APARTMENTS AND CLIMATE ADAPTATION IN MUMBAI

Reimagining Housing Through Climate And Regulatory Transformation

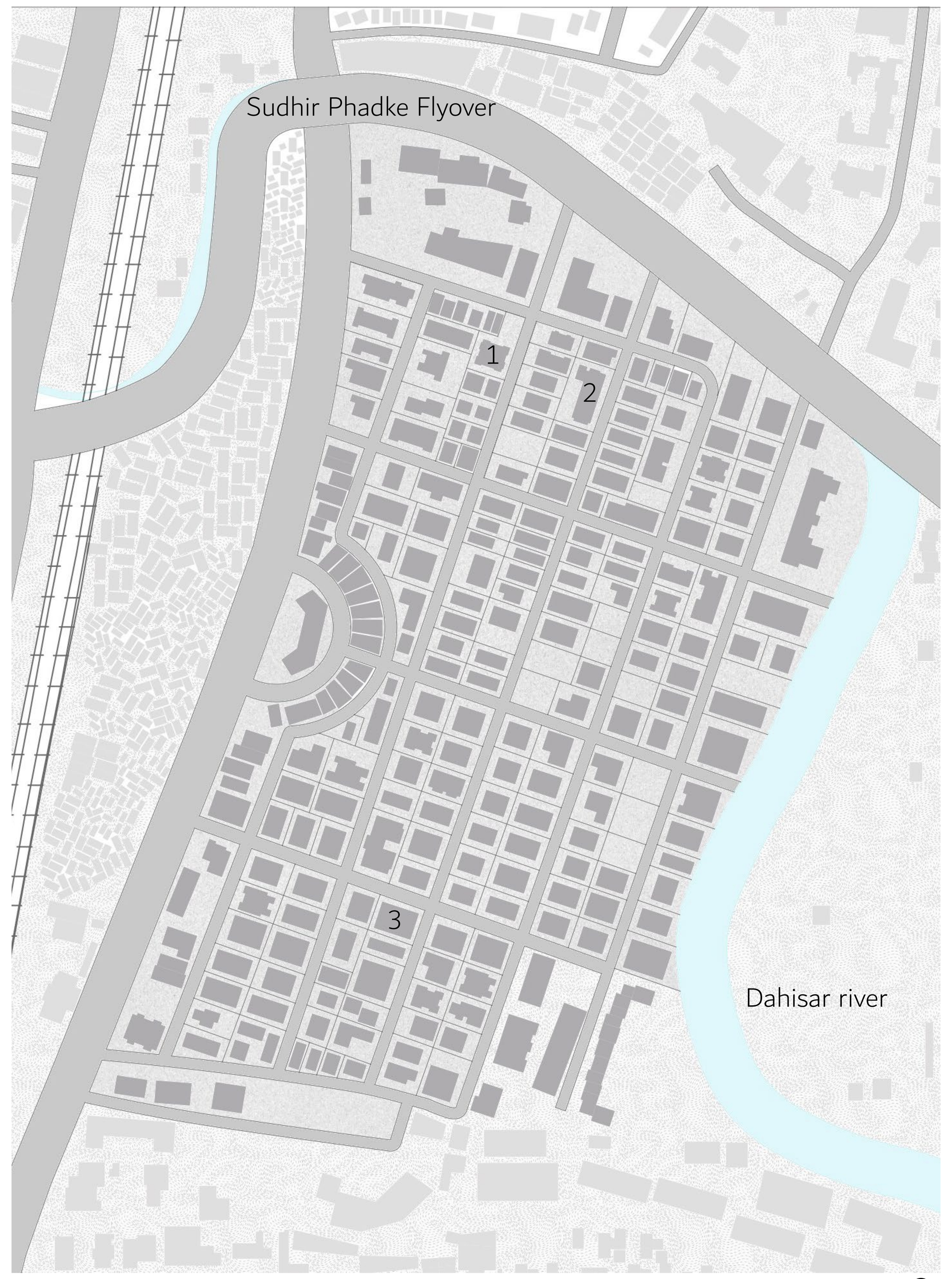
RESEARCH QUESTION

How do DCR's shape the spatial affordances of apartments in Mumbai to adapt to the changing climate and everyday life?

RESEARCH OBJECTIVES

- To analyse how DCRs shape housing builtform.
- To analyse spatial affordances of apartments to adapt to changing climate and everyday life of households.
- To articulate the implications of shifts in DCRs vis-a-vis climate adaptation of apartments.

This thesis examines how successive Development Control Regulations in Mumbai have shaped the spatial character of apartment housing by studying key parameters such as FSI, setbacks, height limits, open spaces and balcony regulations. These factors influence the building envelope, ground permeability and the everyday capacity of households to adapt to changing weather. To understand how shifts in regulations translated into changes in housing form and climate adaptation, the study focuses on **Daulat Nagar in Borivali East**, a neighbourhood that embodies the overlap of multiple regulatory periods. Three buildings from 1970, 1991 and 2018 were selected as case studies, each reflecting the rules of its time. Through these examples, the research shows how changes in regulations altered spatial possibilities, patterns of inhabitation and the lived experience of climate. **The findings reveal a gradual shift from earlier forms that supported climatic comfort and flexibility toward newer forms that prioritise density and restrict everyday adaptation.**

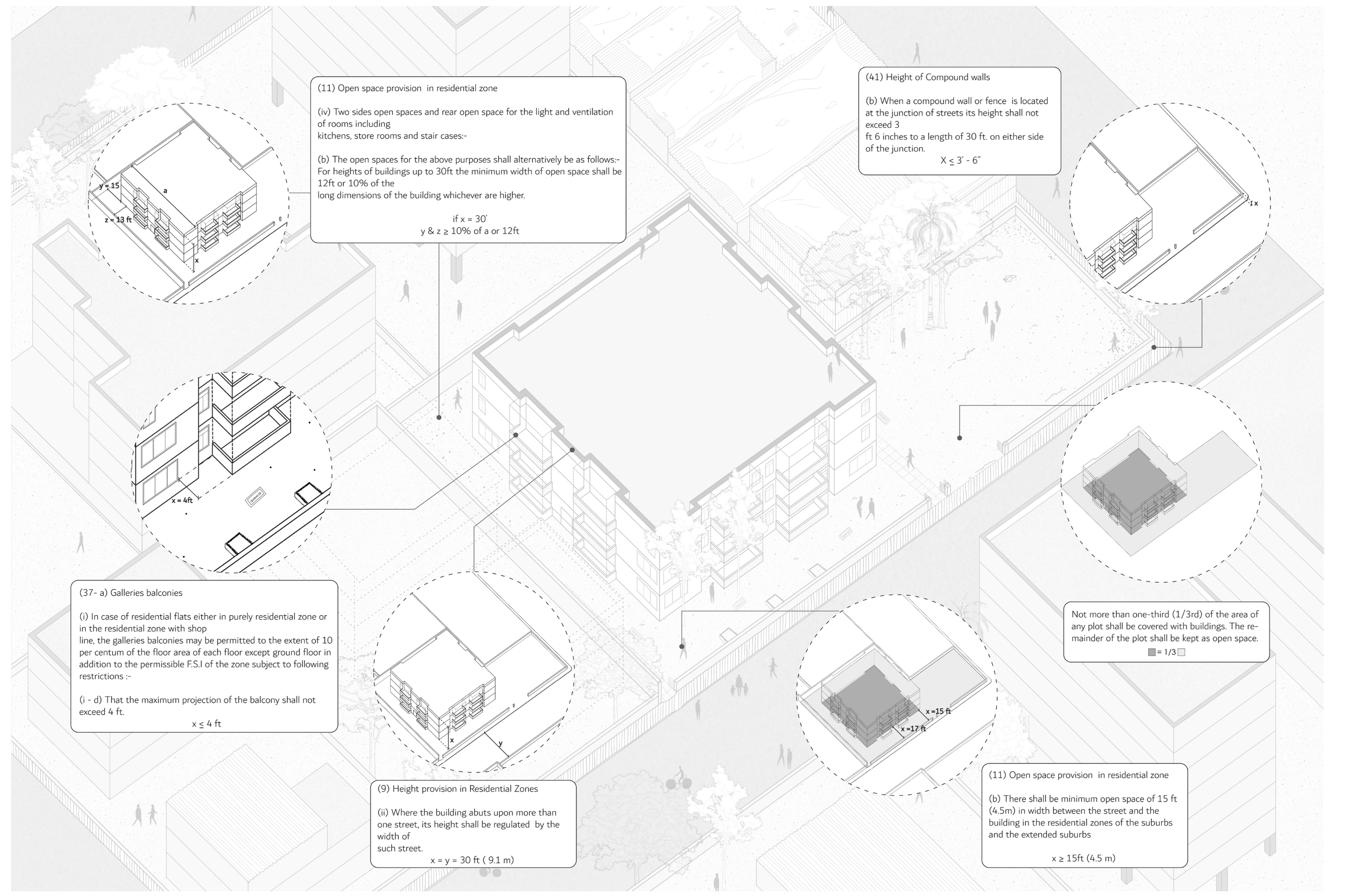


Site - Daulat Nagar, Borivali East,

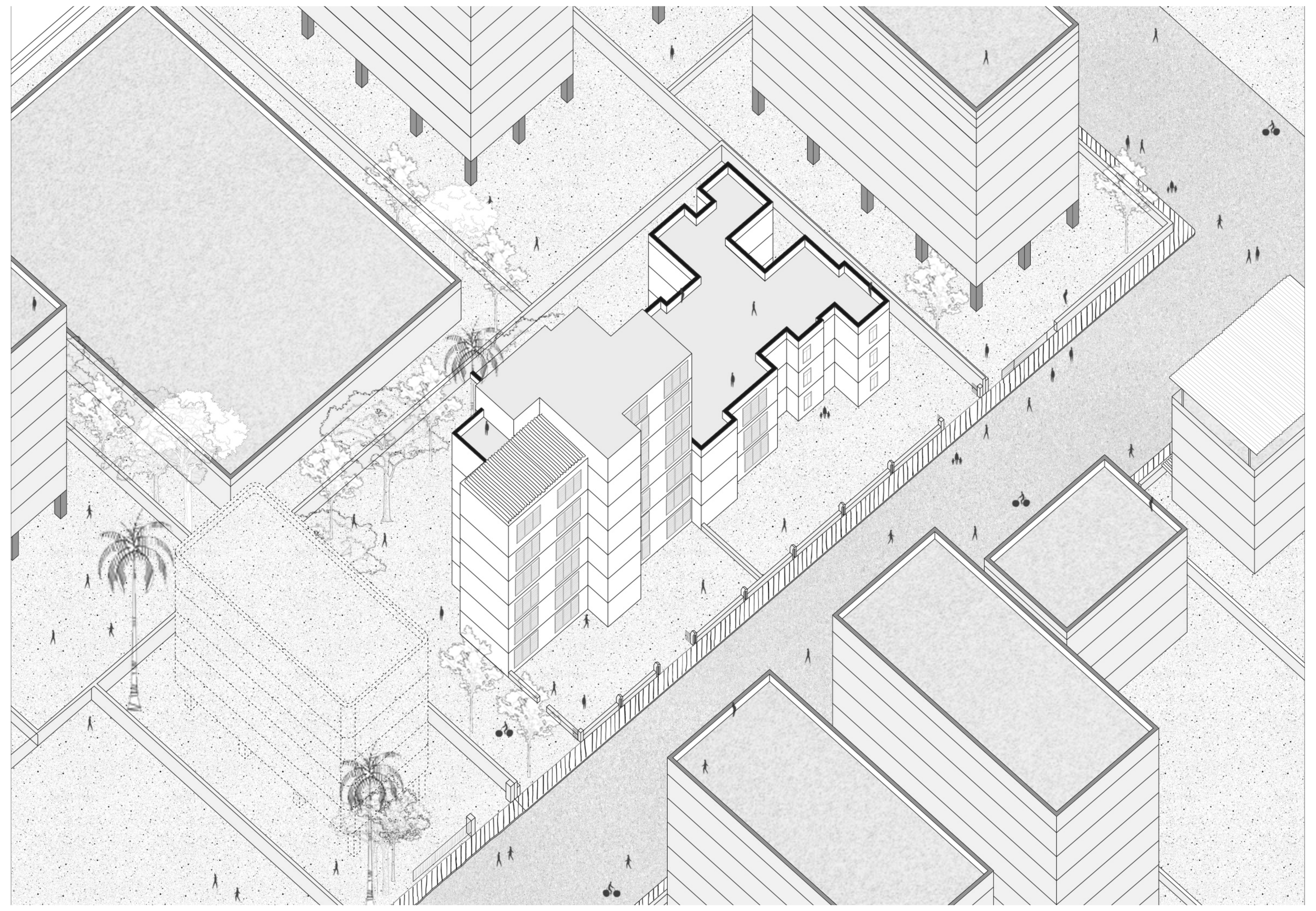
RATIONALE FOR FIELD DELINEATION

	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020
Building Skins			x= 4'				Balconies included in FSI if area exceeds 10% of the floor area.			Balconies Included in FSI			Balconies not Included in FSI upto10%
Open Spaces			1/3 of Plot area				Island City - x = 10ft Suburban Mumbai - x = 15ft			D/ W = H/3 on all sides upto 40m except front + add 10% above 40m Min = 3.6m, Max = 20m			Front open space Island city - 3m Suburbs - 4.5m
Height Restrictions			G+2				H = 1.5 x (X + Y) , H = 2.5			H = 1.5 x road width			H= 3 x (RW+FOS)
Set backs	X	X	Min 3m (Rear, Side, Front)				D/ W = 38ft < 50ft; x = 10ft, y = 17ft - 35ft D/ W < 38ft; x = 6ft - 10ft, y = 17ft - 35ft,			D/ W = H/3 on all sides upto 40m except front + add 10% above 40m Min = 3.6m, Max = 20m			D/W < 20m = H/5, D/W > 20m = H/4, Min = 3.6m, Max = 12m
Floor Space Index – Island city	X	X	X	X	X	X	1.3	1.	1.	2.	2.	3	3
Floor Space Index – Suburbs							0.7	0.7	1	1	2	2.	2.

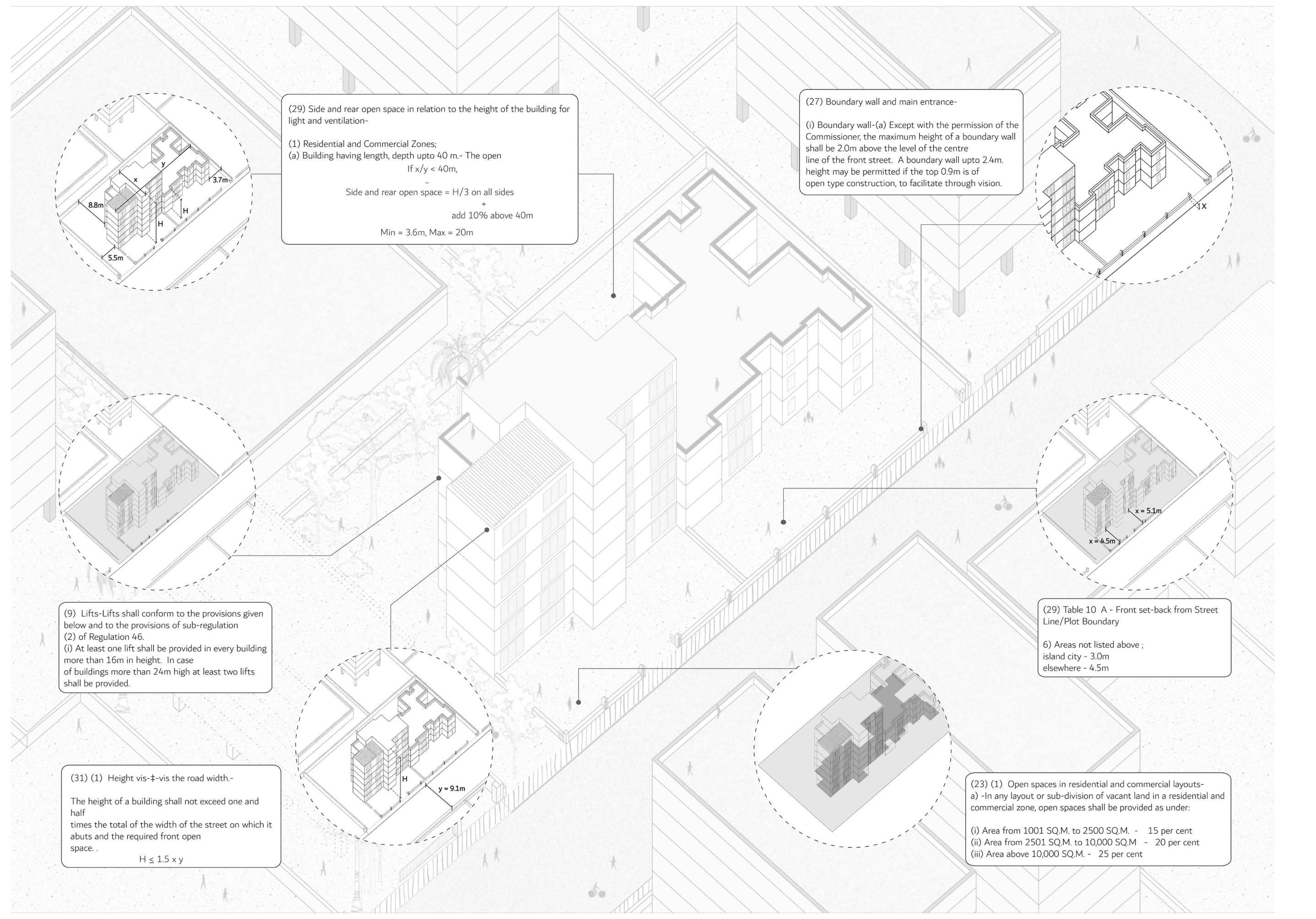
1) Shilpar Building, 1970 - A low rise G+2 structure.



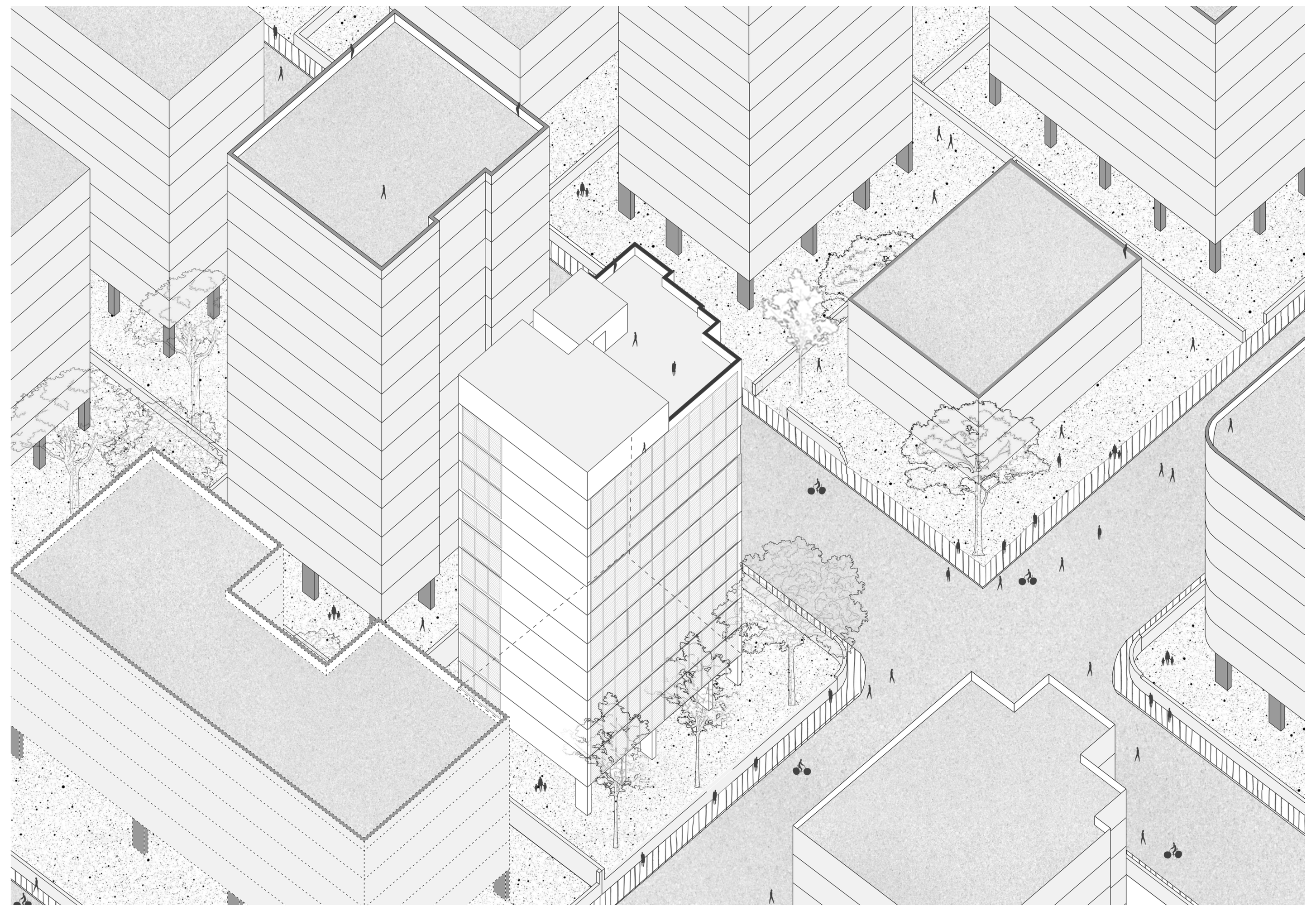
Generous setbacks and low FSI in 1967 allowed more open, percolable ground.



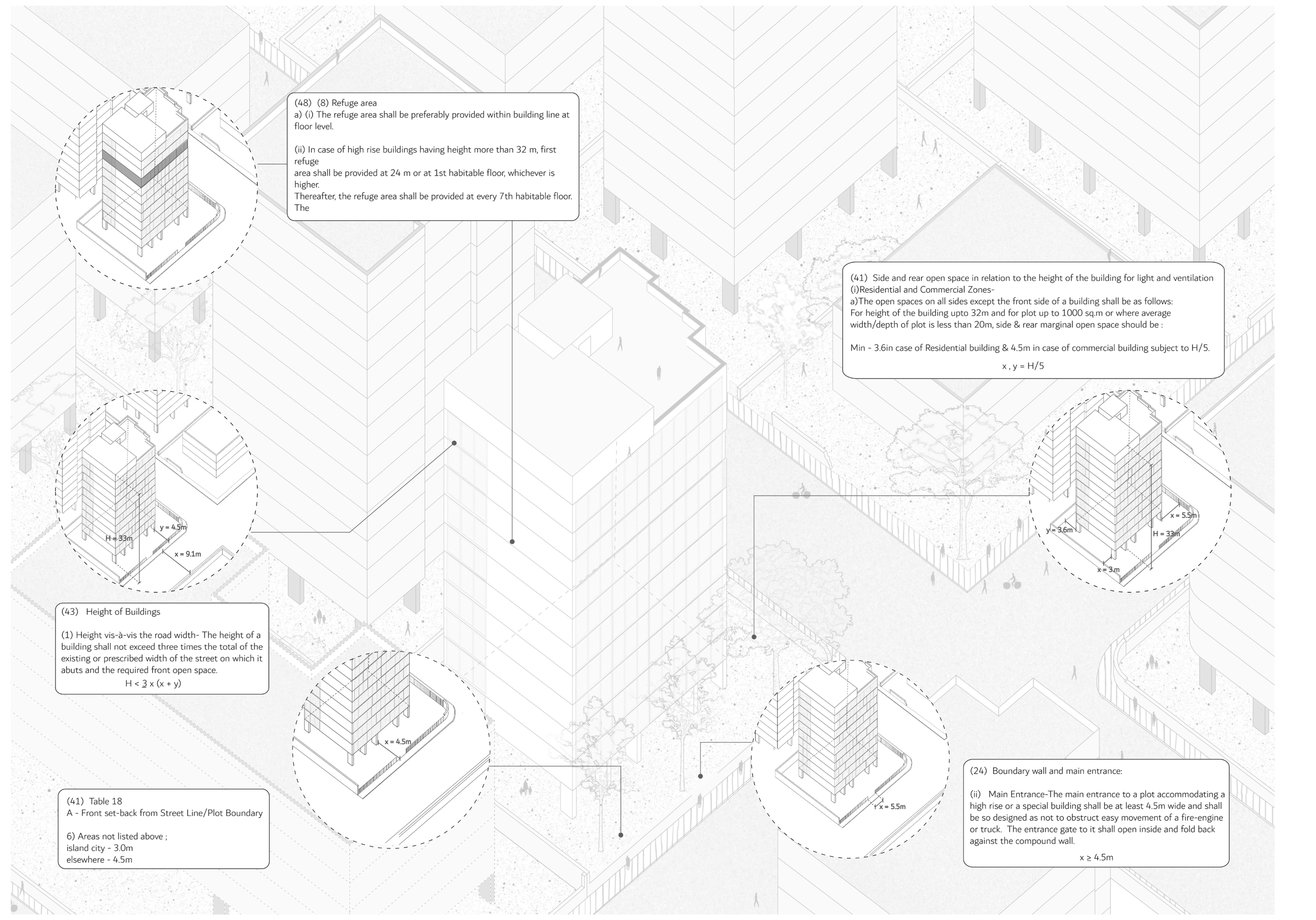
2) Santi Sadan Building, 1991 - Comprises of two wings, A (G+2) and B (G+6)



1991 DCR increased FSI and included balconies into FSI, reducing spatial adaptability.



3) Saikrupa Building, 2018 - G+10 Highrise Building



2034 DCR increased FSI and heights, shrinking open spaces to minimal setbacks.

HOUSEHOLD ANALYSIS

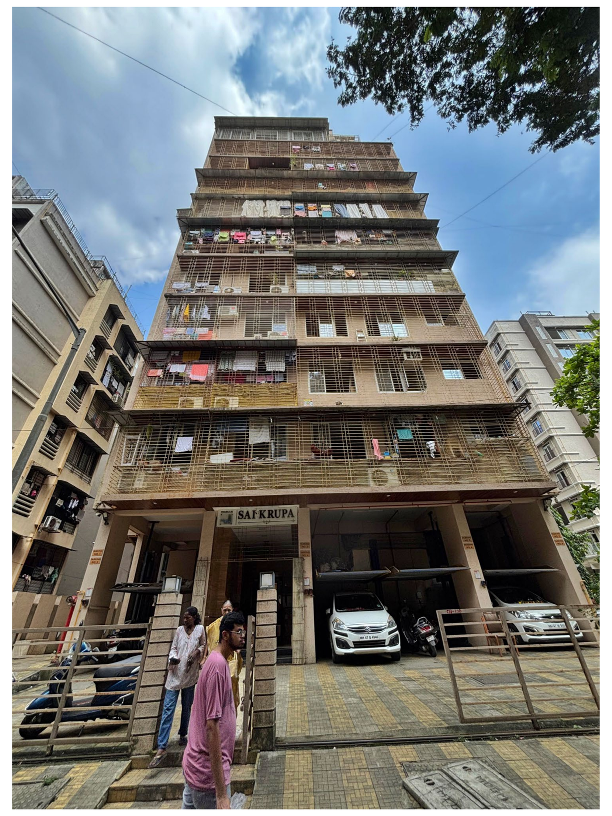
1) Shilpar Building, 1970

I studied one ground-floor and one top-floor household in each building to see how floor level shapes adaptation. Ground floors face flooding and adapt through spatial changes, storage extensions, lofts, and waterproof materials, while top floors deal with heat and dampness using damp-proofing and moisture-resistant materials.

2) Santi Sadan Building, 1991

In the 1991 building, the ground-floor household faces frequent flooding, using foldable beds and storing fewer grains, while the top-floor household struggles with heat and poor airflow from west-facing windows.

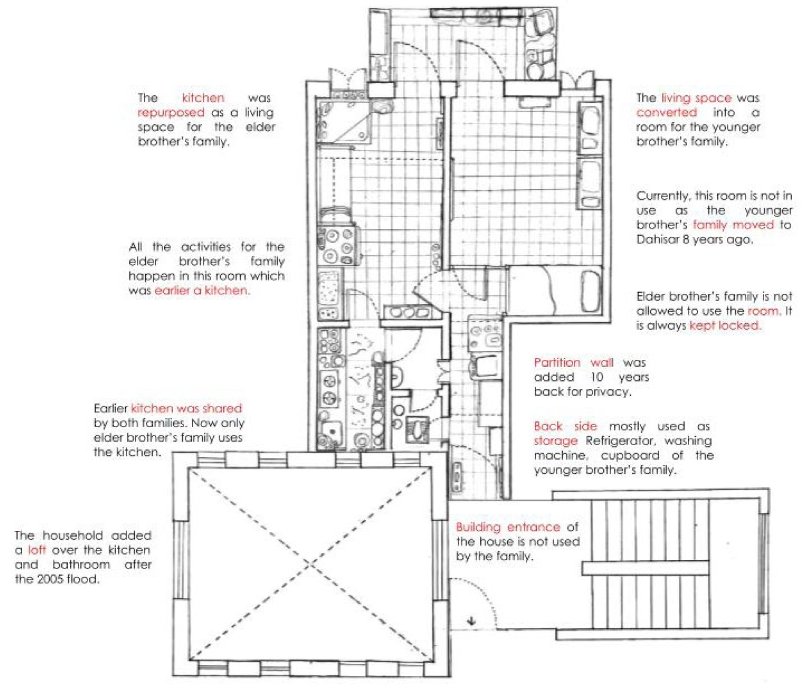
3) Saikrupa Building, 2018



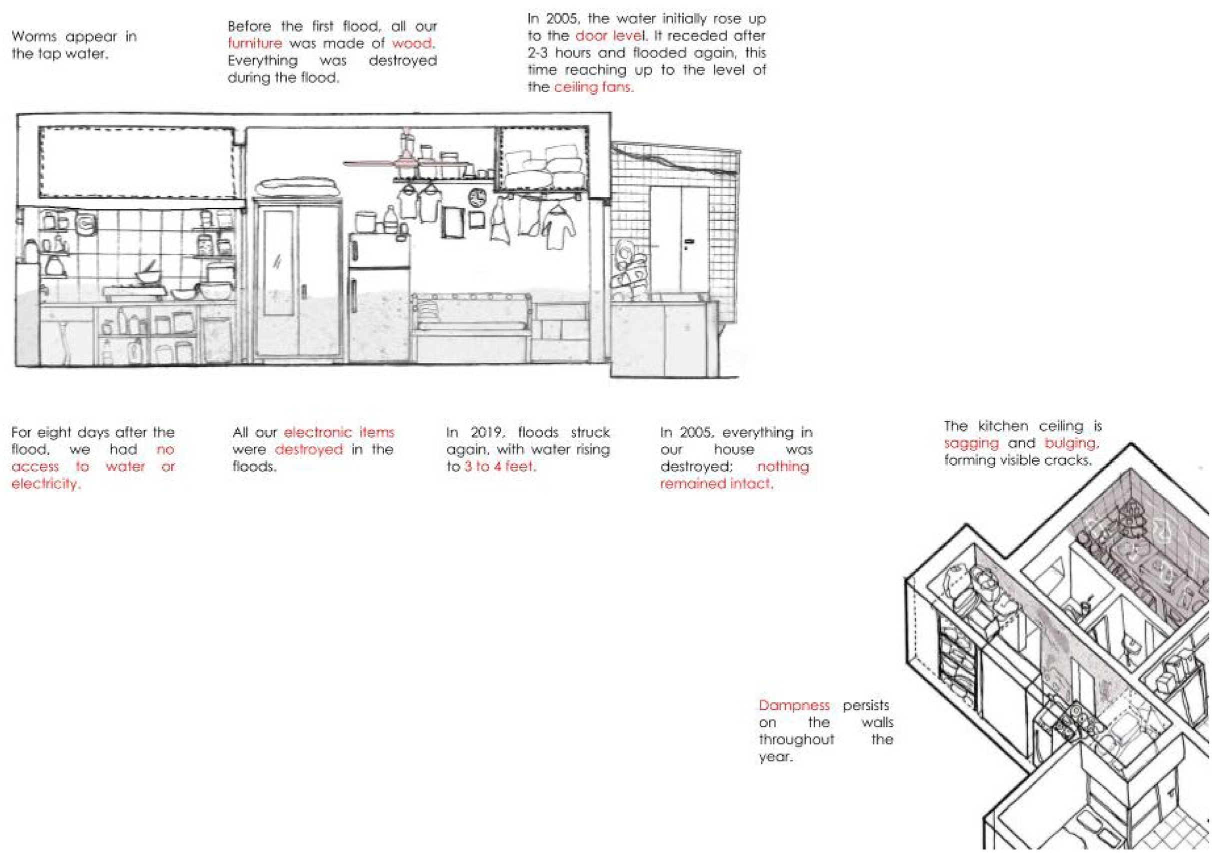
In the redeveloped high-rise, families reconfigure their 1BHK and 2BHK units to maximise space. Although the DCR allows larger windows, lower floors remain dim, forcing heavy reliance on AC and artificial lighting.

SHILPAR BUILDING, 1970, HOUSE 1 GROUND FLOOR

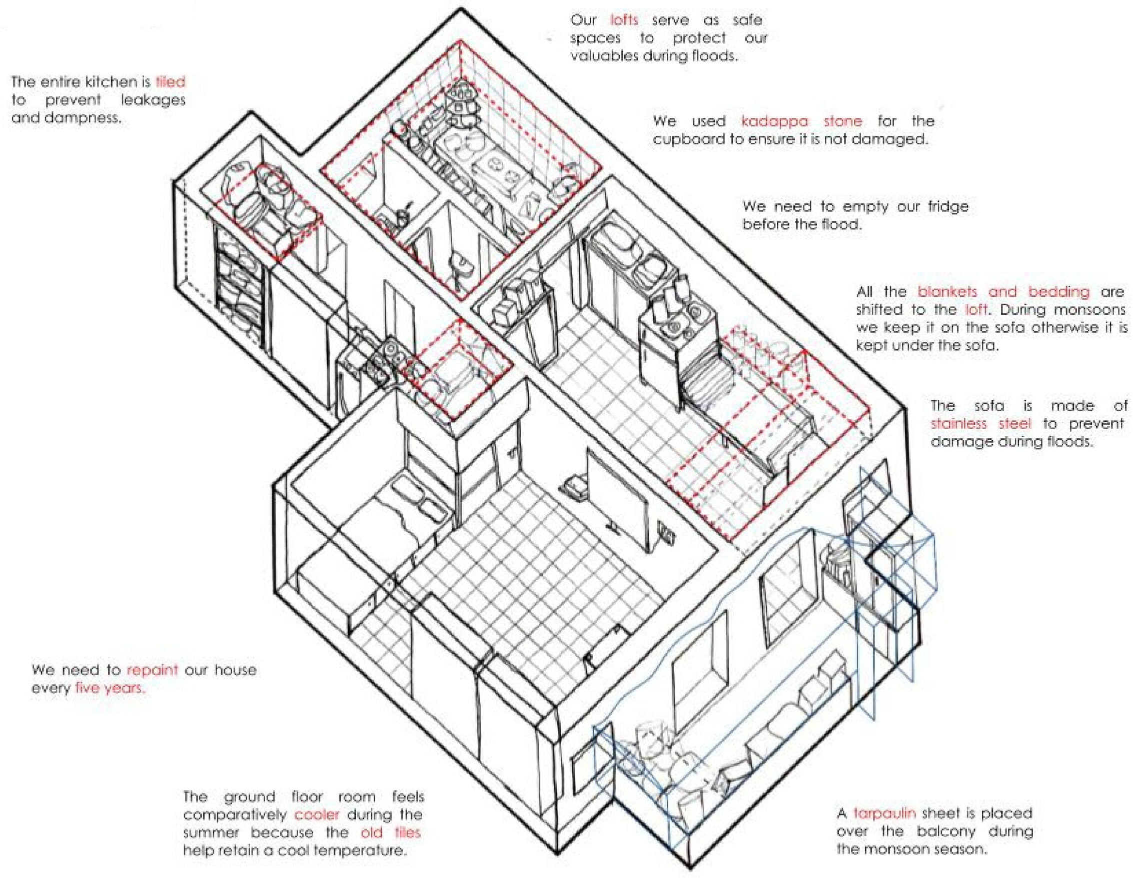
Inhabitation Of Space



Household Challenges

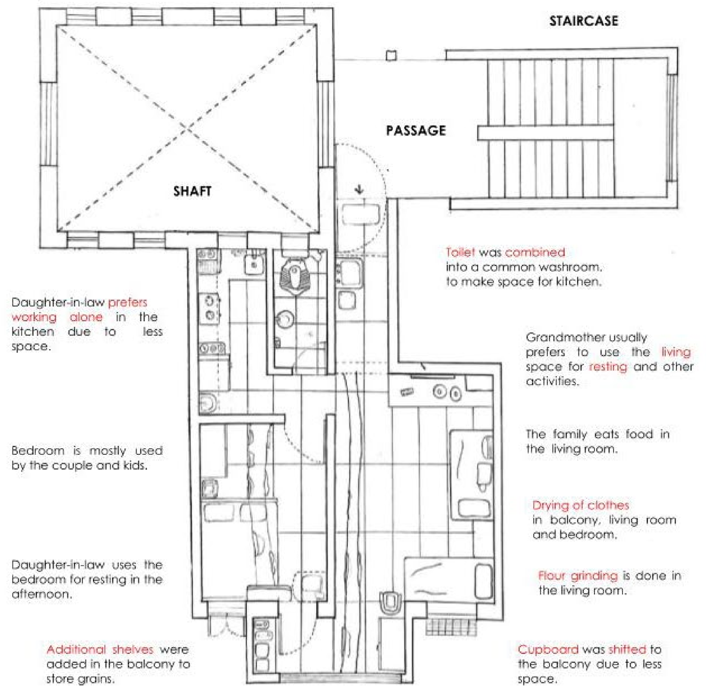


Adaptation Strategeis

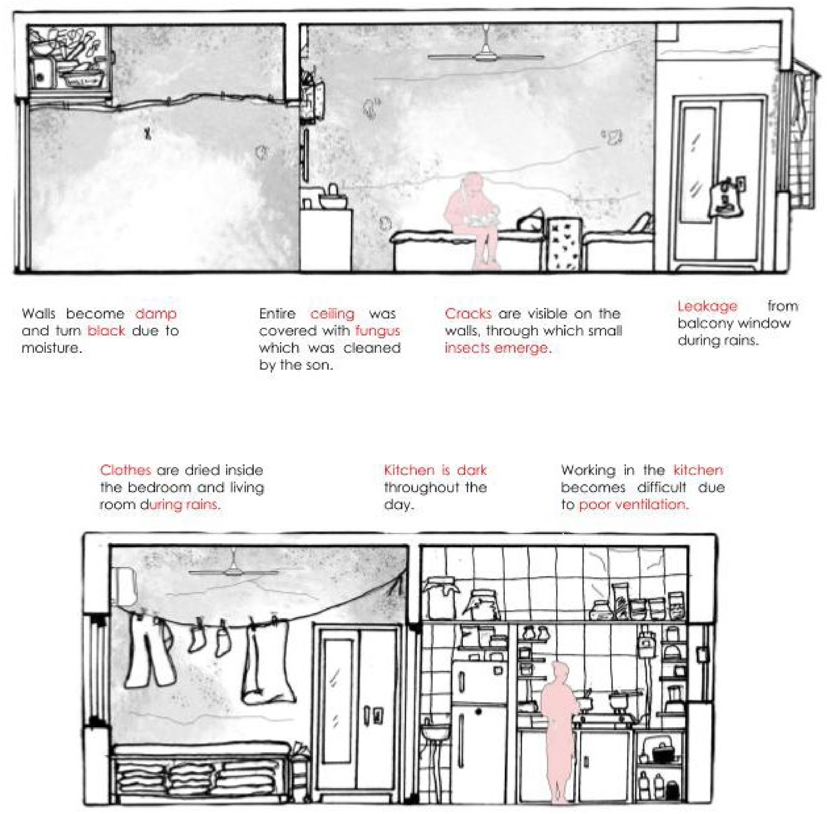


SHILPAR BUILDING, 1970, HOUSE 2 SECOND FLOOR

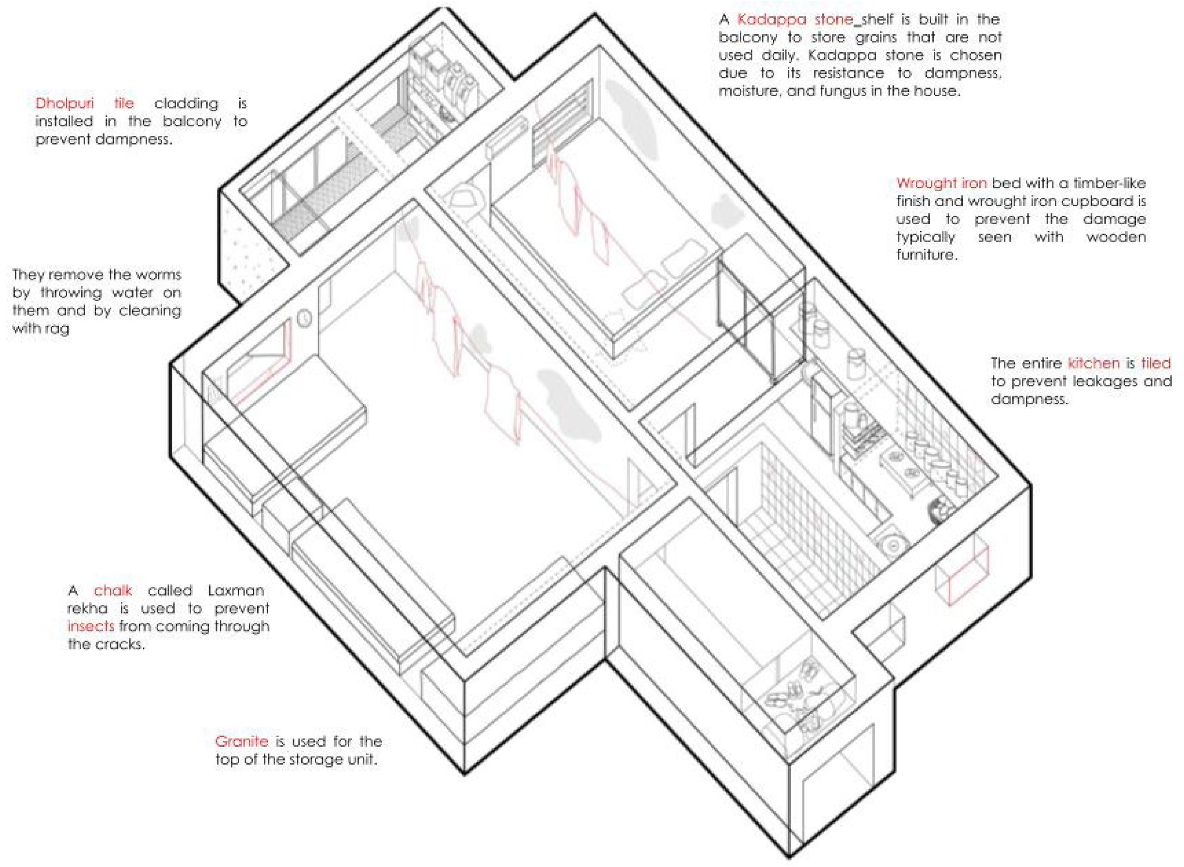
Inhabitation Of Space



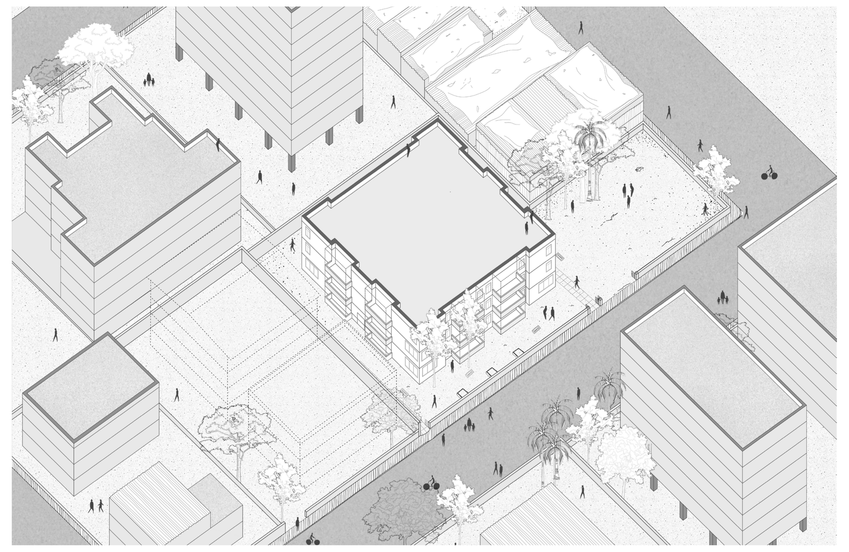
Household Challenges



Adaptation Strategeis

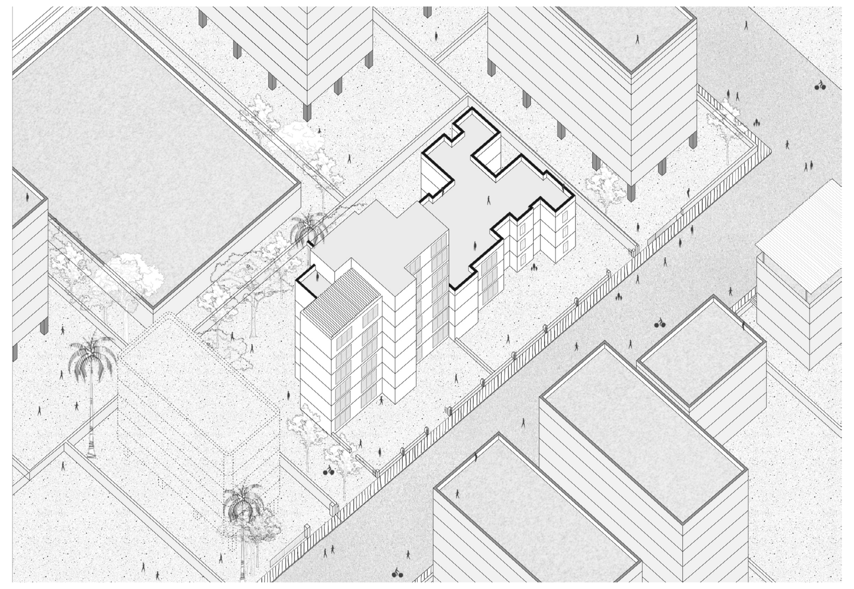


RESEARCH CONCLUSION



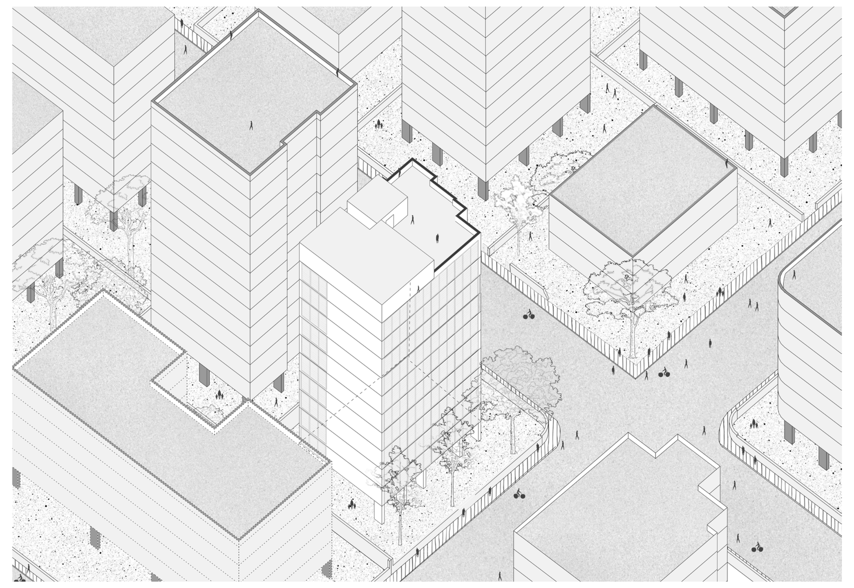
Earlier setbacks provided more ground to absorb water, allowing it to percolate and improve airflow.

Older homes, with balconies and open spaces, offered buffers against the elements and allowed for informal, low-tech adaptations.



Open spaces have diminished, this has resulted in harsher climates.

The building skin which afforded climatic conditions has been reduced.



Open spaces have diminished, this has resulted in harsher climates.

The building skin which afforded climatic conditions has been reduced.

DCRs have modernised housing and maximised built forms and prioritise infrastructure resilience.

THESIS ARGUMENT

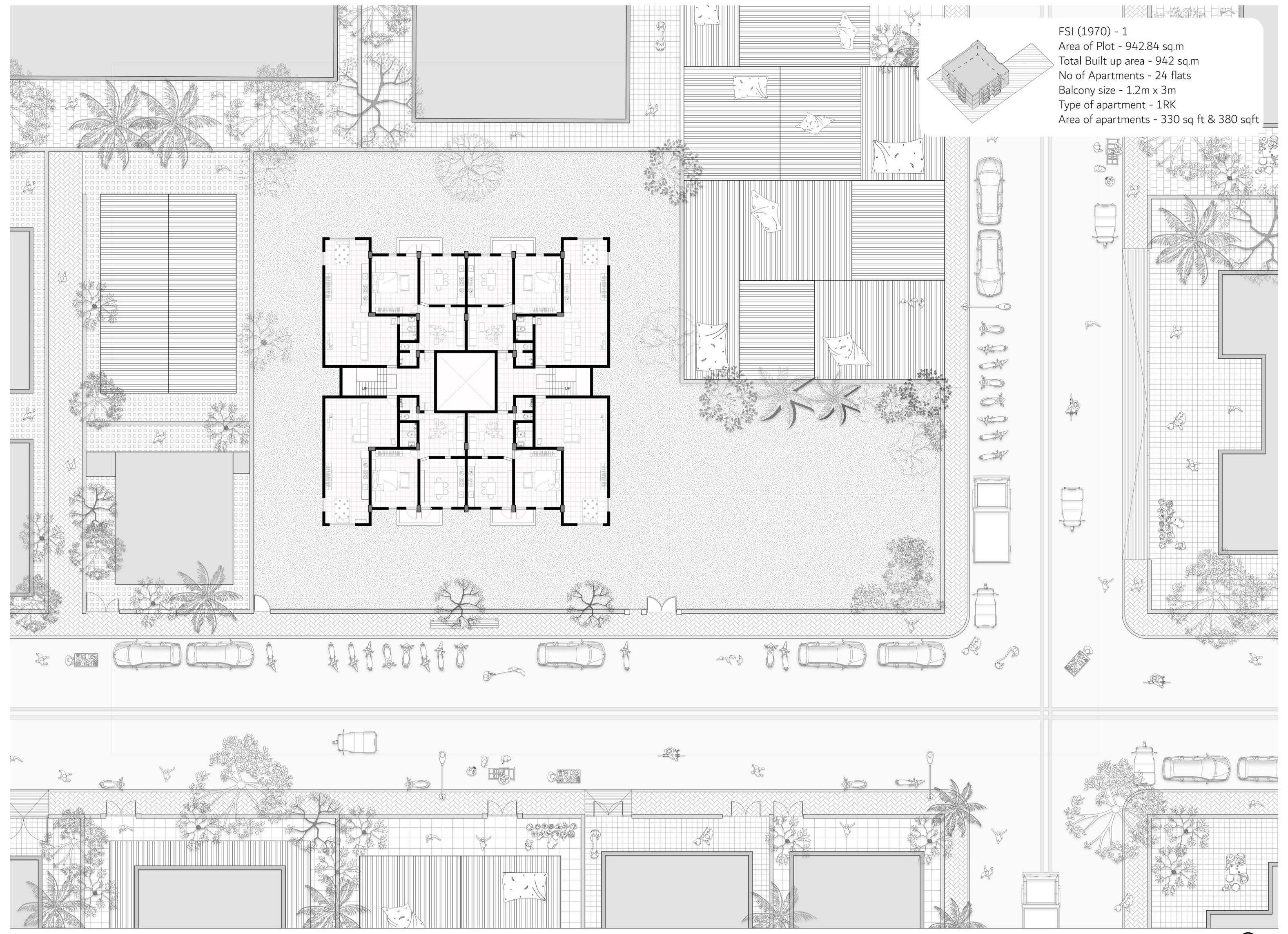
Building on the insights from my research, the thesis argues that older apartments demonstrate greater adaptability to climatic changes due to their inherent spatial flexibility, while newer buildings, prioritise maximising built-up areas.

KEY DEMONSTRATIONS

- **Reimagining apartment type.** What is the nature of housing that can effectively respond to emerging climatic conditions while supporting everyday needs?
- **Rethinking DCRs that prioritise flexible and adaptive spatial configurations.**

DESIGN INTENT

The design intends to rethink the apartment type and the DCRs through the lens of climate. It explores how housing can move beyond maximised efficiency to become adaptable, flexible, and responsive to changing weather and everyday life.



Existing Site Plan


Proposed design isometric showing the south and east facades and their climatic response elements.


Existing on-site building proposed for redevelopment.

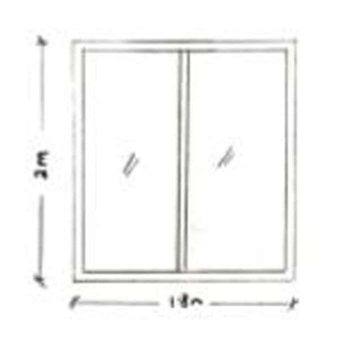
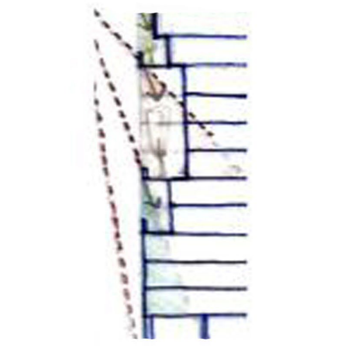
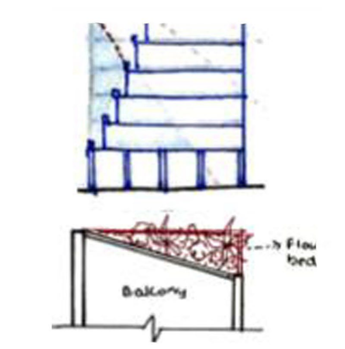
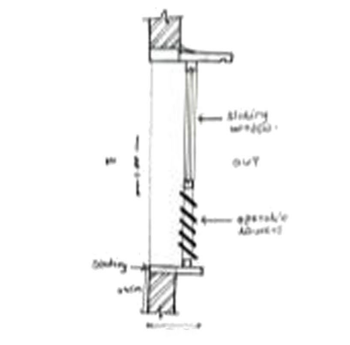
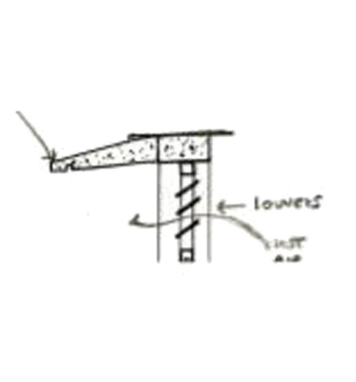
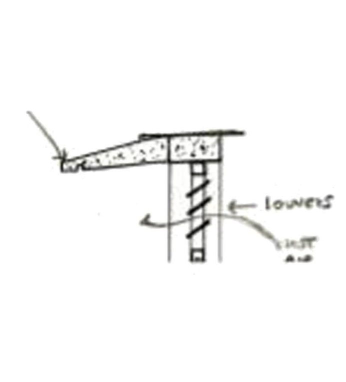
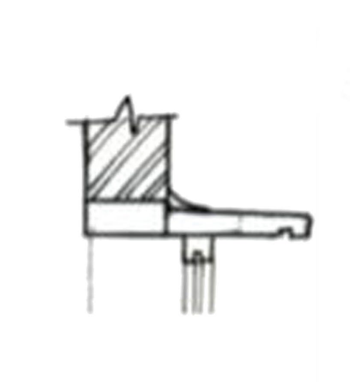
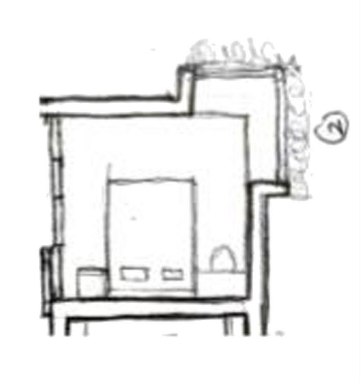
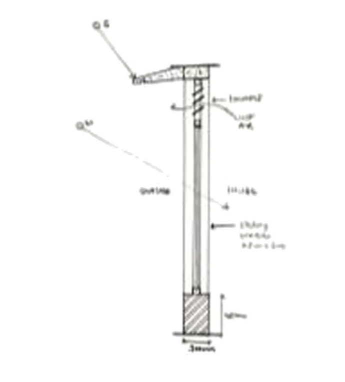
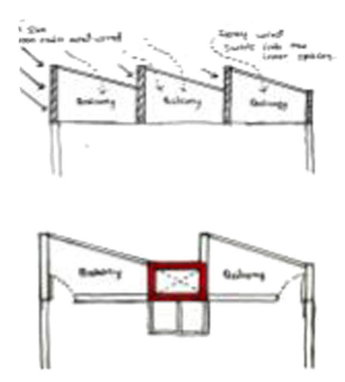
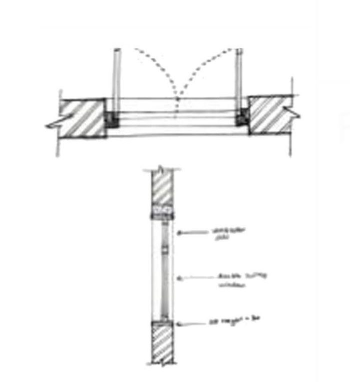
CONCERNS ON SITE

- Residents are leaving because of the buildings condition and floods.
- Houses do not have a dedicated kitchen space. Repurposed kitchen spaces do not receive light and ventilation.
- Top floor houses face difficulty due to summer heat.
- Balconies are covered with tarpaulin sheets during monsoons.
- Open ground and road used as parking space.

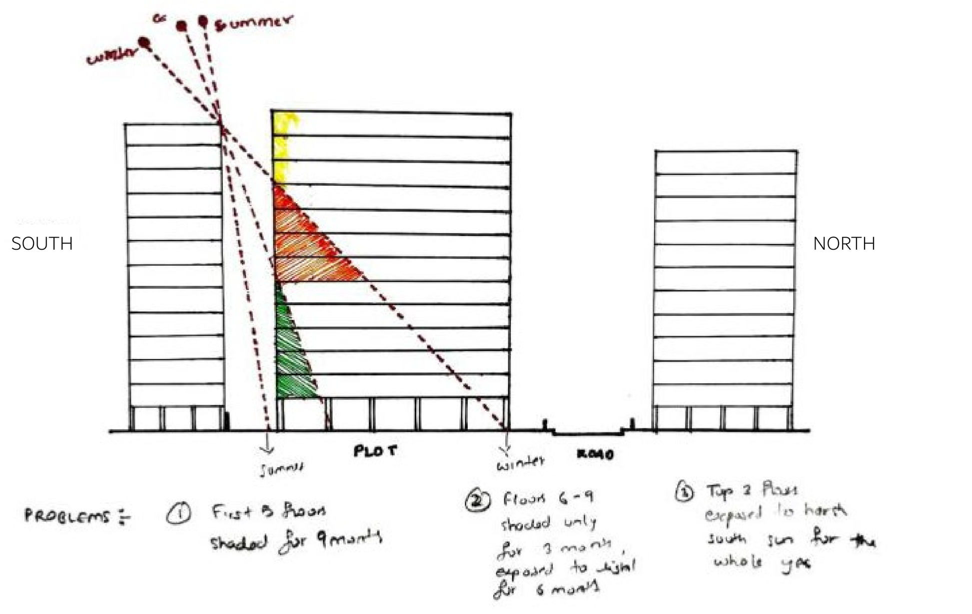
PROPOSED PROGRAMS

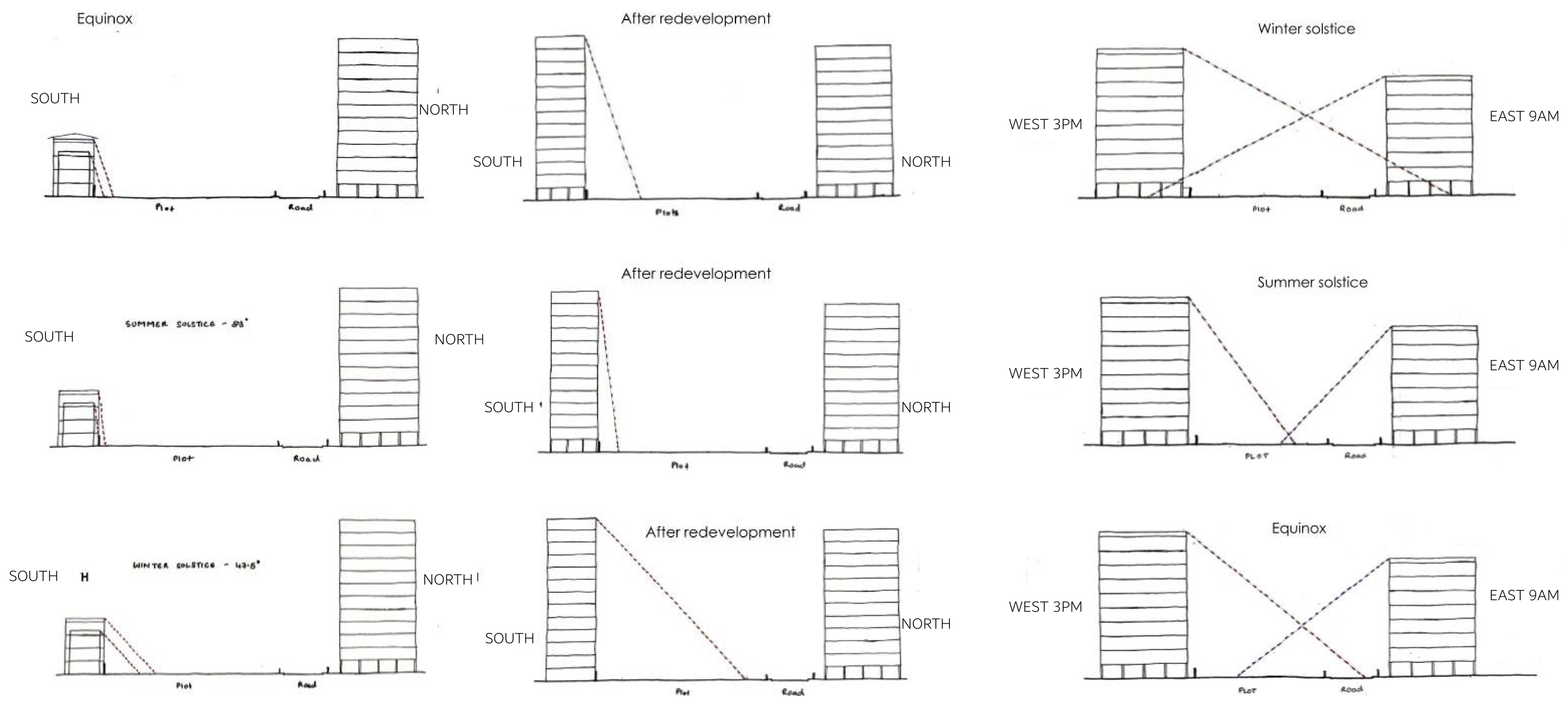
Living Spaces - Redeveloping the apartment
(Parking Space , Additional Sale Flats
Rehab(24 tenements)+48% increment : 1080 sq.m

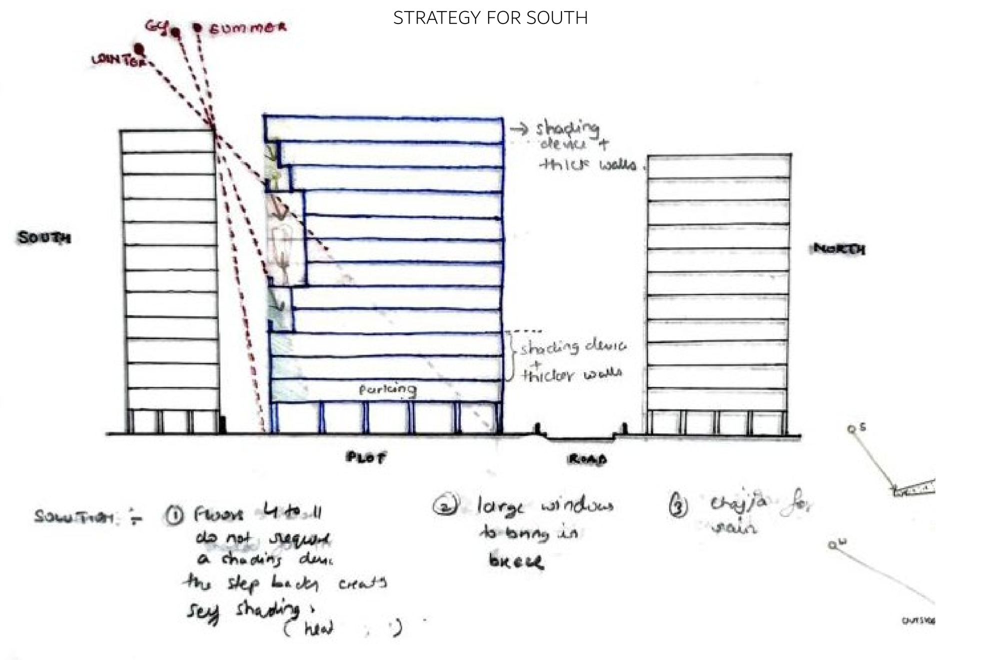
CONCEPTUAL STRATEGIES

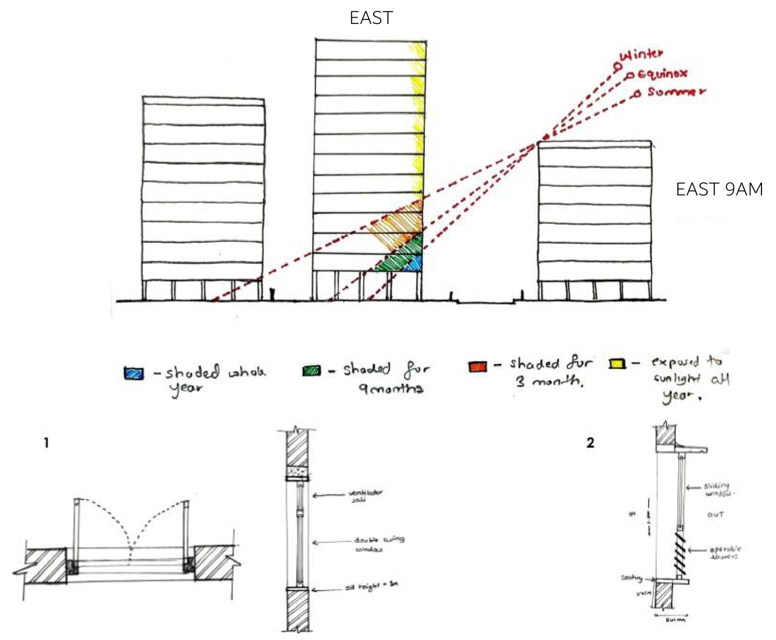
	NORTH	SOUTH	WEST	EAST
SUN (HEAT)				
RAIN				
WIND				

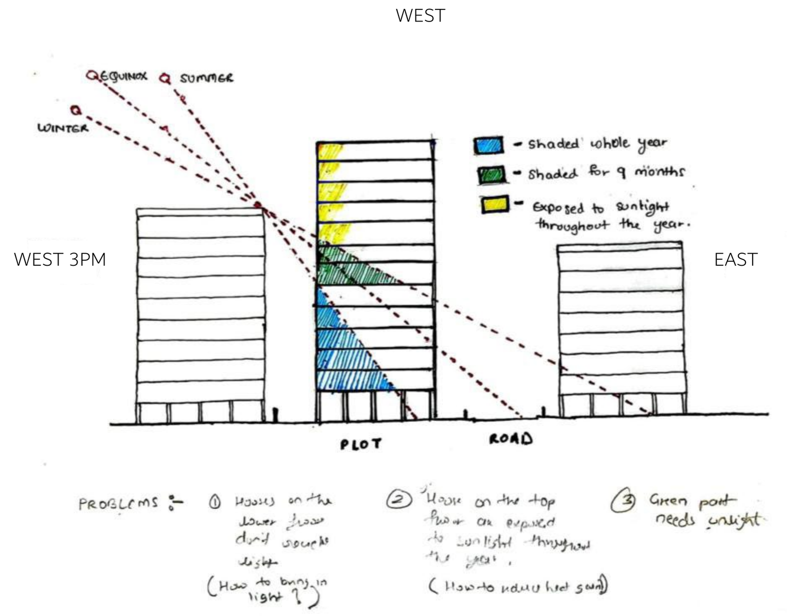
Sectional studies across the east–west and north–south axes show how neighbouring buildings shape the site's solar exposure. The west side remains heavily shaded for most of the year, guiding the use of a protective balcony skin projected to respond to sun angles. On the east, window forms are rethought to bring in soft morning light while filtering low angle glare. North–south analyses further refine the building's massing to balance light, shade, and openness. These insights generate the project's core strategies, shaping the planning and facade to enhance comfort and respond sensitively to the site's climatic context.

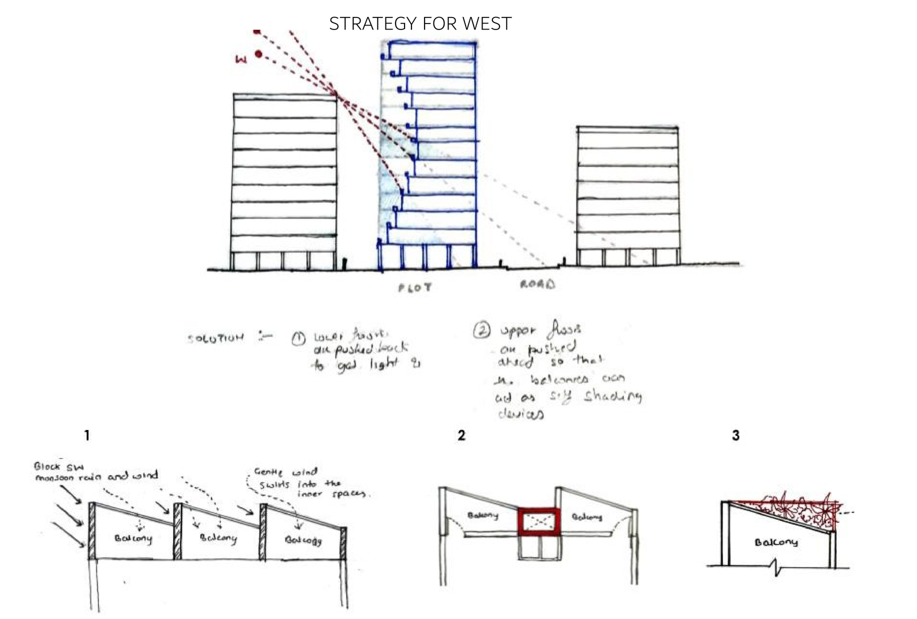




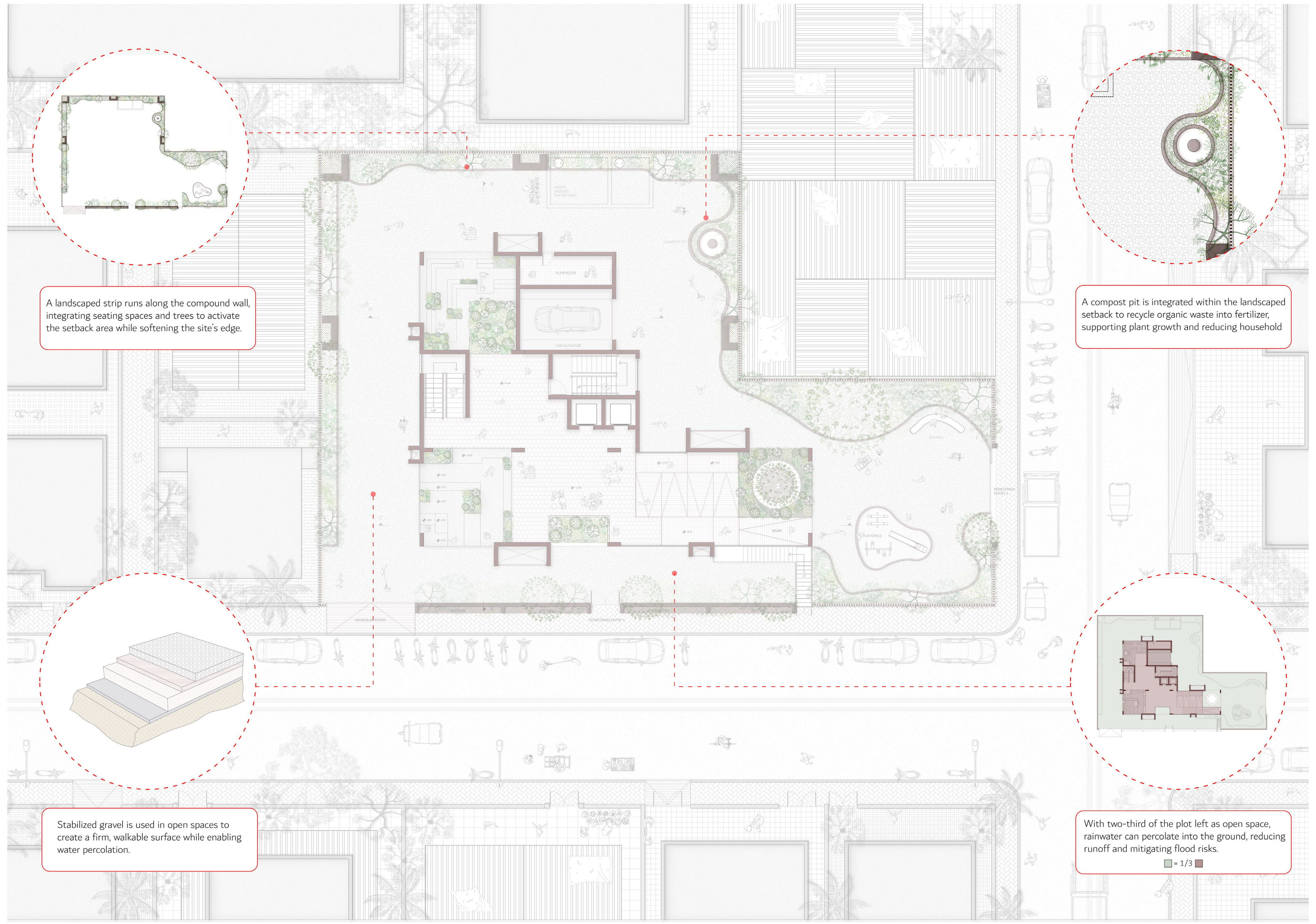






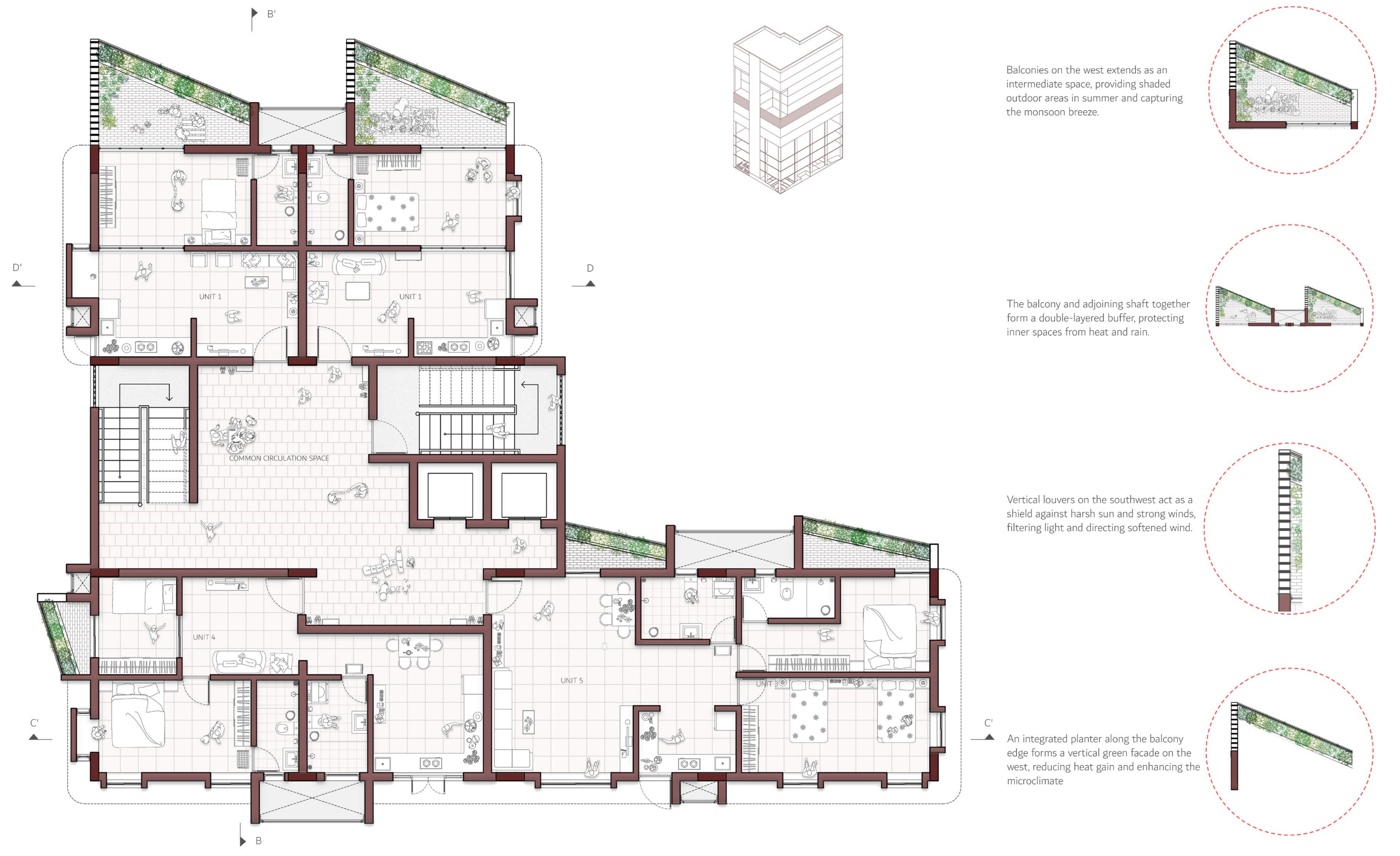


PROPOSED GROUND FLOOR PLAN

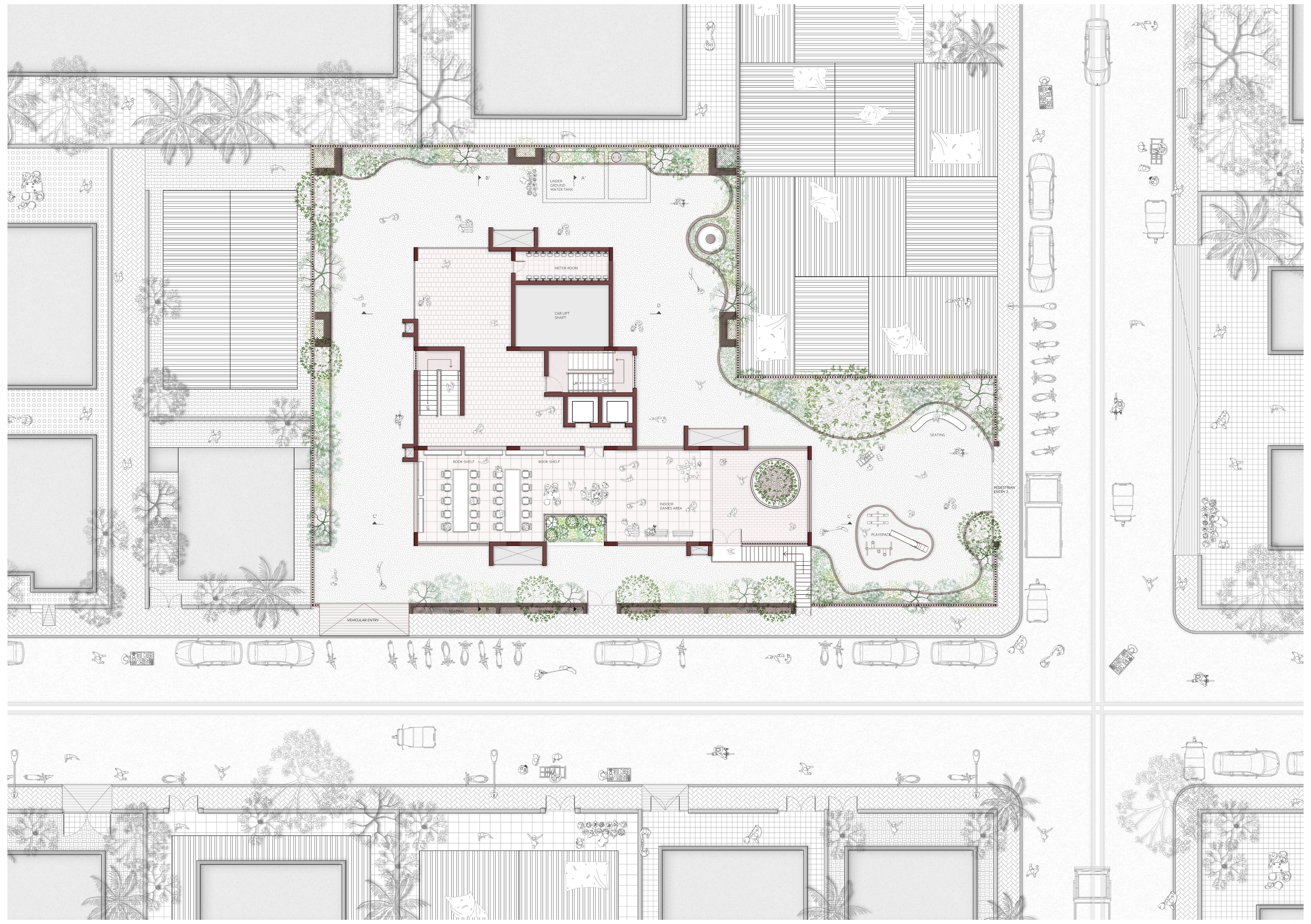


GROUND STRATEGIES

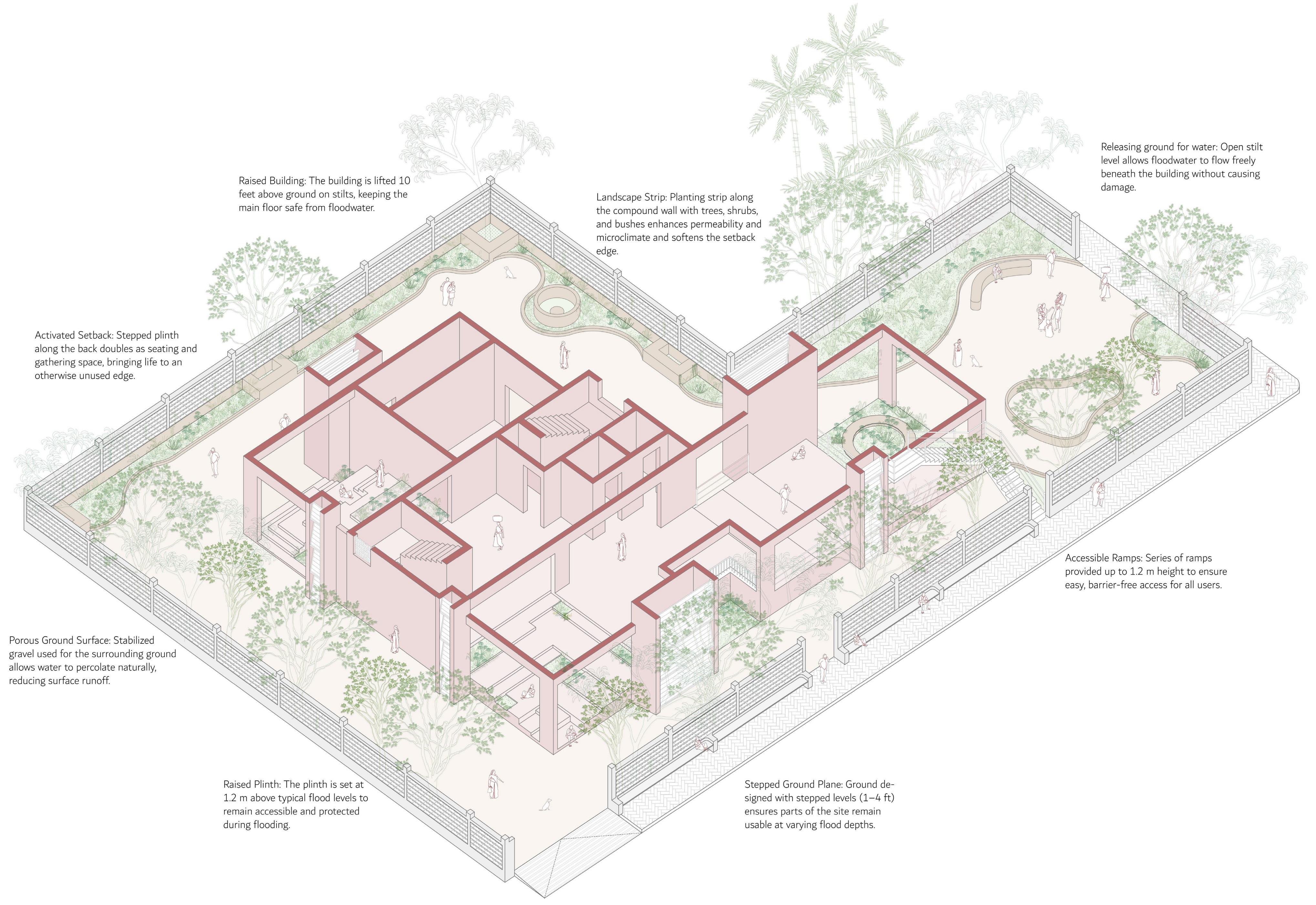
TYPE A: FLOORS- 4,5,10,11
UNIT 1 & 2- 36 sq.m
UNIT 3 - 54 sq.m



TYPE B: FLOORS- 6TH FLOOR
UNIT 1 - 36 sq.m
UNIT 4 - 54 sq.m
UNIT 5 - 65 sq.m

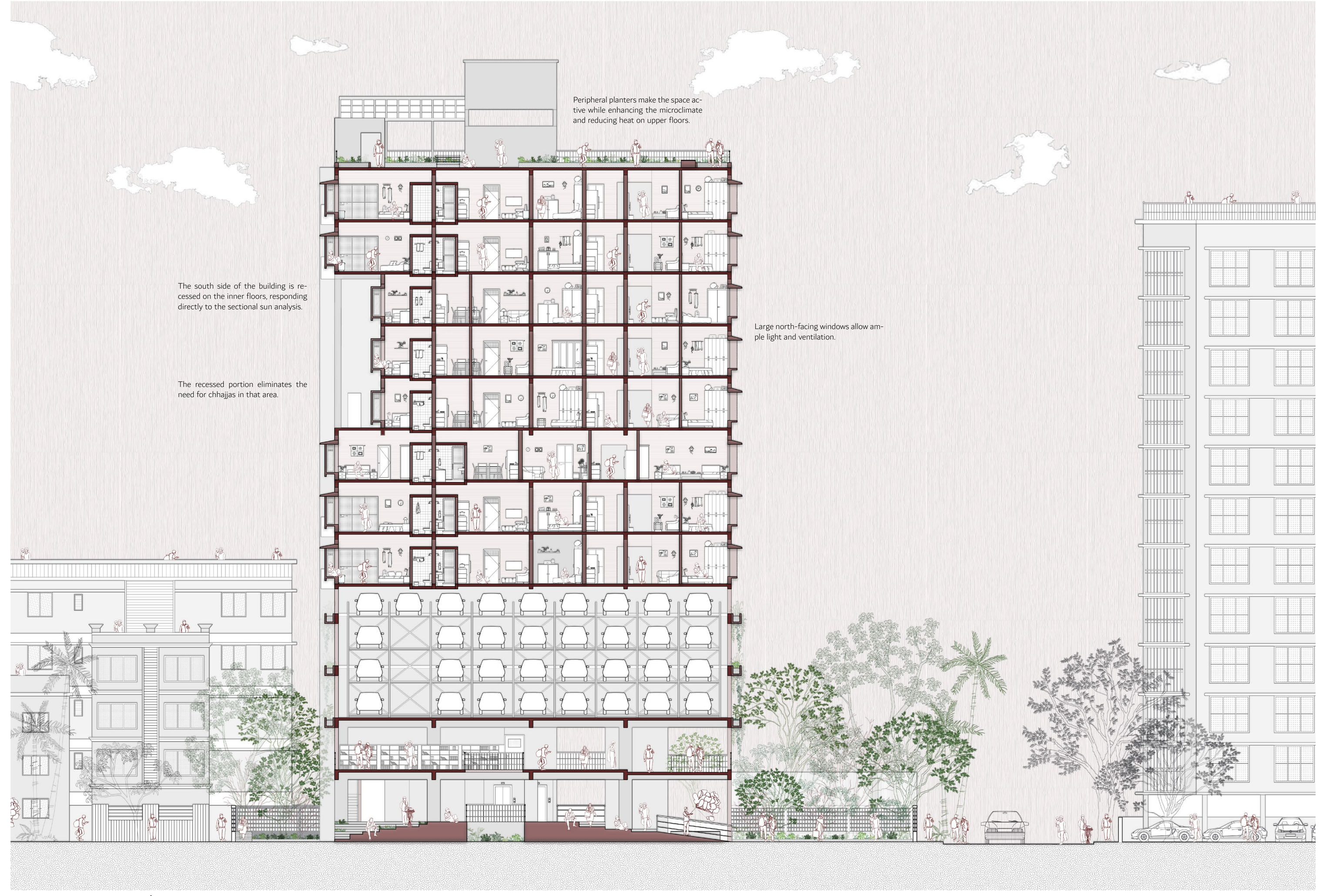


PROPOSED FIRST FLOOR PLAN



RESPONSE TO FLOODS

TYPE C FLOORS- 7,8,9
UNIT 3 - 54 sq.m
UNIT 5 - 65 sq.m

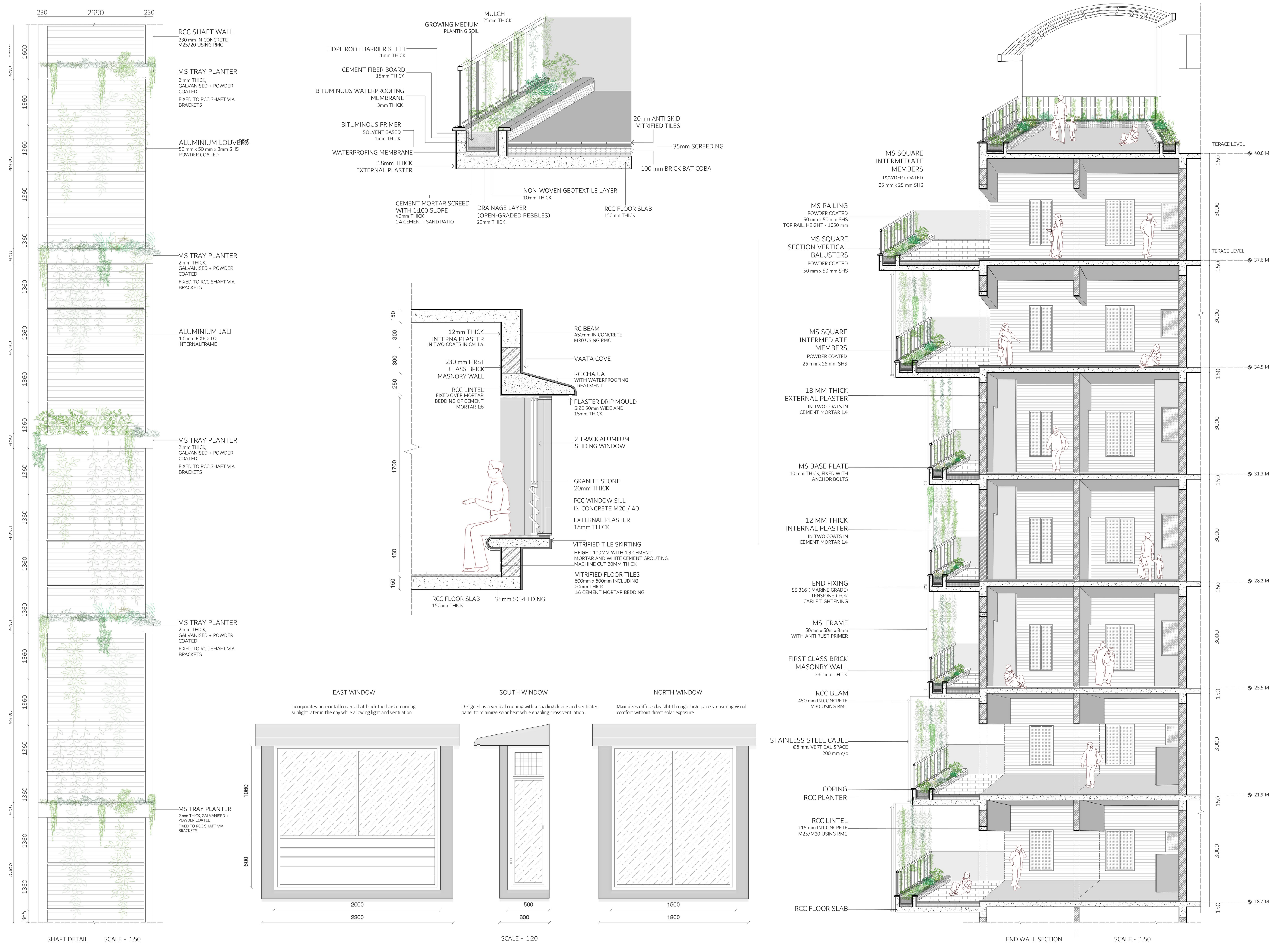


SECTION CC'

WEST ELEVATION

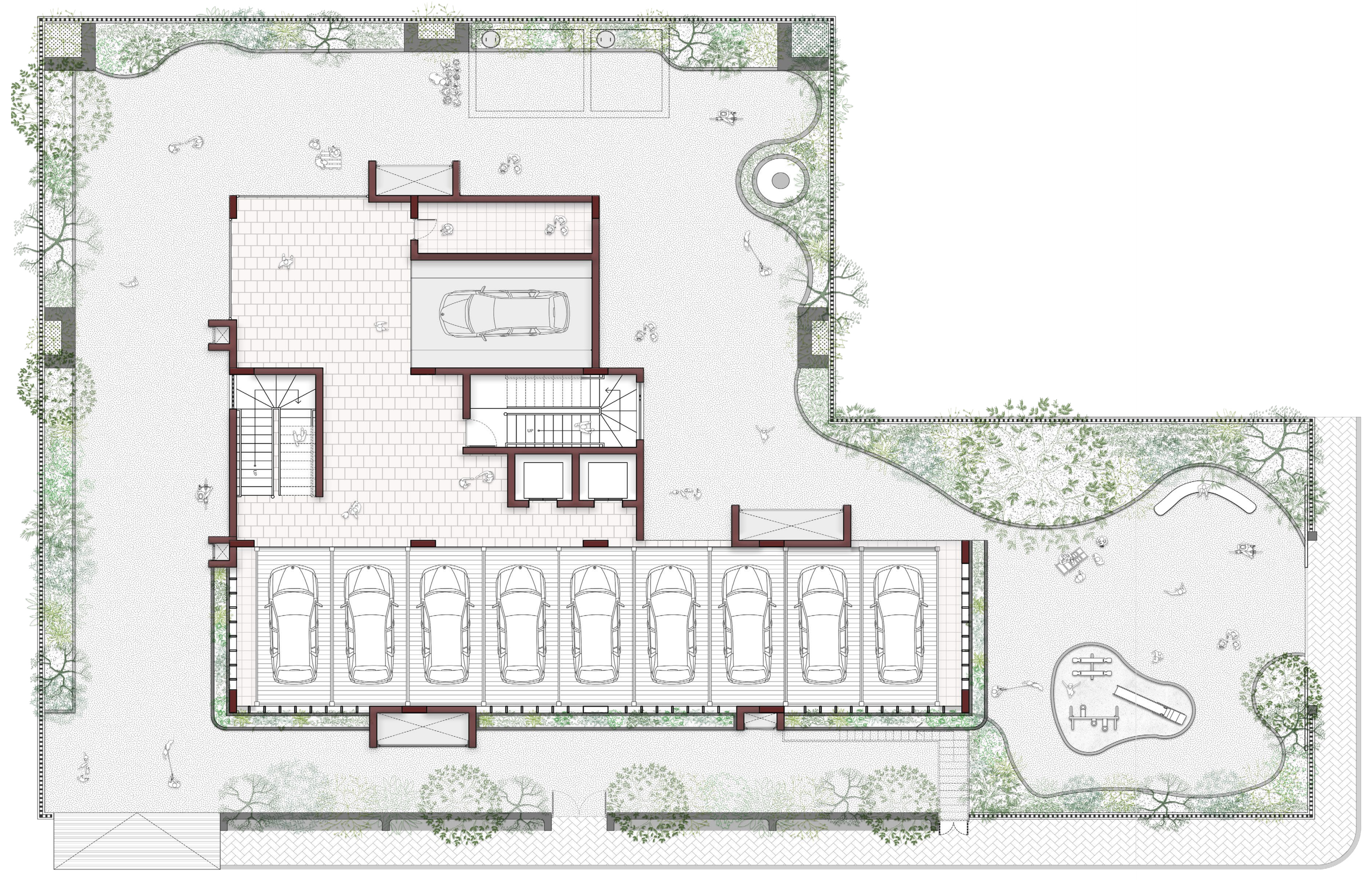
SECTION BB'

EAST ELEVATION

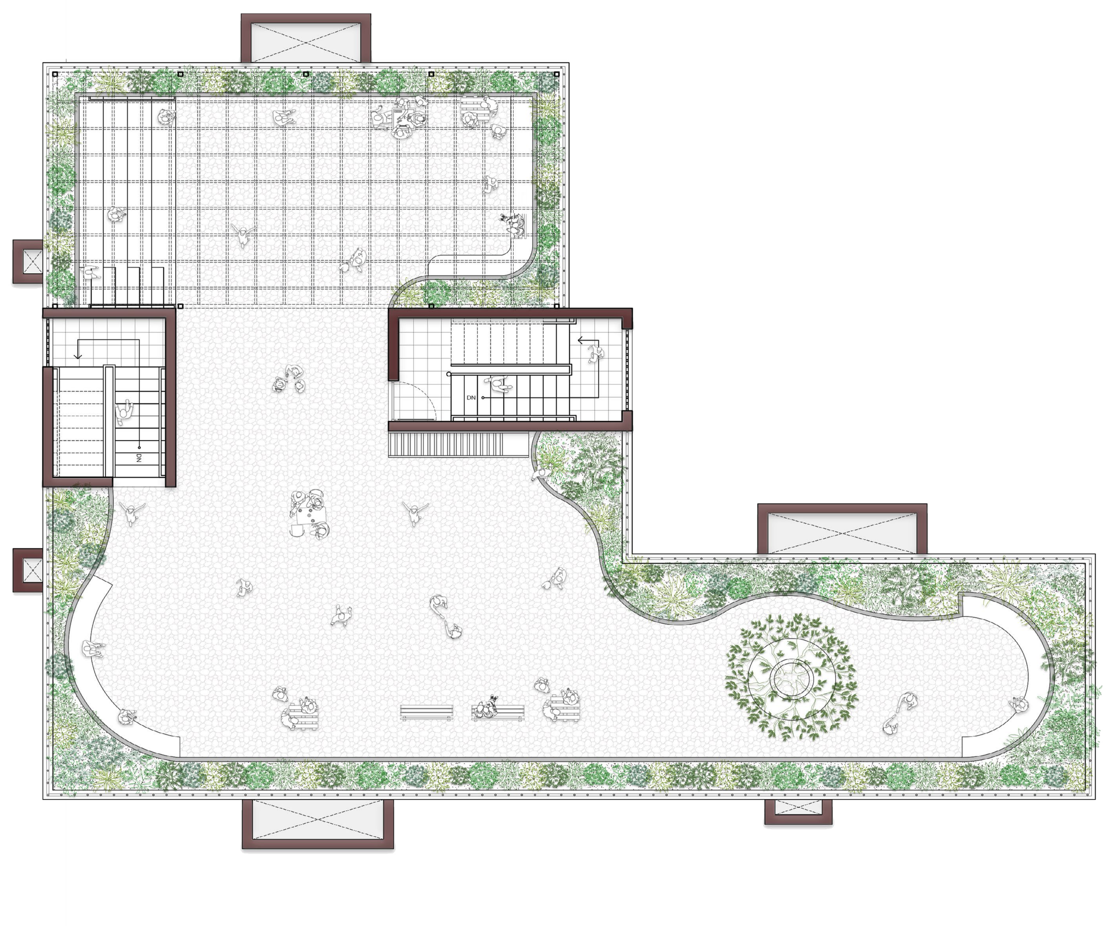


DESIGN DETAILS

SECTION DD'



PARKING PLAN



ROOF PLAN

The building is raised **10 feet** above the ground to **release the ground for flood** water flow and to maintain an **active community space at the ground** level. The plinth is designed as a series of stepped levels up to 1.2 meters, ensuring usable areas remain usable at varying flood levels. A series of ramps on the right side provides barrier-free access to all plinth levels up to 1.2 meters.

Parking levels and service shafts are screened with fins and louvers, with planters integrated to soften the facade visually and ensure that the parking is not visible from the road

Puzzle parking is used due to the tight plot, lifting parking off the ground to keep space open for community use and flood flow, prioritising resilience over maximising parking.

The terrace becomes a shared space with a trellis-covered amphitheatre and parapet planters that improve the microclimate. It also collects and channels rainwater for reuse.

RETHINKING THE NEW DCR FRAMEWORK WITH RESPECT TO CLIMATE

1. Ground as a Climatic Surface
Existing: Treats the ground as a paved buildable or parking surface.

New Framework: At least 50% of the ground area to remain permeable, using materials like stabilised gravel or soft landscape.
Flood-prone sites must integrate multi -level plinths or step grounds that remain usable during different flood levels.

2. Building Setback
Existing: Setbacks are quantified as minimum distances, often left unused or paved for services.

New Framewrok: Setbacks to be treated as shared climatic buffers, with shaded seating, planting strips, and permeable ground.

3. Building Skin as Climatic Interface (Balconies + Louvers + Planters)
Existing: Balconies limited to a fixed projection or counted in FSI beyond 10%, discouraging articulation.

New Framework: Adaptive balconies with variable depths and orientations, responding to sun angles, ventilation, and rainfall.
Balconies to be exempted from FSI when designed as climatic devices (integrating shading, vegetation, and airflow)

4. FSI and Built-Form Flexibility
Existing: FSI dictates the quantum of built area, often incentivising vertical growth at the cost of climatic performance.

New Framework: Introduce a "Climatic Performance Allowance" - additional FSI for buildings that integrate adaptive elements (balconies, porous ground, shading terraces, vertical green facades).

Evaluate FSI not only by built volume, but by environmental contribution, ventilation, permeability,shading, and daylight access.

5. Roof and Terrace as Climatic Commons
Existing: Roofs often remain unregulated spaces, typically left undesigned and occupied by utilities such as water tanks.

New Framework: Terraces becomes accessible community spaces and refuge zones, Roofs to integrate green layers or reflective coatings to reduce heat gain and absorb rainwater.

HOW IS THE PROJECT REPLICABLE ON OTHER SITES?

The architectural form is site-specific, but the **framework is scalable**. By treating the ground as climate infrastructure, the building skin as a climatic interface, and prioritising climatic performance over built volume, the approach **can be applied across redevelopment projects in Mumbai, particularly in flood-prone and high-density areas.** While elements such as balcony depth and facade articulation may vary from site to site, the u**nderlying logic of responding to sun angles,** wind, and exposure to optimise light and ventilation **remains transferable**, enabling each project to develop a context-specific yet climate-responsive outcome.

Proposed design isometric showing the west facade and it's climatic response elements.