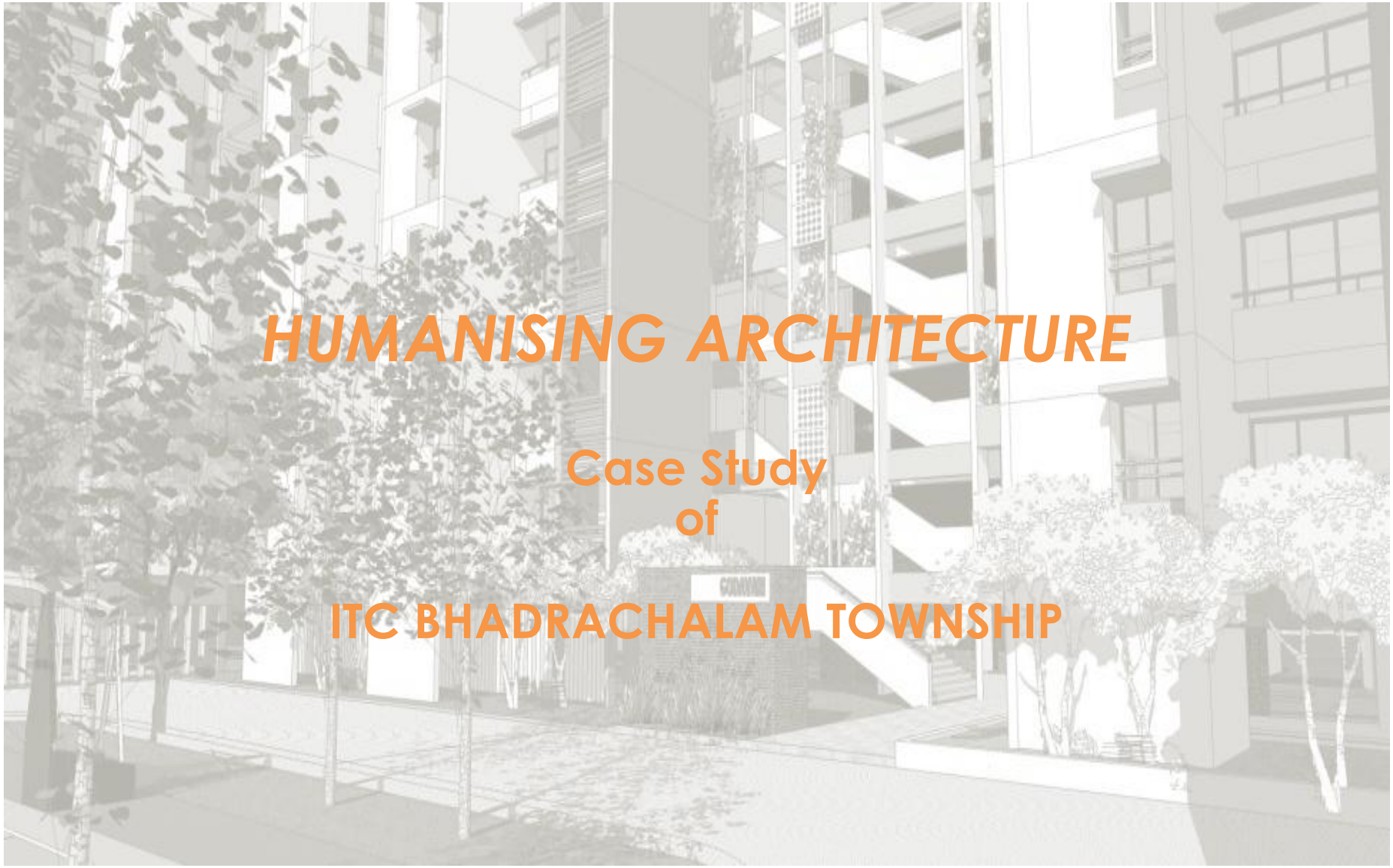


HUMANISING ARCHITECTURE

Case Study of

ITC BHADRACHALAM TOWNSHIP

Green Large Developments
Pilot project for **'Large Scale Sustainable Development'**

GRIHA

inistry of New and Renewable Energy, GoI

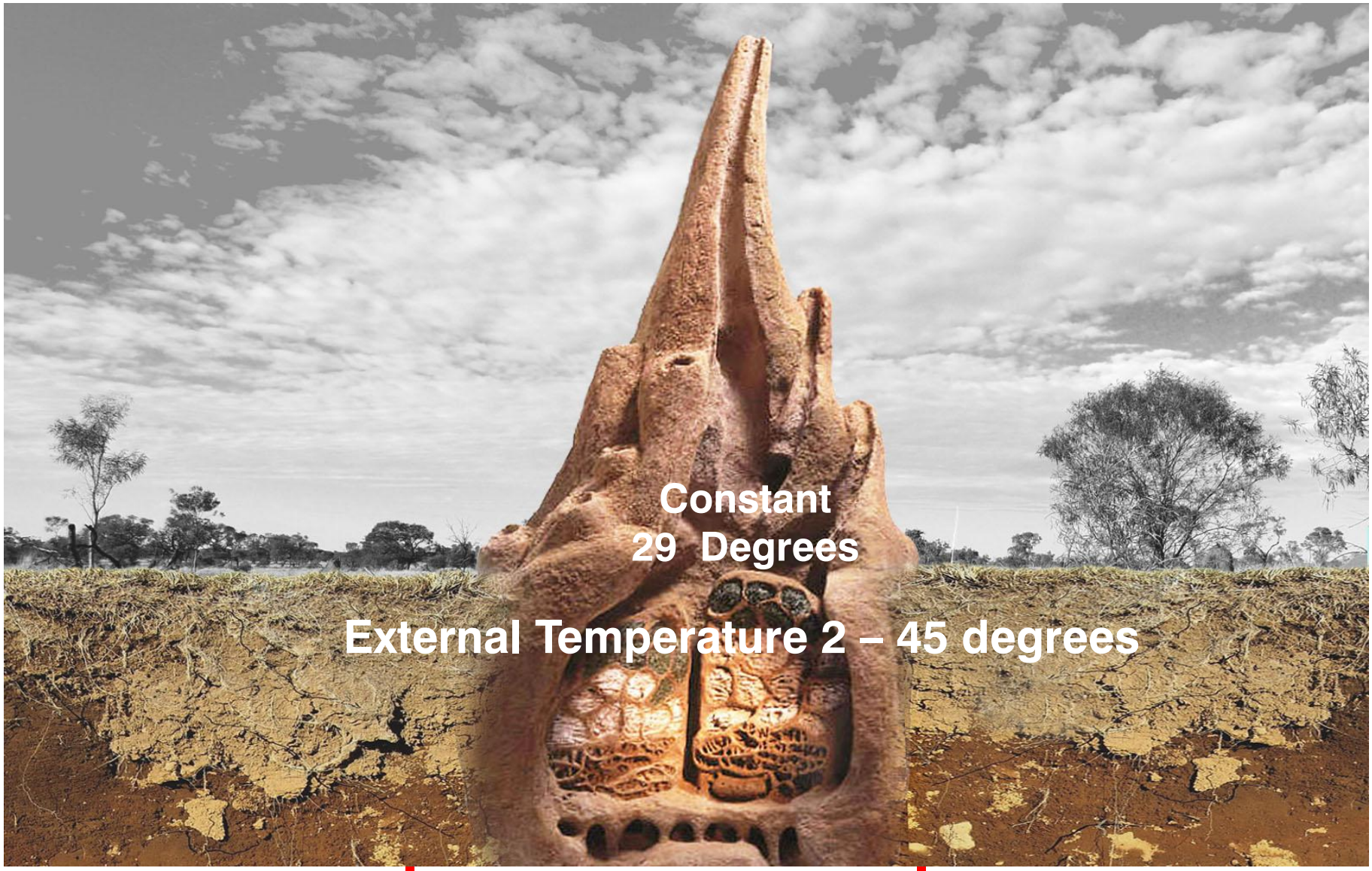
Central Projects Organization
ITC Limited

SPACE MATRIX

3rd Regional Green Building Conference & Exhibition
Innovations in Green Buildings - The GRIHA Approach

TEAM

- CENTRAL PROJECTS ORGANISATION, ITC LTD
- SPACE MATRIX DESIGN CONSULTANTS PVT LTD
- INTEGRATED DESIGN (INDE)
- TERI - BANGALORE



Internal temperature varies by only 1 degree

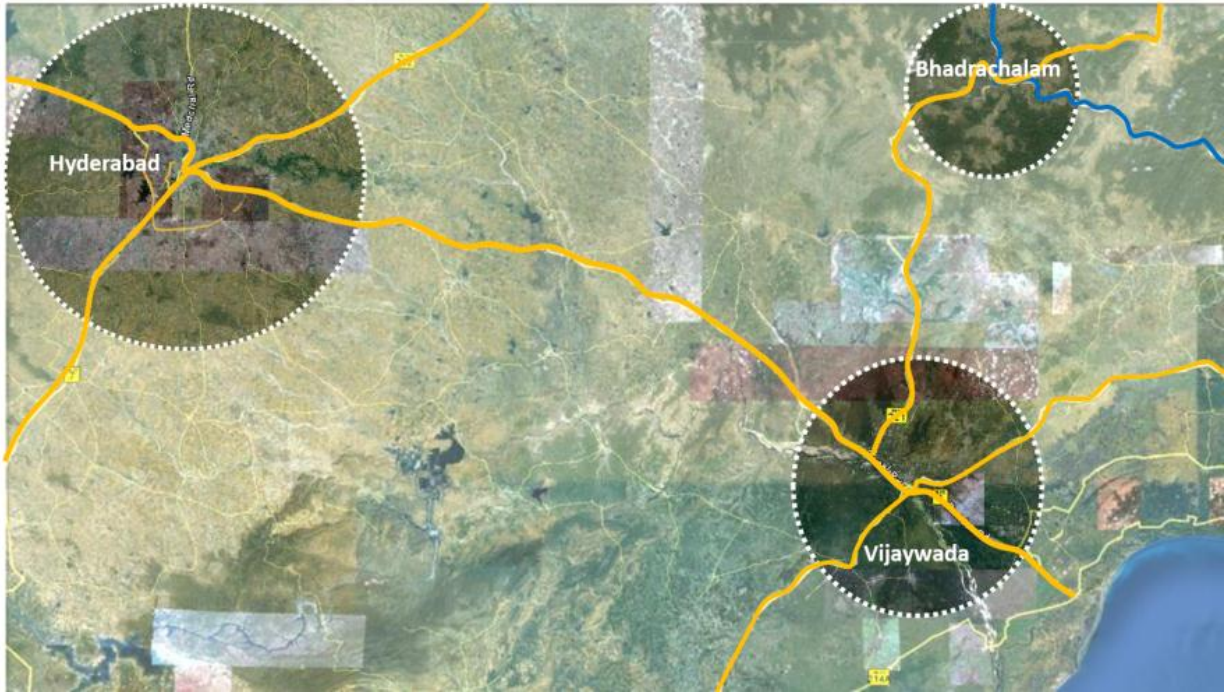
The equivalent of a 2km high building

Captures natural air flow

INTRODUCTION

SITE & CLIMATE ANALYSIS
PROGRAM

Site & Context

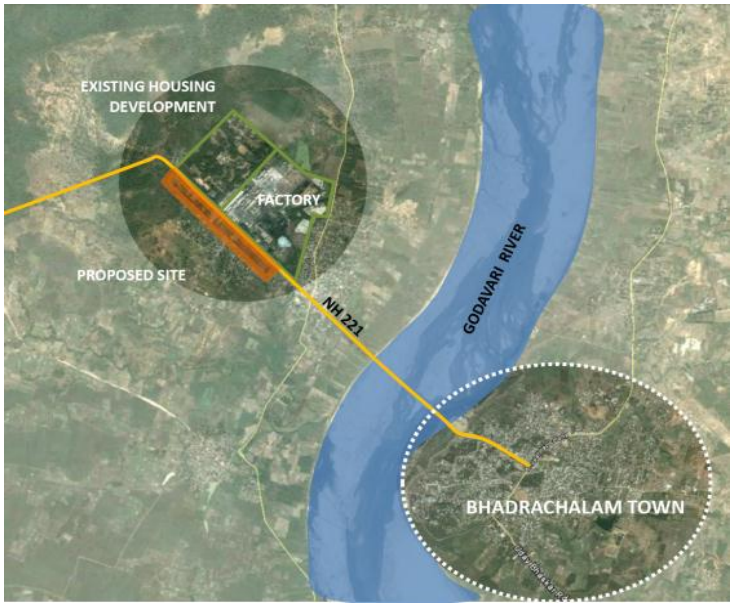


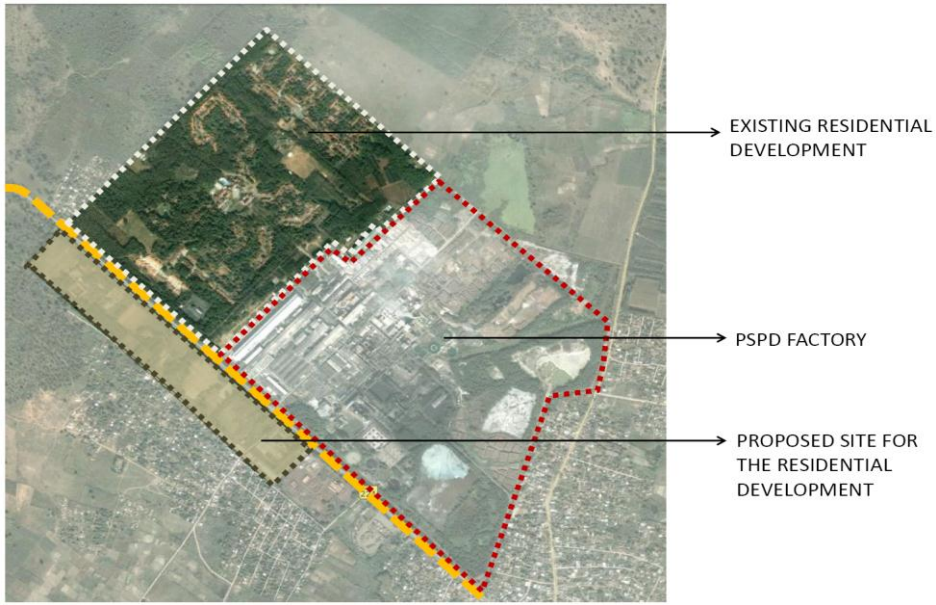
The proposed site is located in Sarapakka Village, Khammam Dist., Andhra Pradesh, 4 kms from the town of Bhadrachalam.

The complete Mill Unit at Bhadrachalam is spread over 500 acres of land. National Highway 221 buffers the proposed site from the ITC Paper Mill factory.

Nearest Railway Station:
Kottagudam (30kms)

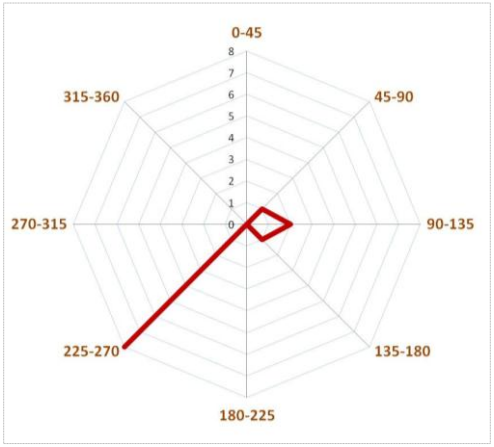
Nearest Airport:
Hyderabad (8hrs drive);
Vijaywada (4hrs drive)





Climate Analysis

17°66', 80°88'
Average Elevation: 63 mts



Predominant wind direction = SW to NE
Maximum wind speed = 3.6 m/s

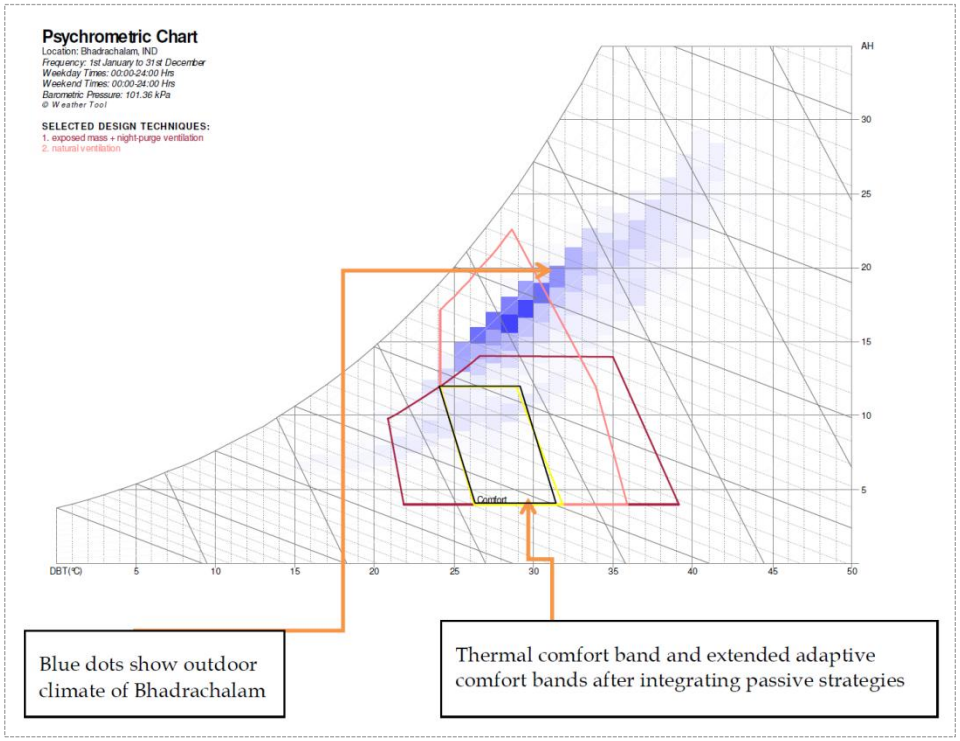
Temperature and RH analysis for Bhadrachalam

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
DBT (Max)	33.6	38.4	41.6	43.5	44.9	45.9	35.8	37.1	36.6	37.9	38.4	32.4	**38.8**
RH	54.7	52.2	49.2	46.8	44.5	57.4	82.9	76.3	79.4	71.3	52.8	59.6	**60.6**

Max Temperature = 46 deg
Max Humidity (RH) = 83%

Sl. No.	Climatic Zone	Mean monthly Maximum Temperature (°C)	Mean Monthly Relative Humidity Percentage (%)
1	Hot & Dry	Above 30	Below 55
2	Warm and Humid	Above 30	Above 55
		Above 25	Above 75
3	Temperate	25-30	Below 75
4	Cold	Below 25	All Values
5	Composite	See. clause 3.2.2* Part 8 Building Services — Section 1 Lighting And Ventilation , National Building Code of India 2005	

As per the climate zone map of India, provided in National Building Code 2005 and the Energy Conservation Code 2007, Bhadrachalam is categorized as - **Warm & Humid Climate.**



*Climatic Study and Analysis provided by **TERI – Bangalore***
Preliminary Energy & Water Report. Project Code: 2011BG04

Program

EXISTING SINGLE STOREY RESIDENTIAL DEVELOPMENT

PROPOSED MULTI STOREYED RESIDENTIAL DEVELOPMENT

1510
FAMILIES

245,000
SQM
BUILT UP AREA

Reuse
Renew
Recycle

LARGE SCALE SUSTAINABLE DEVELOPMENT

DESIGN DRIVERS

METHODS & PROCEDURES

Design Drivers

The development plan envisions various units types and modules for different workforce sections as well as necessary amenities, play areas, infrastructure and open spaces. The project demonstrates a high-standard, sustainable quality of life amongst various sections of users.

This large development (~ 1500 dwelling units; approx. 245,000 sq.m built area) is focused on the model of an "**Integrated Township**" - a place marker for a cost-effective yet sustainable residential development in India.

LAND

ECOLOGY

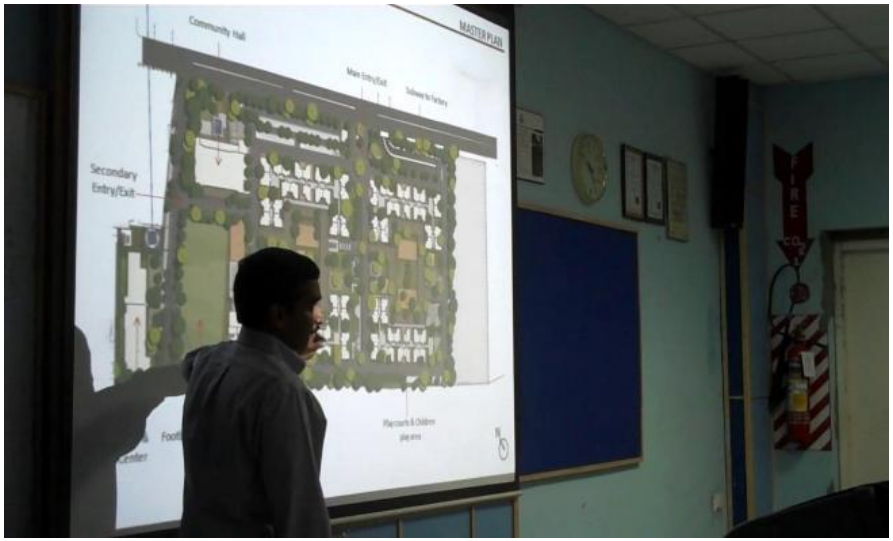
PEOPLE

AFFORDABILITY

DESIGN DRIVERS

STAKEHOLDER PARTICIPATION

Methods & Procedures : Participation



Dedicated user workshop involving participation from Stakeholders (~120 people) covering managers, employee union, ladies and younger population in different sessions.

Integrated design approach – active participation, design workshops from different parties including end users, master planners, architects, landscape architects, environmentalist, geologist, engineers, cost consultants and water consultant.

DESIGN DRIVERS

LAND

Methods & Procedures : Land

Carrying Capacity

EXISTING	PROPOSED
900 FAMILIES	1510 FAMILIES
110 ACRES	43 ACRES
11% GROUND COVER	19% GROUND COVER

LOW DENSITY
1/6TH ACRE PER DWELLING UNIT

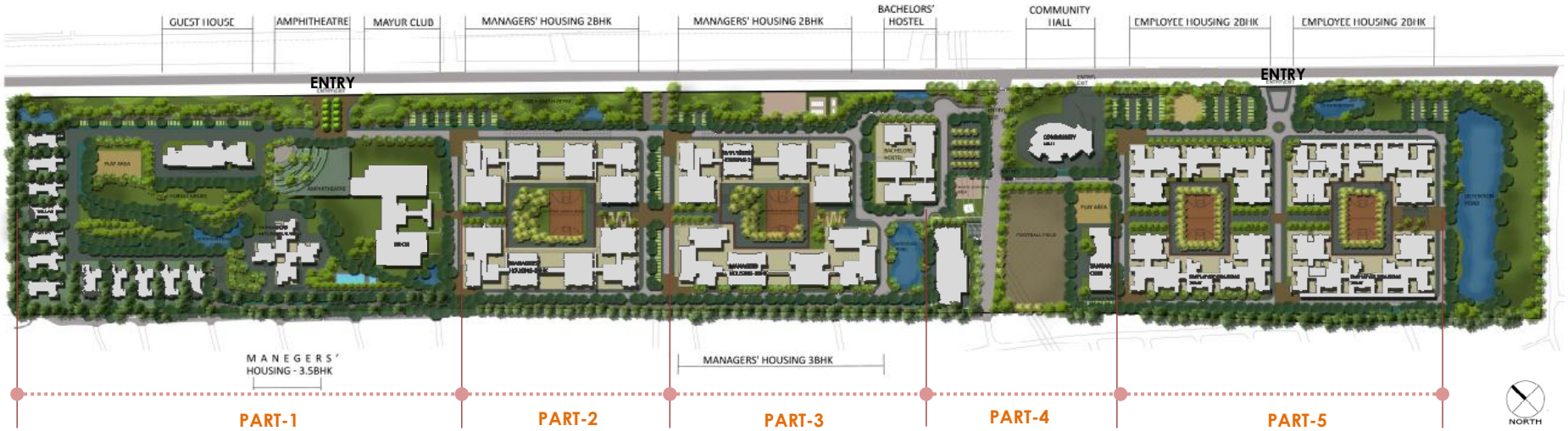
HIGH DENSITY
1/20TH ACRE PER DWELLING UNIT

Sustainable Sites

- **Mandate :** Green cover = 9 m2 /capita = 67,950 sqm. Project achieves a green cover of 1,25,000 sqm, which is 16.5 m2 / capita
- **Intent :** Encourage sites within existing communities.
- **Intent :** Protect and preserve sensitive areas of site and reduce the impact of a development on the environment.

Methods & Procedures : Land

Master Plan



PART-1

DUPLEX VILLA, MAYUR CLUB, GUEST HOUSE, AMPHITHEATER, MANAGERS HOUSING 3.5BHK

PART-2

MANAGERS HOUSING 2BHK

PART-3

MANAGERS HOUSING 2BHK & 3BHK

PART-4

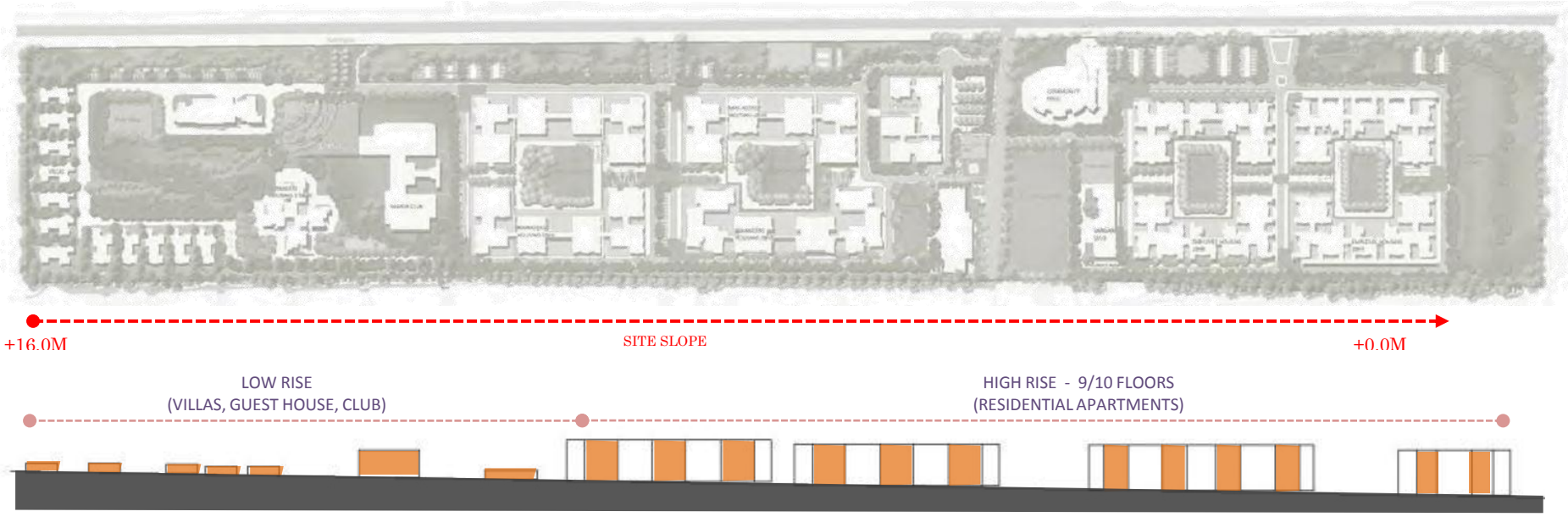
HOSTEL, COMMERCIAL, COMMUNITY HALL, FOOTBALL FIELD, SANGAM CLUB

PART-5

EMPLOYEE HOUSING – 2BHK

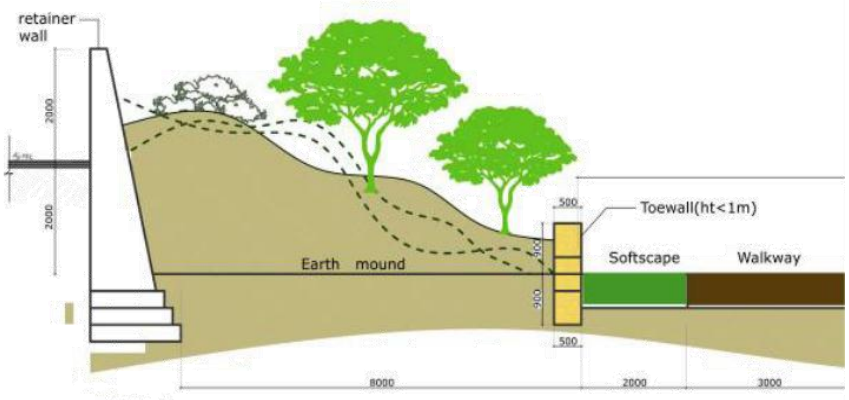
Methods & Procedures : Land

Topography



Earth Balance

Re-use the excavated earth for foundations to create berms as a noise buffer towards the highway



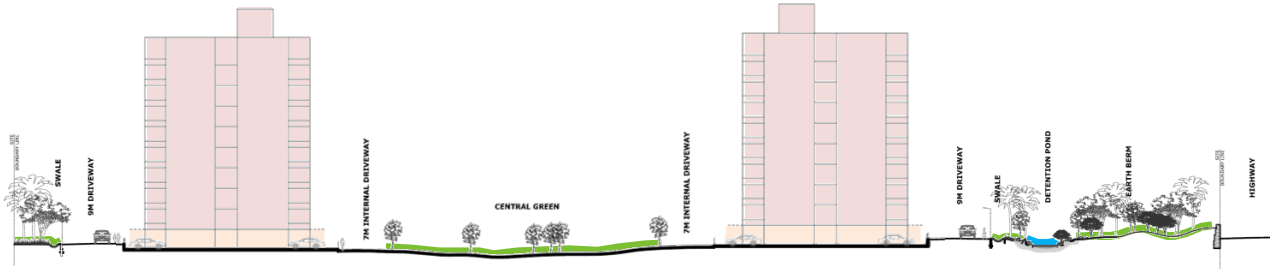
SECTION 01 : Section of earth berm along highway edge

Site Assessment & Planning

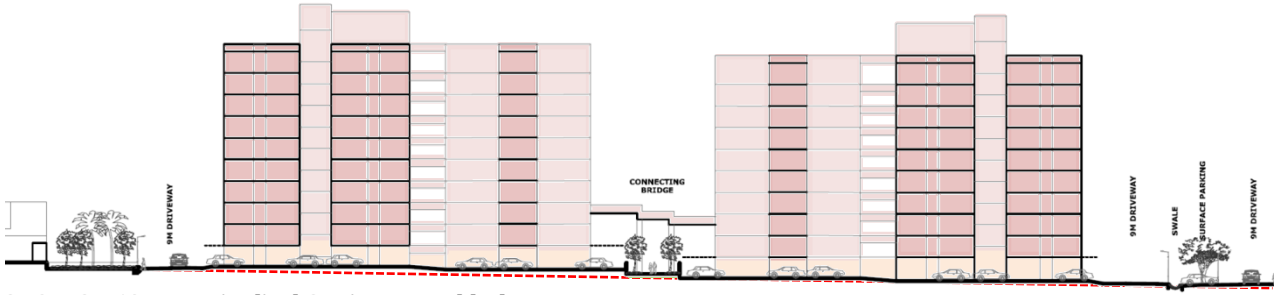
- **Intent :** Preserve & protect the rare and unique geological and geo-morphological features of the site.
- **Intent :** Minimize soil disturbance in design & construction.
- **Intent :** Measures should be taken to store & preserve topsoil.
- **Intent :** Natural and semi-natural plant groupings should be conserved wherever possible and disturbed as little as possible.

Methods & Procedures : Land

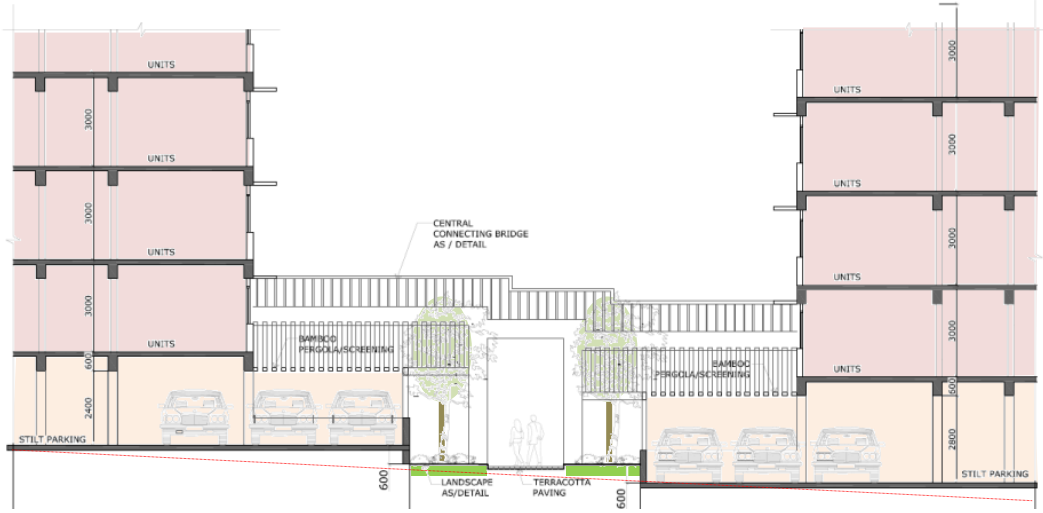
Natural Terrain



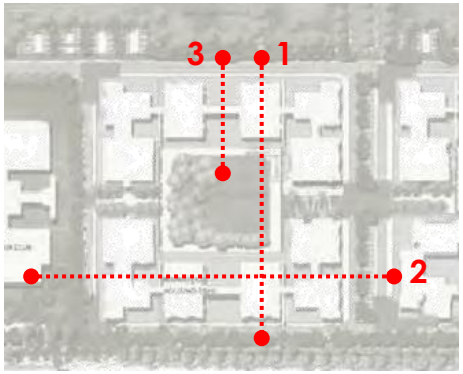
SECTION 01 : Section through block & central green



SECTION 02 : Longitudinal Section across block



SECTION 03 : Detail of Green Connect between parking levels



KEY PLAN

- Elimination of basement parking system, to retain natural terrain
- Modulated internal Levels of stilt parking, minimising cut and fill.
- Porous built form, allowing pedestrian access and green connect

Site Assessment & Planning

- **Intent :** Develop design & engineering strategies to minimize cut & fill of slopes
- **Intent :** Roads & lot layouts should complement the site topography

DESIGN DRIVERS

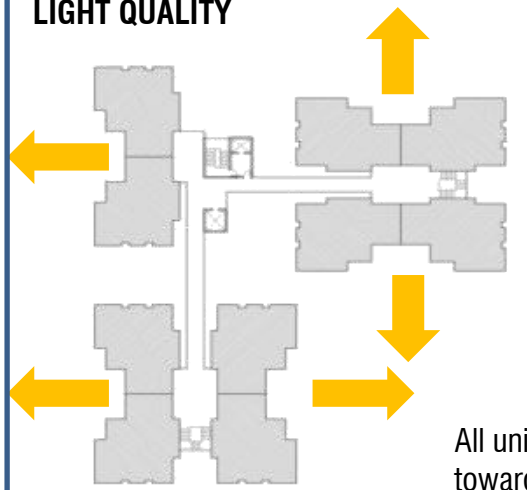
PASSIVE DESIGN

Methods & Procedures : Passive Right Intent

VIEW QUALITY

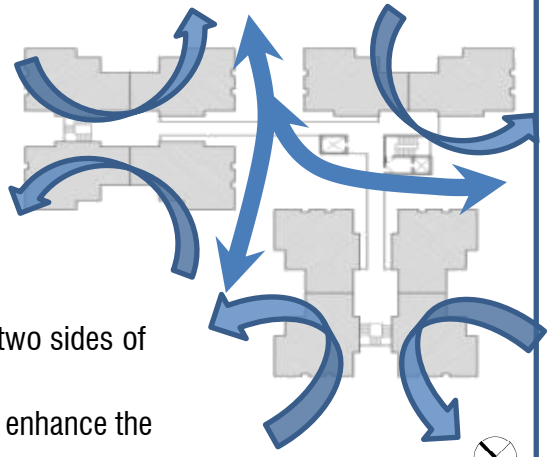
60% units face outwards looking towards an external space (outside site)

LIGHT QUALITY



All units face outwards towards an outdoor space

CROSS VENTILATION



100% units have at least two sides of the unit being open edge.

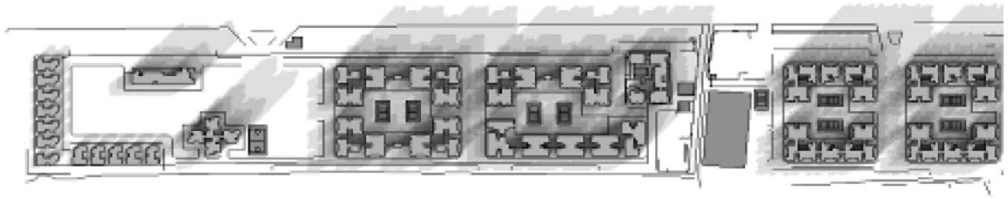
Spacing between units to enhance the cross ventilation.

THERMAL COMFORT

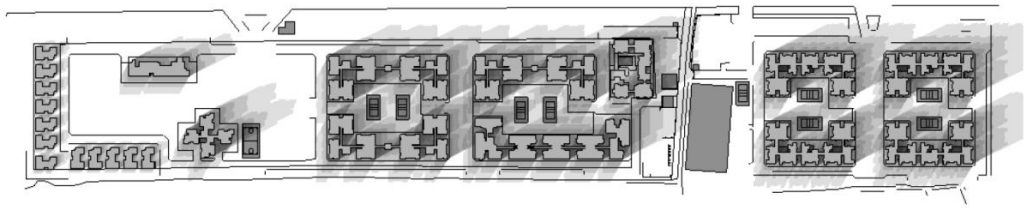
60% units facing north

40% units facing south

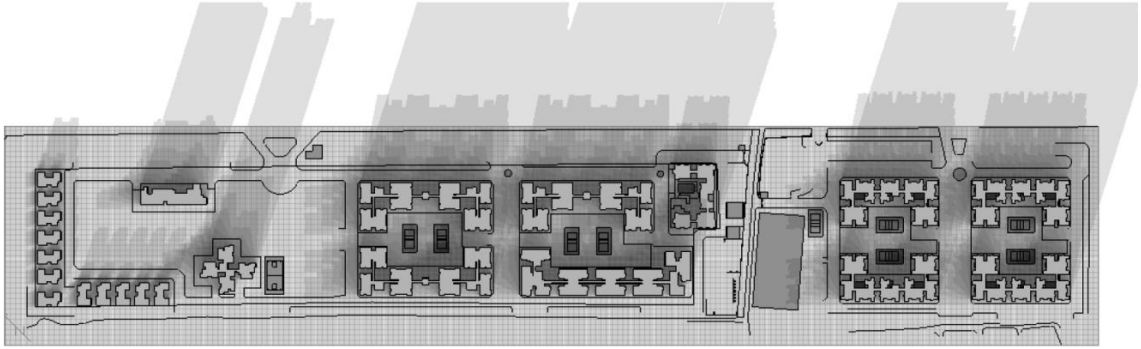
Methods & Procedures : Solar Passive Design



22nd March & September



22nd June



22nd December

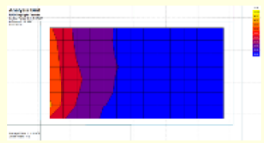
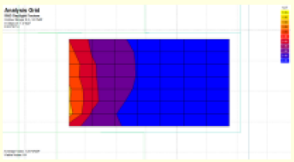
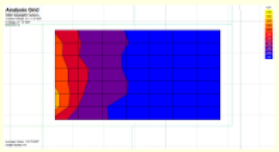
- Buildings are clustered such that they are mutually shaded.
- Reduced the heat gain to buildings.
- Residential Unit – Deep shades and balconies are provided to shade the fenestration.
- Window to Wall ratio is 60% (lower than the maximum permitted by ECBC)
- Appropriate external shading has been recommended to meet the effective SHGC

Solar Passive Design

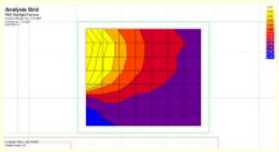
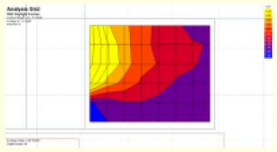
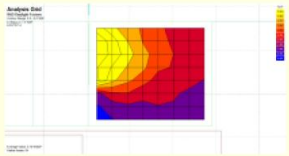
- **Intent :** Integrate solar passive design strategies at various levels and shall be climate responsive
- **Intent :** The built form shall reflect climate responsiveness of the building.
- **Intent :** Space planning of building shall be worked out in order to create thermal buffer zones

Methods & Procedures : Daylight

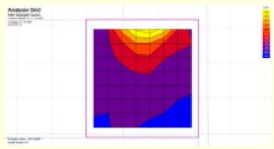
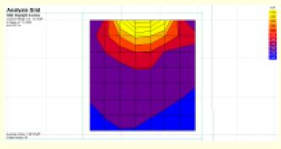
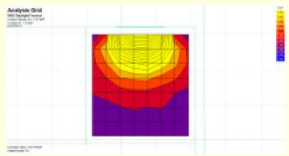
Living & Dining

Ground Floor	Fifth Floor	Ninth Floor
		
Average DF : 1.14	Average DF : 1.2	Average DF :1.28

Kitchen

Ground Floor	Fifth Floor	Ninth Floor
		
Average DF : 2.8	Average DF : 2.95	Average DF :3.2

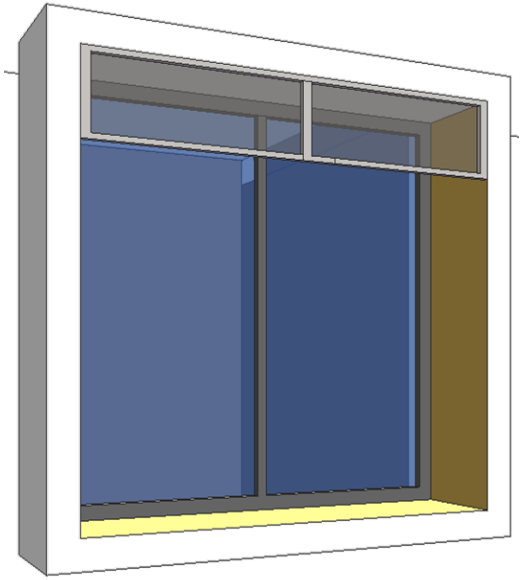
Bedroom

Ground Floor	Fifth Floor	Ninth Floor
		
Average DF : 1.8	Average DF : 2.0	Average DF :3.8
Shading Factor: 1	Shading Factor: 0.83	Shading Factor :0.56

Shading Angles :

Orientation	Shading Design Time	Vertical Shading Angle
North East	09:00hrs , 15th April	56
North West	16:00hrs, 15th April	42.3
South East	10:00hrs, 15th Feb	43.7
South West	15:00hrs, 15th Feb	40.3

- All rooms would require VLT greater than 50% and SHGC less than 0.41
- All Rooms facing the small courtyards would require VLT greater than 70% and SHGC less than 0.41
- Bedrooms would need external shading as per solar geometry (8th, 9th & 10th Floors). Minimal shading is required for the lower floors
- All Kitchen would require VLT greater than 70%.
- Single glazed window not available with VLT 70% and SHGC 0.41. Additional solar shading is provided in accordance to GRIHA
- The total daylight area is estimated to be more than 75% of the total living area.



Shading Device for typical window

DESIGN DRIVERS

ELECTRICAL

Methods & Procedures : Electrical

TOTAL DEMAND LOAD

6010 KW — HOUSING & AMENITIES

210 KW — COMMON UTILITIES

36 KW — STREET LIGHTING

114 KW — LANDSCAPE LIGHTING

Design Goals

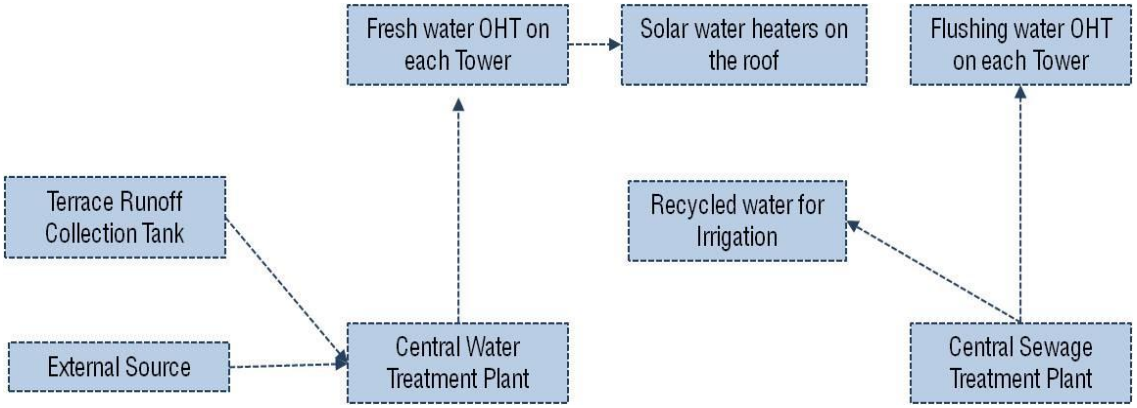
- Increase occupant comfort & improved productivity
- Optimize building system performance
- Reduce building life-cycle costs
- Energy efficient design
- Sustain property values
- Maintenance friendly design
- Optimizing of distribution losses

DESIGN DRIVERS

WATER

Methods & Procedures : Water

Water Management



- Centralized Collection sump of the water source (External)
- Individual Over Head tanks for Fresh water and Flushing water separately
- Solar Hot water of 200 L capacity for each family.
- Approx 15000 kW-hr of energy is saved by Solar water heaters, in terms of electricity required for water heating using Geysers

Carrying Capacity of Site

	Quantity litre/person/day
Fresh water source	832000
Available treated waste water	112000
Total	**944000**
Average water demand per person	110
Carrying Capacity of site	= 899000 / 130
	8582

Note :
Source quanitity as per EIA standards
Source of fresh water is the mill unit
No tapping of water from ground
Average water demand per person as per UDPFI 70 to 130 lpcd

Proposed Water Efficiency

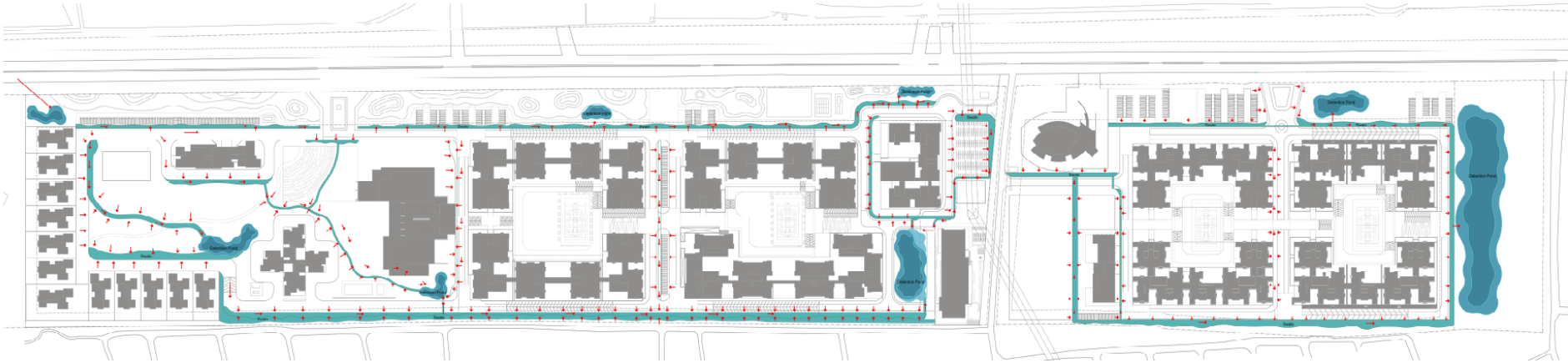
	Litres/day/person		Litres per Annum		
	Baseline-GRIHA	Actual	Baseline-GRIHA	Actual	% of Reduction
Flushing demand	54	14	13,79,70,000	3,57,70,000	74.1%
Domestic demand	165	68	42,15,75,000	17,24,62,500	59.1%
Total	**219**	**81.5**	**55,95,45,000**	**20,82,32,500**	**62.8%**
Irrigation requirement per Sq.M	6	2.4			60

Water Management

- **Intent :** The carrying capacity of the site is 8500 residents.
  Proposed no. of residents is 7550.
- **Intent :** Develop and integrate a water strategy at the community level to ensure that the landscape water requirement at the community level is reduced
- **Intent :** Provision for adequate quality of water for potable and non-potable applications with stringent monitoring plan

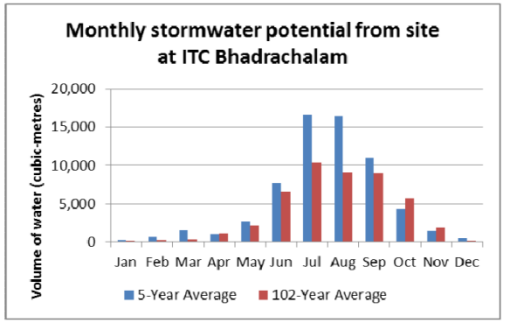
Methods & Procedures : Water

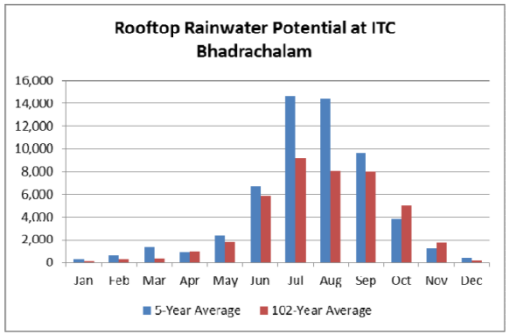
Storm Water Management



Site Storm Water Management Plan

Month	Storm water runoff in months (m3)	Rain water harvested from rooftops in months (m3)	Total (m3)
Jan	259	145	404
Feb	591	330	921
Mar	1,305	728	2,034
Apr	932	520	1,452
May	2,310	1,289	3,599
Jun	6,554	3,658	10,212
Jul	14,170	7,908	22,078
Aug	13,976	7,800	21,776
Sep	9,320	5,201	14,521
Oct	3,750	2,093	5,843
Nov	1,227	685	1,912
Dec	395	221	616
Total	**54,790**	**30,577**	**85,367**





Storm Water Management & Climate Change Adaptation

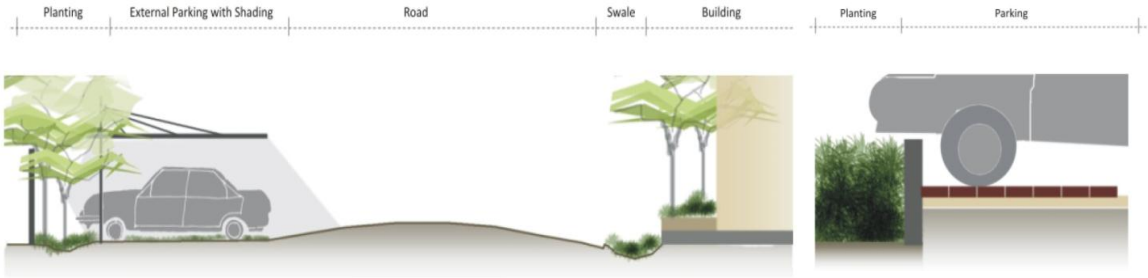
- **Intent :** Reduction of hard paving on site to reduce runoff, increase infiltration and reduce Urban Heat Island effect
- **Intent :** Ensure that the entire rainwater falling on the site is recharged through adequate measures.
- **Adaptation Measure :** Prepare for urban impact: drought and water shortage by extensive rainwater harvesting.

Methods & Procedures : Water

PERVIOUS SURFACES

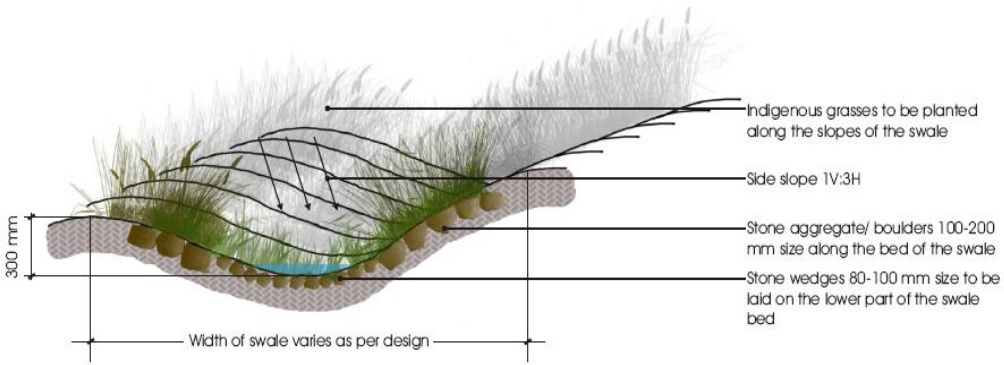
Increase ground water recharge by maximizing pervious surfaces

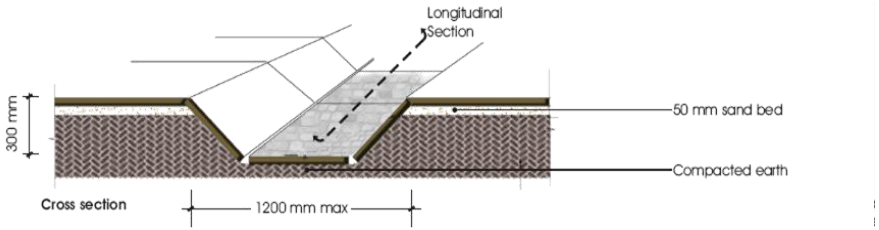
Alternate options to traditional street & parking area paving systems



Typical cross section of road and parking area

Use of wheel stop to increase strips of parking space





SWALES & DETENTION PONDS

Storm water runoff from swales is collected in shallow Detention Ponds, allowing ground water recharge.

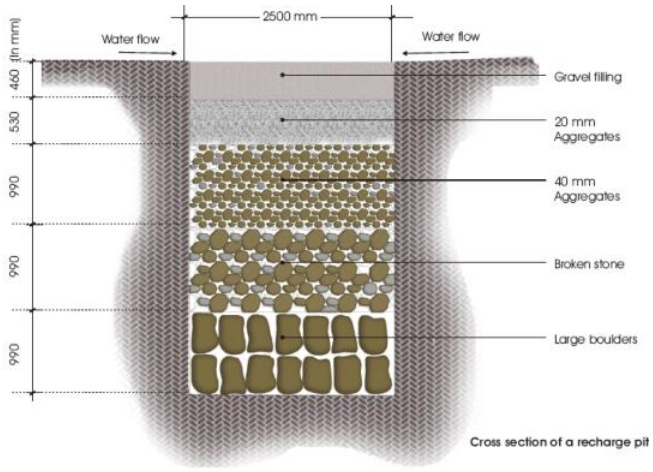
Storm Water Management

Vegetated Swales
direct and collect storm water.

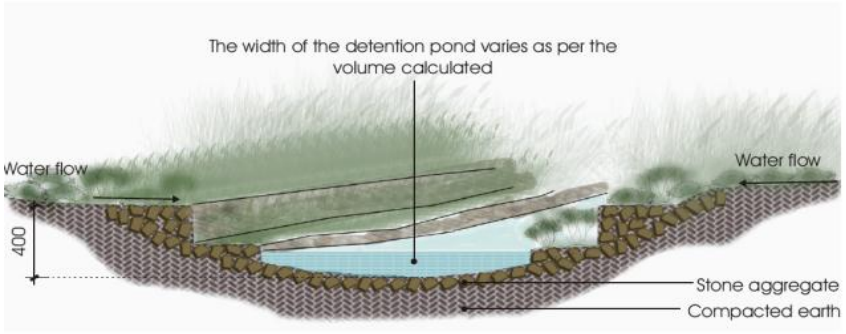
Percolation Pits
harvest incident rain & reinforce passive drainage.

Permeable Surfaces
maximized to allow infiltration and recharge.

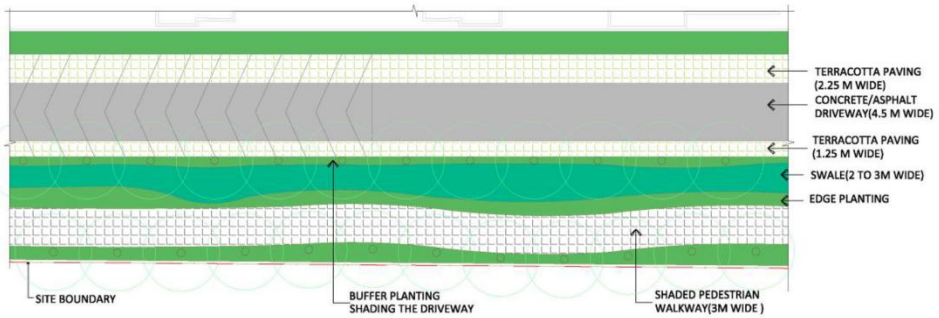
Grading of Land
manage water and control erosion

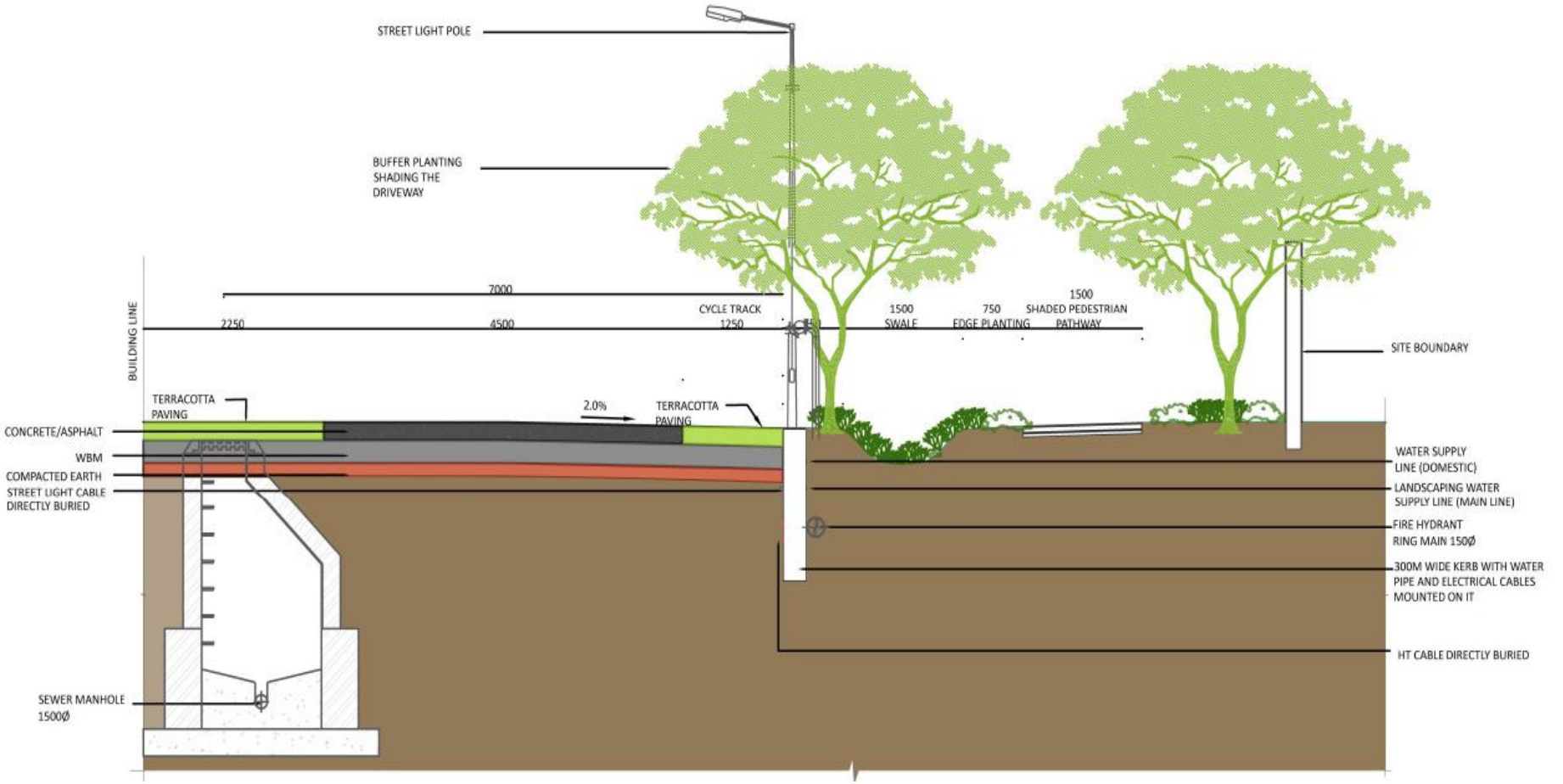


Cross section of a recharge pit



Methods & Procedures : Road Section



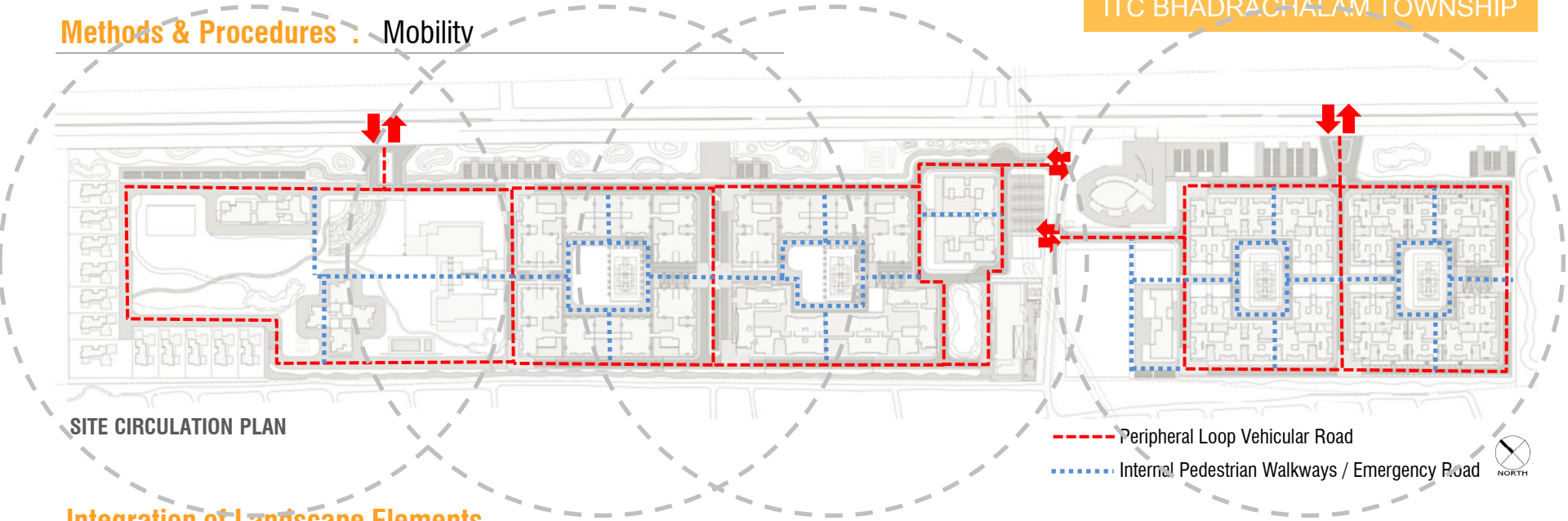


Section 01: High Traffic Loop Roads (Concrete Roads) with swale

DESIGN DRIVERS

MOBILITY

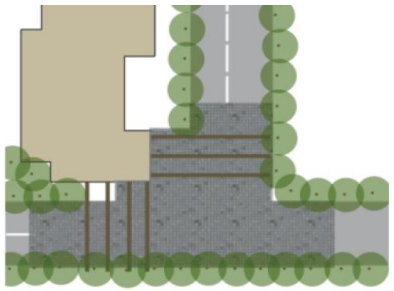
Methods & Procedures : Mobility



SITE CIRCULATION PLAN

Integration of Landscape Elements

Streetscape designed to facilitate pedestrian movement



Plan showing the treatment of circulation highlighting the pedestrian entrance to the building.

Integrated planting and swale along the ramp edge

View of landscape court formed along the circulation

View of pergola space to define the entrance.

- Internal driveways are classified as High Traffic and Low Traffic Roads.
- Internal green courts are pedestrian-only zones.
- Blocks linked through internal pedestrian network.

ROAD WIDTH CALCULATION		
	CARS	2-WHEELER
MANAGERS	573	329
TOTAL PCU AT PEAK HOUR	**902 PCU**	
EMPLOYEES	388	151
TOTAL PCU AT PEAK HOUR	**539 PCU**	
AS PER IRC, ROAD SHALL BE 2 LANE WITHOUT KERB OF 7M WIDTH. HOWEVER, AS PER GO 168, MIN ROAD WIDTH IN GROUP DEVELOPMENTS IS 9M		
TOTAL ROAD WIDTH = 9M		

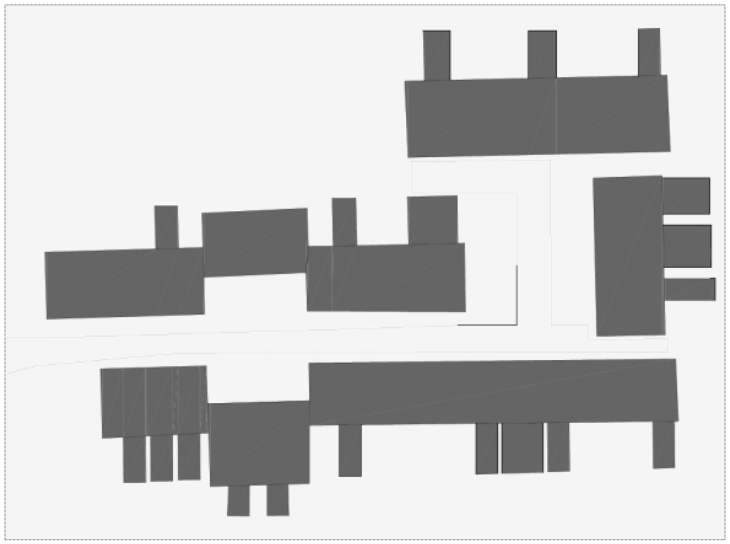
Mobility

- **Intent :** Develop a hierarchical road network
- **Intent :** Follow road classifications and design standards for urban roads - Indian Roads Congress (IRC) codes
- **Intent :** Promote safety, efficiency, community living, environmental and aesthetic quality and cycling & walking

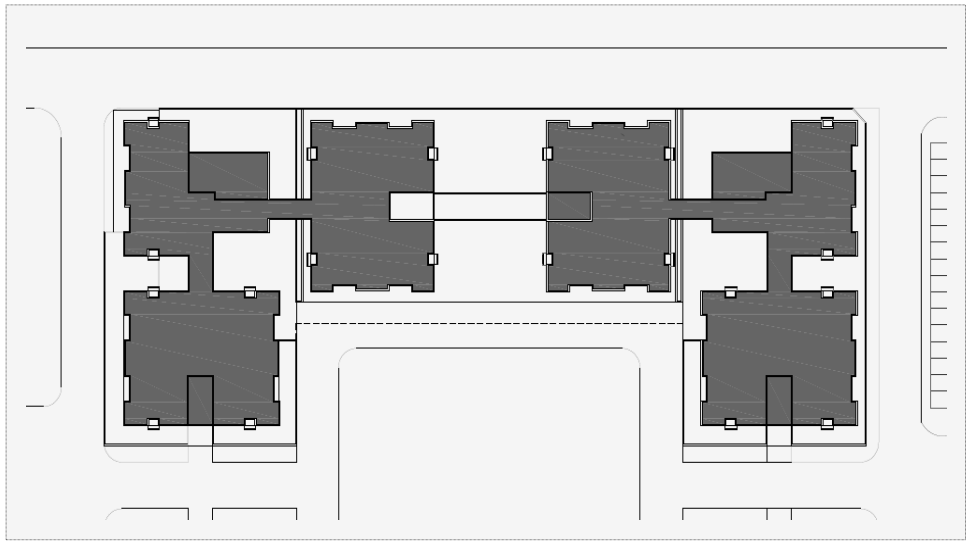
DESIGN DRIVERS

SOCIAL WELL BEING

Methods & Procedures : Social Well Being



EXISTING COLONY CLUSTER
20 HOUSES ALONG A STREET



PROPOSED BLOCK CLUSTER
2 CORES OF 10 UNITS AT EVERY FLOOR, CONNECTED THROUGH BRIDGES

Image : View of Existing Colony

Image : View of Proposed Development

Create equity and social well being

Re-create similar social fabrics and enhancing the sense of identity among users.

Methods & Procedures : Social Well Being

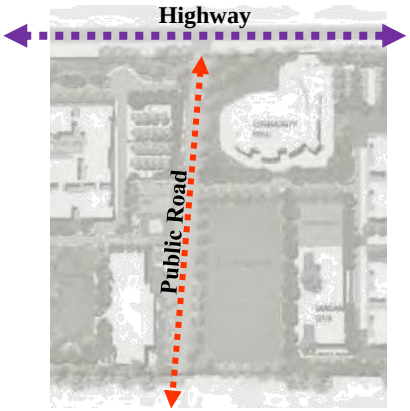
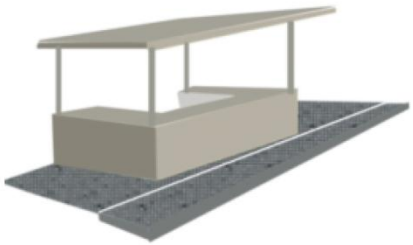


Image : View of the frontage offered by commercial block and its interaction with the public road

Typical section showing extension of road to create a hawker's zone with semi-permanent shaded space for shops.



View of semi-permanent shaded structure in the hawker's zone.

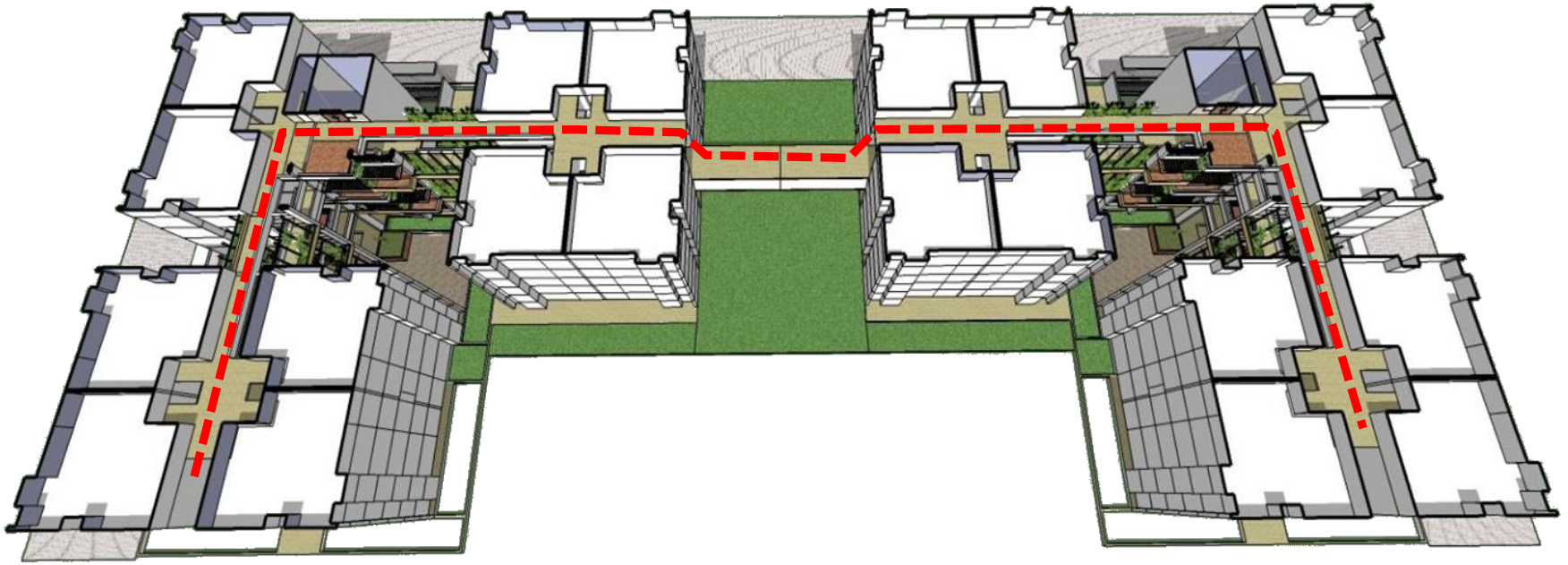
Promote social cohesion and harmony

Intermediate public road through site, connects the adjacent villages to the Highway.
Porous street edge with commercial activities.
Dedicated hawker zone.
Community Hall and Play areas abutting the road

Social Well-being

- **Intent :** Measures to be undertaken on site and within site design to bring in equity and social well being
- **Intent :** Create public and recreational facilities that help build an egalitarian society
- **Intent :** Provide housing for all sections of society
- **Intent :** Room for informal market like vegetable vendors

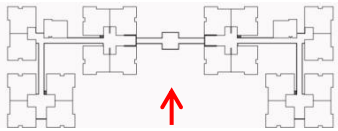
Methods & Procedures : Social Well Being



THREAD & BEAD

Methods & Procedures : Social Well Being

KEY PLAN



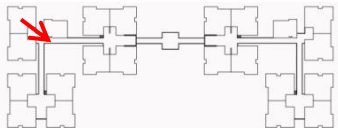
Community Linkage

Pedestrian Connect

Ease of connection, reduced dependency on vertical transportation or mechanical means of transportation.
Landscape designed to emphasize block entrance and retain green connect to higher levels.

Methods & Procedures : Social Well Being

KEY PLAN



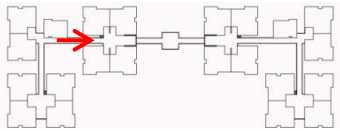
Community Linkage

Landscaped Terraces

Alternating landscaped terraces act community break-out spaces
Create varied experiences and promote social interactions and community activities

Methods & Procedures : Social Well Being

KEY PLAN



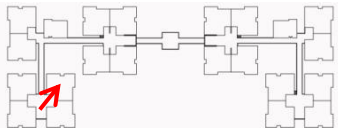
Community Linkage

Interlinking Corridors

Extending the streetscape beyond the ground plane to higher levels of building
Bringing the street character into the building

Methods & Procedures : Social Well Being

KEY PLAN



Community Linkage

Personalisation of Spaces

Corridors extend as Transitional spaces – a passage from the public realm to private.
Allow for personalisation, bringing quality and identity to spaces.

DESIGN DRIVERS

MATERIALS

Methods & Procedures : Locally Available Materials

- *100% of the building blocks shall have at least 40% fly ash (by volume).*
- *Minimum 30% of OPC, used for masonry and plaster mortar, shall be replaced by fly ash.*

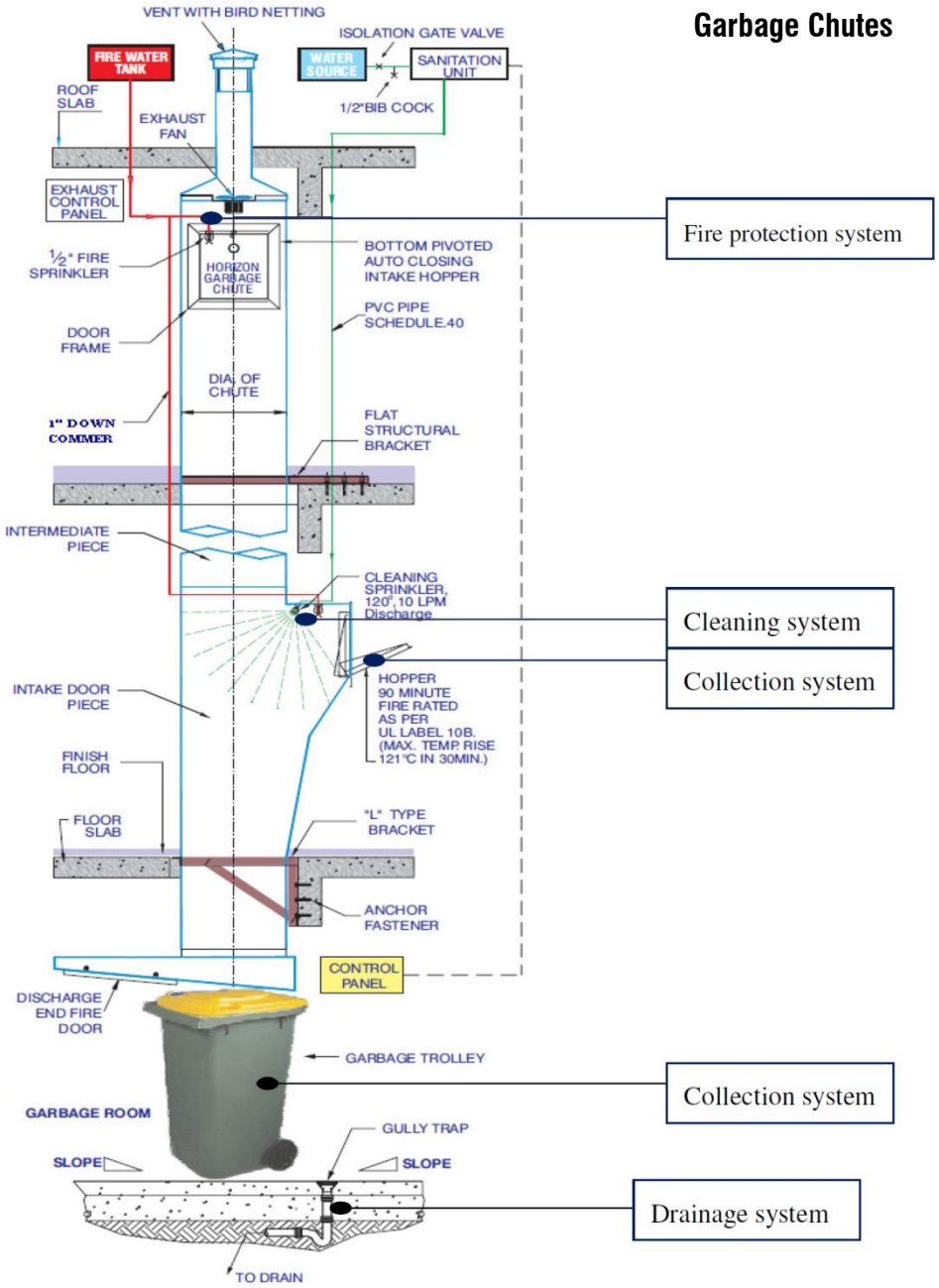
Fly Ash Bricks

To be produced locally.
Fly Ash to be sourced from the adjacent paper mill

DESIGN DRIVERS

WASTE

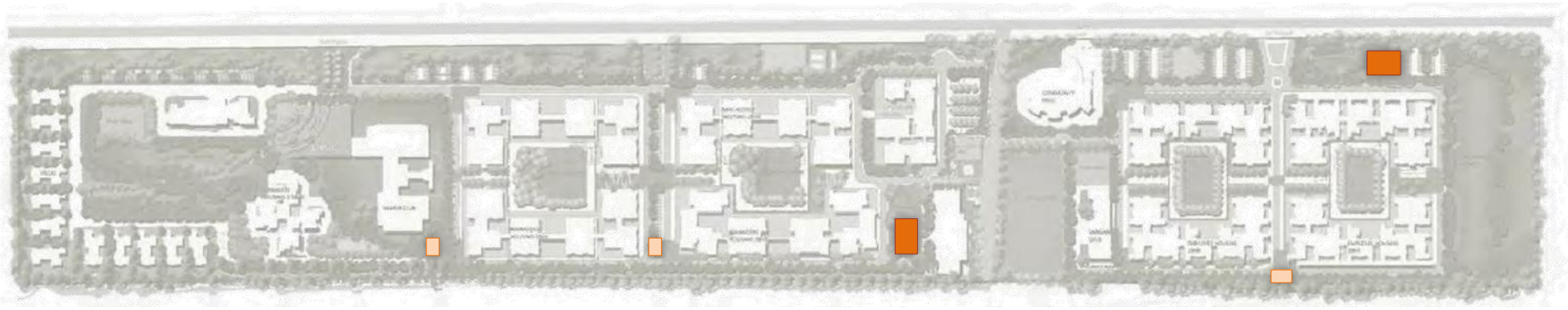
Methods & Procedures : Solid Waste Management

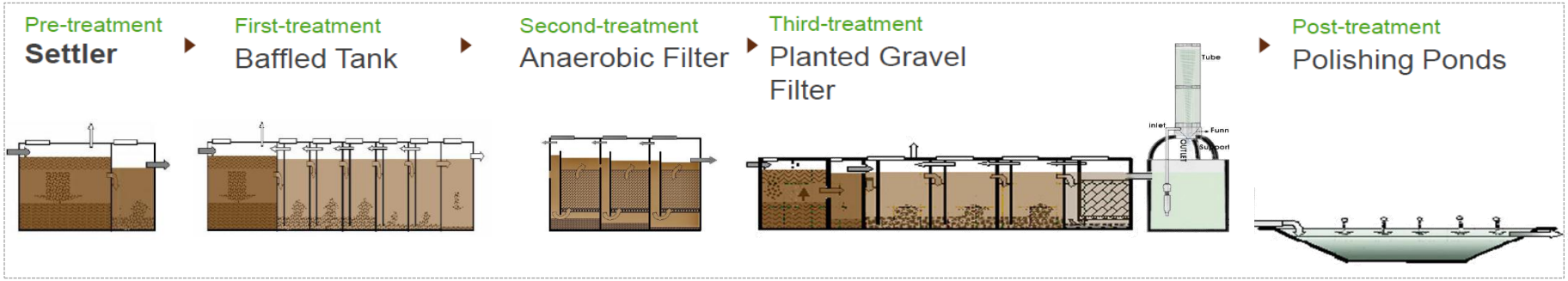


Solid Waste Management

- **Intent :** Ensure that organic waste and recyclables must be collected and stored separately in multi coloured containers/bins at both decentralized and centralized level.
- **Intent :** Ensure a facility/system for effective and efficient management of waste
- **Intent :** Arrangements for secondary collection and communal storage for recyclables should be made to be taken up on a frequent basis

Methods & Procedures : Sewage Waste Management





Vortex Treatment

Elimination of odours and colours
Natural self purification process
Low energy consumption (1 to 3Hp)
Reduced footprint
No chemicals or additives required
Scalability for different types and quantities of waste water
Easy maintenance and operation
Aesthetic integration within landscape
Low running cost

FOOT PRINT REDUCTION
From ~1m2/user
To ~0.15m2/user

Study and Analysis provided by : ***Auroville Centre for Scientific Research***

SUMMARY

Summary

Sustainable Site

16.5%

GREEN COVER PER CAPITA

Water Management

62.8%

REDUCTION FROM BASELINE

Social Wellbeing

EQUITY

SOCIAL CONNECT

Mobility

PedShed

400M RADIUS

Energy

PASSIVE
RIGHT

Waste Management

vortex
de-wats

" In the coming decades, the survival of humanity will depend on our ecological literacy - our ability to understand the basic principles of ecology and to live accordingly... "

(Fritjof Capra – Founder - Centre for Ecolitracy, Berkeley, California)

THANK YOU