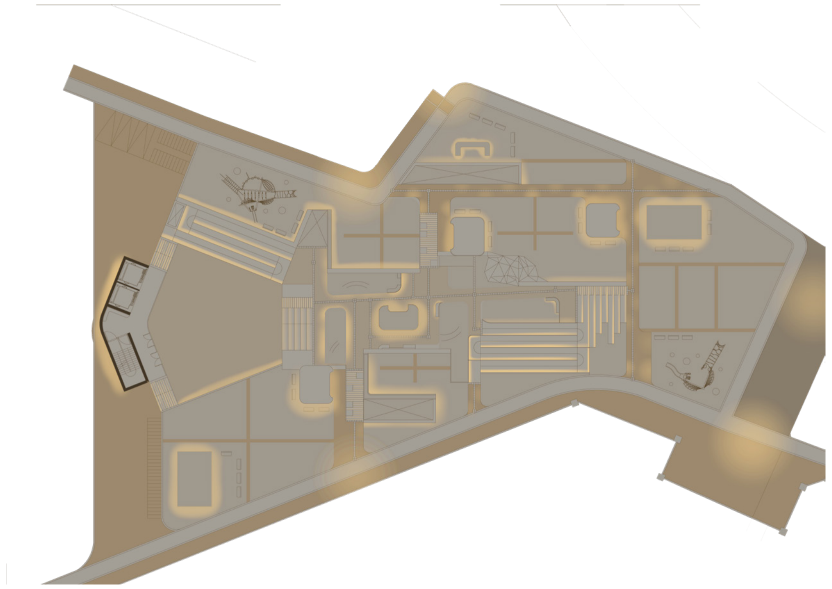
LANDSCAPE STRATEGIES



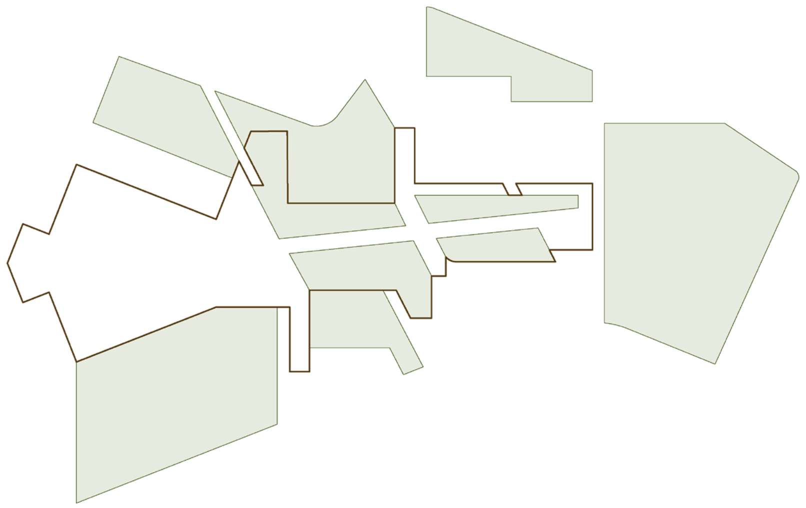
PERIPHERAL MOVEMENT



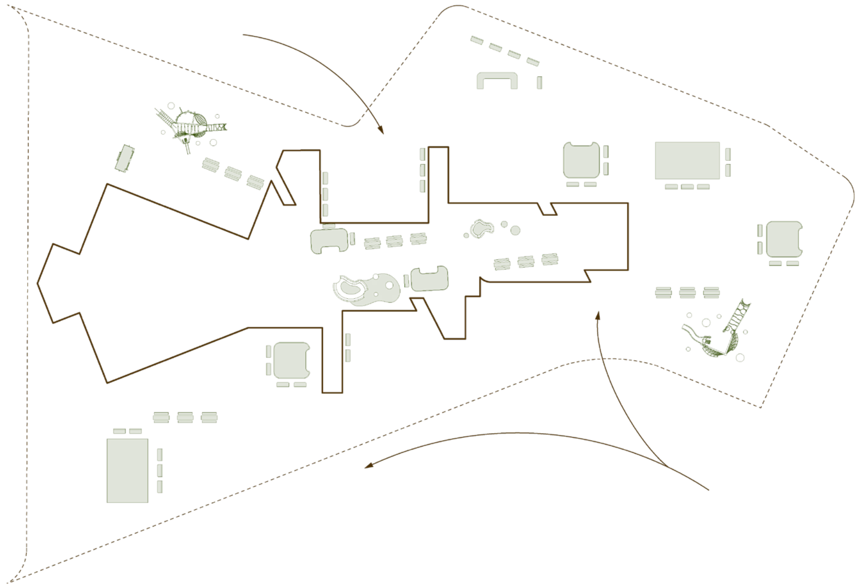
ACCESS POINTS



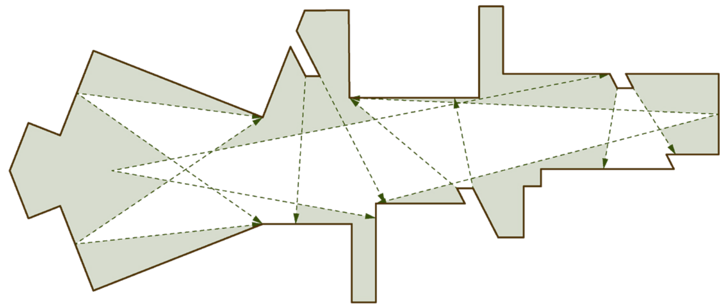
SAFETY



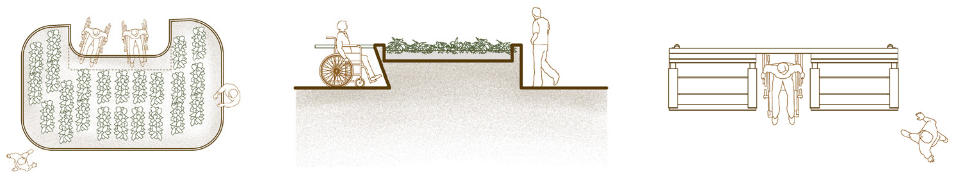
GREEN ZONES



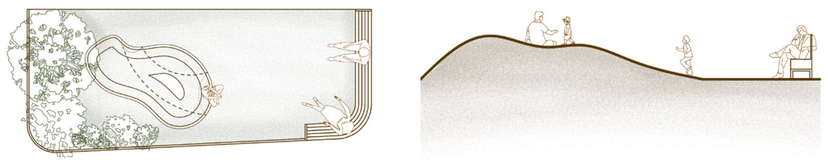
SOCIAL ZONES



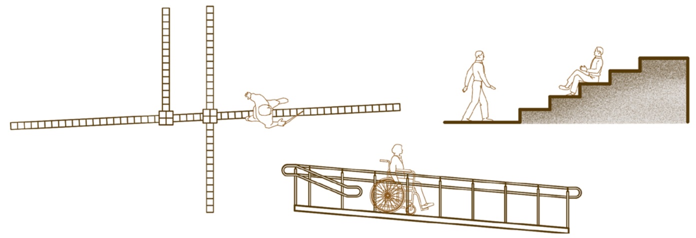
SIGHT LINES



INCLUSIVE SEATING SPACES

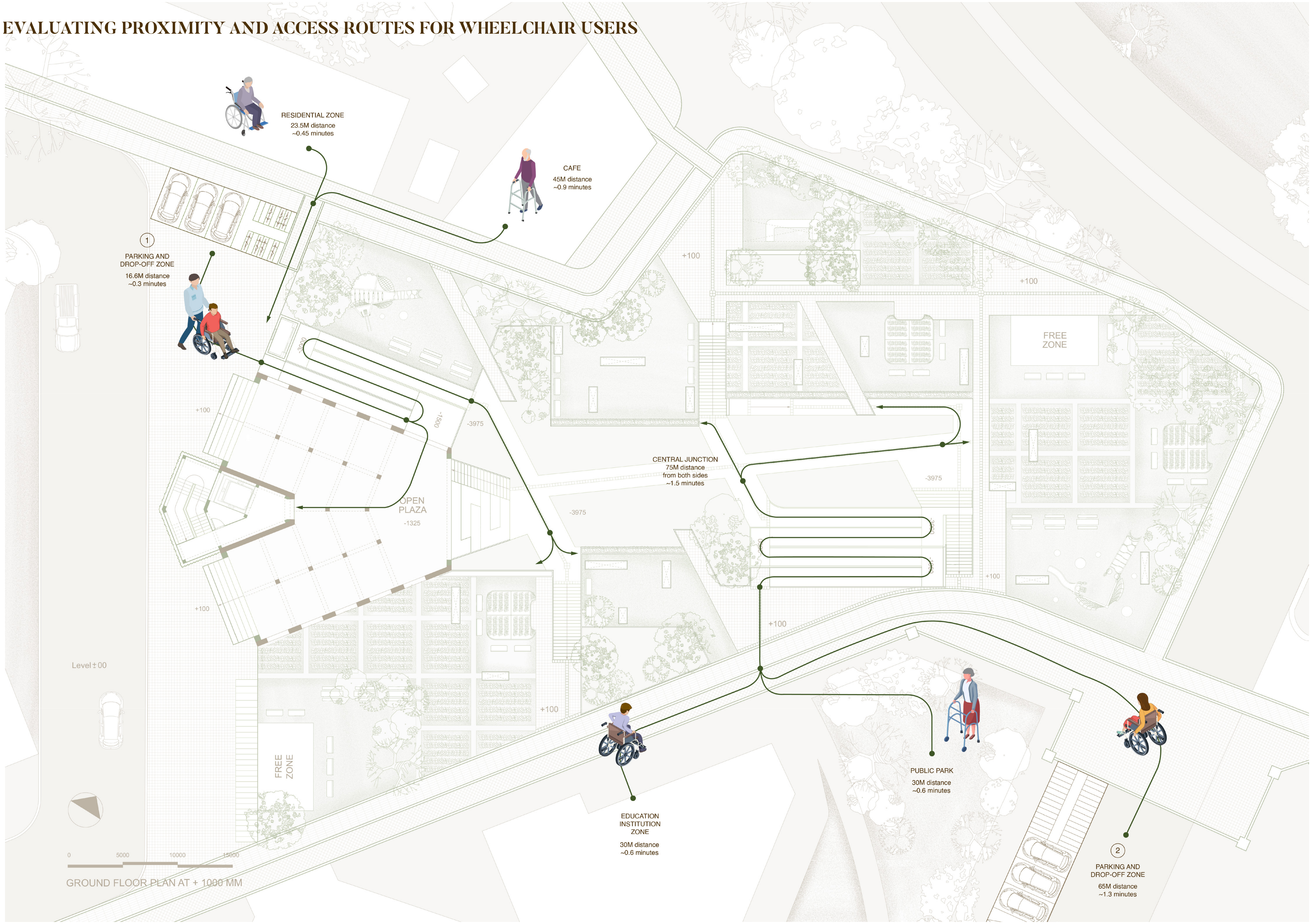


PLAY ZONES

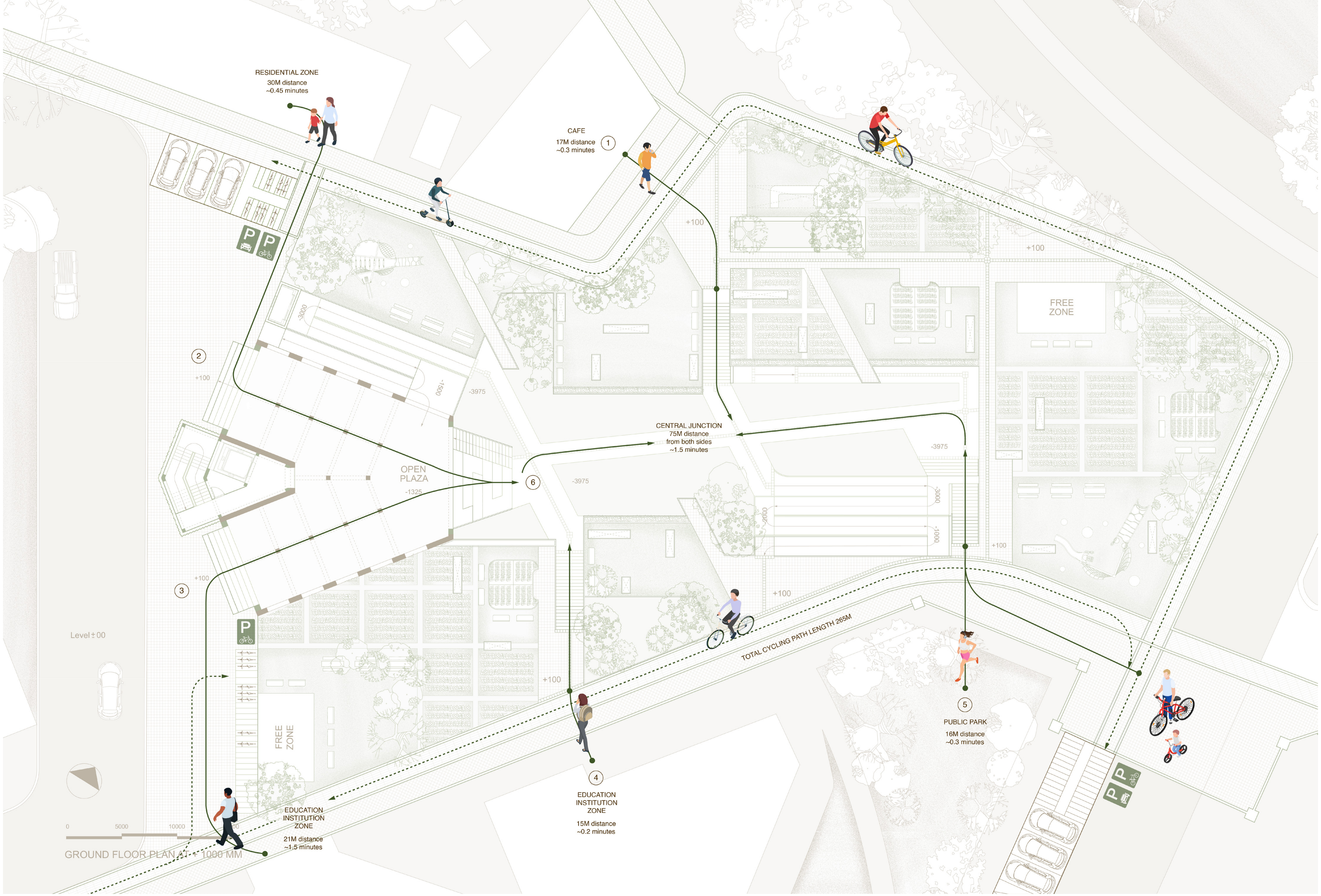


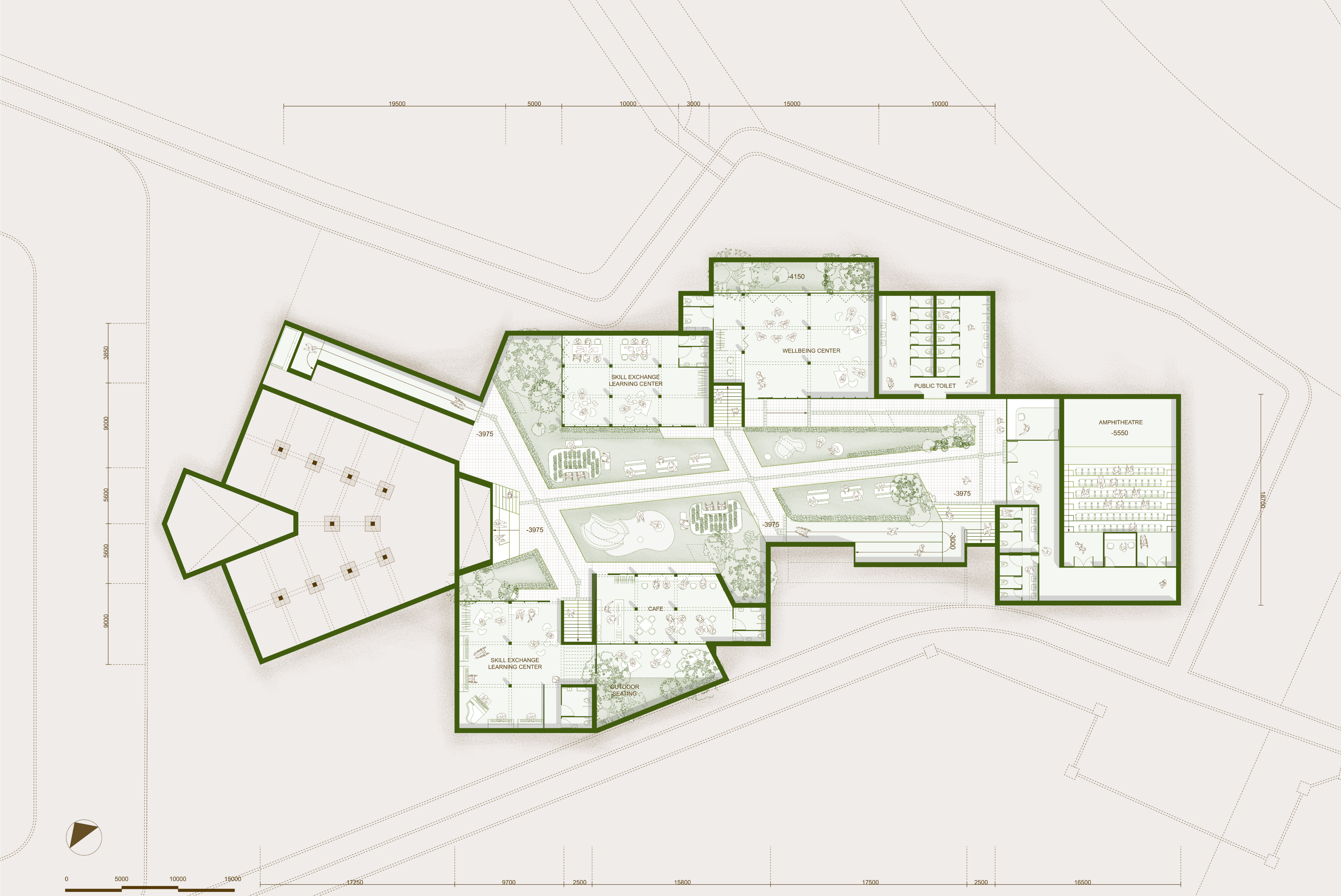
INCLUSIVE ACCESS

EVALUATING PROXIMITY AND ACCESS ROUTES FOR WHEELCHAIR USERS



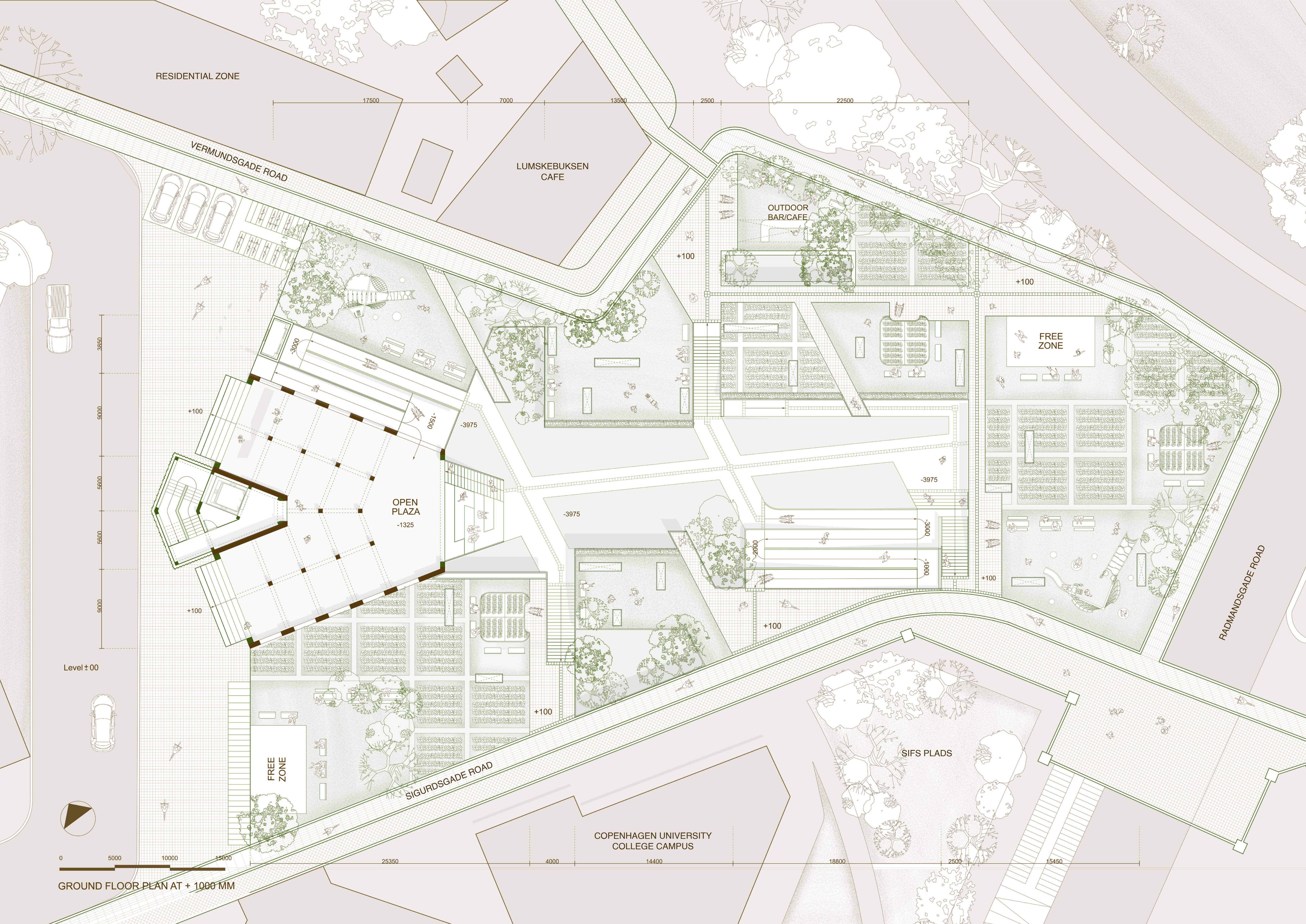
EVALUATING PROXIMITY AND ACCESSIBILTY FOR DIVERSE PASSERBY





GROUND FLOOR PLAN AT -2000 MM

SHARED LEARNING SPACE FOR INTERGENERATIONAL DIALOGUE



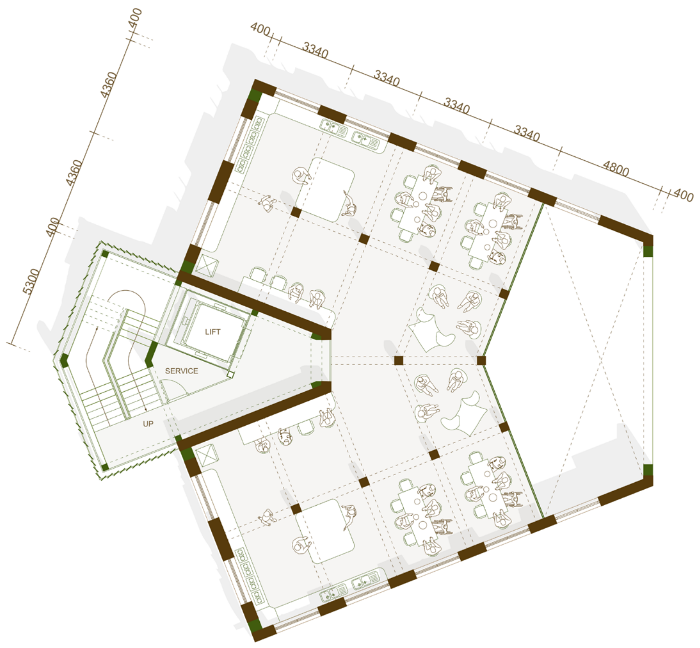
GROUND FLOOR PLAN AT + 1000 MM

ISOMETRIC VIEW HIGHLIGHTING SHARED GROUNDS

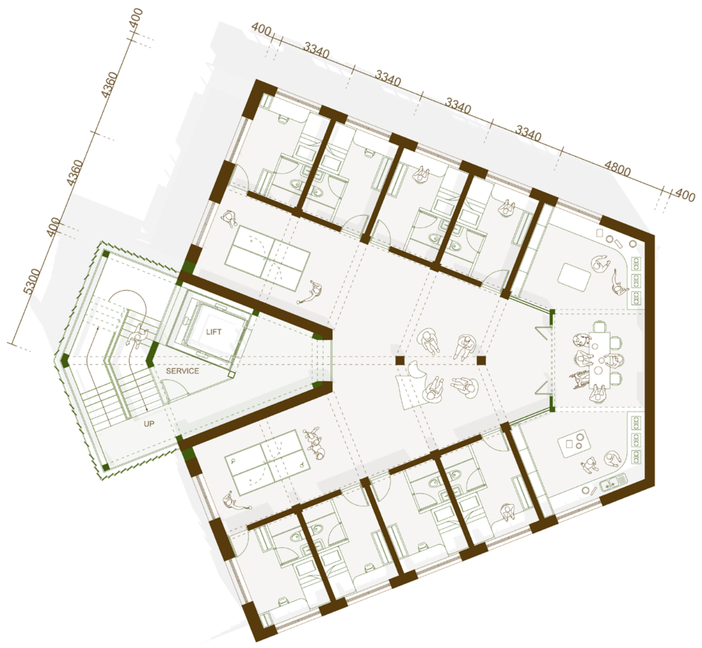
COMMUNITY FREE ZONES FOR POP-UP STALLS AND ACTIVITIES

FREE ZONES FOR FOOD TRUCKS

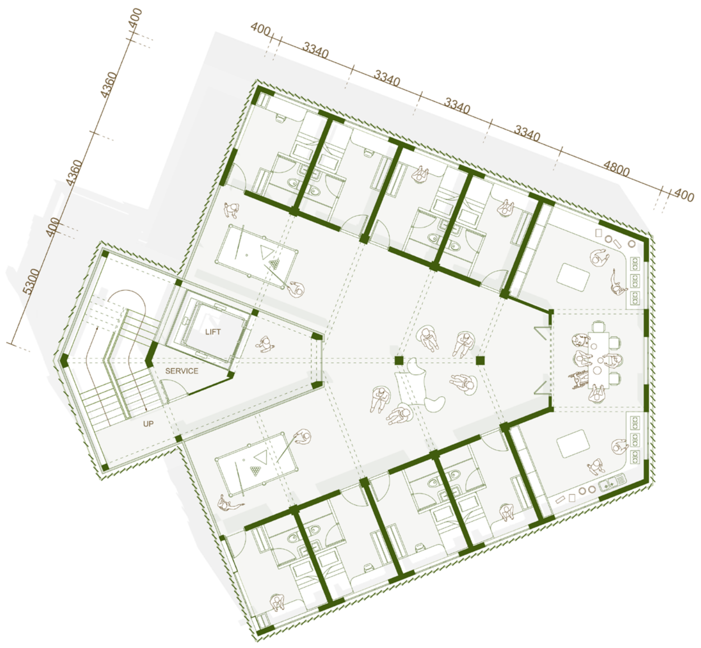
SEATING DESIGNED FOR DIVERSE USER GROUPS



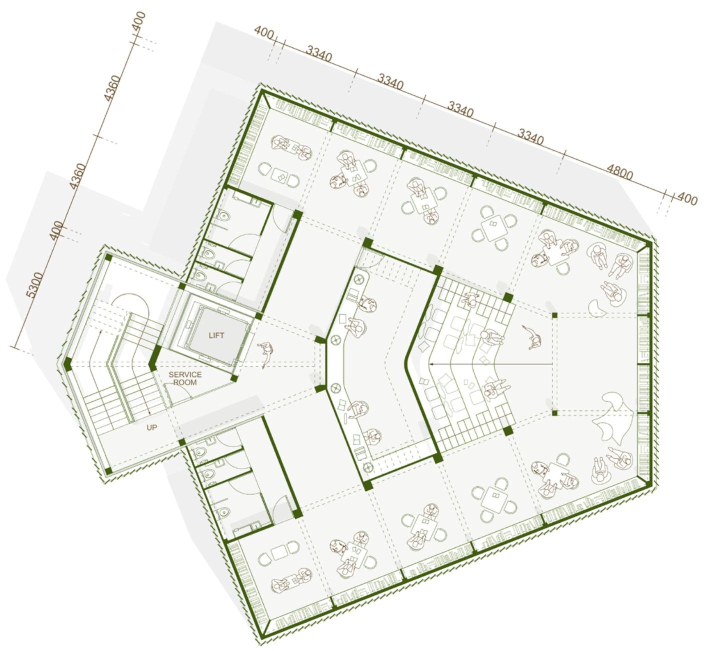
FIRST FLOOR PLAN : EXISTING STRUCTURE
COMMUNITY KITCHEN CUT AT +3900 MM



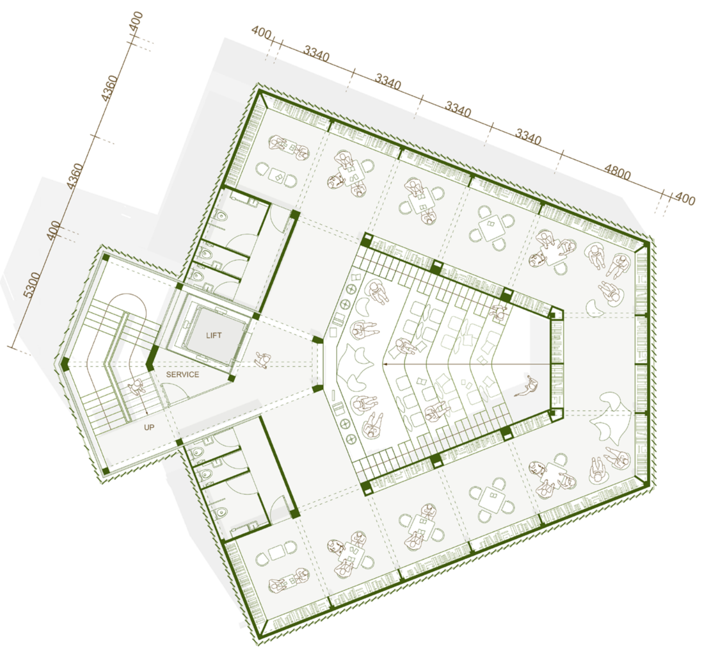
SECOND FLOOR PLAN : EXISTING STRUCTURE
STUDENT ROOMS CUT AT +7500 MM



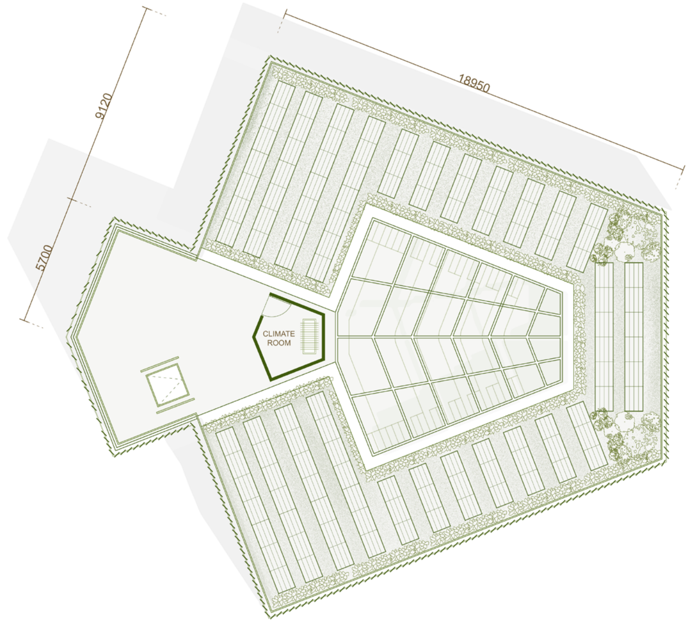
THIRD FLOOR PLAN : NEW STRUCTURE
STUDENT ROOMS CUT AT +11500 MM



FOURTH FLOOR PLAN : NEW STRUCTURE
LIBRARY CUT AT 15500 MM



FIFTH FLOOR PLAN : NEW STRUCTURE
LIBRARY CUT AT 19000 MM



TERRACE FLOOR PLAN
BLUE GREEN SOLAR ROOF CUT AT 21000 MM

PLAZA AS A SHADED RESTING SPACE AND TEMPORARY MARKET HUB

COMMUNAL KITCHEN OPENING UP
TO THE SHARED LANDSCAPE

STUDENT LIVING AND SOCIAL SPACES

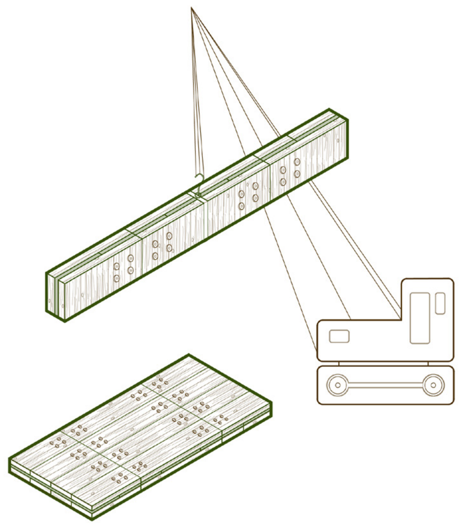
A COMMUNITY LIBRARY DESIGNED FOR PUBLIC ENGAGEMENT

04 Integrated Design and Climate Analysis

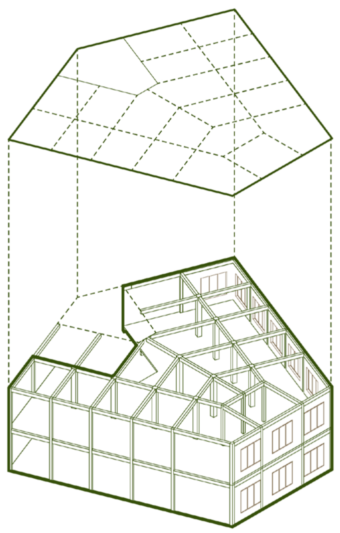
INTEGRATED DESIGN AND CLIMATE ANALYSIS

SECTION B-B'

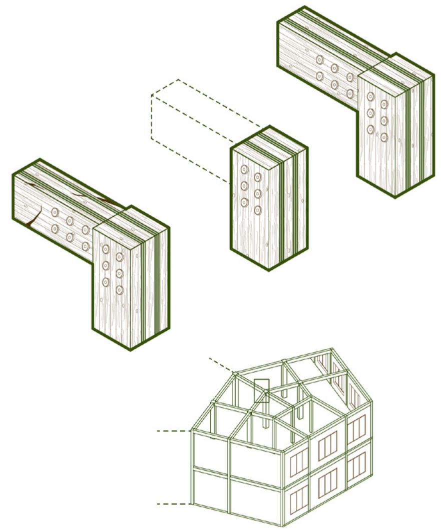
CHOOSING TIMBER AS THE NEW MATERIAL



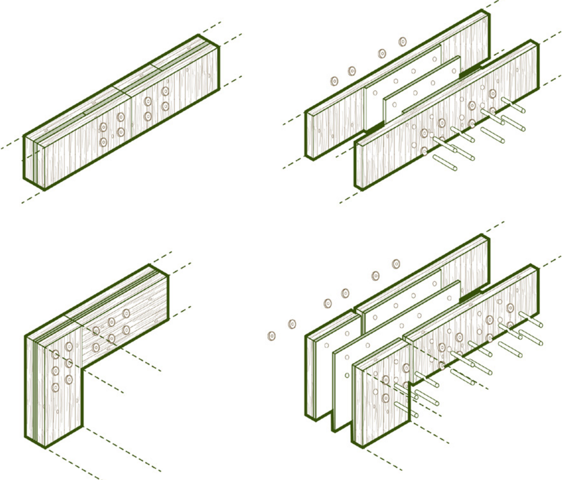
PREFABRICATED TIMBER MEMBERS



ADAPTING TO THE EXISTING GRID



MODULAR MEMBERS

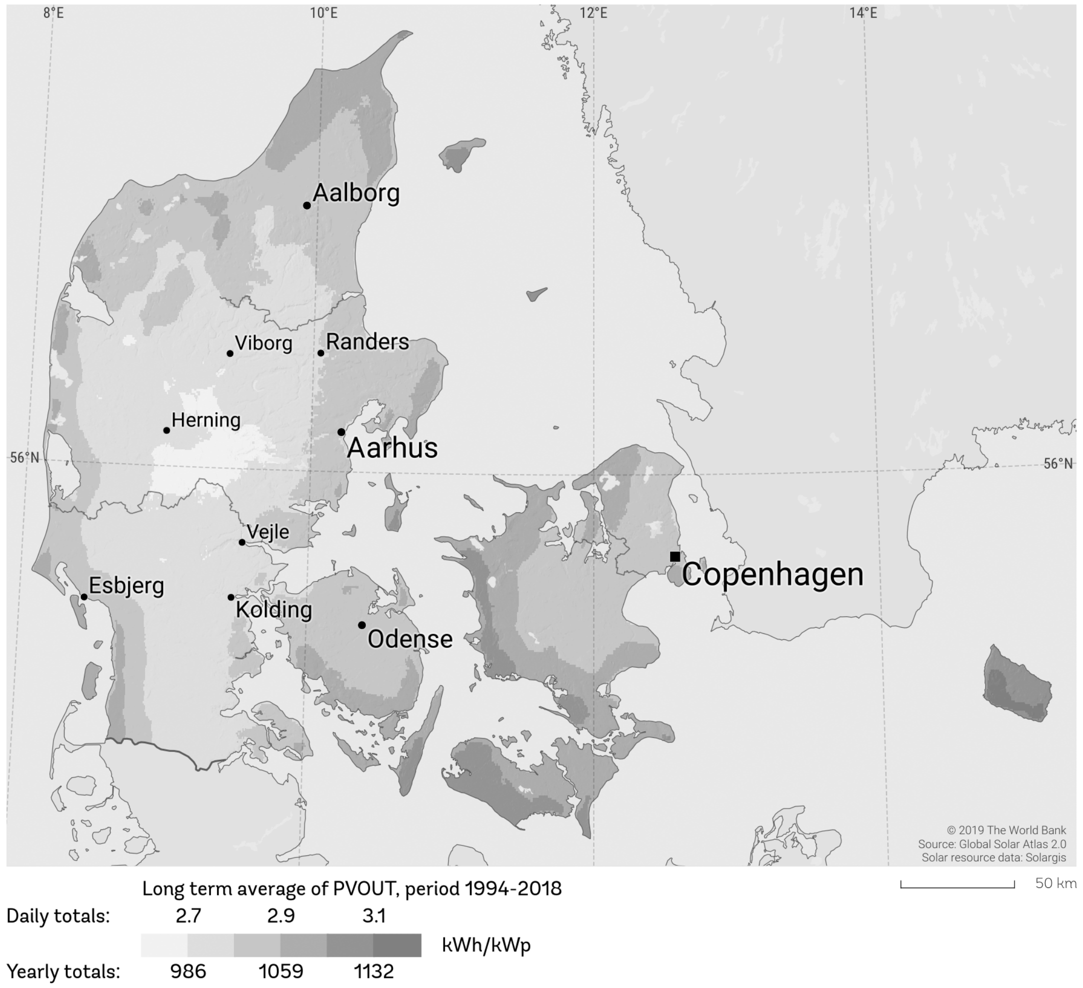


DRY INSTALLATION PROCESS

SECTION A-A'

NEED FOR SOLAR

PHOTOVOLTAIC POWER POTENTIAL DENMARK



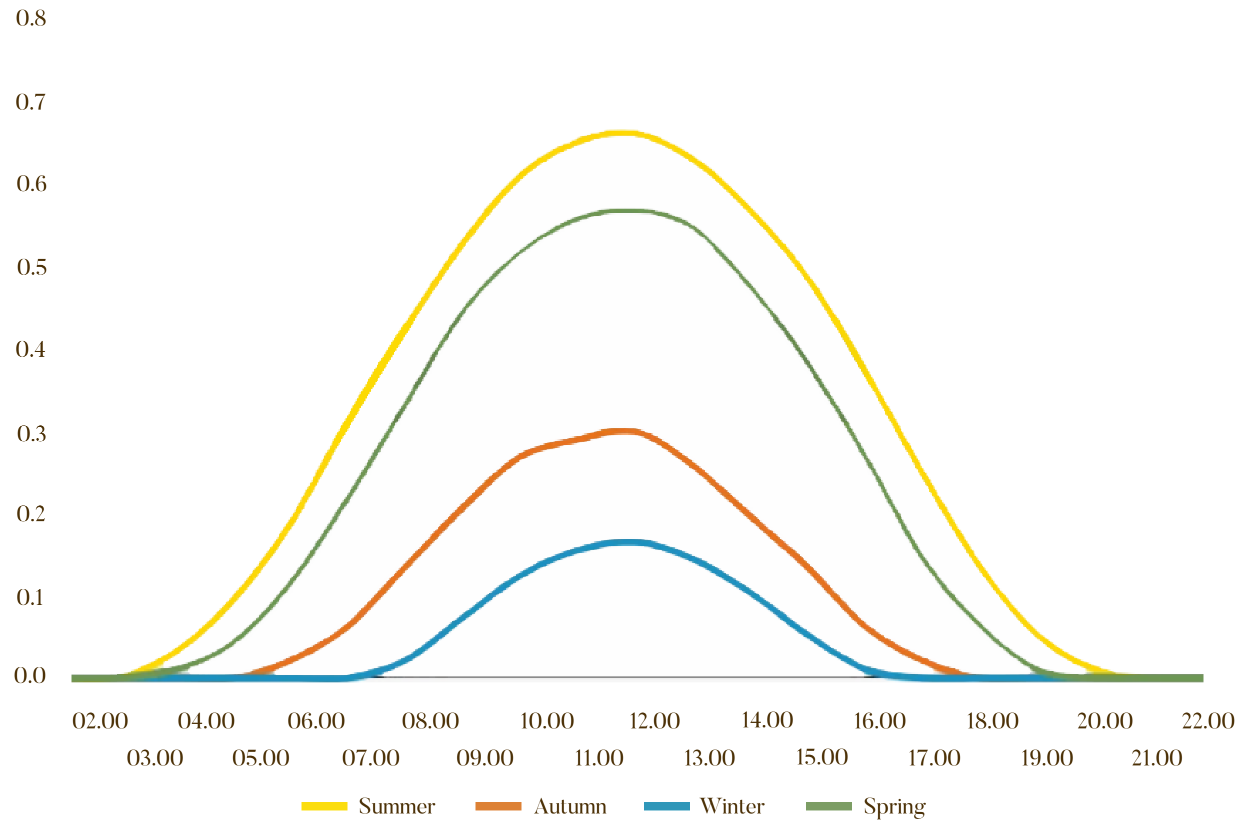
While Denmark gets a large portion of energy from wind, **solar energy complements wind** by providing power during less windy periods (especially in summer)

Copenhagen aims to become **carbon-neutral by 2025.** To support this, Copenhagen plans to **install 60,000 m²** of solar panels on municipal buildings, contributing to a **40% reduction** in energy consumption in building.

Source | https://profilesolar.com/locations/Denmark/Copenhagen/

IMPACT OF SOLAR ENERGY ACROSS SEASONS

SOLAR PV ANALYSIS OF COPENHAGEN, DENMARK



IDEAL TILT OF SOLAR PANELS IS 47° SOUTH IN COPENHAGEN, DENMARK

The **ideal tilt of Solar panels is 47° South** in Copenhagen, Denmark. Seasonally adjusted solar panel tilt angles are as follows :

Summer	Autumn	Winter	Spring
39° South	**58°** South	**68°** South	**47°** South

CASE STUDIES

SWISS TECH CONVENTION CENTER

DYE-SENSITIZED SOLAR CELLS convert light into electricity through photosensitizers dye compounds that absorb light and inject electrons into an array of oxide nanocrystals which subsequently are collected as electric current.

MANUFACTURER | Solaronix, Switzerland

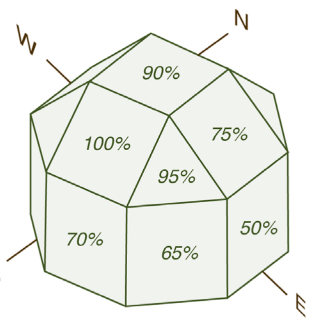
- coloured transparent panel
- cheap to produce
- lightweight
- flexible (choice of colour)
- shade the building from direct sunlight
- each one 35 by 50 cm in size

AN EXPERIMENT

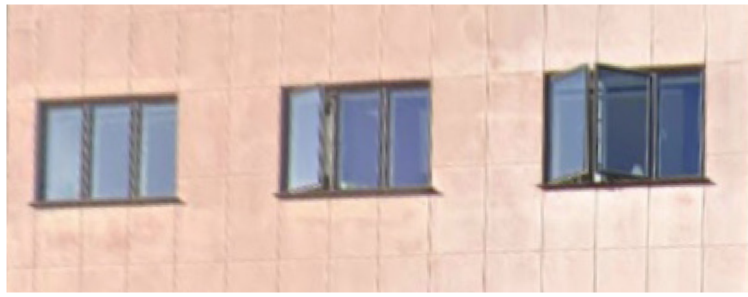
SOLAR PAVILION WITH RED DYE-SENSITIZED SOLAR CELL MODULES

Danish Technological Institute (DTI), Roskilde University (Denmark), EPFL (Denmark) and Solaronix (Switzerland) have experimented by making a pavilion with dark red tiles but will soon scale up.

While surfaces tilted towards the sun receive the most energy, secondary and tertiary surfaces can still contribute meaningful amounts of PV generated electricity.

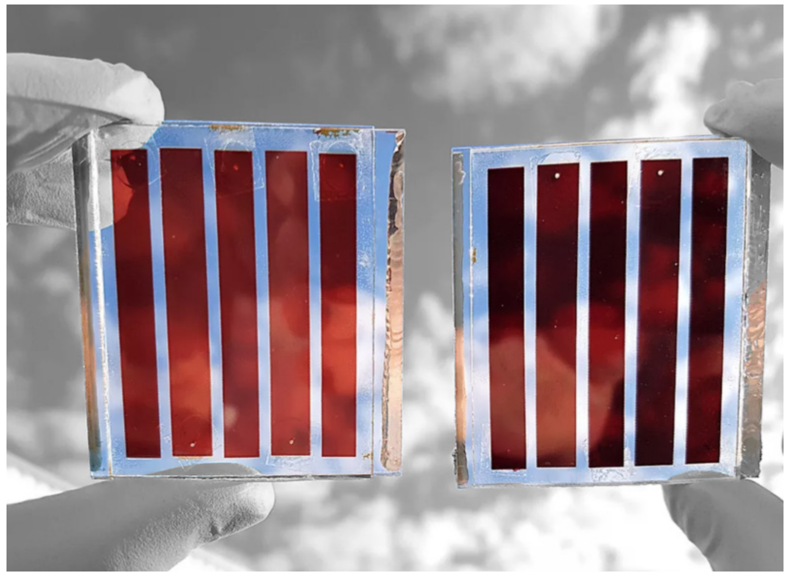


IMPLEMENTATION IN DESIGN



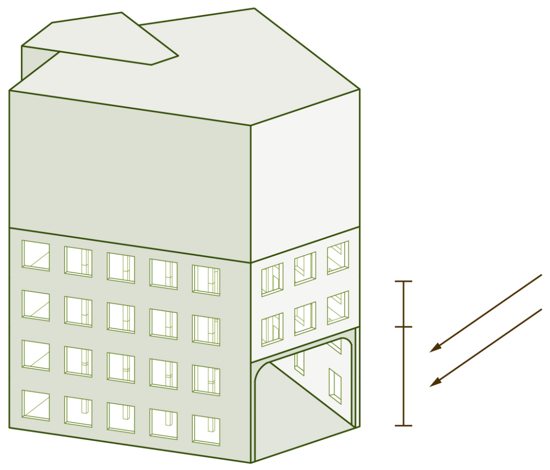
FIGARO EXTERNAL TILES

DYE SOLAR CELL COLOURS

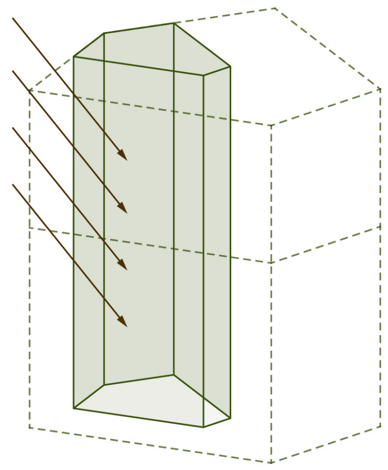


DYE-SENSITIZED SOLAR CELLS (DSCS)
PAVILION EXPERIIMENT IN DENMARK

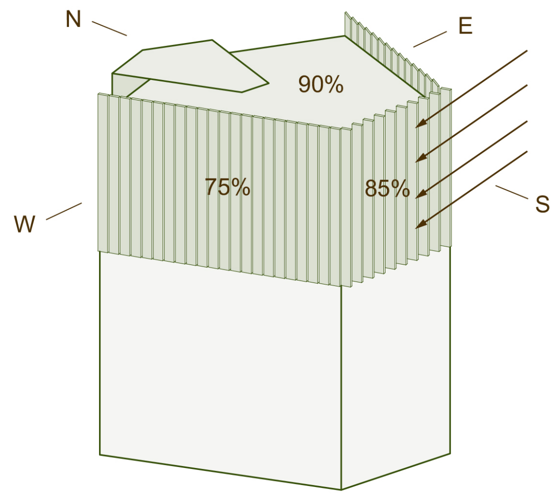
USING SUNLIGHT AS A DESIGN TOOL



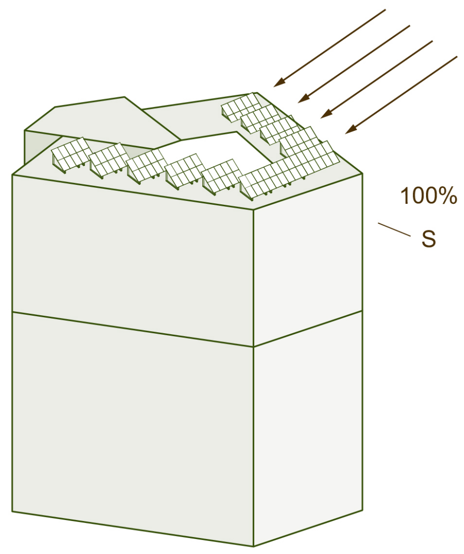
DOUBLE HEIGHT OPEN PLAZA



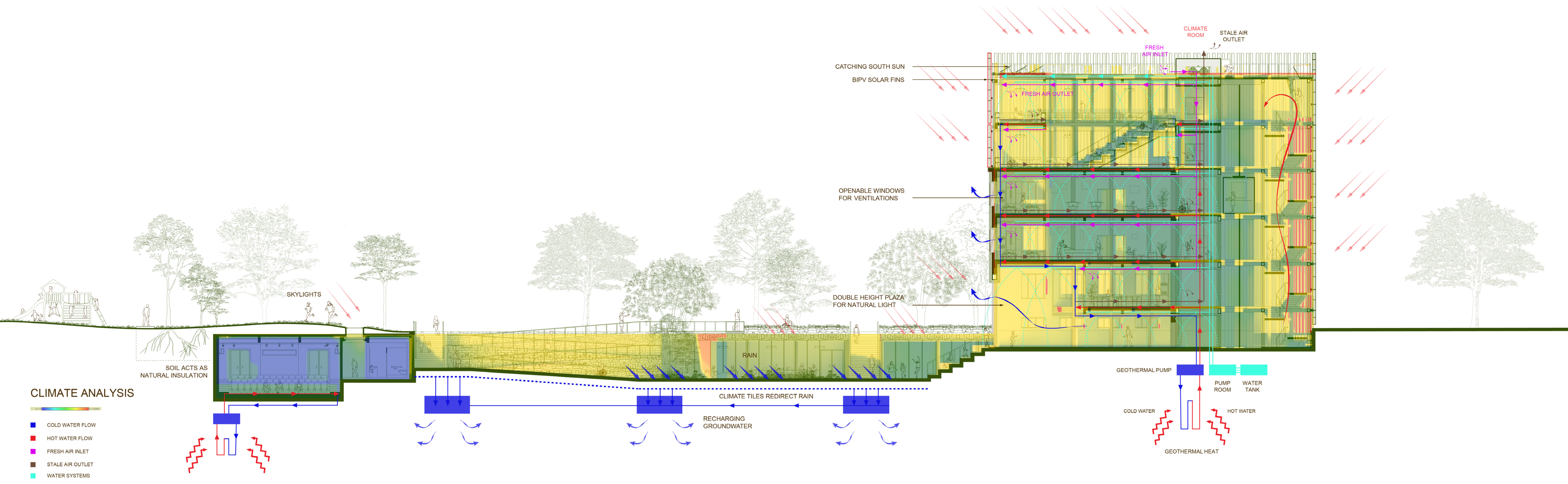
TRANSPARENT CORE



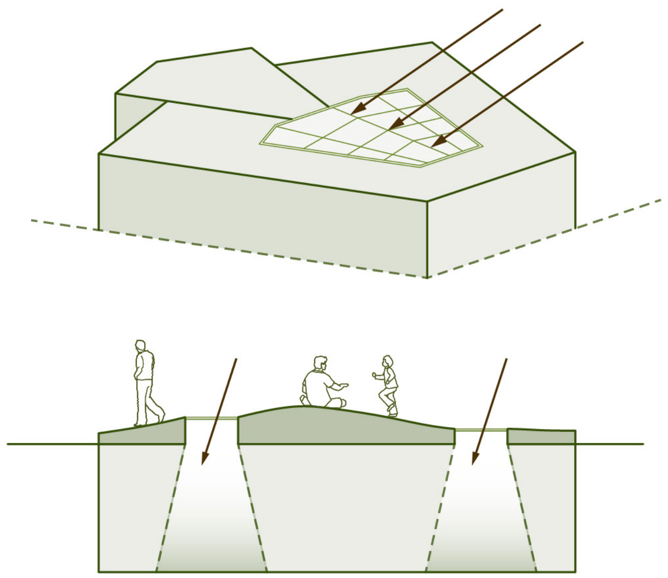
BIPV SOLAR FINS



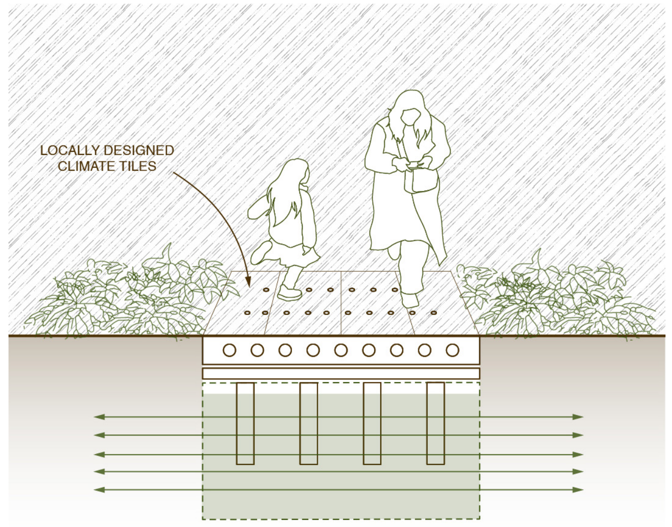
BLUE GREEN SOLAR TERRACE



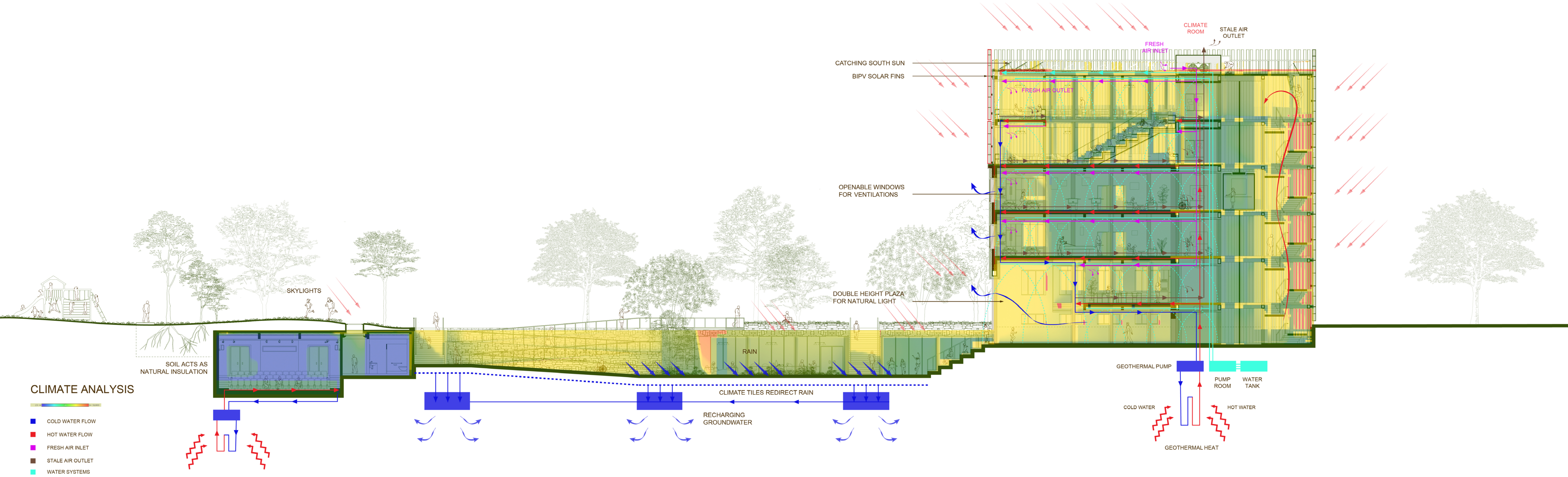
USING SUNLIGHT AND WATER AS DESIGN TOOLS



SKYLIGHTS

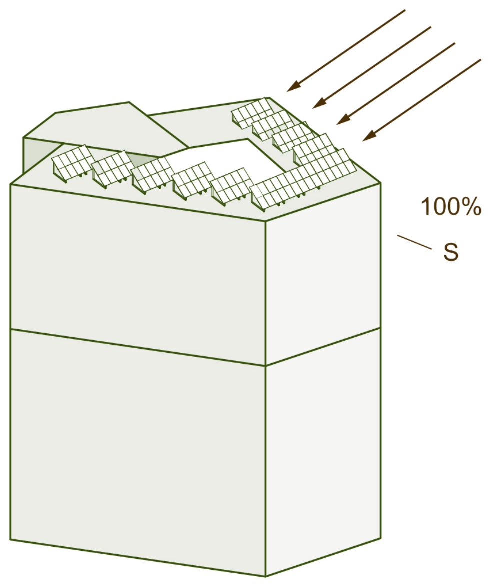


CLIMATE TILES



CLIMATE ANALYSIS

SOLAR CALCULATION



BLUE GREEN SOLAR TERRACE

19,260 kWh/year

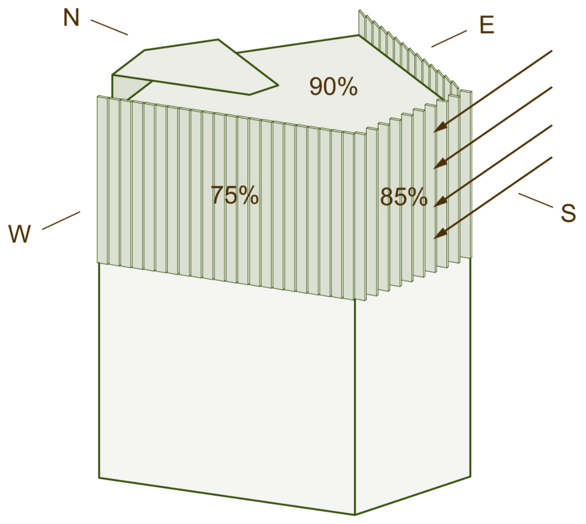
A Blue-Green roof has vegetation and water retention below the panels. Benefits: Cool the panels, improve air circulation around them and reduces overheating

Cooler panels = higher efficiency
Studies show this boost is around 5–10% more than typical roofs.

Solar panel area: 100 m²
South-facing at optimum tilt

Energy Calculation

Facade	Solar irradiance on horizontal roofs (kWh/m²/year)	Area	Panel Efficiency	Boost from Blue Green Roof	Total Annual Energy
South	1000	100	18%	7%	19,260 kWh/year



DSSC SOLAR FINS (SMALLER FINS)

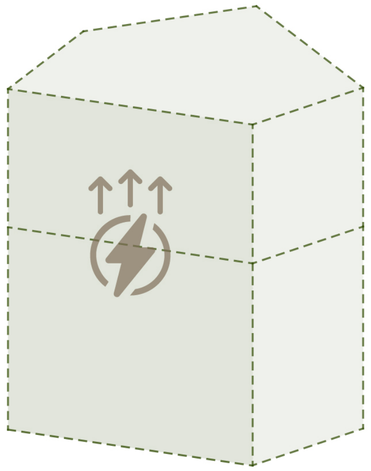
15,523.5 kWh per year

Dye-Sensitized Solar Cells (DSSC) are lightweight, semi-transparent, and work well in diffused sunlight, making them suitable for vertical applications like fins on facades in places like Copenhagen, which gets less direct sunlight than sunnier regions.

Energy Calculation

Facade	Solar irradiance on vertical surfaces (kWh/m²/year)	Number of Fins	Area per Fin m²	Total Area	DSSC Effeciency (realistic for vertical application)	Total Annual Energy
South	700	36	2.12	76.32	7%	3,739.68 kWh/year
East	500	62	2.12	131.44	7%	4,600.4 kWh/year
West	500	62	2.12	131.44	7%	4,600.4 kWh/year
North	300	58	2.12	123.0	7%	2,583 kWh/year

SOLAR CALCULATION



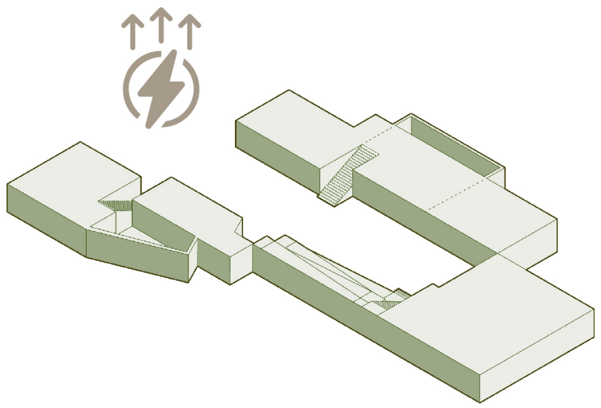
FIGARO

Subtotal
= 263,200 kWh/year

Energy Consumption Calculation

EUI (Energy Use Intensity) is the average annual energy consumed per square meter for a particular use type. These are estimated values based on data from EU building standards, BREEAM/LETI benchmarks, and general architectural practices for public buildings.

Program	Area (m²)	EUI (kWh/m²)	Annual Energy (kWh)
Ground floor plaza	300	130	39,000
Community kitchen (first floor)	235	250	58,750
Student housing (second + third floor)	600	310	93,000
Library (Fourth + fifth floor)	565	260	73,450

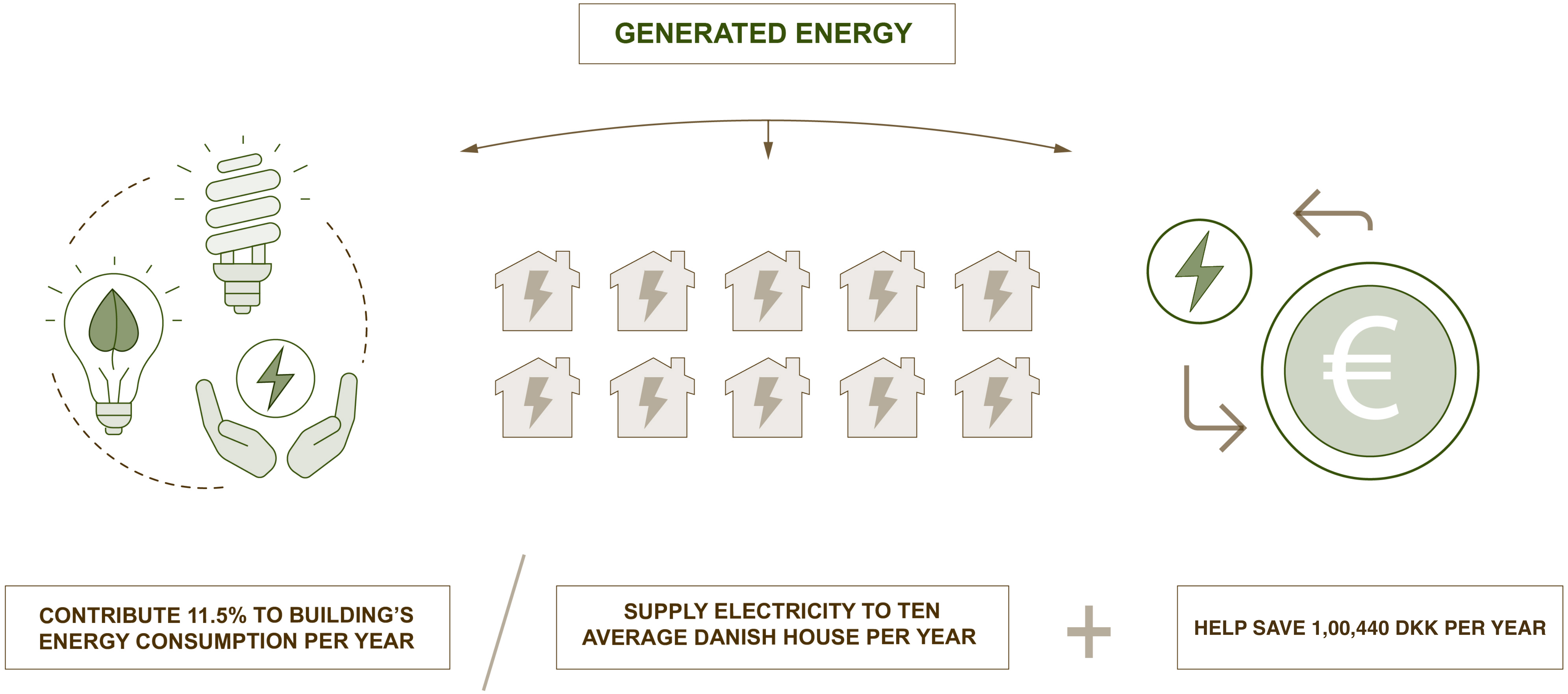


SHARED LANDSCAPE

Subtotal
= 105,520 kWh/year

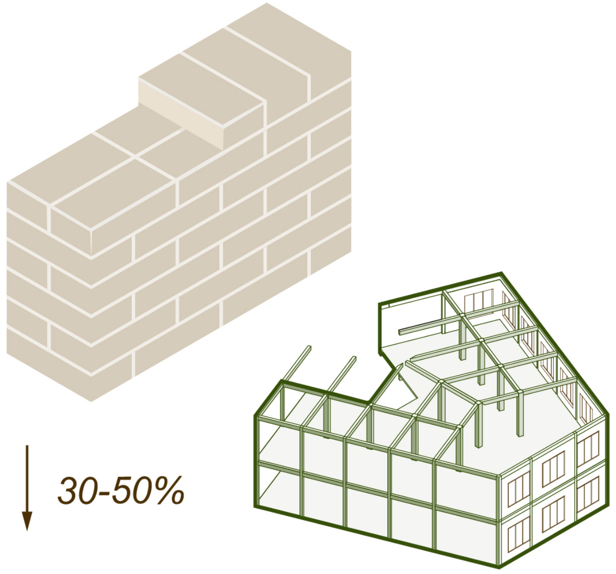
Program	Area (m²)	EUI (kWh/m²)	Annual Energy (kWh)
Skill exchange centre	180	119	21,420
Well-being centre	150	136	20,400
Public toilet	100	102	10,200
Auditorium	250	170	42,500
Cafe	100	110	11,000

ENERGY CONSUMPTION 3,68,720 kWh per year

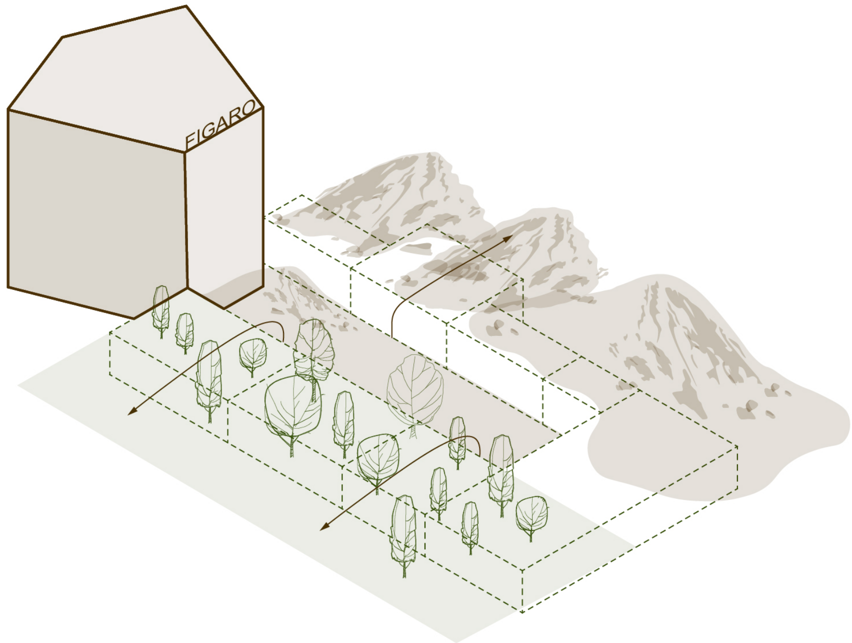

GENERATED ENERGY
CONTRIBUTE 11.5% TO BUILDING'S ENERGY CONSUMPTION PER YEAR
SUPPLY ELECTRICITY TO TEN AVERAGE DANISH HOUSE PER YEAR
HELP SAVE 1,00,440 DKK PER YEAR

THROUGH THE LENS OF SUSTAINABILITY AND COPENHAGEN LESSONS

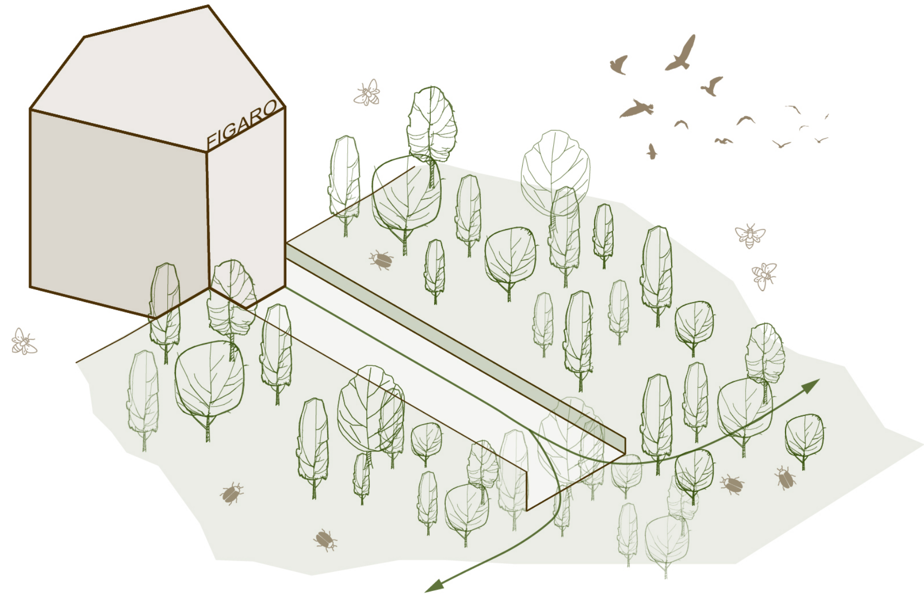
REDUCE CONSTRUCTION WASTE



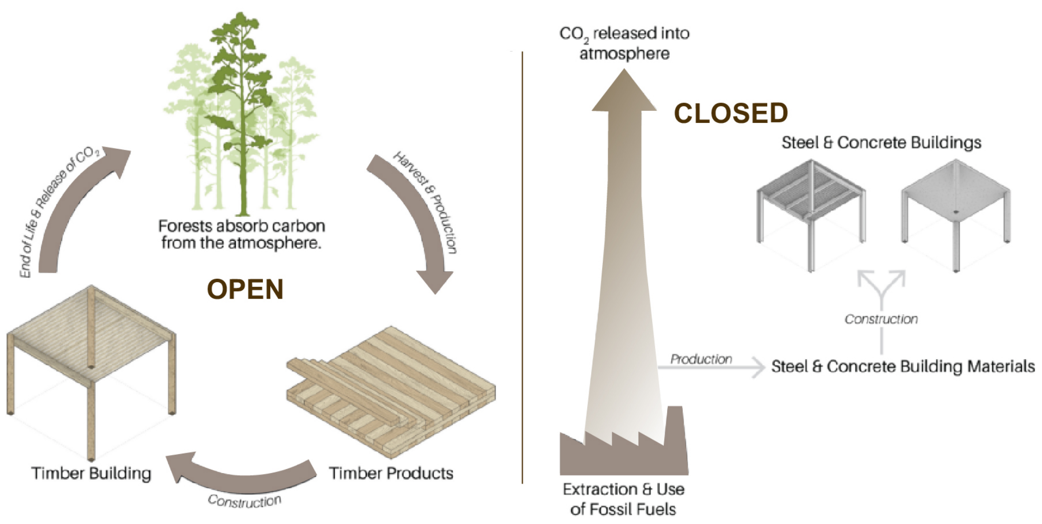
REUSE EXISTING MATERIALS TO
PRESERVE EMBODIED CARBON



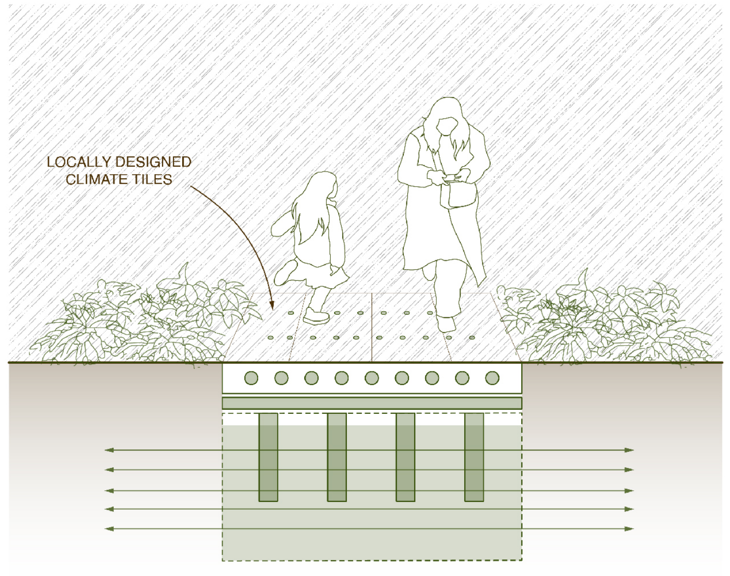
REINTEGRATING EXCAVATED
SOIL INTO THE LANDSCAPE



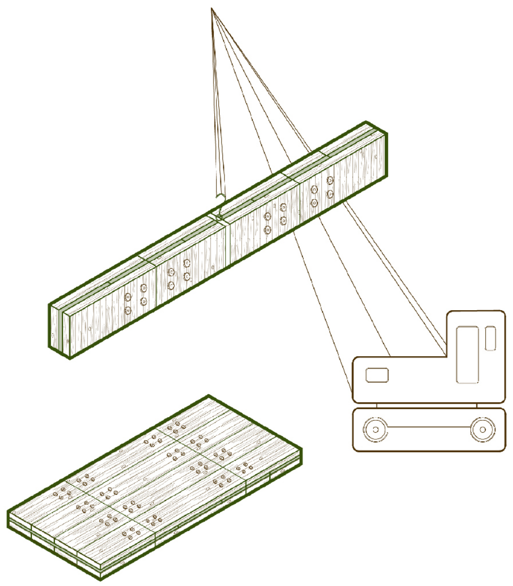
RESTORING ECOLOGICAL BALANCE BY INTEGRATING
THREE TIMES MORE GREEN IN THE URBAN FABRIC



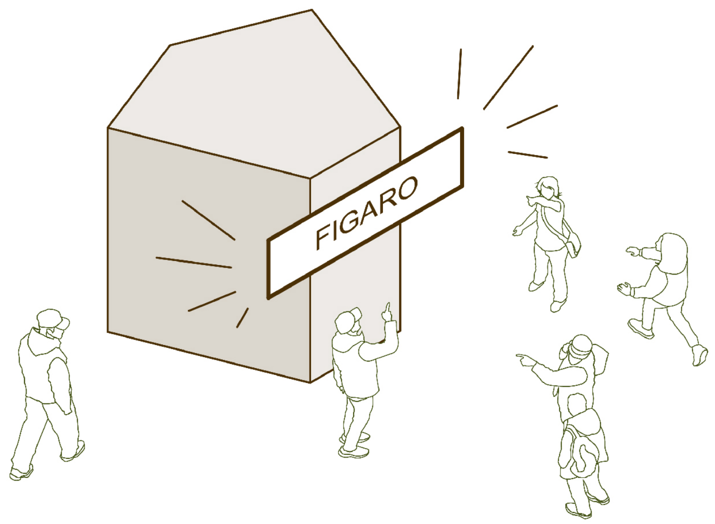
RENEWABLE BUILDING STRATEGY:
USING TIMBER FLITCH STRUCTURE



RECHARGE GROUND WATER AND REDUCE
SURFACE RUNOFF USING CLIMATE TILES



USING PREFABRICATED TIMBER
TO AVOID CONSTRUCTION WASTE



RESTORING NEIGHBORHOOD IDENTITY

05 Facade fragment and details

FACADE FRAGMENT AND DETAILS

EXISTING FACADE FRAGMENT
PLAN, SECTION, ELEVATION AND DETAILS

0 2500 5000 10000

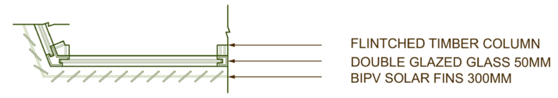
PLAN C-C'

SECTION C-C'

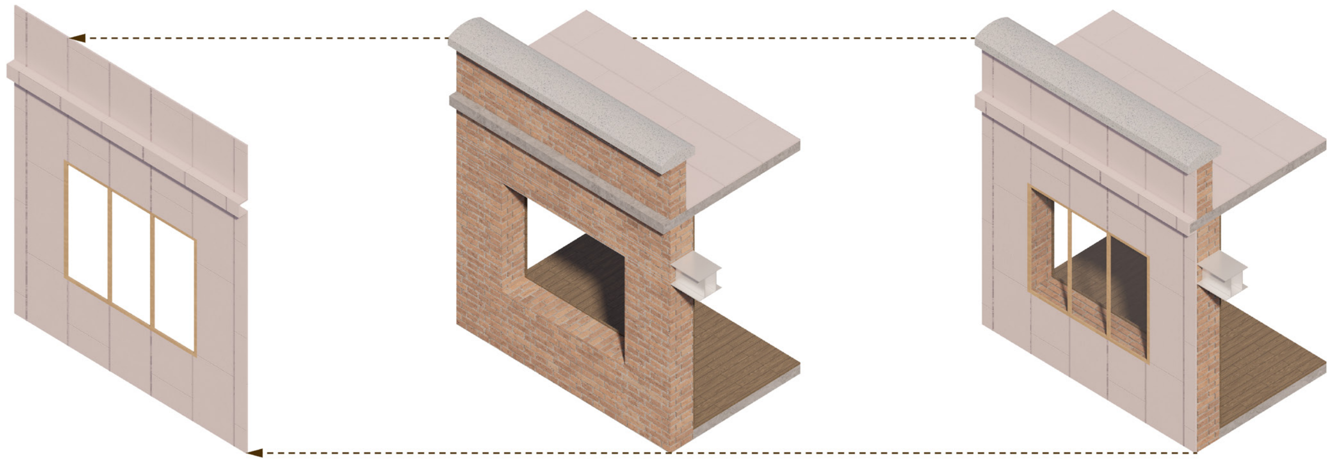
ELEVATION C-C'

TRANSFORMED FACADE FRAGMENT
PLAN, SECTION, ELEVATION AND DETAILS

0 2500 5000 10000



PLAN C-C'

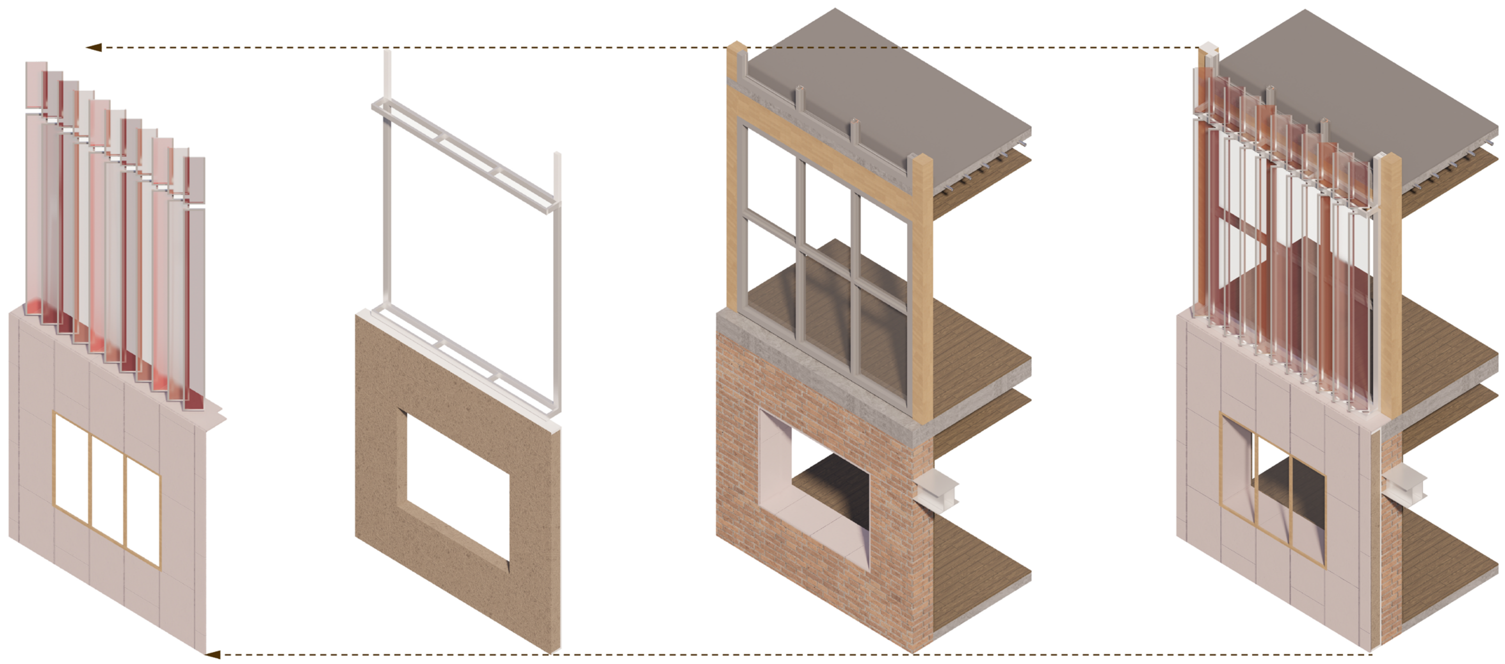


EXTERIOR TILE CLADDING

BRICK LOAD BEARING STRUCTURE 400MM
AND TWO I BEAMS AT LINTEL LEVEL

FIGARO'S EXISTING
FACADE FRAGMENT

UNDERSTANDING EXISTING FACADE LAYERS



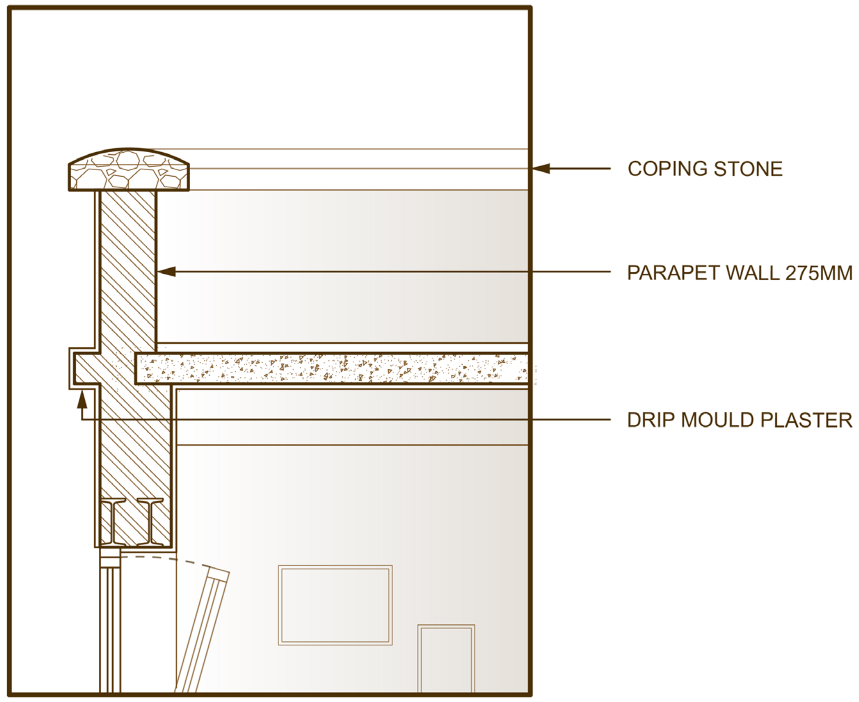
BIPV SOLAR FINS ARE THEN
ATTACHED TO THE FRAME AND
ORIENTED TOWARDS SOUTH

AN ALUMINIUM FRAME WAS
ADDED TO SUPPORT THE
INSTALLATION OF SOLAR FINS

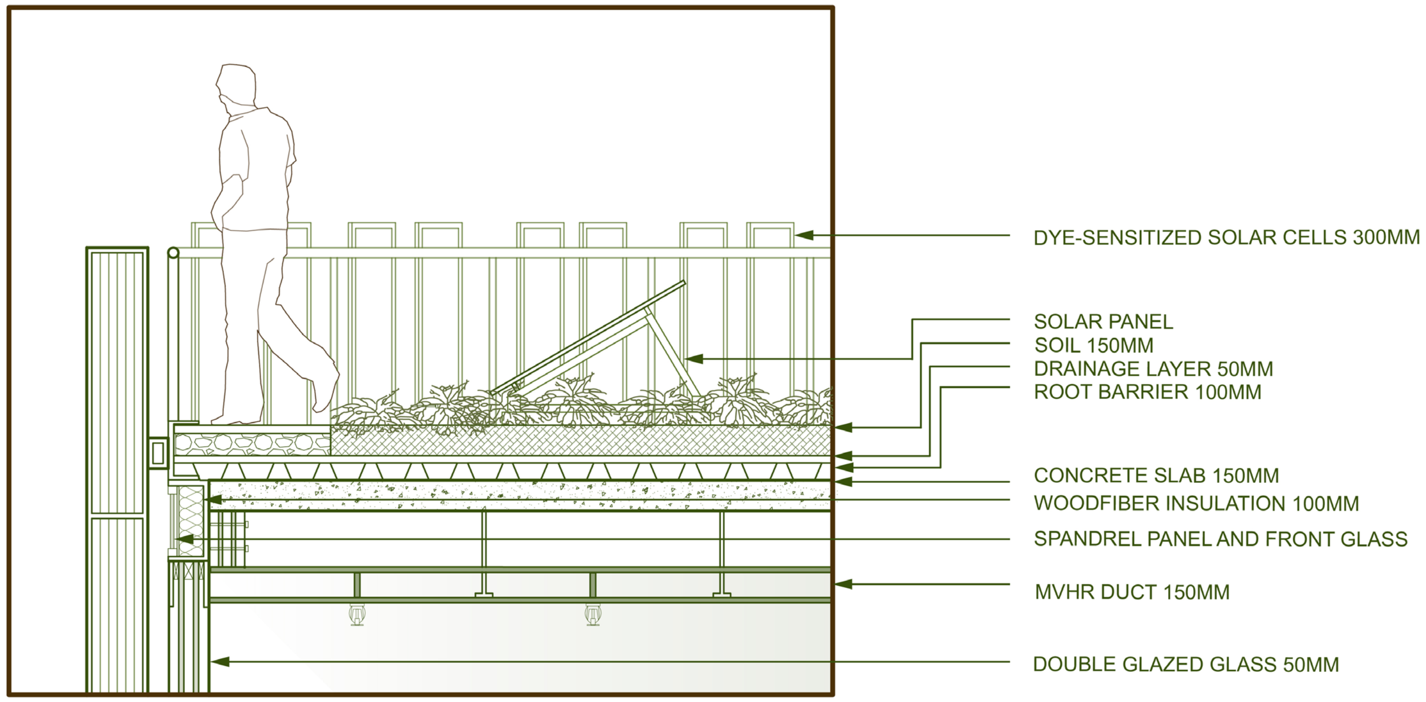
A PREFABRICATED TIMBER STRUCTURE
WITH DOUBLE-GLAZED GLASS WAS ADDED
ONTO THE EXISTING BRICK WALL

FIGARO'S PROPOSED
FACADE FRAGMENT

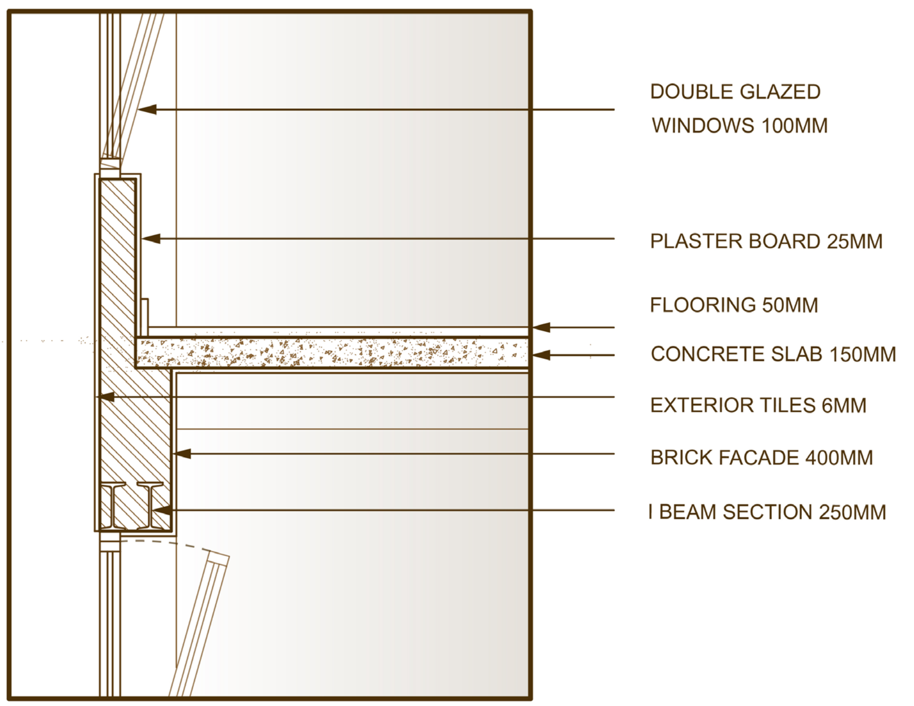
UNDERSTANDING TRANSFORMED FACADE LAYERS



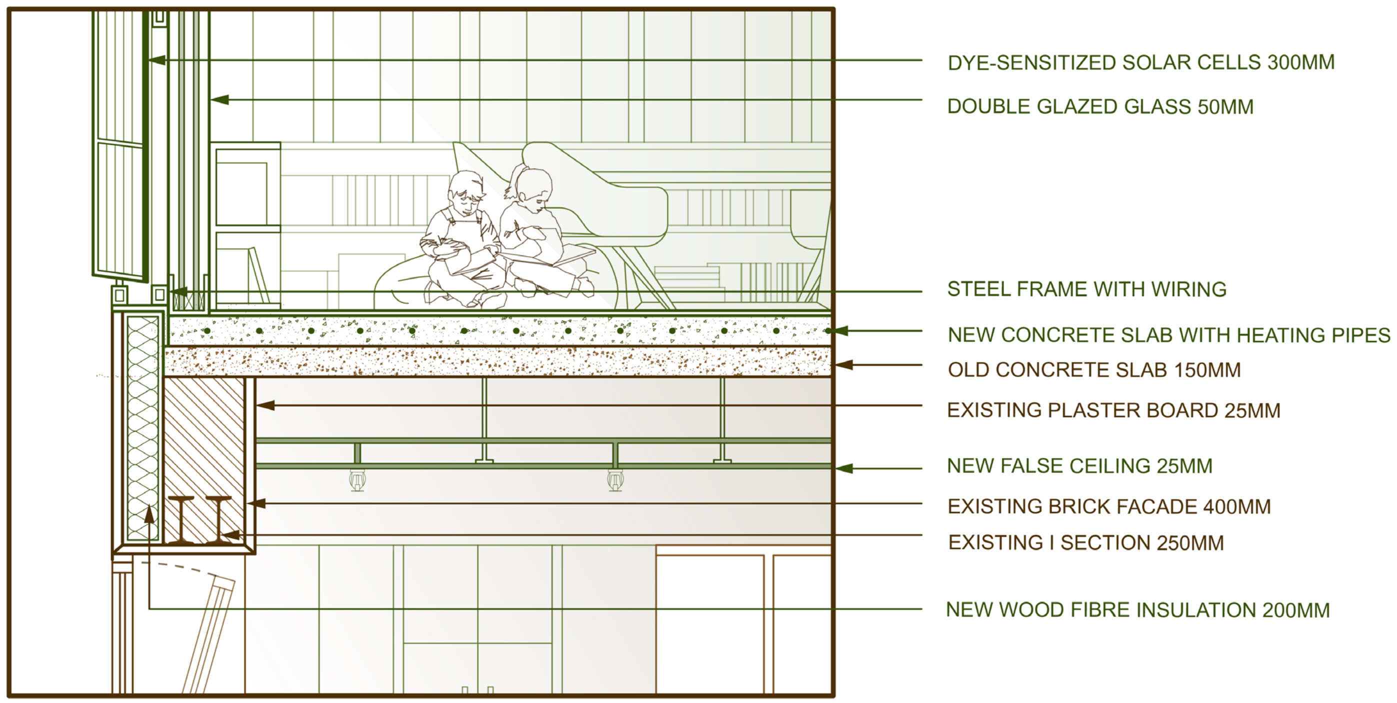
(1) EXISTING ROOF TERRACE



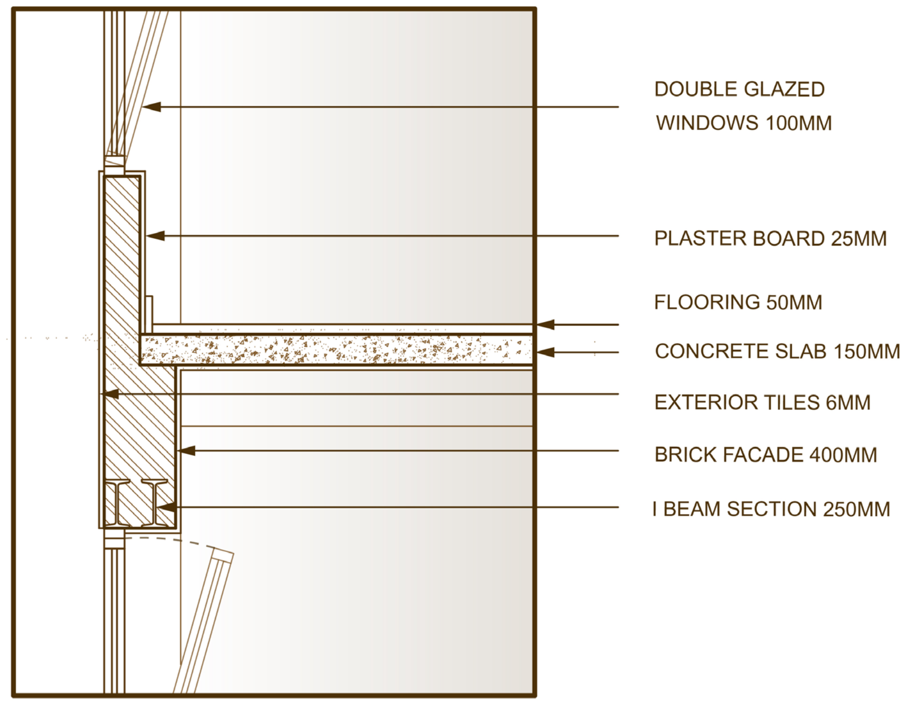
(3) BLUE GREEN SOLAR TERRACES



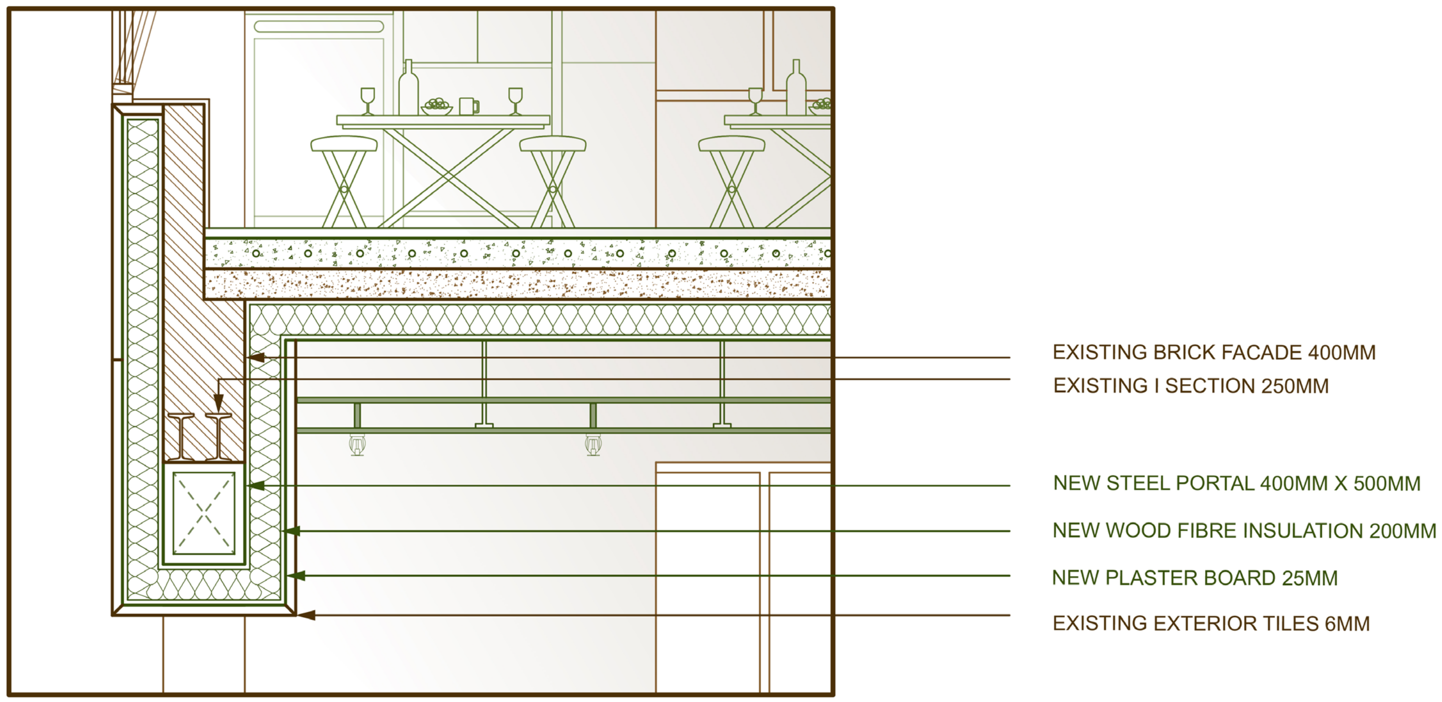
② EXISTING BRICK FACADE



④ INTERSECTION BETWEEN OLD AND NEW



③ EXISTING BRICK FACADE



⑤ STEEL PORTAL FOR DOUBLE HEIGHT PLAZA