



GRIHA's
IMPACTFUL

50

BEYOND GREEN BUILDING BLOCKS



GRIHA
A GRIHA council publication

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FOREWORD



Dr. Vibha Dhawan

President,
GRIHA Council

Director general ,
The Energy & Resource Institute

Dear Readers,

The building industry, while driving economic growth and development, stands as one of the largest contributors to global emissions. In response, energy-efficient and sustainability rating systems are continually evolving, with a shared goal of achieving net-zero emissions.

India's fast-growing economy and burgeoning population have propelled a significant rise in emissions over recent decades. Yet, this is not a challenge confined to one nation—it is a global concern. Around the world, sustainability rating systems have established comprehensive frameworks to evaluate the environmental performance of buildings, addressing critical aspects such as energy and water efficiency, waste management, materials and resource optimization, occupant comfort, and health.

In India, the Green Building Rating for Integrated Habitat Assessment (GRIHA) has been a pioneering force since its inception in 2007. It provides a robust mechanism to assess building projects against nationally defined sustainability benchmarks, evaluating their environmental performance holistically throughout their life cycle.

With the global building stock projected to grow exponentially, material and resource consumption—and their environmental repercussions—are poised to escalate. This makes it imperative for clean energy transitions to disrupt traditional economic models that depend on rising material demand and production, which are major drivers of carbon emissions. In this context, building rating systems like GRIHA play a pivotal role in offering transparent and effective evaluation mechanisms to advance sustainable practices in the construction sector.

This book presents 50 exemplary GRIHA-rated projects across India, showcasing innovative approaches to site planning, passive design strategies, efficient landscaping, and cost-effective architectural measures. These case studies emphasize the optimization of resources and reduction of carbon emissions, serving as a valuable repository of knowledge for professionals in the built environment. More importantly, they stand as a testament to the progress being made toward sustainable and eco-friendly practices in India's construction industry.

I am delighted to witness GRIHA's growing impact in accelerating the adoption of green practices in both new and existing buildings across the nation, contributing to a more sustainable future. I extend my heartfelt congratulations to my colleagues at the GRIHA Council for curating this inspiring collection of case studies, which I believe will guide and inspire many in the journey toward sustainable development.

Here's to building a greener tomorrow!

PREFACE



Mr. Sanjay Seth

Vice President-cum-Chief Executive Officer,
GRIHA Council
Senior Director,
The Energy & Resource Institute

Dear Friends and Colleagues,

Buildings and construction account for nearly 40% of global carbon emissions, driven by operational processes such as lighting, cooling, and heating, as well as the production and transport of materials. Recognizing this, the United Nations highlights buildings and construction as critical tools for promoting sustainable consumption and production patterns.

The global urgency to address the carbon footprint of the built environment was underscored at the 26th Conference of Parties (CoP26) in Glasgow, where India presented its ambitious “Panchamrit” commitments. These targets include achieving net-zero emissions by 2070, reducing projected carbon emissions by 1 billion tons by 2030, meeting 50% of energy needs through renewables, and reaching 500 GW of non-fossil energy capacity. These milestones demonstrate India’s determination to lead by example in the global fight against climate change.

In this context, green building certifications like GRIHA (Green Rating for Integrated Habitat Assessment) play a pivotal role. They provide a framework to assess and improve the environmental performance of buildings over their life cycle, while also acting as benchmarks for sustainable investment and innovation.

By promoting resource efficiency, occupant comfort, and reduced operational costs, GRIHA empowers stakeholders—designers, investors, manufacturers, government bodies, and NGOs—to accelerate decarbonization and adopt best practices in sustainability.

GRIHA, as an indigenous rating system, seamlessly integrates scientific advancements with traditional knowledge to create cost-effective and culturally relevant solutions. Highlighted in India's INDC (Intended Nationally Determined Contributions) as a tool for greenhouse gas (GHG) mitigation, GRIHA continues to influence national policies and enjoys strong support from public and private entities alike. The inclusion of social dimensions in its framework sets it apart, ensuring that the built environment fosters inclusivity, accessibility, and community well-being.

This coffee table book showcases 50 exemplary GRIHA-rated projects from across India, illustrating how resource optimization, carbon reduction, and innovative strategies contribute to sustainable building practices. Each case study highlights the tangible benefits of integrating advanced technologies and sustainable operational practices, while also proving that sustainability is both achievable and economically viable.

We hope this publication serves as an inspiration and a guide for building owners, developers, and policymakers to adopt greener practices in both new and existing projects. These case studies demonstrate the significant impact that buildings can have in shaping a more sustainable, inclusive, and resilient future.

I extend my sincere gratitude to all those who contributed to this publication and look forward to continued efforts in showcasing the transformative potential of sustainable construction.

Together, let us advance toward our shared goal of environmental stewardship and sustainability

ACKNOWLEDGEMENT



Ms. Shabnam Bassi

Deputy CEO-Cum-Secretary,
GRIHA Council

Director,
The Energy & Resource Institute

Dear Reader,

It gives me great pleasure to introduce “Beyond Green Building Blocks: GRIHA’s Impactful 50” — a Coffee Table Book that celebrates the milestones of sustainable architecture and responsible construction across India. This publication is not merely a compilation of buildings; it is a tribute to the shared vision, relentless innovation, and unwavering commitment of an entire ecosystem of changemakers who are reshaping the future of our built environment.

This book brings together 50 exemplary projects that reflect the breadth and depth of green building practices. Each of these projects, certified under the GRIHA rating system, tells a unique story of how sustainable design can be seamlessly integrated into the diverse social, climatic, and economic contexts of our country.

This achievement would not have been possible without the thoughtful collaboration and sincere efforts of a wide range of stakeholders. I extend my heartfelt gratitude to our esteemed clients, facility managers, green building consultants, architects, engineers, and developers.

I also wish to express my profound appreciation to the incredible teams at GRIHA and TERI. Your relentless dedication, precision in technical evaluations, and passion for sustainability have driven the successful realization of this ambitious endeavour. The hours spent curating, compiling, and verifying details have translated into a product that not only informs but also inspires. This book stands as a reflection of your professional excellence and your belief in the transformative power of sustainable development.

A special word of thanks is reserved for Dr. Vibha Dhawan, Director General of TERI, whose visionary leadership and steadfast support continue to be the foundation of the GRIHA Council's progress. Her encouragement, insight, and unflagging belief in the cause of green buildings have made this publication possible and continue to guide our efforts as we work toward a more sustainable and equitable future.

To everyone who contributed to this project, thank you for your dedication to sustainability and your invaluable role in shaping a greener, more sustainable future.

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INTRODUCTION



WHAT ARE GREEN BUILDINGS?

Green buildings, also known as sustainable or eco-friendly constructions, are designed to minimize environmental impact and enhance resource efficiency throughout the building's lifecycle. By focusing on energy efficiency, water conservation, and the use of sustainable materials, green buildings address the pressing challenges of climate change and environmental degradation.

Key features include advanced insulation, energy-efficient lighting, and renewable energy integration, which reduce carbon emissions. Techniques like rainwater harvesting and greywater recycling promote water management, while using recycled and locally sourced materials conserves natural resources.

Beyond environmental benefits, green buildings offer economic advantages like lower utility costs and higher property values, as well as healthier, more productive indoor environments. Green buildings represent a comprehensive solution to sustainable development, integrating environmental, economic, and social well-being for a better future.



WHY WE NEED GREEN BUILDINGS?

The rapid pace of urbanization is amplifying resource demands and intensifying the environmental impact of the built environment, positioning sustainable construction as a vital solution to global and national sustainability challenges. Further, green buildings play a critical role in addressing key United Nations Sustainable Development Goals (SDGs), specifically SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

In India, the rapid increase in population and economic growth has placed unprecedented pressure on natural resources, with urban areas particularly strained by the diminishing availability of water and the growing demand for energy. The construction sector is one of the largest consumers of resources, from energy and water to raw materials, and contributes significantly to waste generation and greenhouse gas emissions. This scenario underscores the urgency of adopting green building practices, which can mitigate these pressures while fostering a more sustainable and resilient urban future.



Green buildings are essential because they provide an integrated solution to reducing the environmental footprint of the construction sector. They incorporate energy-efficient designs, sustainable water management systems, and the use of eco-friendly materials, while enhancing indoor environmental quality. These buildings not only lower energy consumption and reduce carbon emissions but also promote water conservation through innovations like rainwater harvesting and greywater recycling, helping to address the SDGs at multiple levels.

India's commitment to sustainable development is reflected in the adoption of GRIHA (Green Rating for Integrated Habitat Assessment), the green building rating system, which aligns with global sustainability standards and is integrated into the National Action Plan on Climate Change. GRIHA plays a pivotal role in guiding the building industry towards practices that reduce resource consumption, minimize waste, and promote renewable energy, all while ensuring legal compliance through frameworks like the Energy Conservation Building Code (ECBC) and the Solar Buildings Programme.



WHY RATE GREEN BUILDINGS ?

Despite the progress, there are challenges in shifting from traditional construction methods to sustainable alternatives. Overcoming these hurdles requires a concerted effort in education, awareness, and the provision of financial incentives. Government policies, subsidies, and collaborations with financial institutions are critical to driving widespread adoption. Green building rating systems, such as GRIHA, provide a structured framework to guide this transition, offering measurable benchmarks and encouraging compliance with sustainable practices. These systems help bridge the gap between policy goals and on-ground implementation, driving accountability across the construction sector. Government policies, subsidies, and collaborations with financial institutions are critical to driving widespread adoption.

In conclusion, green building ratings are a key pathway to sustainable development, directly supporting the SDGs by promoting energy efficiency, water conservation, and responsible resource use, ensuring cities grow sustainably while balancing environmental and economic goals.

ABOUT GRIHA COUNCIL

GRIHA, an acronym for **Green Rating for Integrated Habitat Assessment**, is a Sanskrit word that translates to “**abode**.” This rating system has been designed to evaluate and enhance the environmental performance of buildings across their entire life cycle—from construction through operation to demolition. Human habitats, or buildings, have complex interactions with the environment, consuming significant resources such as energy, water, and materials, while also generating waste and emissions. GRIHA’s core objective is to reduce resource consumption, waste generation, and the overall ecological footprint of buildings, ensuring that they operate within nationally defined benchmarks for sustainability.

In line with the adage, “what gets measured, gets managed,” GRIHA takes a quantitative approach to assess key performance areas such as energy consumption, water usage, waste generation, and the integration of renewable energy systems. By establishing measurable criteria, GRIHA enables building professionals to manage and mitigate environmental impacts effectively, striving to optimize resource efficiency throughout the building’s life cycle.

As a nationally recognized rating tool, GRIHA provides a structured framework for evaluating a building’s environmental impact against defined benchmarks. It offers a holistic view, covering critical aspects such as energy efficiency, water conservation, waste management, and indoor environmental quality. The system not only promotes adherence to accepted national and international energy and environmental standards but also encourages the adoption of emerging technologies and best practices in sustainable construction. By balancing established practices with innovative concepts, GRIHA sets the benchmark for what constitutes a truly sustainable, green building.

GRIHA’s rating system, grounded in scientific and environmental principles, aims to guide architects, engineers, developers, and policymakers toward creating buildings that are environmentally responsible, resource-efficient, and capable of enhancing the quality of life for their occupants. By promoting sustainability in the built environment, GRIHA plays a pivotal role in mitigating climate change and fostering long-term environmental stewardship.



“We, at *GRIHA Council*, stand for *credibility*,
integrity, and *inclusiveness*, while upholding
Indian ethos for *future-ready* and
sustainable habitat.”

- vision statement for GRIHA Council

RATINGS & CERTIFICATIONS UNDER GRIHA COUNCIL

RATINGS

GRIHA

SVAGRIHA
(SIMPLE
VERSATILE
AFFORDABLE
GRIHA)

GRIHA
for
**AFFORDABLE
HOUSING**

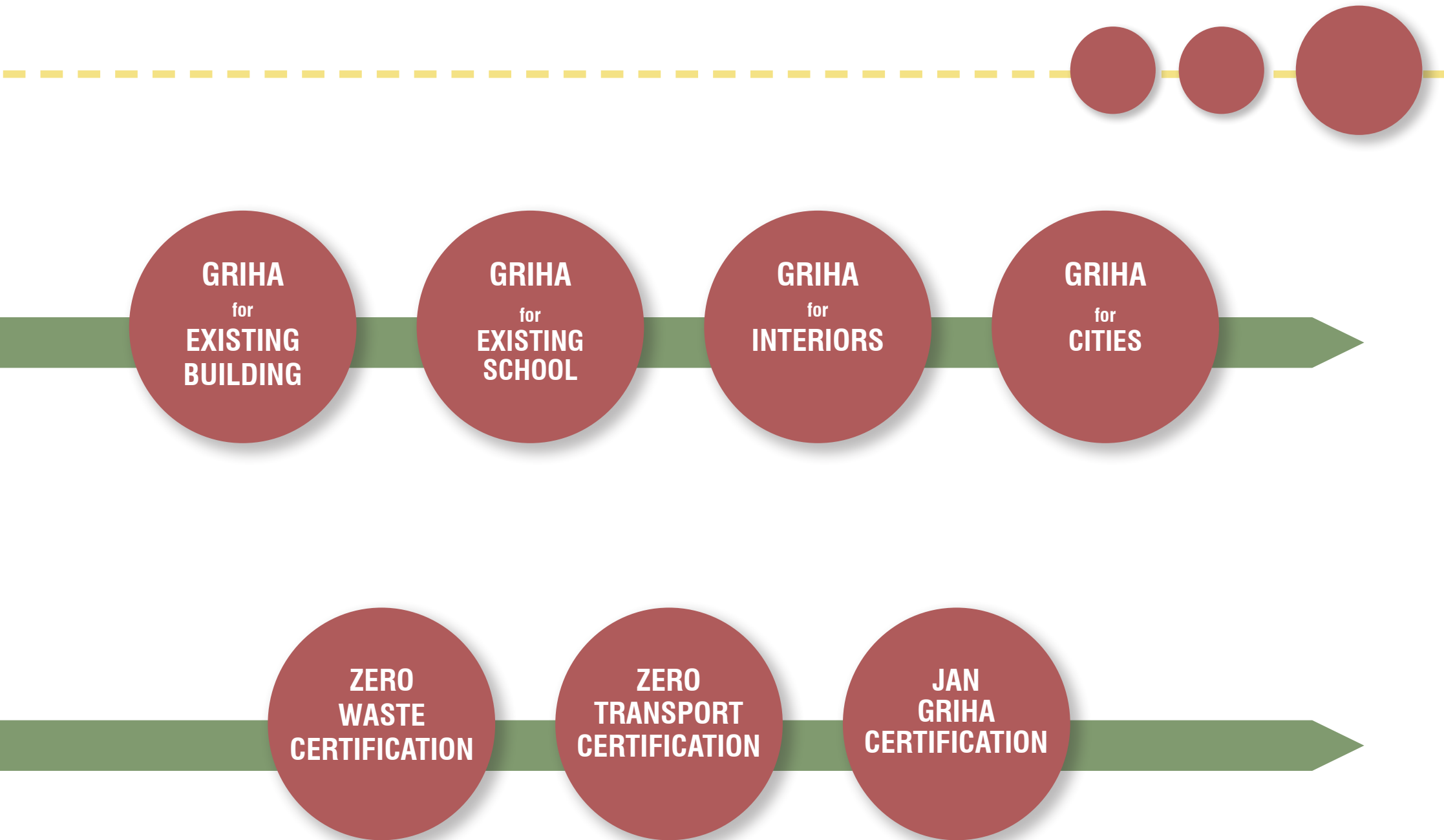
GRIHA
for
**LARGE
DEVELOPMENT**

CERTIFICATIONS

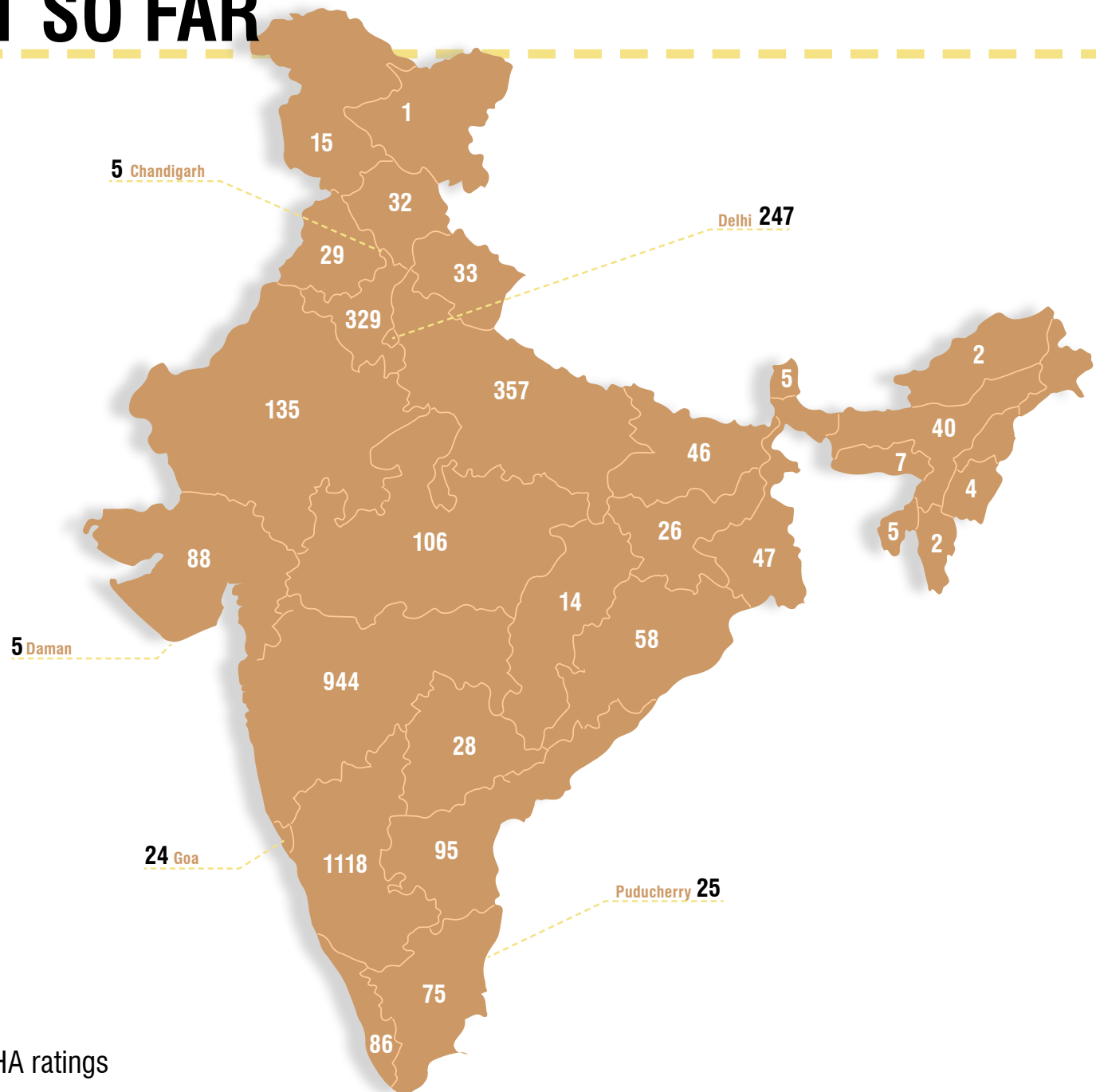
**DECARBONISING
HABITAT
PROGRAMME
(DHP)**

**WATER
POSITIVE
CERTIFICATION**

**ENERGY
POSITIVE
CERTIFICATION**



GRIHA IMPACT SO FAR



Statewise registered projects under various GRIHA ratings



4000+ projects registered across India exceeding the **930+ million square feet** of built-up area. **1300+** buildings successfully rated.

More than **2,66,770+ new trees** have been planted & **55,000+ trees** have been preserved.

Under these projects **650+ MWp** of renewable energy systems have been installed & are responsible for saving **29700+ GigaWh** Of energy & preventing **8400+ Gigatons** of carbon dioxide from being released into the atmosphere every year.

GRIHA rated projects have contributed to water savings of **1,04,192+ Megalitre/annum.**

**Based on information reported up till November 2023*

ABOUT THE BOOK



The launch of '*GRIHA's Impactful 50: Beyond Green Building Blocks*' holds particular significance as it aligns with the 50th anniversary of The Energy and Resources Institute (TERI), a pioneering institution in the field of sustainable development. This synchronicity underscores a profound moment in the journey towards a greener, more sustainable future.

As TERI commemorates half a century of dedication to environmental stewardship and resource conservation, the selection of 50 exemplary GRIHA-rated projects serves as a testament to the progress made in sustainable construction practices over the years. These projects stand as shining examples of innovation, resilience, and commitment to environmental responsibility.

However, beyond being a mere commemoration of past achievements, the launch of the '*GRIHA's Impactful 50: Beyond Green Building Blocks*' Coffee Table Book serves as a catalyst for future action. It represents a call to arms for the construction industry, policymakers, and stakeholders to redouble their efforts in promoting sustainability and resilience in the built environment.

By showcasing the success stories of these 50 projects, the book not only celebrates the strides made thus far but also inspires and empowers others to follow suit. It serves as a roadmap for future endeavors in sustainable construction, offering valuable insights, best practices, and lessons learned from real-world implementations.

Moreover, the timing of the book's release amidst TERI's 50th-anniversary festivities amplifies its impact and outreach. It provides a platform to engage a broader audience, including industry professionals, policymakers, students, and the public, in the dialogue surrounding sustainable development and the imperative for action.

The launch of the '*GRIHA's Impactful 50: Beyond Green Building Blocks*' represents a pivotal moment in the ongoing quest for sustainability. It symbolizes a collective commitment to building a more resilient, equitable, and environmentally conscious future for generations to come, guided by the principles of innovation, collaboration, and stewardship.



SELECTION OF THE CASE STUDIES

The selection process for the '*GRIHA's Impactful 50: Beyond Green Building Blocks*' book was meticulously designed to identify India's most impactful, innovative, and exemplary green building projects. By adhering to a stringent set of criteria, the book ensures that only projects demonstrating outstanding sustainability performance and broad applicability were chosen, offering a comprehensive showcase of the country's leadership in sustainable development.

Key selection factors included:

Performance Metrics: Projects were evaluated based on third-party validated data, focusing on energy efficiency, water conservation, waste management, site planning, and indoor environmental quality. Priority was given to projects with significant reductions in resource use, renewable integration, and lower carbon footprints.

Innovation and Best Practices: Projects showcasing innovative technologies, design strategies, and construction practices that advanced sustainability were prioritized, especially those offering scalable solutions.

Diversity in Building Types and Locations: The selected projects represent a range of building types—residential, commercial, institutional, and hospitality—and come from various regions across India, addressing diverse climatic challenges.

Social Impact and Scalability: Projects were assessed for their scalability and positive social impact, focusing on replicability, cost-effectiveness, operational expenditure (OPEX), life-cycle cost (LCC), and payback periods.

Community Engagement and Stakeholder Collaboration: Projects demonstrating meaningful community involvement and strong stakeholder partnerships were given special attention for their holistic approach to sustainability.

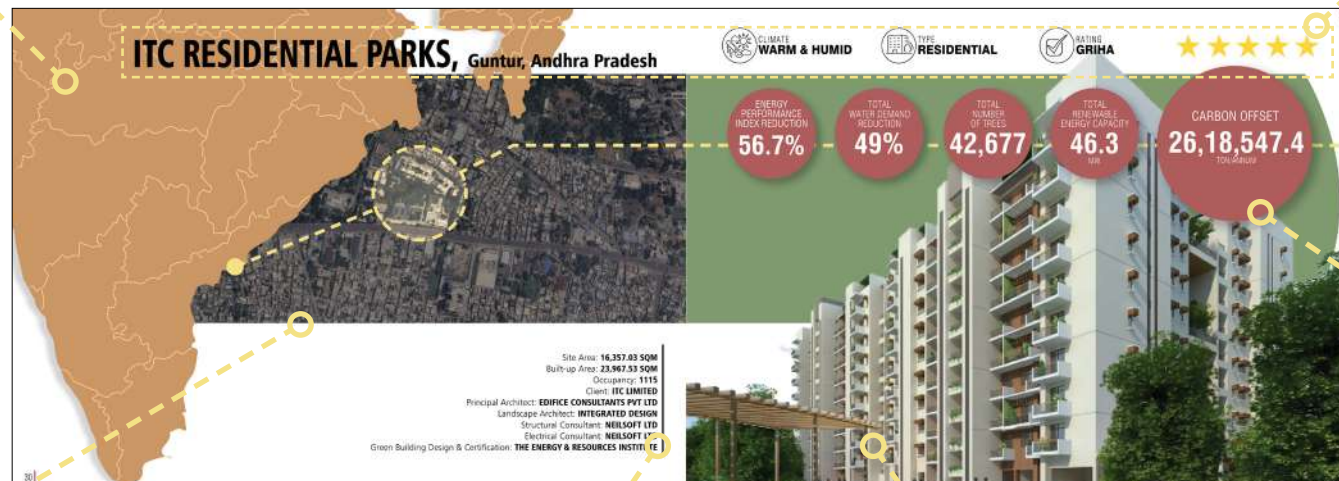
By adhering to these stringent criteria, the '*GRIHA's Impactful 50: Beyond Green Building Blocks*' book showcases India's most impactful green building projects, aiming to inspire and empower industry professionals to embrace sustainable practices and foster a more resilient built environment.

HOW TO READ THIS BOOK?

'GRIHA's Impactful 50: Beyond Green Building Blocks' offers a deep dive into sustainable construction, presenting innovative strategies and solutions implemented by project teams to meet GRIHA standards. Each case study spans four pages: The first two pages provide a project overview, covering essential details like project data, climate zone, building typology, GRIHA variant and rating, area statements, and project team. They also feature critical performance metrics, including the Energy Performance Index (EPI), renewable energy capacity, and carbon offset, highlighting the project's sustainability achievements.

LOCATION MAP

Map showcasing the location of the project in respect to the state & city



TYPOLGY INFO

this band has the name, location, climate classification, function type and the rating type along with the star rating of the project

SATELLITE VIEW

Highlighting the location of the project on satellite view to have an idea of the immediate context of the project

KEY PROJECT INFO

Includes area, occupancy, and the team behind the project.

PROJECT IMAGE

One overall image to give the reader an idea of what the project looks like

PROJECT IN NUMBERS

Reduction in Energy Efficiency Index, decrease in water consumption, installed renewable energy capacity, total trees planted, and overall carbon offset collectively highlight the project's quantified impact

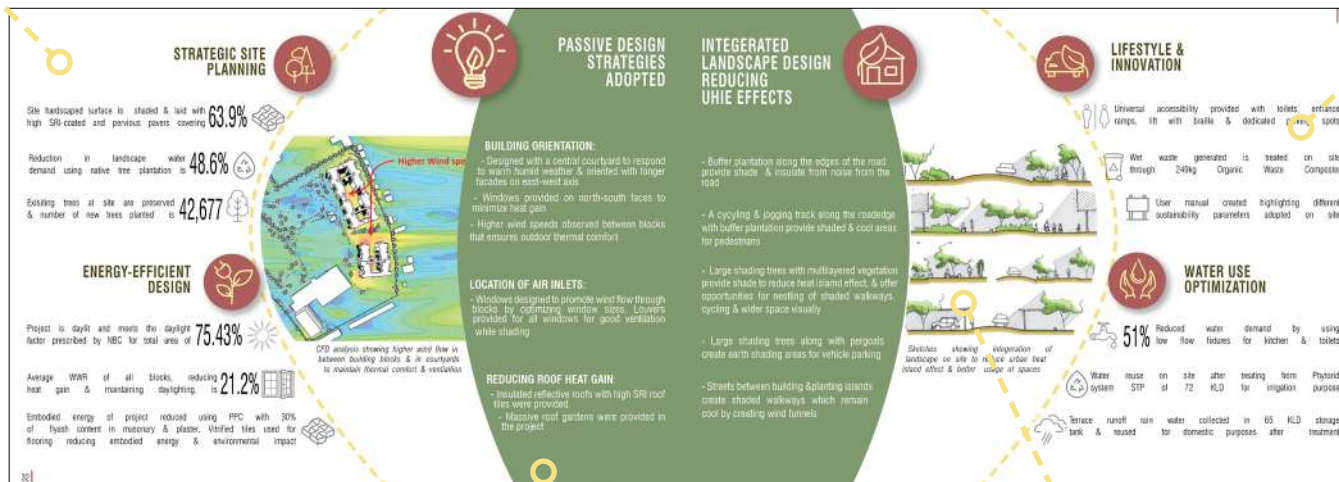
Reading through the detailed descriptions on pages 3 and 4 of each case study invites readers to immerse themselves in the nuanced approaches these projects have taken to address complex sustainability challenges. From innovative water conservation measures to groundbreaking passive design techniques, each narrative offers a wealth of knowledge and inspiration. Readers are encouraged to think critically about how these strategies can be adapted and applied in different contexts, promoting a broader understanding and appreciation of sustainable design principles in action.

PROJECT FEATURES

Divided into 4 themes to highlight the overall features of the project

Strategic Site Planning:
Sustainable infrastructure (e.g., stormwater management), native plant selection for biodiversity, and urban heat island reduction via reflective surfaces and green roofs.

Energy Efficient Design:
Optimized design for natural light/ventilation, energy-efficient systems, renewable energy, and sustainable materials with low embodied energy.



PROJECT FEATURES

Divided into 4 themes to highlight the overall features of the project

Lifestyle and Innovation:
Waste reduction strategies, health-focused indoor environment, and inclusive design for accessibility.

Water Use Optimization:
Water-saving fixtures, rainwater harvesting,

KEY HIGHLIGHTS
the unique feature of the project is described in detail here

PROJECT IMAGE
Sketch or zoomed image of a feature of the building that highlights its uniqueness

CASE STUDIES PROJECTS INDEX

SNO.	PROJECT NAME	CITY	STATE/UT	
1	ITC Residential Parks	Guntur	Andhra Pradesh	
2	The Bihar Museum	Patna	Bihar	
3	Phase I of Development of Nalanda University NET Zero Campus	Nalanda	Bihar	
4	Proposed International Terminal at Chandigarh Airport	Chandigarh	Chandigarh	
5	Indian Institute of Technology - Bhilai	Bhilai	Chhattisgarh	
6	Pawan Hans Heliport (Passenger Terminal Building & Utility Building), Sector 36, Rohini	New Delhi	Delhi	
7	Punjab National Bank Headquarters, Dwarka	New Delhi	Delhi	
8	Expansion & Modernization of the British School	New Delhi	Delhi	
9	UIDAI Headquarter Building	New Delhi	Delhi	
10	Reconstruction of HPCL Petrol Pump, Pick N Drive, Meera Bagh, New Delhi	New Delhi	Delhi	
11	Smart Ghar -3, Rajkot Municipal Corporation	Rajkot	Gujarat	
12	Light House Project	Rajkot	Gujarat	
13	Raksha Shakti University	Ahmedabad	Gujarat	
14	Indian Institute of Technology, Gandhinagar	Gandhinagar	Gujarat	
15	EIL Complex	Gurugram	Haryana	
16	HAREDA - Akshay Urja Bhawan	Panchkula	Haryana	
17	Milestone Experion Centre	Gurugram	Haryana	
18	Treasury Building at Kuthar	Solan	Himachal Pradesh	
19	Convention Centre and Allied Building at Darbhanga House Complex	Ranchi	Jharkhand	
20	Titan New Corporate Campus	Bengaluru	Karnataka	
21	R&D Unit for Astra Microwave Products Ltd	Bengaluru	Karnataka	
22	Employee Residential Building of ITC (Mudfort)	Bengaluru	Karnataka	
23	Ladies Hostel project at Indian Institute of Science	Bengaluru	Karnataka	
24	Annex Building, EMPRI	Bengaluru	Karnataka	
25	Tamara Luxury Hotel (New Name: O by Tamara)	Thiruvananthapuram	Kerala	



STARS AWARDED	GRIHA CATEGORY	TPOLOGY	BUILT-UP AREA (SQ. MTR.)	CARBON REDUCTION (T/ANNUM)	PAGE NO.
★★★★★★	GRIHA	Residential	57,208	26,18,547	30
★★★★★★	GRIHA	Institutional	25,000	14,96,295	34
★★★★★★	GRIHA LD	Institutional	3,41,000	61,59,873	38
★★★★★	GRIHA	Airport	4,24,362	3,89,734	42
★★★★★★	GRIHA LD	Institutional	13,99,300	1,37,78,198	46
★★★★★	GRIHA	Airport	3,403	3,92,279	50
★★★★★★	GRIHA	Institutional	37,874	18,78,929	54
★★★★★★	GRIHA	Institutional	21,300	17,91,313	58
★★★★★★	GRIHA	Institutional	8,635	6,19,052	62
★★★★★★	SVAGRIHA	Commercial	100	1,454	66
★★★	AH	Residential	57,408	14,71,924	70
★★★★	AH	Residential	47,827	13,86,983	74
★★★★★★	GRIHA LD	Institutional	7,28,791	34,27,042	78
★★★★★★	LD	Institutional	1,27,534	54,02,776	82
★★★★★★	GRIHA	Commercial	32,837	16,78,050	86
★★★★★★	GRIHA	Commercial	5,100	77,785	90
★★★★★★	GRIHA	Commercial	22,916	12,77,040	94
★★★★★	SVA GRIHA	Commercial	277	2,699	98
★★★★★	GRIHA	Institutional	11,469	7,72,379	102
★★★★★★	GRIHA	Commercial	25,344	7,58,130	106
★★★★★★	GRIHA	Commercial	10,215	6,85,516	110
★★★★★★	GRIHA	Residential	13,875	9,44,901	114
★★★★★★	GRIHA	Residential	5,473	1,38,372	118
★★★★★★	SVAGRIHA	Institutional	1,283	7,388	122
★★★★★	GRIHA	Commercial	13,741	35,40,512	126

CASE STUDIES PROJECTS INDEX

SNO.	PROJECT NAME	CITY	STATE/UT	
26	IIM	Kozhikode	Kerala	
27	Atulya IT Park	Indore	Madhya Pradesh	
28	Mr. Azad Jain Residence	Indore	Madhya Pradesh	
29	LHP	Indore	Madhya Pradesh	
30	Smart Data Enterprises	Nagpur	Maharastra	
31	BPCL, Residential Building	Mumbai	Maharastra	
32	Royal Orange County	Pune	Maharastra	
33	Gandhi Research Foundation	Jalgaon	Maharastra	
34	Pimpri Chinchwad New Town	Pune	Maharastra	
35	Govardhan Eco Village	Wada	Maharastra	
36	Grape County Resort	Nashik	Maharastra	
37	VVIP Circuit House	Pune	Maharastra	
38	Vastukar Design Studio	Bhubaneswar	Odisha	
39	Gratitute Ecovilla	Puducherry	Puducherry	
40	STPI Incubation Centre	Mohali	Punjab	
41	Bhamashah Data Centre	Jaipur	Rajasthan	
42	Manipal University Campus	Jaipur	Rajasthan	
43	Singareni powerproject 2x600 MW, Service Building	Pegadapalli	Telangana	
44	ITC Kohenur	Hyderabad	Telangana	
45	Airport Terminal Building	Agartala	Tripura	
46	Office Building, Design Associates Inc.,	Noida	Uttar Pradesh	
47	HPCL, Administrative Block	Kanpur	Uttar Pradesh	
48	Pavna Residence	Aligarh	Uttar Pradesh	
49	UPES	Dehradun	Uttarakhand	
50	Office Complex for CIL	Kolkata	West Bengal	

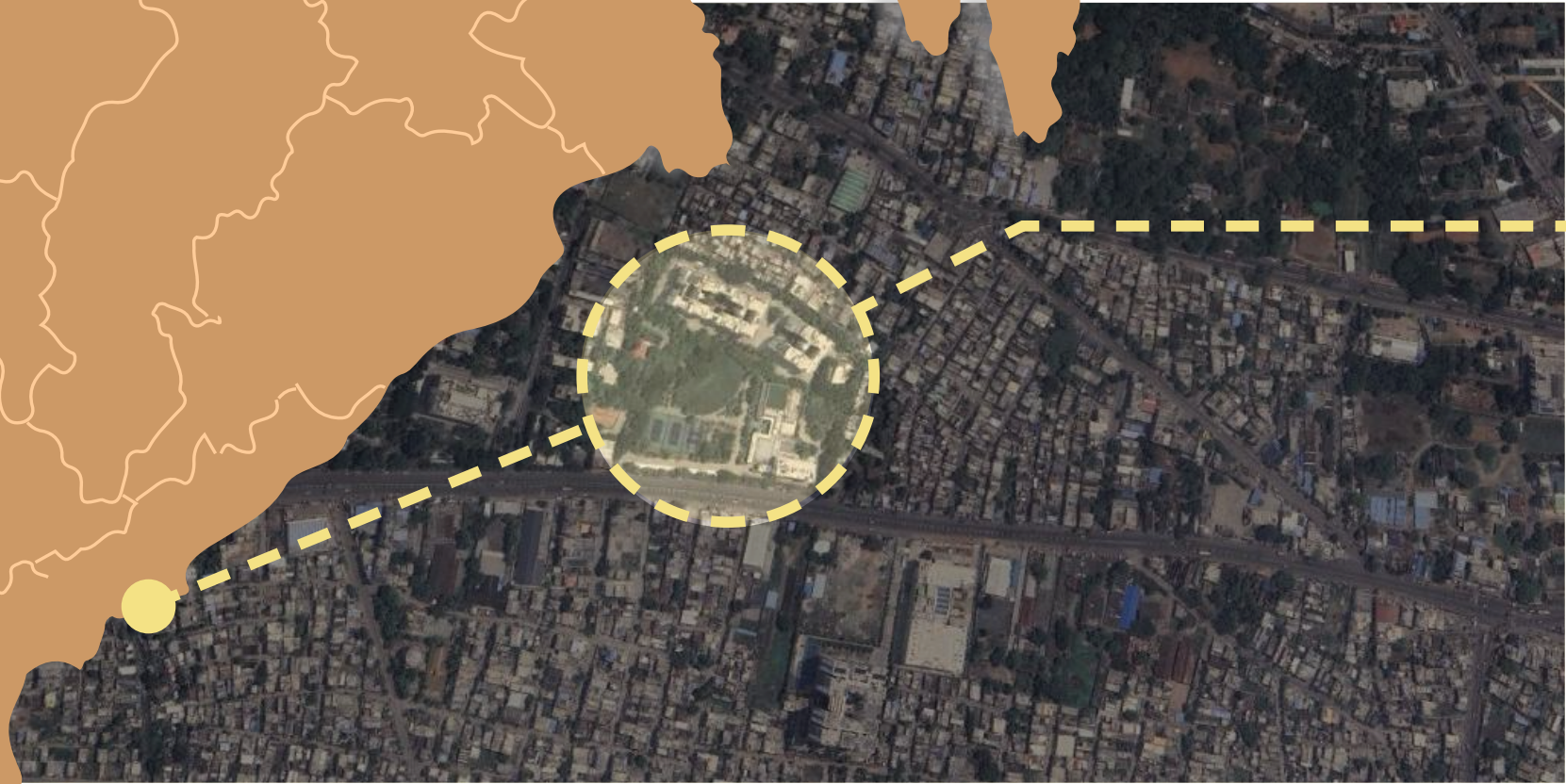


STARS AWARDED	GRIHA CATEGORY	TPOLOGY	BUILT-UP AREA (SQ. MTR.)	CARBON REDUCTION (T/ANNUM)	PAGE NO.
★★★★★★	GRIHA	Institutional	29,599	29,19,863	130
★★★★★	GRIHA	Commercial	14,050	8,34,581	134
★★★★★★	SVAGRIHA	Residential	541	1,987	138
★★★★★	AH	Residential	44,352	11,76,954	142
★★★★★	GRIHA	Commercial	2,972	1,84,240	146
★★★★★	GRIHA	Commercial	8,000	9,11,338	150
★★★★★★	GRIHA	Commercial	23,968	20,77,336	154
★★★★★★	GRIHA	Institutional	4,000	2,46,295	158
★★★★★★	GRIHA	Institutional	10,834	1,24,374	162
★★★★★★	GRIHA	Commercial	2,401	1,84,351	166
★★★★★★	SVA GRIHA	Institutional	1,475	9,216	170
★★★★★	GRIHA	Institutional	4,887	1,50,032	174
★★★★★★	SVAGRIHA	Commercial	453	3,198	178
★★★★★★	SVAGRIHA	Residential	474	1,664	182
★★★★★★	SVAGRIHA	Commercial	10,700	13,35,100	186
★★★★★★	GRIHA	Commercial	23,921	11,20,811	190
★★★★★	GRIHA	Institutional	53,173	37,54,556	194
★★★★★★	GRIHA	Service Building	6,087	40,17,959	198
★★★★★★	GRIHA	Residential	49,595	1,50,52,406	202
★★★★★	GRIHA	Commercial	53,173	6,21,176	206
★★★★★★	SVAGRIHA	Commercial	1,002	5,924	210
★★★★★	SVAGRIHA	Commercial	1,875	1,958	214
★★★★	SVAGRIHA	Residential	2,406	2,920	218
★★★★★	GRIHA	Institutional	33,787	8,11,577	222
★★★★★	GRIHA	Commercial	25,520	11,11,610	226



CASE STUDIES

ITC RESIDENTIAL PARKS, Guntur, Andhra Pradesh



Site Area: **16,357.03 SQM**

Built-up Area: **23,967.53 SQM**

Occupancy: **1115**

Client: **ITC LIMITED**

Principal Architect: **EDIFICE CONSULTANTS PVT LTD**

Landscape Architect: **INTEGRATED DESIGN**

Structural Consultant: **NEILSOFT LTD**

Electrical Consultant: **NEILSOFT LTD**

Green Building Design & Certification: **THE ENERGY & RESOURCES INSTITUTE**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

56.7%

TOTAL
WATER DEMAND
REDUCTION

49%

TOTAL
NUMBER
OF TREES

42,677

TOTAL
RENEWABLE
ENERGY CAPACITY

46.3
MW

CARBON OFFSET

26,18,547.4
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **63.9%**



Reduction in landscape water demand by native tree plantation is **48.6%**



Existing trees at site are preserved & number of new trees planted is **42,677**



ENERGY-EFFICIENT DESIGN



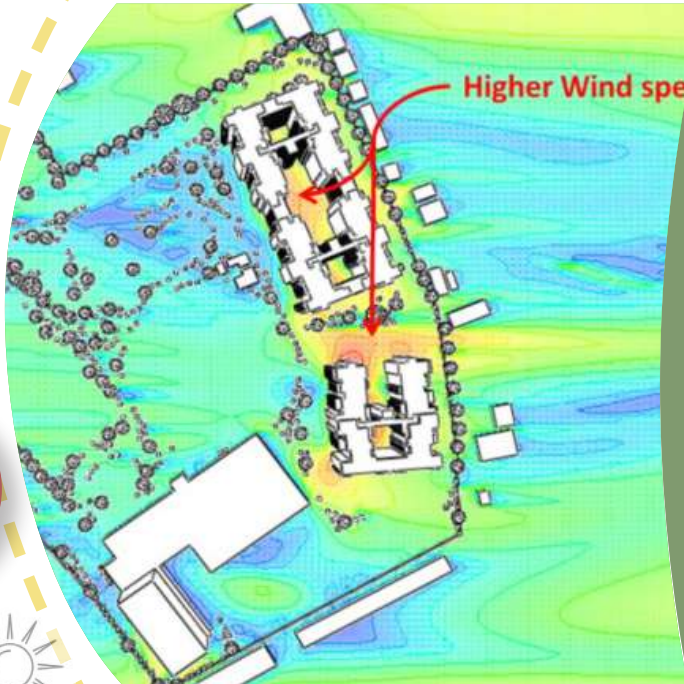
Project is daylit and meets the daylight factor prescribed by NBC for total area of **75.43%**



Average WWR of all blocks, reducing heat gain & maintaining daylighting, is **21.2%**



Embodied energy of project reduced using PPC with 30% of flyash content in masonry & plaster, Vitrified tiles used for flooring reducing embodied energy & environmental impact



CFD analysis showing higher wind flow in building blocks & in courtyards to maintain thermal comfort & ventilation



PASSIVE DESIGN STRATEGIES ADOPTED

BUILDING ORIENTATION:

- Designed with a central courtyard to respond to warm humid weather & oriented with longer facades on east-west axis
- Windows provided on north-south faces to minimize heat gain
- Higher wind speeds observed between blocks that ensures outdoor thermal comfort

LOCATION OF AIR INLETS:

- Windows designed to promote wind flow through blocks by optimizing window sizes. Louvers provided for all windows for good ventilation while shading

REDUCING ROOF HEAT GAIN:

- Insulated reflective roofs with high SRI roof tiles were provided.
- Massive roof gardens were provided in the project

INTEGRATED LANDSCAPE DESIGN REDUCING UHI EFFECTS



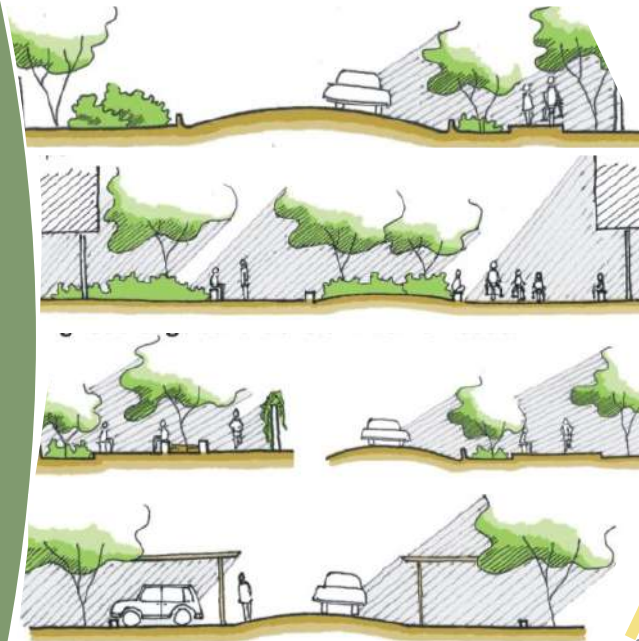
- Buffer plantation along the edges of the road provide shade & insulate from noise from the road

- A cycling & jogging track along the roadedge with buffer plantation provide shaded & cool areas for pedestrians

- Large shading trees with multilayered vegetation provide shade to reduce heat island effect, & offer opportunities for nestling of shaded walkways, cycling & wider space visually

- Large shading trees along with pergolas create earth shading areas for vehicle parking

- Streets between building & planting islands create shaded walkways which remain cool by creating wind funnels



Sketches showing integration of landscape on site to reduce urban heat island effect & better usage of spaces



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Wet waste generated is treated on site through 249kg Organic Waste Composter



User manual created highlighting different sustainability parameters adopted on site



WATER USE OPTIMIZATION



51% Reduction in water demand using low flow fixtures for kitchen & toilets



Water reuse on site after treating from Phytorid system STP of 72 KLD for irrigation purpose



Terrace tank & reused runoff rain water collected in 65 KLD storage for domestic purposes after treatment

THE BIHAR MUSEUM, Patna, Bihar



Site Area: **54,000 SQM**
Built-up Area: **25,000 SQM**
Year of completion: **2020**
Occupancy: **608**

Client: **BIHAR CONSTRUCTION DEPARTMENT**

Principal Architect: **OPOLIS ARCHITECTS + MAKI & ASSOCIATES**

Structural consultants: **MAHENDRA RAJ CONSULTANTS**

Landscape consultants: **FORETHOUGHT CONSULTANTS**

Green Building Design & Certification: **ENVIRONMENTAL DESIGN SOLUTIONS PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
INSTITUTIONAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

53.1%

TOTAL
WATER DEMAND
REDUCTION

51%

TOTAL
NUMBER
OF TREES

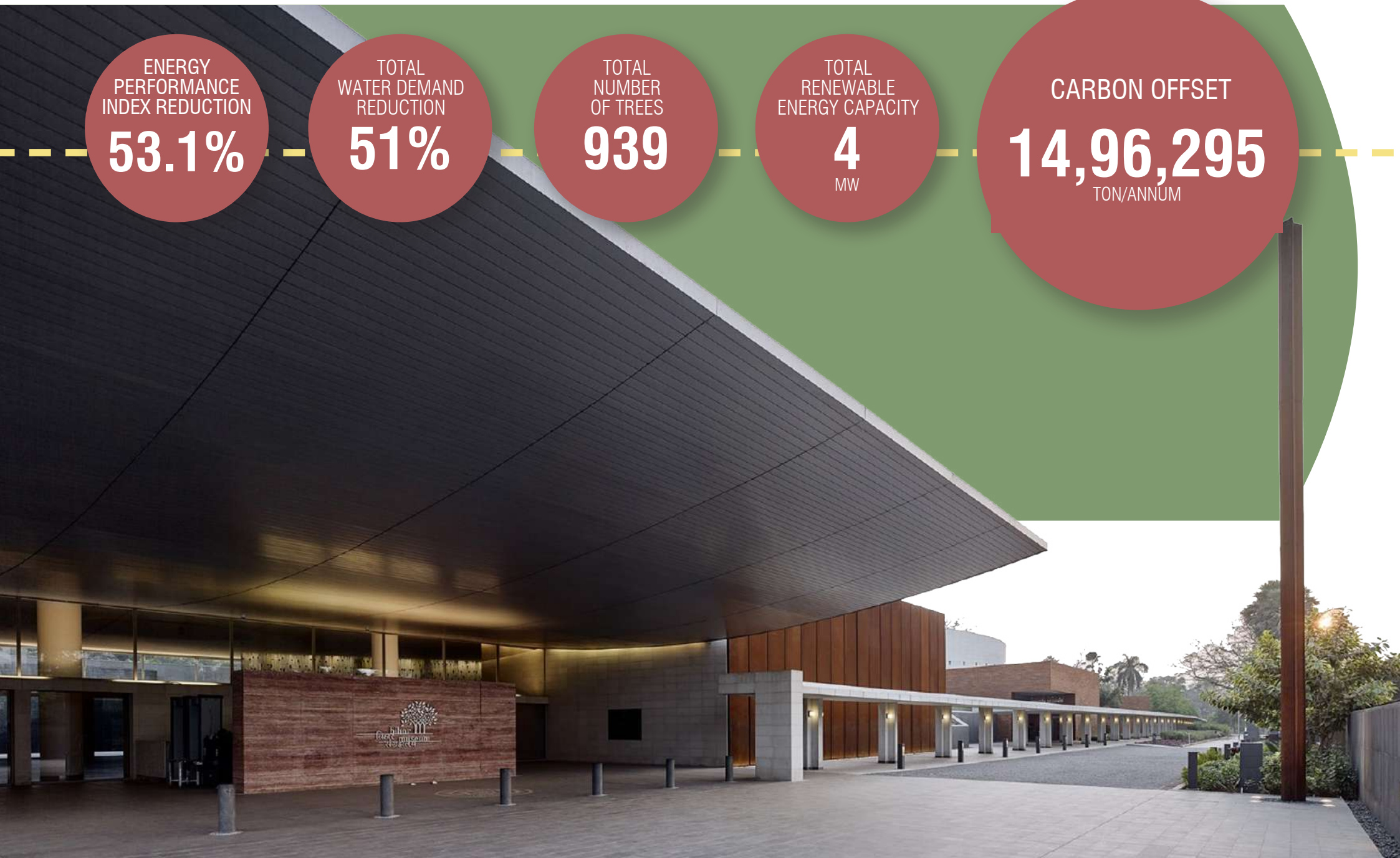
939

TOTAL
RENEWABLE
ENERGY CAPACITY

4
MW

CARBON OFFSET

14,96,295
TON/ANNUM



STRATEGIC SITE PLANNING

Existing & new 165 mature trees preserved at site is **774**



Site hardscaped surface laid with high SRI-coated and pervious pavers covering **67%**



Hard paving was reduced at site with integrated landscape clusters to reduce UHIE

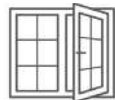


ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **54%**



Materials used for door & windows are low energy materials like Aluminium & MS doors with recycled content



Reduction in embodied energy of structural system of the building using flat slab & pre-cast panels is **15%**



Image showing one of the courtyards of the building with walkways & air inlets for ventilation

BUILDING ENVELOPE PERFORMANCE

12%

WindowWall Ratio(WWR) for all buildings

0.21 W/m²K U value

Building envelope using fly ash bricks & optimum insulation.

0.4 SHGC

63 % VLT

1.5 W/m²K U value

DGU unit for glazing in the project, complying to requirements of ECBC 2007

PASSIVE DESIGN STRATEGIES



ORIENTATION

- Building is longitudinally oriented in North-South direction reduces direct solar radiation entering the building

- Multiple courtyards provided to ensure open spaces & provide day light & ventilation to all spaces in the building

FENESTRATION DESIGN

- Windows are located along the north & south façade, & overlooking the courtyards

- Air inlets are provided at strategic locations to facilitate natural air movement inside the building

LANDSCAPE DESIGN

- Extensive green areas have been planned within the courtyards, on the roof & around the building reducing heat gains, maintaining micro climate & reducing noise from roadside



Image showing envelope construction with insulation & flyash brick



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



BMS installed to control air-conditioning & fresh air units at individual spaces



Central waste segregation area with colour coded bins provided in project



WATER USE OPTIMIZATION



60.5% Reduction in water demand using low flow fixtures for kitchens & toilets

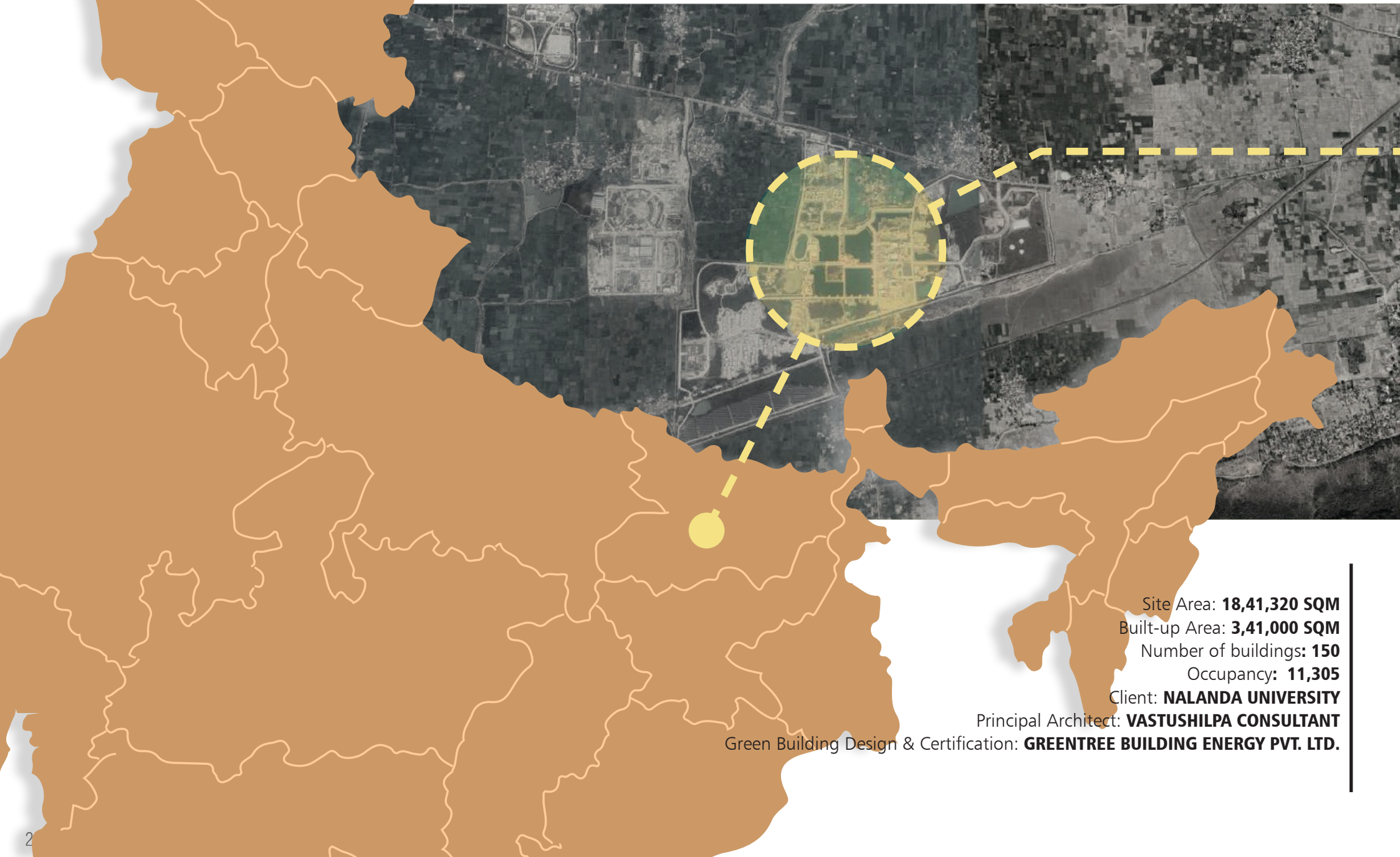


62.5% Reduction in annual landscape irrigation demand by planting native species plants



47% Annual water reuse after treating from MBBR type 930KLD STP on site for flushing & irrigation

NALANDA UNIVERSITY CAMPUS, Rajgir, Bihar



Site Area: **18,41,320 SQM**
Built-up Area: **3,41,000 SQM**
Number of buildings: **150**
Occupancy: **11,305**
Client: **NALANDA UNIVERSITY**

Principal Architect: **VASTUSHILPA CONSULTANT**

Green Building Design & Certification: **GREENTREE BUILDING ENERGY PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
INSTITUTIONAL



RATING
GRIHA LD
MASTER PLAN



ENERGY
PERFORMANCE
INDEX REDUCTION

45.9%

TOTAL
WATER DEMAND
REDUCTION

100%

TOTAL
NUMBER
OF TREES

3390

TOTAL
RENEWABLE
ENERGY CAPACITY

4.45
MW

CARBON OFFSET

61,59,872.8
TON/ANNUM



STRATEGIC SITE PLANNING

Project retains the existing site contours & slopes, existing natural water bodies, & dense tree clusters for more than 75% of site area

390 existing mature trees preserved & New trees planted at site are **3000**

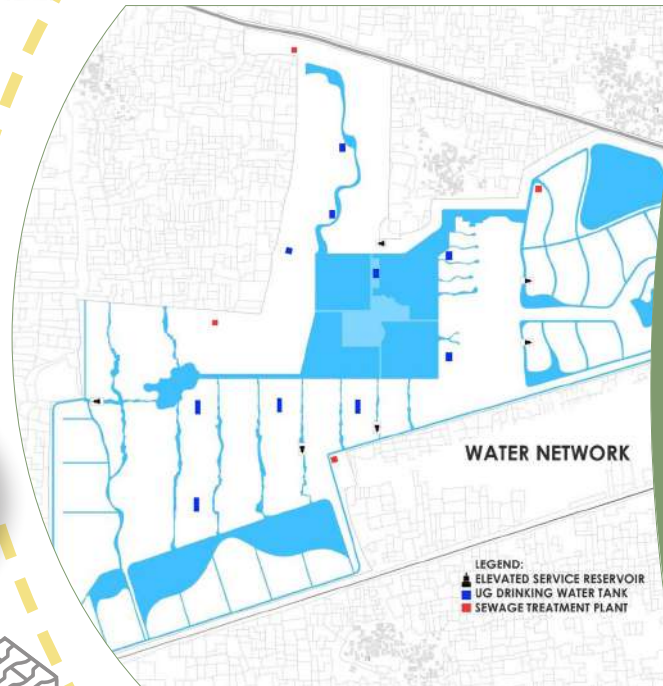
Hard paving was reduced at site with integrated landscape clusters to reduce UHIE

ENERGY-EFFICIENT DESIGN

Compressed Stabilised Earth Blocks used for walling made from soil excavated at site reducing embodied energy of structure

Plastic waste generated is used to construct roads at site reducing use of cement by **5%**

Recycled concrete & hollow bricks are used to construct & reduce dependence on natural materials



Storm runoff management plan with seasonal water bodies at site



STRATEGIES FOR ACHIEVING NET ZERO ENERGY & CARBON

ENERGY

- Energy consumption reduced using incorporative passive building design to maintain favorable microclimate, daylighting. Further Descant Evaporative (DEVAP) cooling technology used to achieve energy reduction
- 2.2 MWp Combined heat & power(CHP) engine proposed by use of biofuel, generated from waste in surrounding farms, to provide energy for the building operations
- Integrated with solar renewable power to facilitate clean energy & achieve net zero

CARBON

- Vehicular access is restricted & entire site perimeter is accessible by cycling or walking, combined with proper footpath & cycling network
- Electrical vehicles used for transport within site

STRATEGIES FOR ACHIEVING NET ZERO WASTE & WATER



WASTE

- Construction waste is reduced by reutilizing all excavated mud at site for walling and filling
- Organic and agricultural waste used in bio-gas plants
- Sludge from bio-gas plant to be used as manure for landscaping
- Recyclable and E- waste to be given for recycling plants and recycled materials to be bought back for site use

WATER

- Rainwater capture and harvesting using traditional Ahar- Pyne catchment system, to be reused after appropriate treatment
- Strict monitoring of water use to avoid wastage and assuring reduced demand



Plan showcasing the electric vehicle operated network in the project



LIFESTYLE & INNOVATION



100% Organic waste treated at site with organic waste composter of 700kg/ day capacity



Electric charging facility for 90 cars & 60 bikes has been provided within the campus



Dedicated walking, cycling tracks & bicycle parking provided along all roads



WATER USE OPTIMIZATION



All fixtures throughout campus are low flow fixtures to reduce water demand & usage



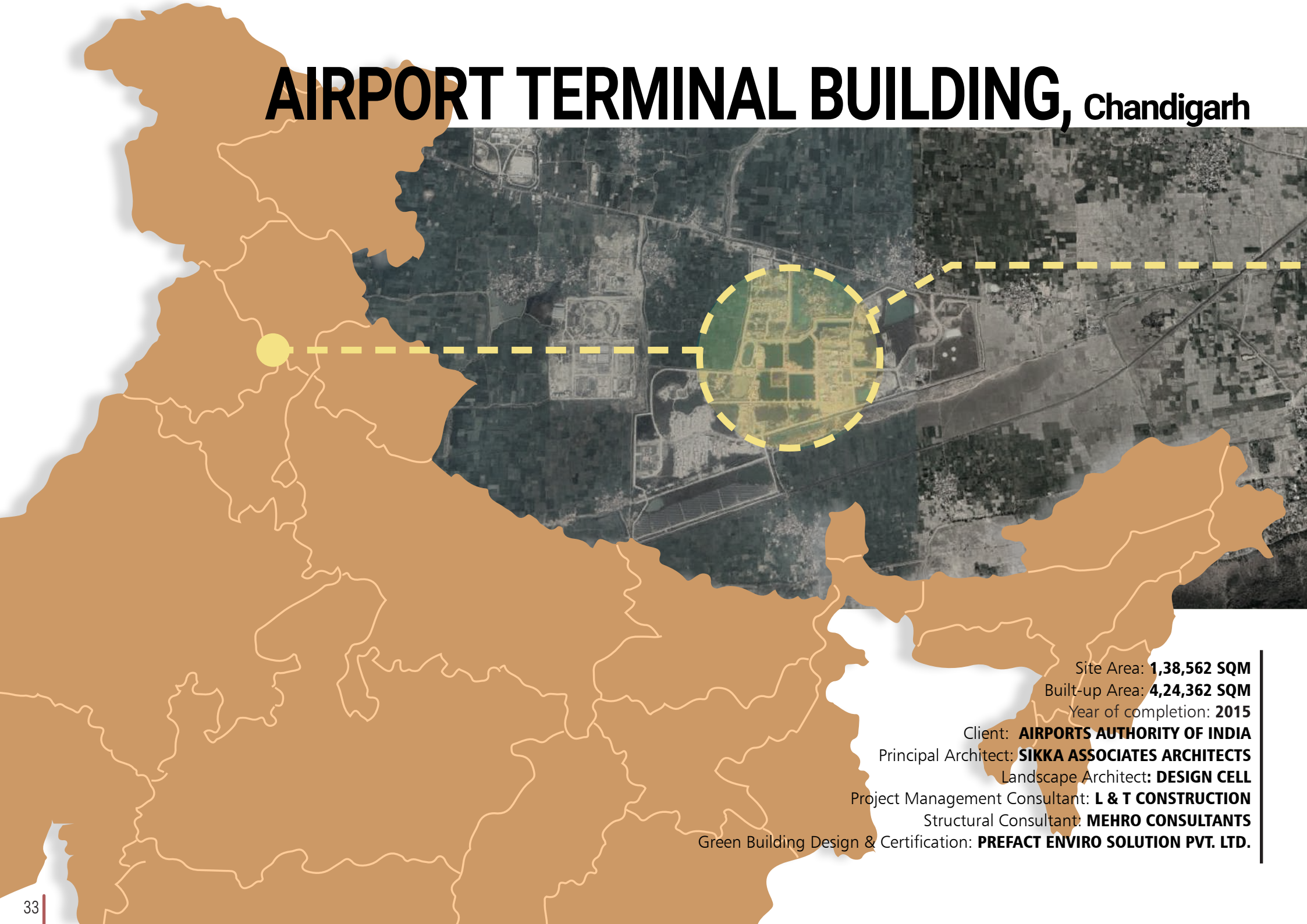
Metering & sub-metering of all water usage considered on BMS for continuous monitoring & auditing



100%

Self sufficient water campus with water harvesting management system & reuse of grey water after treatment by DEWATS of 235kld capacity

AIRPORT TERMINAL BUILDING, Chandigarh



Site Area: **1,38,562 SQM**

Built-up Area: **4,24,362 SQM**

Year of completion: **2015**

Client: **AIRPORTS AUTHORITY OF INDIA**

Principal Architect: **SIKKA ASSOCIATES ARCHITECTS**

Landscape Architect: **DESIGN CELL**

Project Management Consultant: **L & T CONSTRUCTION**

Structural Consultant: **MEHRO CONSULTANTS**

Green Building Design & Certification: **PREFACT ENVIRO SOLUTION PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

58%

TOTAL
WATER DEMAND
REDUCTION

50%

TOTAL
NUMBER
OF TREES

1410

TOTAL
RENEWABLE
ENERGY CAPACITY

5
MW

CARBON OFFSET

3,89,734
TON/ANNUM



STRATEGIC SITE PLANNING

Services have been aggregated & planned along the transport corridor for optimized laying

Automatic timer based lighting controls installed for all outdoor lighting in the project

Number of new native trees planted in all around the site is **1410**

ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **67%**

Fly ash content by weight AAC blocks used in walling to reduce embodied energy

Materials used in the building interiors for internal partitions, false ceiling & built furniture are low environment impact materials



Rendered image of the layout of the master plan of the Chandigarh airport



BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN

58%

WindowWall Ratio(WWR) for all buildings

0.074 Btu/hr/sq.ft. U value

Building envelope double wall with an air gap
A double wall with an air gap

0.2 SHGC

30% VLT

0.32 Btu/hr/sq.ft. U value

DGU unit for glazing in the project, complying to requirements of ECBC 2007

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



ORIENTATION

- The building is oriented in the northeast & southwest direction
- North & south walls have curtain walls which draws natural light deep inside the building reducing dependence on artificial light
- East & west façade have a solid wall to curtail solar heat gain from those directions, therefore reducing cooling load

FENESTRATION DESIGN

- Windows are located along the northeast & southwest façade with adequate provision of shading to prevent heat gain
- Building entrance positioned in a way that users will be sheltered from the direct impacts of local site & climatic conditions of wind & solar radiation

- A large overhang is provided for shading of the windows ensuring lower heat gain from envelope, while permitting daylighting



A close up image of the front facade of building showing the deep overhang in the project shading the façade



LIFESTYLE & INNOVATION



Relative humidity, CO2 & temperature sensors are installed at all AHU levels for monitoring



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Designated segregation areas & multicolour bins provided for waste in project



WATER USE OPTIMIZATION



67% Reduction in water demand using low flow fixtures for kitchens & toilets

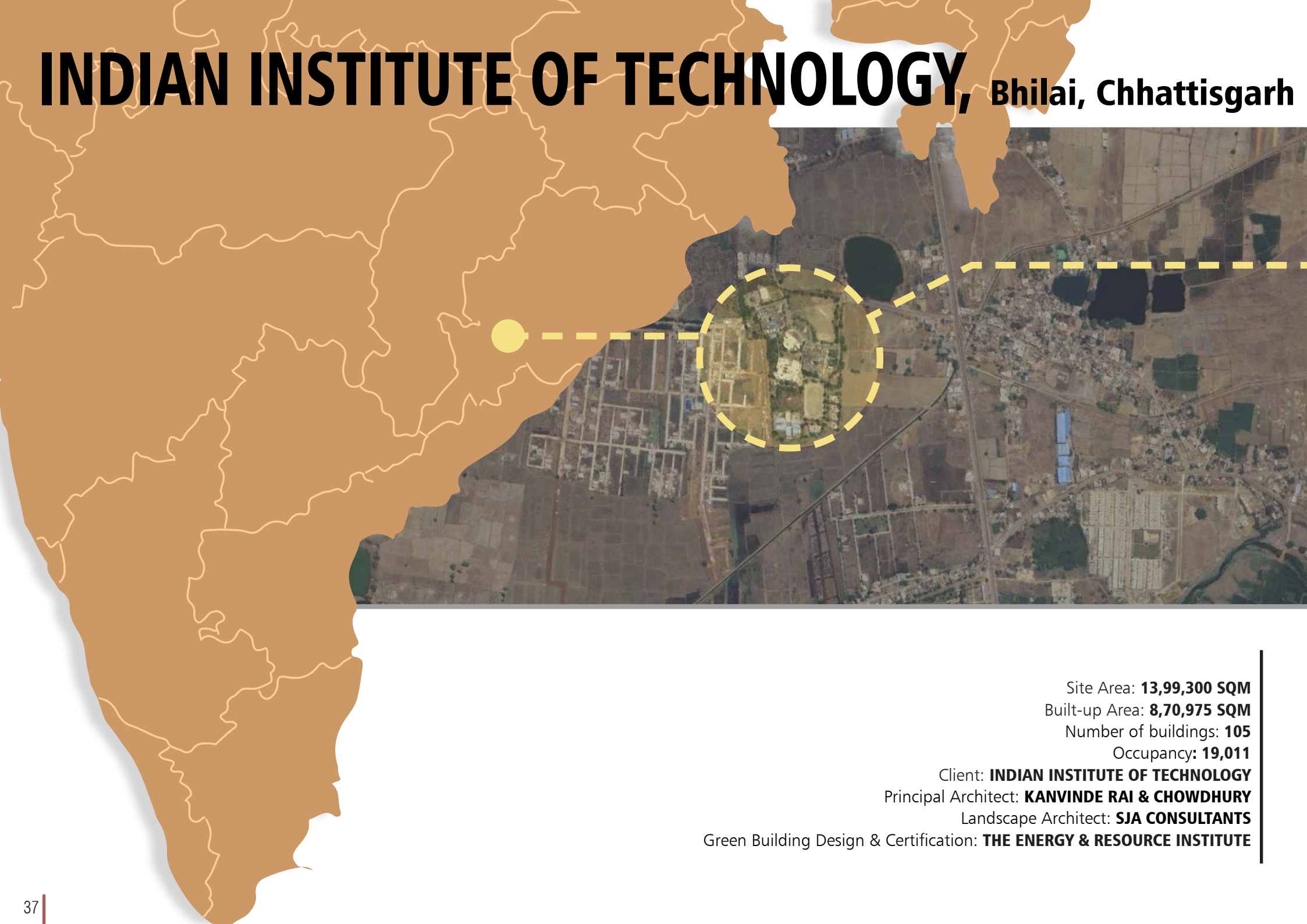


39% Reduction in annual landscape irrigation demand by planting native species plants



50% Annual water reuse on site after treating from extended aeration technology of 930KLD STP for flushing & irrigation

INDIAN INSTITUTE OF TECHNOLOGY, Bhilai, Chhattisgarh



Site Area: **13,99,300 SQM**
Built-up Area: **8,70,975 SQM**
Number of buildings: **105**
Occupancy: **19,011**

Client: **INDIAN INSTITUTE OF TECHNOLOGY**

Principal Architect: **KANVINDE RAI & CHOWDHURY**

Landscape Architect: **SJA CONSULTANTS**

Green Building Design & Certification: **THE ENERGY & RESOURCE INSTITUTE**



CLIMATE
WARM & HUMID



TYPE
INSTITUTIONAL



RATING
GRIHA LD



ENERGY
PERFORMANCE
INDEX REDUCTION

51.8%

TOTAL
WATER DEMAND
REDUCTION

68%

TOTAL
NUMBER
OF TREES

4533

TOTAL
RENEWABLE
ENERGY CAPACITY

2.6
MW

CARBON OFFSET

8,61,71,692



STRATEGIC SITE PLANNING

Reduction in landscape water demand using Microdrip & microspray irrigation is **75.12%**

45% of existing tree cover was retained and number of new trees planted at site is **4533**

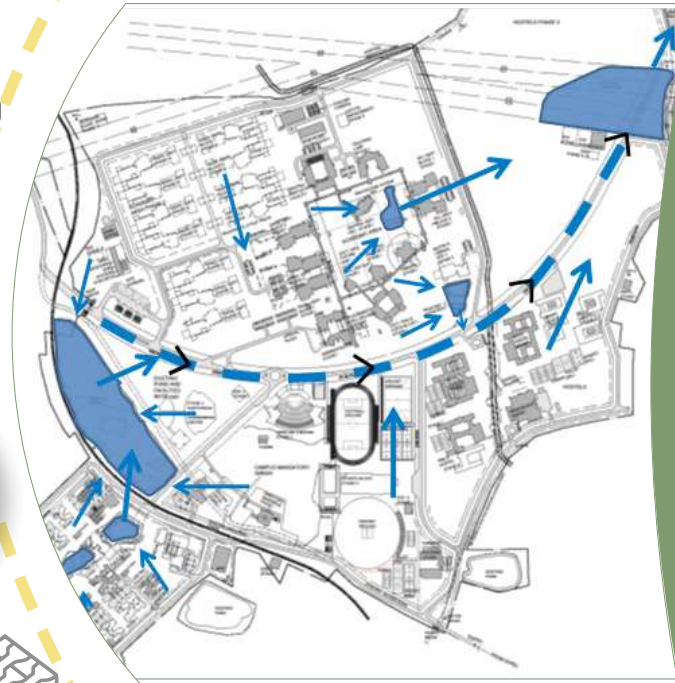
23.80 square meters of green space per capita, enhancing environmental quality

ENERGY-EFFICIENT DESIGN

Reduction in embodied energy of non structural application using flyash bricks is **32%**

Reduction of energy consumption in the project by design optimization is **75.12%**

Reduction in cement usage through the incorporation of fly ash and Ground Granulated Blast Furnace Slag (GGBS) in structural applications is **25%**



Storm runoff management plan with seasonal water bodies at site



BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN

FENESTRATION DESIGN

- Appropriate fenestration on south & east faces to minimize the direct ingress of sunlight
- Vertical fenestration are provided on west faces.
- Light shelves integrated in window design for natural light penetration into the hostel rooms
- Adequate punctures in the façade are provided to permit cross ventilation through courtyards

REDUCING HEAT GAIN

- Insulated roof finished with china mosaic for reflection of 70% incident sunlight
- Optimization of building envelope by using insulated cavity walls, insulated roofs and high performance insulated glass for reduction of heat gain
- Optimization of window wall ratio to balance between daylight and heat gain
- Appropriate external shading devices and large overhangs to reduce radiation and external heat gain

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



ORIENTATION

- Orientation of the building blocks is predominantly North South. Optimal Building orientation with rooms avoided on west side
- The architectural design is optimized as per climate & sun-path analysis
- Width of buildings kept optimal to provide natural light in majority of the work areas & allowing air movement
- Provision of internal courtyards to provide natural lighting to inner core & create shaded spaces for interaction

CIRCULATION & SERVICES

- Covered walkways at two levels linking the various Departments & Lecture Halls/ Library/ around the water body in the Academic Zone are integrated in the design as active movement paths fostering interaction outside of the enclosed spaces
- Services are also laid combined with these walkways to create efficient construction



Sketch showing section through the connecting bridges at site with clubbed services also running along pathways



LIFESTYLE & INNOVATION



10% Landscape area is dedicated for food production for consumption in project



BMS system installed for real time monitoring & demand side management



Dedicated walking, cycling tracks & bicycle parking with benches provided along all roads



WATER USE OPTIMIZATION



59.4% Reduction in water demand using low flow fixtures for kitchen & toilets

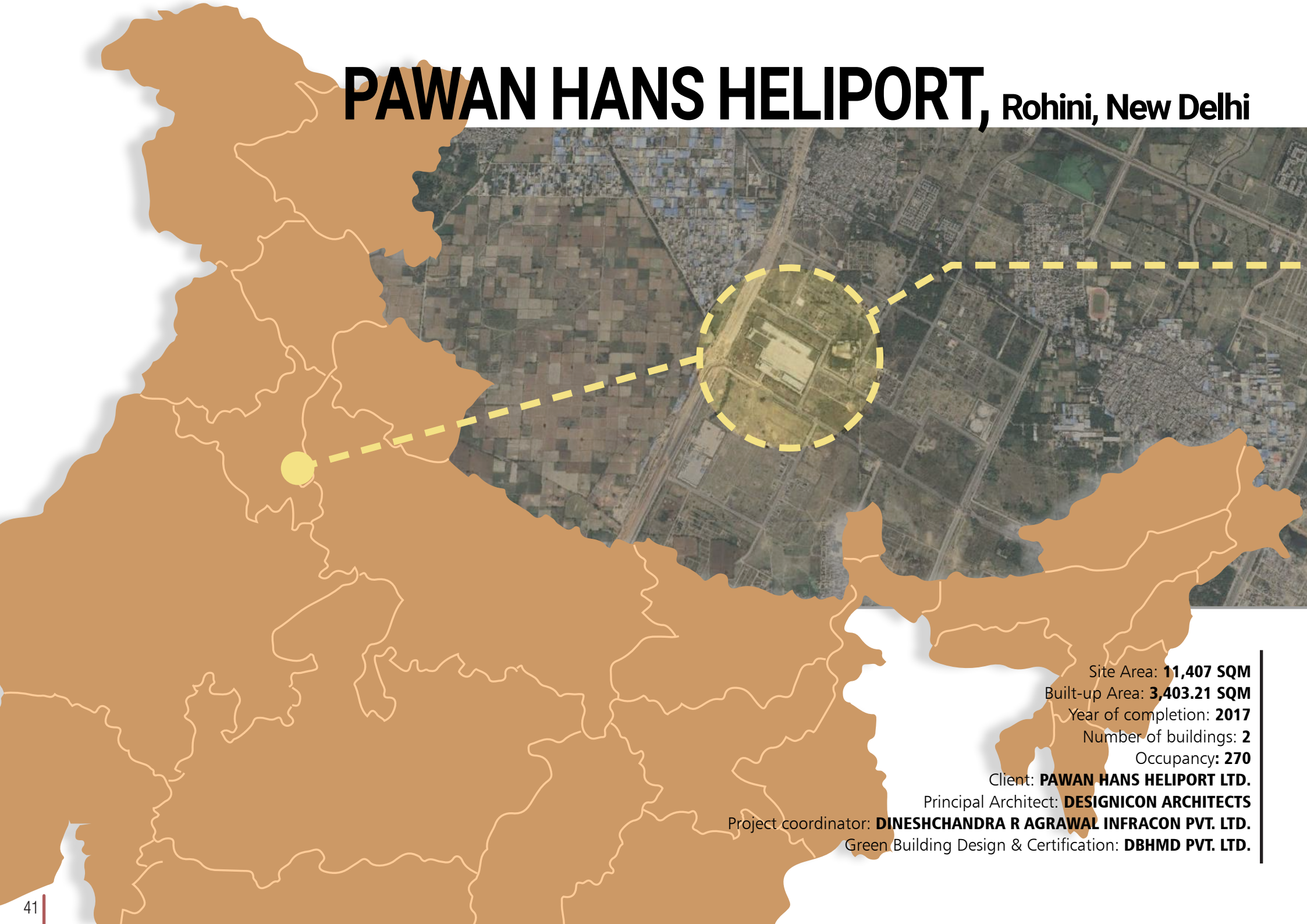


Harvesting of surface rainwater runoff at site to recharge aquifers via seasonal water bodies



84.22% Annual water reuse after treating from MBBR STP for flushing & irrigation on site

PAWAN HANS HELIPORT, Rohini, New Delhi



Site Area: **11,407 SQM**

Built-up Area: **3,403.21 SQM**

Year of completion: **2017**

Number of buildings: **2**

Occupancy: **270**

Client: **PAWAN HANS HELIPORT LTD.**

Principal Architect: **DESIGNICON ARCHITECTS**

Project coordinator: **DINESHCHANDRA R AGRAWAL INFRACON PVT. LTD.**

Green Building Design & Certification: **DBHMD PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

63.2%

TOTAL
WATER DEMAND
REDUCTION

44.3%

TOTAL
NUMBER
OF TREES

657

TOTAL
RENEWABLE
ENERGY CAPACITY

5
kW

CARBON OFFSET

3,92,279.16



STRATEGIC SITE PLANNING

Offset in energy consumption in landscaping lighting using photovoltaics is **11.5%**



Automatic timer based lighting controls installed for all outdoor lighting in the project



Number of new trees planted of native species at site is **657**



ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **77.5%**



Embodied energy reduced by using AAC blocks with fly ash content by weight of **65%**



Materials used in the building interiors are low environment impact materials like flush doors, aluminum window frames & vitrified tiles with recycled content



BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN

34%

Window Wall Ratio(WWR) for all buildings

0.6W/m²K U value

Building envelope using fly ash bricks with Granite & ACP cladding.

0.24 SHGC

47% VLT

1.7W/m²K U value

DGU unit for glazing in the project, complying to requirements of ECBC 2007

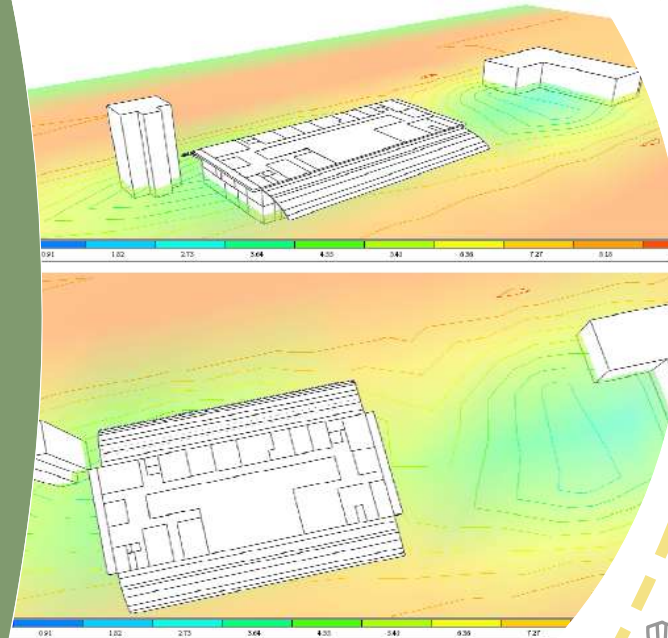


Image showing the large overhangs for shading of building facade & entrance

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



- Air conditioned areas like Clubhouse are north-south elongated to reduce direct heat gain
- High performance glass, insulated roof & bricks for walls in facade to reduce energy load for cooling
- Curated shading devices are provided for habitable & air conditioned spaces to reduce direct heat gain & energy load for cooling
- Day lighting ensured in all habitable areas to reduce demand for artificial lighting
- Building blocks placed at site to reduce wind trap in between blocks and verified using CFD simulation before construction to ensure windflow.



CFD analysis showcasing no wind trap generated between blocks



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Designated segregation areas & multicolour bins provided for waste in project



Dedicated parking provided for electric vehicles



WATER USE OPTIMIZATION



54.8% Reduced water demand by using low flow fixtures for kitchens & toilets



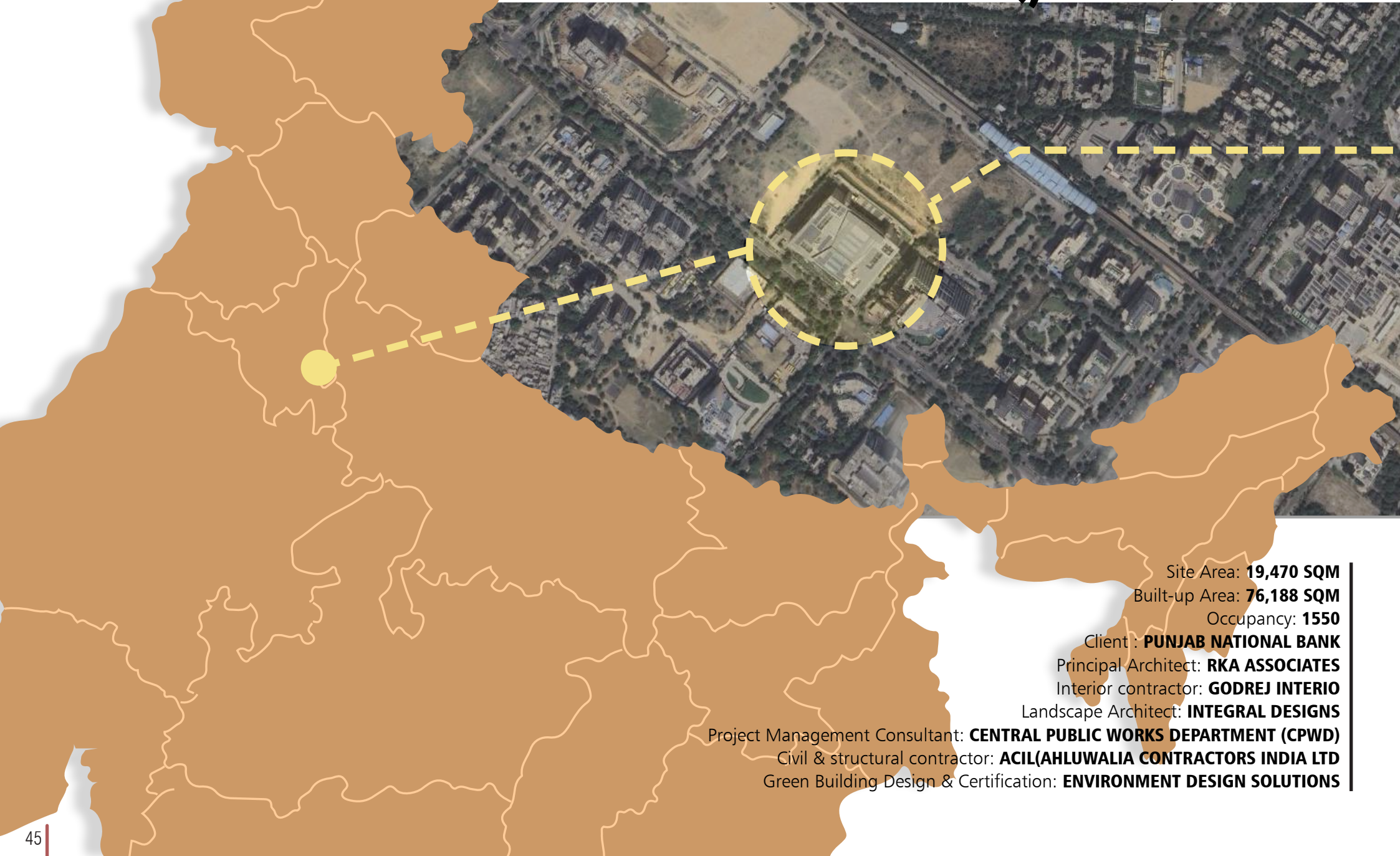
Four rainwater harvesting pits provided along with de-silting chambers in the project



30%

Reduction in annual landscape water demand by providing efficient sprinkler & drip irrigation system

PUNJAB NATIONAL BANK HQ, Dwarka, New Delhi



Site Area: **19,470 SQM**

Built-up Area: **76,188 SQM**

Occupancy: **1550**

Client : **PUNJAB NATIONAL BANK**

Principal Architect: **RKA ASSOCIATES**

Interior contractor: **GODREJ INTERIO**

Landscape Architect: **INTEGRAL DESIGNS**

Project Management Consultant: **CENTRAL PUBLIC WORKS DEPARTMENT (CPWD)**

Civil & structural contractor: **ACIL(AHLUWALIA CONTRACTORS INDIA LTD**

Green Building Design & Certification: **ENVIRONMENT DESIGN SOLUTIONS**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

58.2%

TOTAL
WATER DEMAND
REDUCTION

81%

TOTAL
NUMBER
OF TREES

270

TOTAL
RENEWABLE
ENERGY CAPACITY

202
kW

CARBON OFFSET

18,78,929.1
TON/ANNUM



STRATEGIC SITE PLANNING

1,560 cubic meters of excavated topsoil was preserved during construction and reused for site landscaping



Reduction in landscape water demand using drip irrigation is **79%**



Number of new trees planted of native species at site is **269**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **76%**



Embodied energy reduced by using AAC blocks with fly ash content by weight of **55%**



Materials used in the building interiors are low environment impact materials like compressed wood, veneer wall paneling & gypsym partitions



Image showing the central courtyard in the building with opening & daylight access to ear level



OPTIMIZATION OF BUILDING ENVELOPE PERFORMANCE

FENESTRATION DESIGN

- The windows have been provided on all façade with the vision glazing of 3200 mm
- All the windows in the facades are recessed with overhangs, which make them completely shaded, cutting direct heat gain and glare on the south-west and south-east envelope
- The effective SHGC is 0.25 which will help in reducing the heat gain inside the building

CENTRAL ATRIUM

- The atrium is experienced at different levels with the entrance, corporate floor, upper-level bridges and terraces
- Light is admitted into the atrium from the sides and by some sky lit panels within the metal roof from the top. Metal screen patterns from the roof create a very interesting interplay of light while shading the space from direct heat gain
- The Central atrium is non-airconditioned, thermal comfort is maintained by designing for ventilation & air movement by leveraging venturi effect

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES

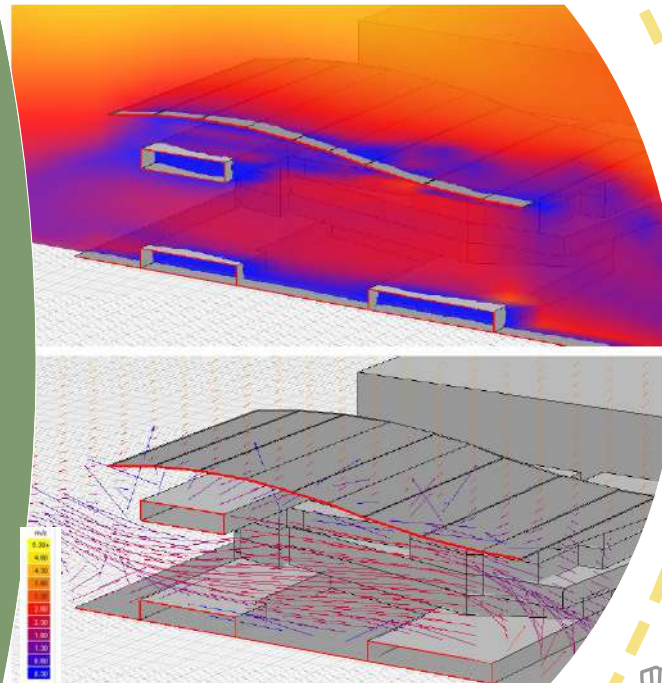


ORIENTATION

- The design has been developed as a compact squarish plan-oriented along north-east & south-west directions
- Planned according to the wind direction. This allows the design of site layout for wind protection & solar access in winter at the same time adequate sun protection & ventilation in summer
- The compact footprint also allows to have more of open green spaces in terms of native vegetation. Within the site constraint strong emphasis has been laid to develop more of open & vegetative spaces either in form of plantation or grass pavers

CIRCULATION & SERVICES

- Entry plaza is located in Southwest & heavily shaded to ensure protection from elements .
- The public plaza in the SW direction with water body & green space helps in cooling the wind entering the building through evaporative cooling



CFD analysis of venturi effect in the courtyard space of the building showcasing the wind movement



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Organic waste treated at site using Automatic composting machine of 125kg/day



32 number of parking dedicated to electric vehicles with charging points



WATER USE OPTIMIZATION



81.1% Reduction in water demand using low flow fixtures for kitchens & toilets.



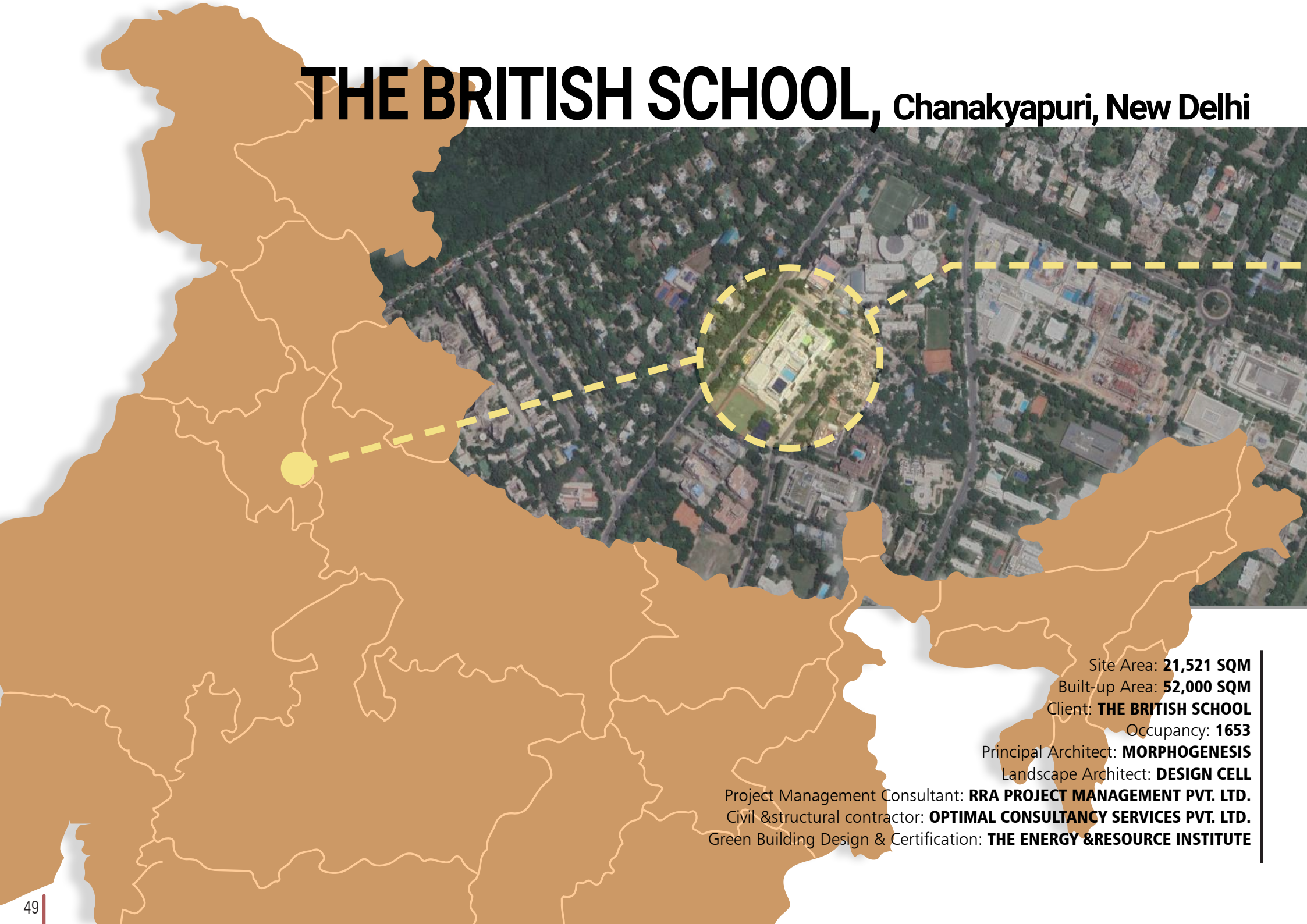
Collection of surface rainwater run-off for recharging water table using rain water harvesting pit at site



93.9%

Annual water resuse after treating from MBBR 25KLD STP for flushing & irrigation on site

THE BRITISH SCHOOL, Chanakyapuri, New Delhi



Site Area: **21,521 SQM**

Built-up Area: **52,000 SQM**

Client: **THE BRITISH SCHOOL**

Occupancy: **1653**

Principal Architect: **MORPHOGENESIS**

Landscape Architect: **DESIGN CELL**

Project Management Consultant: **RRA PROJECT MANAGEMENT PVT. LTD.**

Civil & structural contractor: **OPTIMAL CONSULTANCY SERVICES PVT. LTD.**

Green Building Design & Certification: **THE ENERGY & RESOURCE INSTITUTE**



CLIMATE
COMPOSITE



TYPE
INSTITUTIONAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

73%

TOTAL
WATER DEMAND
REDUCTION

65%

TOTAL
NUMBER
OF TREES

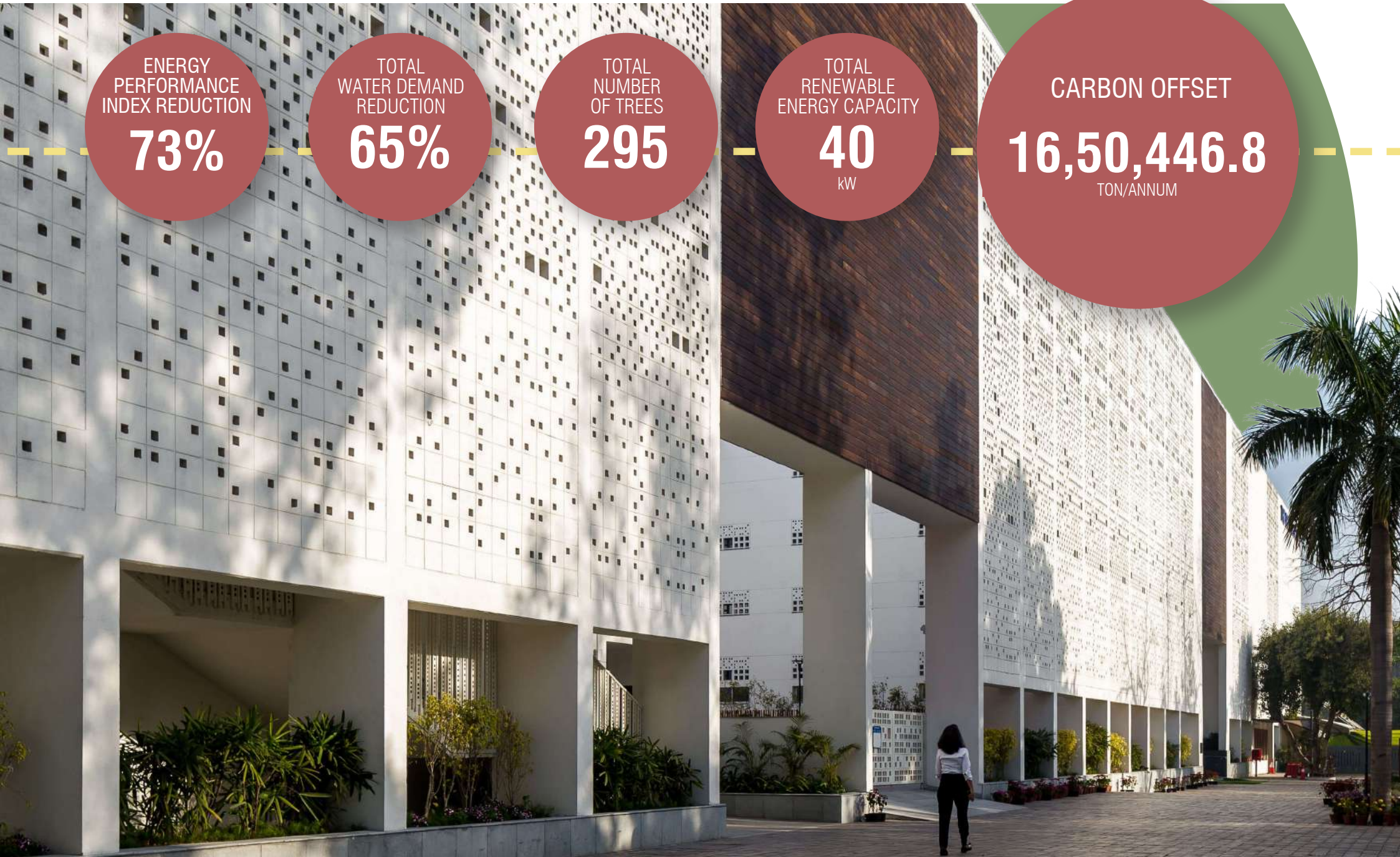
295

TOTAL
RENEWABLE
ENERGY CAPACITY

40
kW

CARBON OFFSET

16,50,446.8
TON/ANNUM



STRATEGIC SITE PLANNING

Services have been aggregated & planned along the transport corridor for optimized laying



Reduction in landscape water demand using drip irrigation is **56%**



Number of new trees planted of native species were planted at site is **292**



ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **62%**



Embodied energy reduced by using AAC blocks with fly ash content by weight of **43%**



Low-energy materials such as flush doors and aluminum frames with recycled content were used in the building interiors, covering **92%**



3D view of the building showing courtyards & use of jaali
Source: Morphogenesis



BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN

12.5%

Window Wall Ratio(WWR) for all buildings

0.3 W/m²K U value

Building external walls provided with cavities as insulation for better thermal performance

0.5 SHGC

75 % VLT

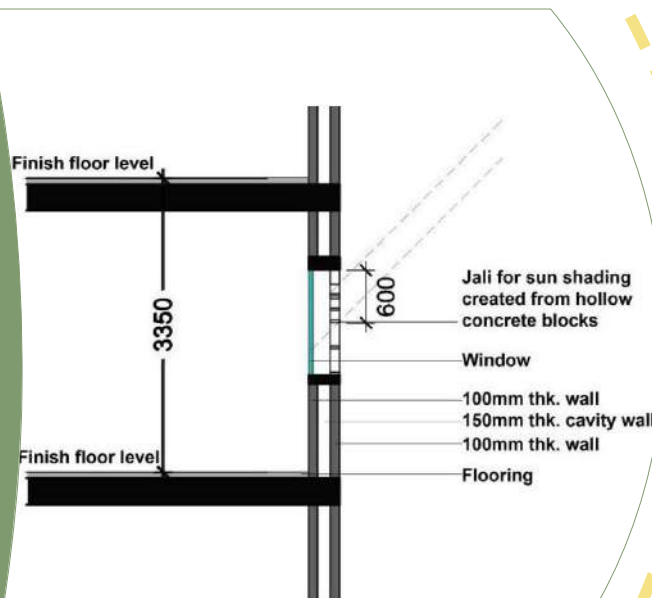
1.95 W/m²K U value

DGU unit for glazing in the project, complying to requirements of ECBC 2007

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



- Courtyards & corridors act buffer spaces to classrooms to reduce heat gain and provide insulation for maintaining indoor comfort
- Spaces not regularly occupied are on top floors of the school which act as thermal buffer to the regularly occupied spaces.
- Hollow concrete block jali provided as shading devices to reduce direct heat gain as well as air circulation
- All exterior walls provided with cavities for providing better insulation for maintaining indoor environmental quality
- Occupancy sensors to control internal lighting have been installed
- 100% Outdoor lighting has automatic timer based control



Part section showing details of jali for sun protection in the facade



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Project workshops organizes environmental awareness involving students & nearby residents



Dedicated parking charging provided for points and electric vehicles



WATER USE OPTIMIZATION



Annual water recharge of 9,235 kL is achieved through five rainwater harvesting pits installed on the site

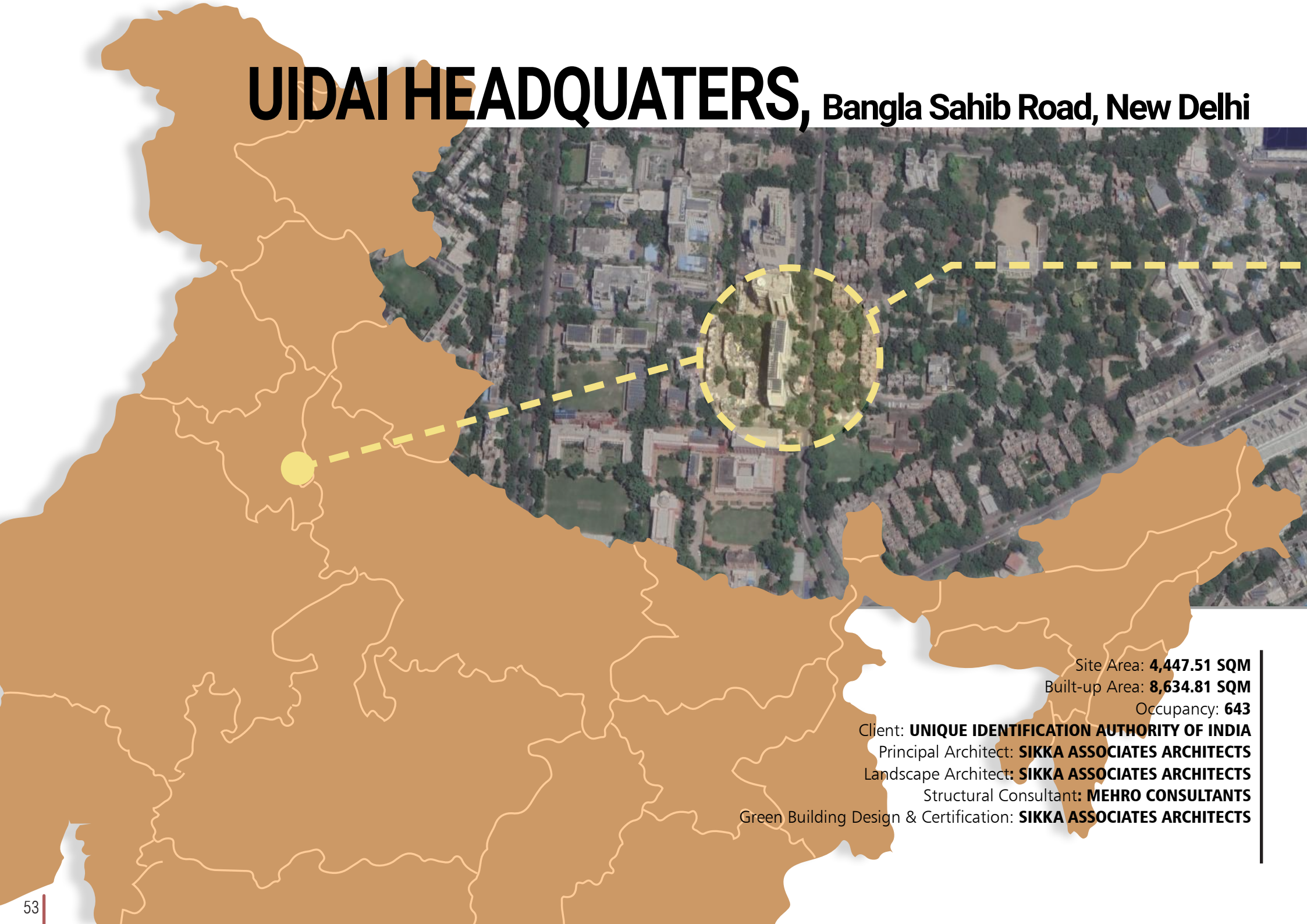


65% Reduction in water demand using low flow fixtures for kitchens & toilets



46% Annual water reuse on site after treating from MBRR 72.9 KLD STP for flushing & irrigation

UIDAI HEADQUARTERS, Bangla Sahib Road, New Delhi



Site Area: **4,447.51 SQM**

Built-up Area: **8,634.81 SQM**

Occupancy: **643**

Client: **UNIQUE IDENTIFICATION AUTHORITY OF INDIA**

Principal Architect: **SIKKA ASSOCIATES ARCHITECTS**

Landscape Architect: **SIKKA ASSOCIATES ARCHITECTS**

Structural Consultant: **MEHRO CONSULTANTS**

Green Building Design & Certification: **SIKKA ASSOCIATES ARCHITECTS**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



(PROVISIONAL)

ENERGY
PERFORMANCE
INDEX REDUCTION

62.2%

TOTAL
WATER DEMAND
REDUCTION

52.3%

TOTAL
NUMBER
OF TREES

638

TOTAL
RENEWABLE
ENERGY CAPACITY

100
kW

CARBON OFFSET

6,19,051.97
TON/ANNUM

STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **51%**



Reduction in annual irrigation demand by using drip irrigation is **40%**



48 existing trees preserved & number of new native species were planted is **590**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **75%**



Materials used in the building interiors are low environment impact materials like flush doors with recycled content, teak windows & vitrified tiles reducing embodied energy



Reduction in embodied energy using non structural application of AAC blocks & flyash concrete is **37.8%**



Image showing the solar panels on roof used to provide shade for service outlets & roof, reducing heat gain

BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN



22.3%
window wall ratio(WWR) for all buildings

0.24 W/m²K U value
Building external walls provided with heat resistant tiles & efficient insulation

0.23 SHGC
40 % VLT

1.36 W/m²K U value
DGU unit for glazing in the project, complying to requirements of ECBC 2007

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



- Building is longitudinally oriented in North-South direction & consumes 35.74% less energy as per results of PRM (Performance Rating Method)
- 73.05% External wall area has service areas & buffer zones to reduce heat gain in habitable areas
- Maximum buffer areas in west façade of the building as west receives the harshest sun
- The heat gain from the building in design case is 29.21 W/m² & in base case 45.45 W/m², indicating the effects of passive design features
- Blinds / curtains are provided to avoid glare in occupied areas in summer months



Image of facade under construction showing the steel framework constructed to reduce RCC structure



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Environmentally friendly cleaning chemical products are being used for housekeeping



Robotic carbon shuttle parking provided to reduce emissions from vehicular movement



WATER USE OPTIMIZATION



54% Reduction in water demand using low flow fixtures for kitchens & toilets

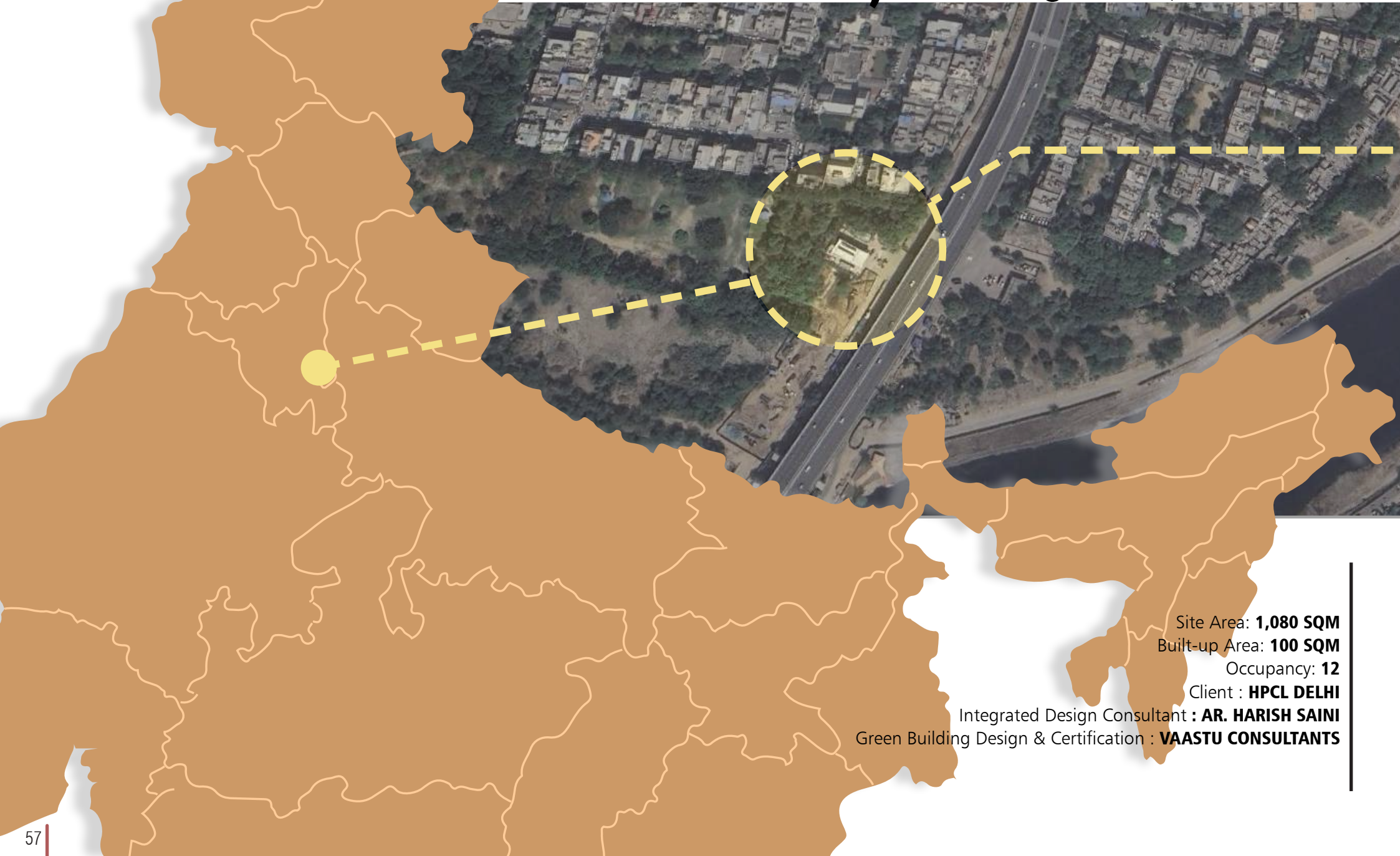


Collection surface rainwater run-off for recharging water table using rain water harvesting pit



100% Annual water reuse on site after treating from MBBR 25KLD STP for flushing & irrigation

PICK N DRIVE PETROL PUMP, Meera Bagh Road, New Delhi



Site Area: **1,080 SQM**
Built-up Area: **100 SQM**
Occupancy: **12**
Client : **HPCL DELHI**

Integrated Design Consultant : **AR. HARISH SAINI**
Green Building Design & Certification : **VAASTU CONSULTANTS**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

53%

TOTAL
WATER DEMAND
REDUCTION

57%

TOTAL
NUMBER
OF TREES

12

TOTAL
RENEWABLE
ENERGY CAPACITY

10
kW

CARBON OFFSET

1454
TON/ANNUM



STRATEGIC SITE PLANNING

More than 50% of the external wall surface area had buffer spaces, such as service areas

Number of new native trees have been planted within site boundary are **12**

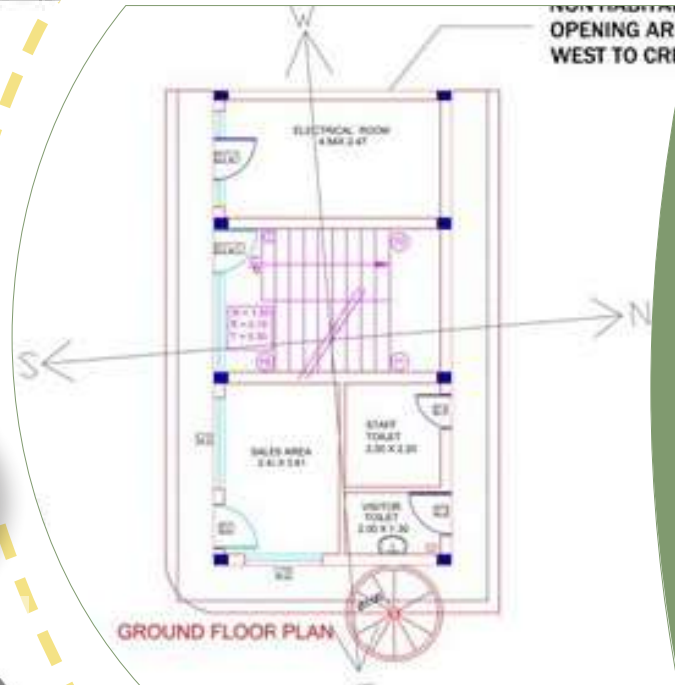
Percentage of total site surface soft paved, shaded by trees is **54%**

ENERGY-EFFICIENT DESIGN

LPD of the project is 4.83 W/m², which is lower than the ECBC specified limit of 10.80 W/m²

Reduction in embodied energy by using PPC for slab and flyash bricks in masonry walls is **55%**

Materials used in the building interiors are low environment impact materials like Granite and polished glazed vitrified tiles for flooring



Plan showing orientation of the east west alignment of the structure



BUILDING ENVELOPE DESIGN TO REDUCE HEAT GAIN

0.29 SHGC
28 % VLT
3.8 W/m²K U value

Glazing utilized in the project with Tinted film coating with following specification

84% glare reduction
99% UV blocked

Envelope performance further improved with following measures

- use of fly ash bricks
- use of thermal insulation board

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



- Building orientation is along east west axis to reduce heat gain in summer and maximise heat gain in winters
- High SRI paint used in exterior surfaces of the project
- Good Fenestration Design for reducing Direct Heat Gain and Glare while maximising Daylight Penetration.
- Non habitable are provided along the west face of the building to act as thermal mass
- All habitable areas are daylit and meet the day lighting factors prescribed by NBC



Close up image of facade of building showcasing use of tinted selective film on glass and shading in glazing



LIFESTYLE & INNOVATION



Essential amenities—including a grocery store, ATM, park, and pharmacy—are located close to the site, reducing dependence on transportation



Dedicated parking provided for electric vehicles



Environmental awareness signage's have been displayed at multiple locations



WATER USE OPTIMIZATION



57% Reduction in water demand using low flow fixtures for kitchens & toilets

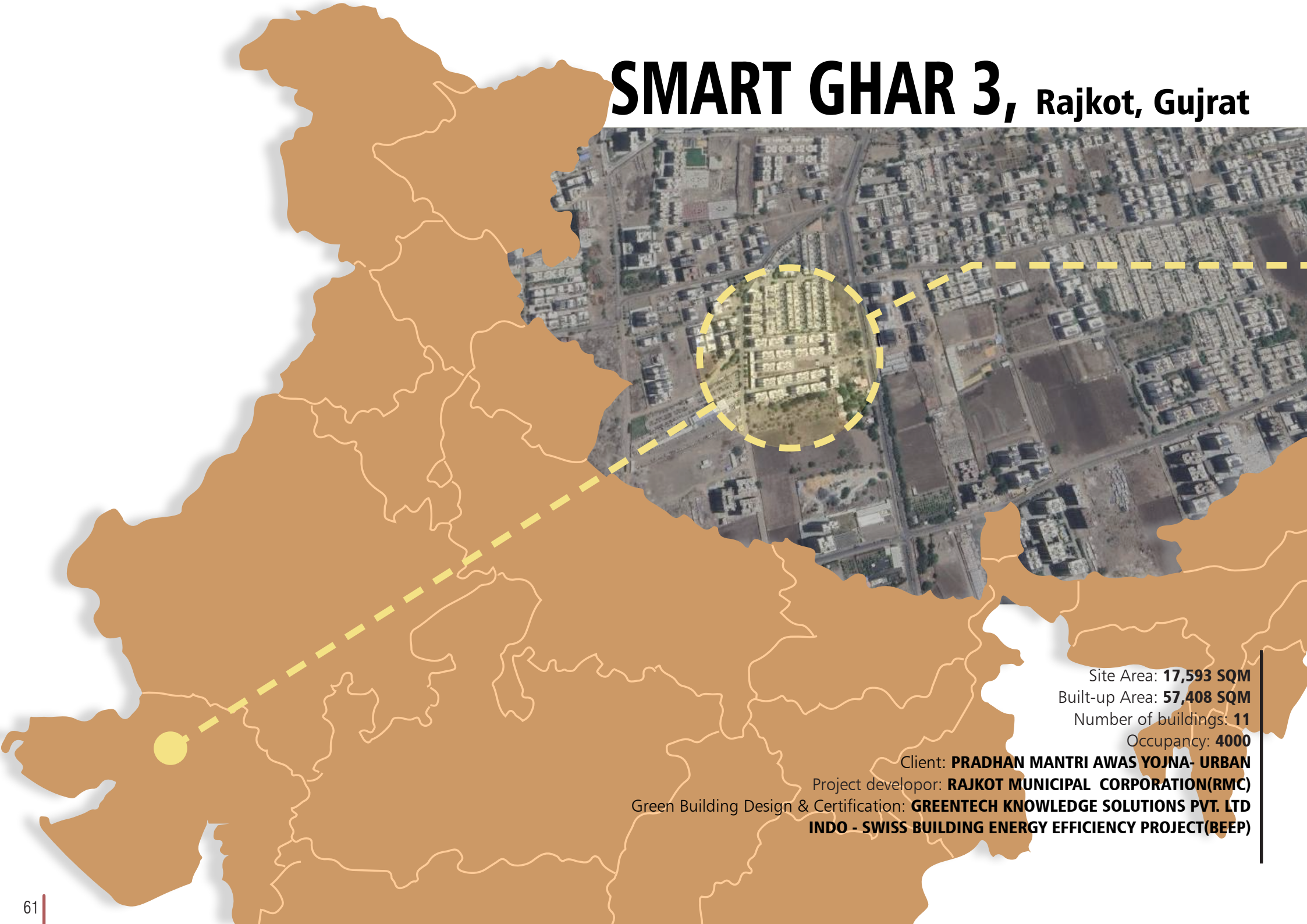


Rainwater storage tank of 1,200 litres capacity has been constructed on site for reuse after treatment



94.5% Reduction landscape water demand has been demonstrated by using native trees

SMART GHAR 3, Rajkot, Gujrat



Site Area: **17,593 SQM**
Built-up Area: **57,408 SQM**
Number of buildings: **11**
Occupancy: **4000**

Client: **PRADHAN MANTRI AWAS YOJNA- URBAN**

Project developer: **RAJKOT MUNICIPAL CORPORATION(RMC)**

Green Building Design & Certification: **GREENTECH KNOWLEDGE SOLUTIONS PVT. LTD**
INDO - SWISS BUILDING ENERGY EFFICIENCY PROJECT(BEEP)



CLIMATE
HOT & DRY



TYPE
RESIDENTIAL



RATING
GRIHA AH



ENERGY
PERFORMANCE
INDEX REDUCTION

34%

TOTAL
WATER DEMAND
REDUCTION

53.2%

TOTAL
NUMBER
OF TREES

764

TOTAL
RENEWABLE
ENERGY CAPACITY

65
kW

CARBON OFFSET

14,71,924
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **50%**



A dedicated space for an informal market is planned within the site boundary to serve residents' needs



Number of new native trees have been planted at site is **764**



ENERGY-EFFICIENT DESIGN



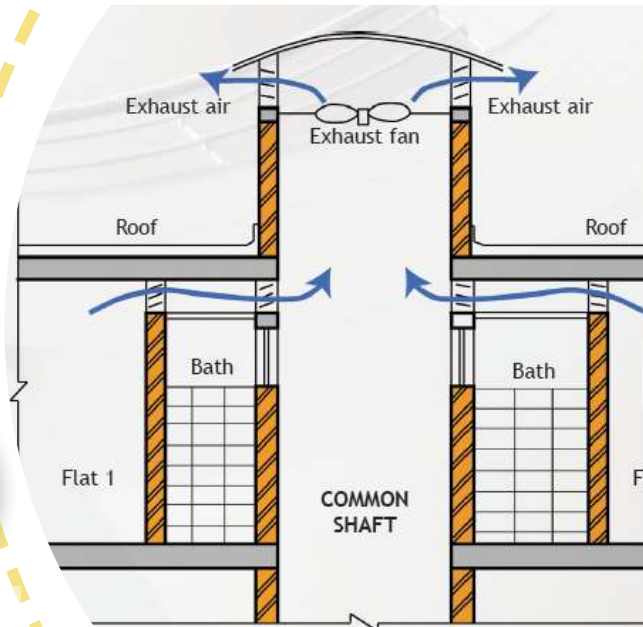
Astronomical timer installed for all outdoor lighting in the project to reduce electric consumption



Light-colored paints were applied to the façade to minimize heat gain through the walls



AAC blocks containing 65% fly ash by volume were used for wall construction reducing embodied energy of project



Conceptual sketch showing assisted ventilation using existing service shaft

OPTIMIZATION OF FENESTRATION DESIGN & VENTILATION



FENESTRATION

- Taller, partially glazed casement windows are used to enhance natural ventilation, offering up to 90% openability. The window shutters are two-thirds opaque to limit heat gain, while the one-third glazing ensures ample daylight

VENTILATION

- Provision has been made to ensure adequate ventilation (air change rate: 10) through all flats, by using the existing service shaft between two flats. This assisted ventilation concept will have a roof feature and a fan on top of the shaft, which will create negative pressure in the shaft (with / without ambient wind) improving air-change through the flats

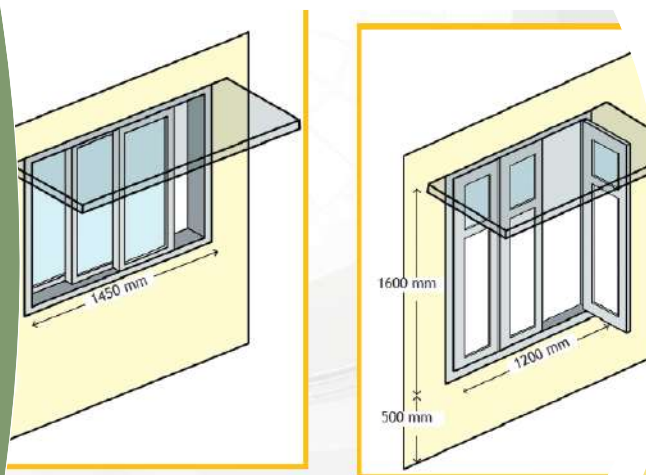
OPTIMIZATION OF BUILDING ENVELOPE PERFORMANCE



- The walls are constructed of 230 mm AAC blocks¹, which has a U-value of 0.8 W/m².K. This is lower than the U-value of 230 mm burnt clay brick wall (U-value 2 W/m².K), thus allowing less conduction heat gains through the wall. Walls on the southern side are cavity walls, constructed of 230 mm AAC blocks on both sides of an air cavity of 50 mm (U-value 0.3 W/m².K).

- The roof will have external insulation (40 mm polyurethane foam) which reduces the U-value of the roof from 2.7 W/m².K to 0.56 W/m².K. The roof will also have high-reflective china mosaic finish.

- By adopting the energy efficiency measures it is estimated to reduce peak summer room temperature by >5°C, as well as increase the number of comfortable hours (those below 30°C) from ~2600 hours to ~6300 hours.



Sketch showing optimum fenestration design utilized in the project



LIFESTYLE & INNOVATION



50.4% Reduction in carbon footprint of building occupants by close proximity of all services



Mural painted depicting around culture of entrance for awareness



Dedicated parking provided for charging points and electric vehicles



WATER USE OPTIMIZATION

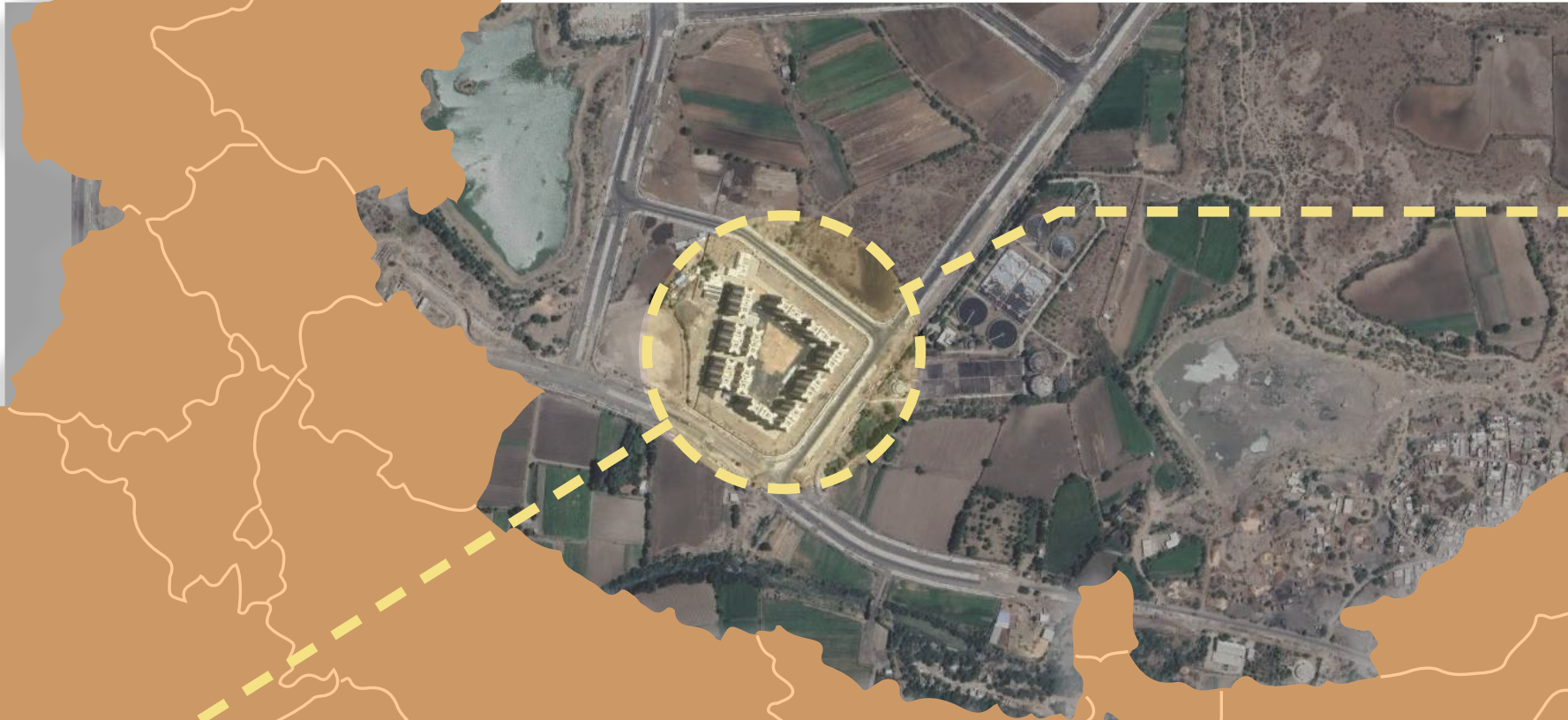


50.9% Reduction in water demand using low flow fixtures for kitchen & toilets



51.7% Reduction in irrigation water requirement using native plant species for landscaping

LIGHTHOUSE PROJECT, Rajkot, Gujrat



Site Area: **29,223.1 SQM**
Built-up Area: **44,492.91 SQM**
Occupancy: **4160**
Number of buildings: **12**
Occupancy: **4160**

Client: **PRADHAN MANTRI AWAS YOJNA- URBAN**

Green Building Design & Certification: **NEEV ENERGY & SUSTAINABLE SOLUTIONS**



CLIMATE
HOT & DRY



TYPE
RESIDENTIAL



RATING
GRIHA AH



ENERGY
PERFORMANCE
INDEX REDUCTION

39%

TOTAL
WATER DEMAND
REDUCTION

38.9%

TOTAL
NUMBER
OF TREES

39

TOTAL
RENEWABLE
ENERGY CAPACITY

40.2
kW

CARBON OFFSET

13,86,983
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **69%**

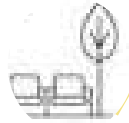
Reduction in annual landscape water demand achieved by using micro sprinkler systems & planting native vegetation

Modular tunnel formwork technology was employed for the structural construction of the project, ensuring efficiency and precision

ENERGY-EFFICIENT DESIGN

Reduction in cement usage through the incorporation of Ground Granulated Blast Furnace Slag (GGBS) in structural applications is **44%**

Materials used in the building interiors are low environment impact materials like pressed WPC for door & windows, stone for flooring & counters



Photograph showing mutual shading amongst the building blocks by offset plan.



ENSURING VISUAL COMFORT FOR OCCUPANTS

76.2%

Total living area meets UDI criteria to ensure visual comfort of occupants using the following measures:

- Single glazed unit of 5mm thickness & VLT of 0.89, SHGC of 0.83 & U-value of 5.90 ensures that maximum daylight enters the space with minimal heat gain.

- Each room has access to an outdoor view & one window. Mutual shading of buildings helps reduce glare within the spaces.

- Local shading in the form of overhangs & vertical fins (through the building shape) ensure UDI levels are maintained in the space.

- All the interior spaces have white walls & ceilings which ensure uniform propagation of daylight in the space.

ACTIVE AND PASSIVE LOW IMPACT DESIGN STRATEGIES



REDUCING HEAT GAIN:

- Light colour scheme used for all external surfaces to reduce heat gain through walls, reducing heat gain from envelope.
- High SRI white china mosaic tiles installed on the rooftop ensuring reduced heat gain from roof.

SHADING:

- Offset create mutual shading among elements in the building to ensure reduce heat gain.
- External windows shaded by overhangs of projection factor(PF) of 0.5 to ensure reduced direct heat gain.

ACTIVE FEATURES:

- BEE 5-star equivalent fans were installed in the project.
- Tenant guidelines issued to state that desert coolers to be installed by occupants.



Photograph showing light coloured exterior with shading used for windows.



LIFESTYLE & INNOVATION



75% Reduction in carbon footprint of building occupants by proximity of all services



Universal accessibility for residents improved with slip resistant surfaces, double grab bars & ramps



Common area walls are painted with environment awareness murals for residents



WATER USE OPTIMIZATION

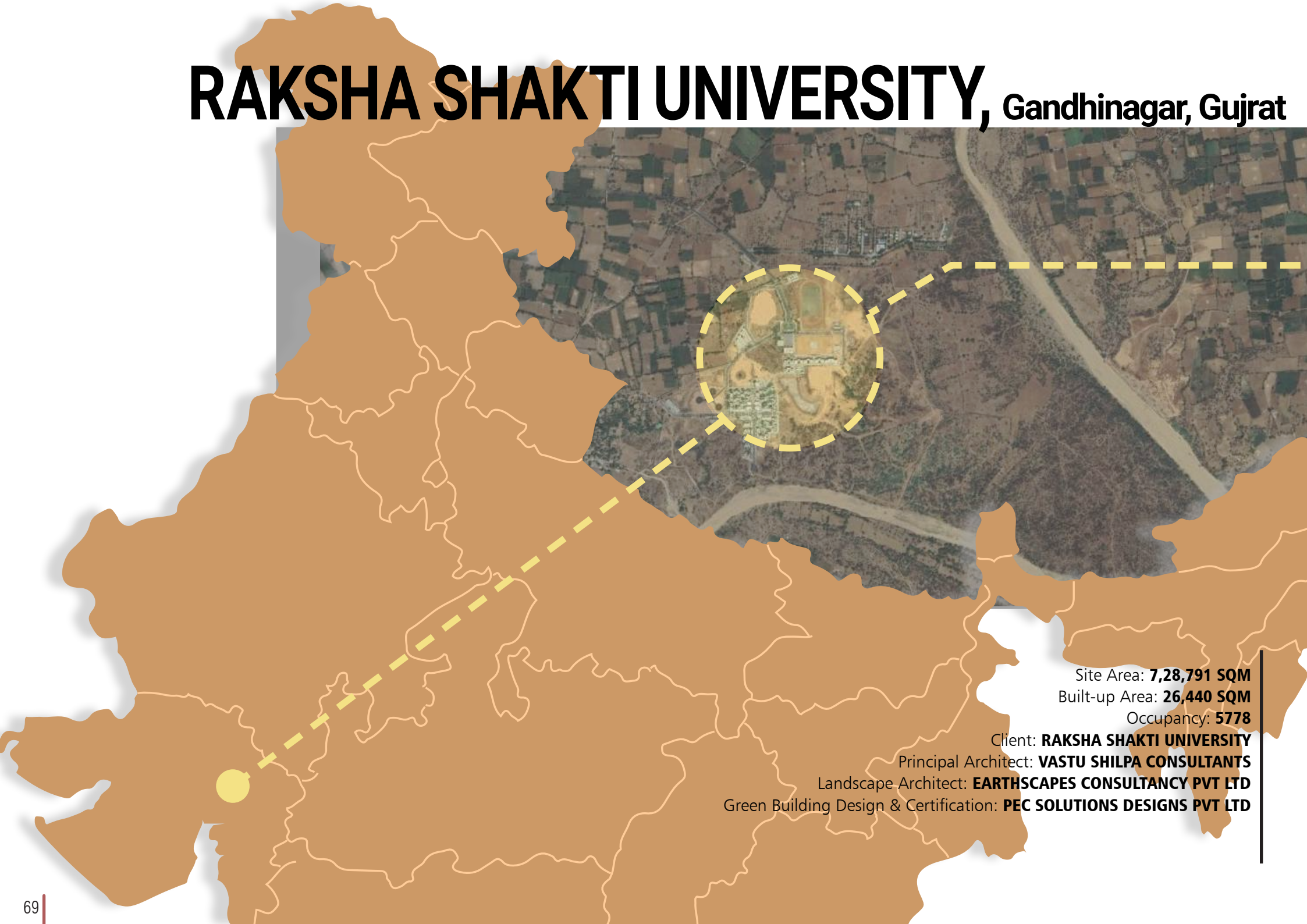


65% Reduced water demand by using low flow fixtures for kitchens & toilets



Annual water reuse on site after treating from prefabricated FRP type underground 235KLD STP for flushing & irrigation

RAKSHA SHAKTI UNIVERSITY, Gandhinagar, Gujrat



Site Area: **7,28,791 SQM**
Built-up Area: **26,440 SQM**
Occupancy: **5778**

Client: **RAKSHA SHAKTI UNIVERSITY**
Principal Architect: **VASTU SHILPA CONSULTANTS**
Landscape Architect: **EARTHSCAPES CONSULTANCY PVT LTD**
Green Building Design & Certification: **PEC SOLUTIONS DESIGNS PVT LTD**



CLIMATE
HOT & DRY



TYPE
INSTITUTIONAL



RATING
GRIHA LD



ENERGY
PERFORMANCE
INDEX REDUCTION

45%

TOTAL
WATER DEMAND
REDUCTION

38%

TOTAL
NUMBER
OF TREES

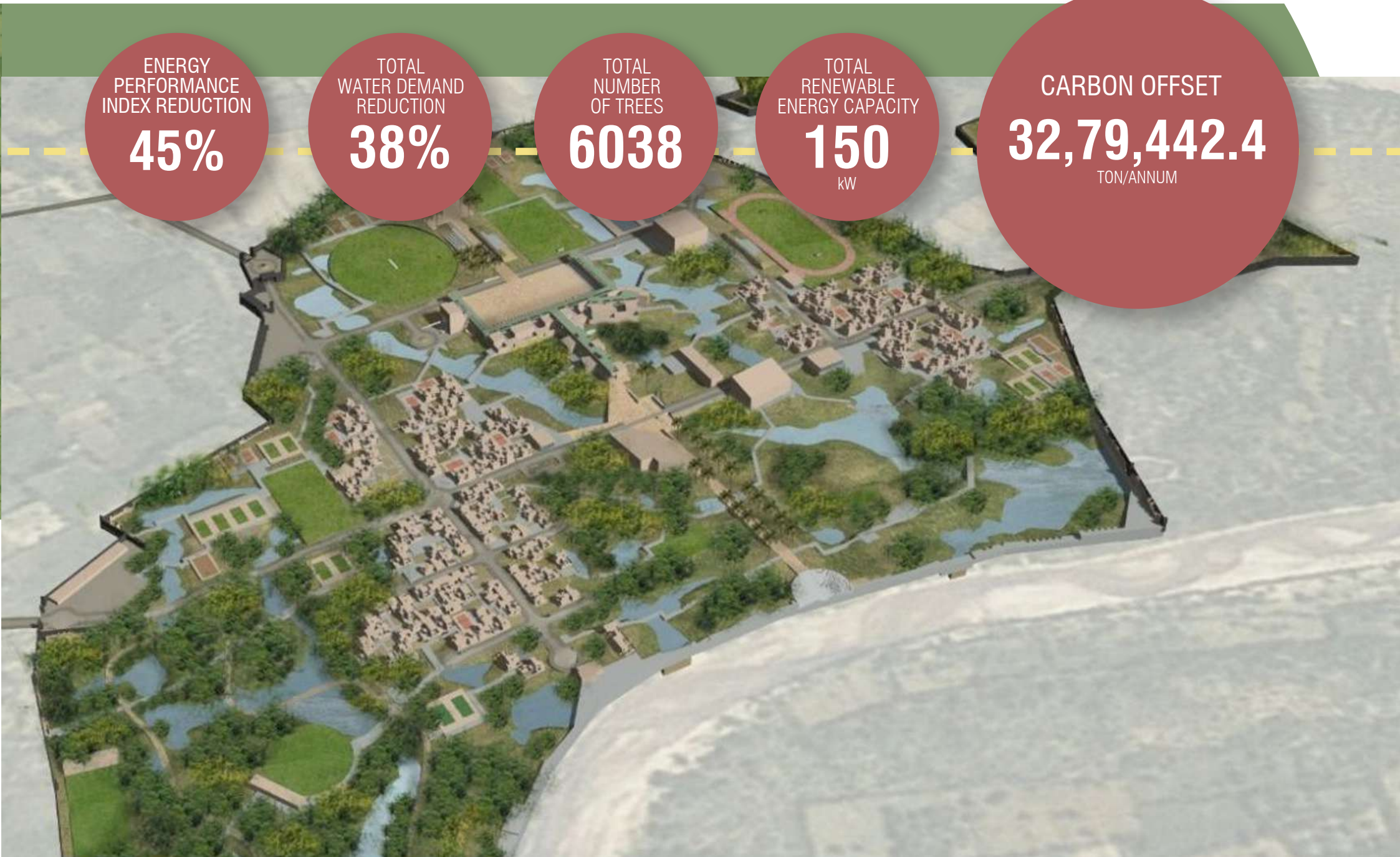
6038

TOTAL
RENEWABLE
ENERGY CAPACITY

150
kW

CARBON OFFSET

32,79,442.4
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **71.2%**



390 existing mature trees preserved and number of new trees planted is **5648**



Hard paving was reduced at site with integrated landscape clusters to reduce UHIE



ENERGY-EFFICIENT DESIGN



Glass Reinforced Concrete panel cladding with air gap from walls to reduce heat gain



Astronomical timer installed for all outdoor lighting in the project to reduce electric consumption



Recycled materials were incorporated into the road construction to significantly reduce embodied energy



Image showing various form of shading devices design used in the building design

OPTIMIZATION OF FENESTRATION DESIGN & VENTILATION



DECREASE EXPOSED SURFACE AREA

The buildings in the project are designed & orientated taking into consideration the solar path & wind direction, such that maximum of the building surfaces face N-S thus decreasing the exposed surface area in E-W direction.

INCREASE THERMAL RESISTANCE & INCREASE THERMAL CAPACITY (TIME LAG)

All the institutional buildings are cladded with Glass Reinforced Concrete (GRC) panels at adequate distance from the building surface forming an air gap i.e. time lag, which act as an excellent thermal insulation

INCREASE SURFACE REFLECTIVITY

High reflective and light coloured tiles has been proposed on the roof areas of all the buildings.

REDUCE SOLAR HEAT GAIN

Minimum fenestration openings are designed in east – west orientation

OPTIMIZATION OF BUILDING ENVELOPE PERFORMANCE



INCREASE BUFFER SPACES

The project design comprises of following features which contribute towards passive designing & helps to increase the buffer spaces:

- Incorporates courtyards to enhance daylight and ventilation, minimizing direct heat gain.
- GRC panel cladding is used on the building envelope, positioned at an adequate distance from the surface.
- Water bodies are strategically placed in wind flow directions to provide passive cooling.

INCREASE SHADING

Following are the shading strategies incorporated in various types of buildings:

- Institutional Building: GRC Panel cladding in the building envelope at an adequate distance from the building surface
- Hostel Building: Self Shaded Concrete Jalis with fixed & openable panels of Shera board & Glass + thick tree plantation surrounding the buildings



Image showing use of courtyards with shading devices and water bodies in building blocks



LIFESTYLE & INNOVATION



66% Organic waste treated at site with organic waste composter of 1000kg/ day capacity.



Footpaths, cycle tracks, parking & benches provided to facilitate pedestrian movement within the site



Motorized transport has been restricted to the residential & service areas only



WATER USE OPTIMIZATION



All fixtures throughout campus are low flow fixtures to reduce water demand and waste

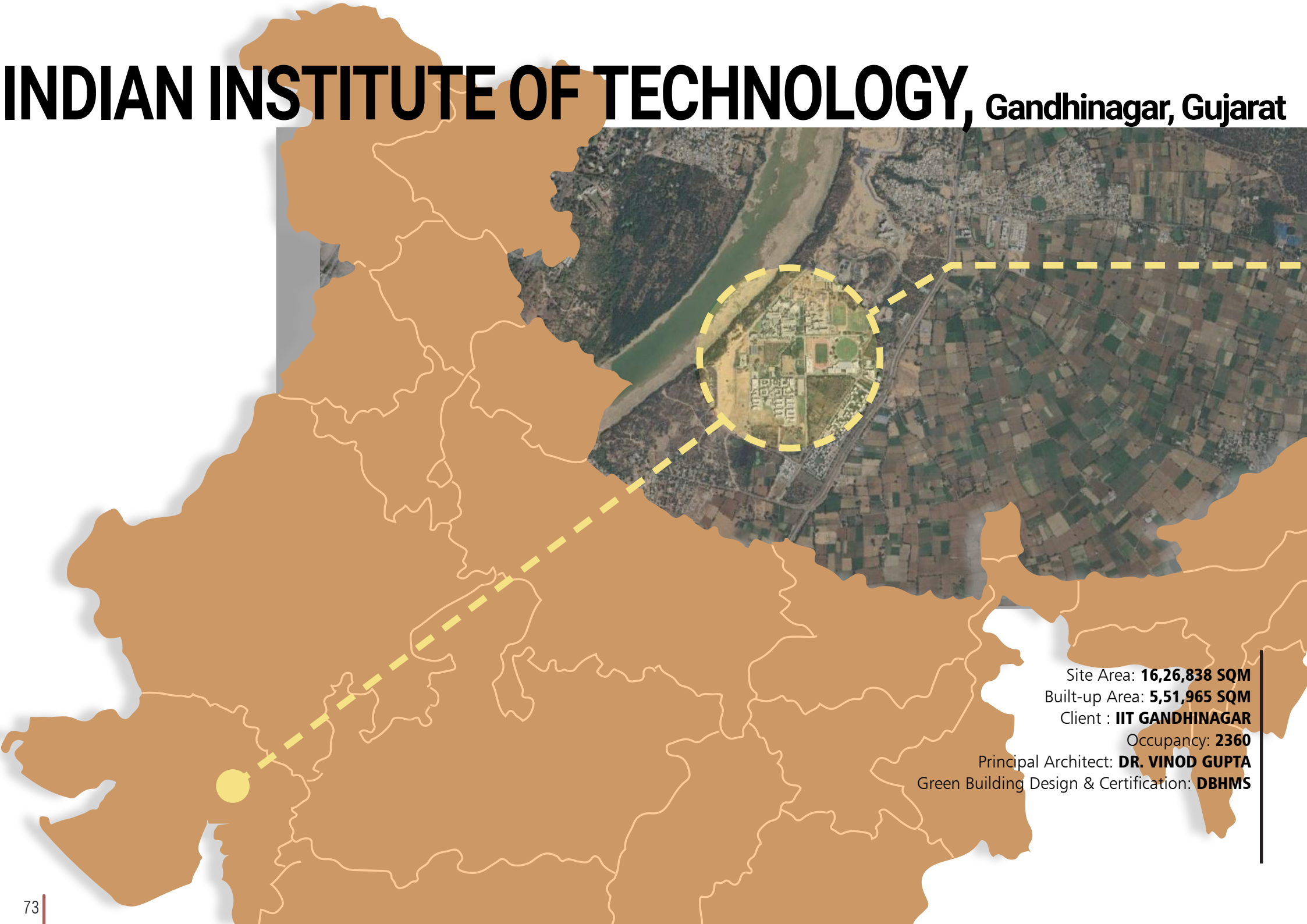


Metering & sub-metering of all water usage considered on BMS for continuous monitoring & auditing



Self sufficient water campus with water harvesting management system & reuse of grey water after treatment by MBBR type of STP

INDIAN INSTITUTE OF TECHNOLOGY, Gandhinagar, Gujarat



Site Area: **16,26,838 SQM**
Built-up Area: **5,51,965 SQM**
Client : **IIT GANDHINAGAR**
Occupancy: **2360**

Principal Architect: **DR. VINOD GUPTA**
Green Building Design & Certification: **DBHMS**



CLIMATE
HOT & DRY



TYPE
INSTITUTIONAL



RATING
GRIHA LD



ENERGY
PERFORMANCE
INDEX REDUCTION

44.8%

TOTAL
WATER DEMAND
REDUCTION

30%

TOTAL
NUMBER
OF TREES

1226

TOTAL
RENEWABLE
ENERGY CAPACITY

500
kW

CARBON OFFSET

52,80,137.16
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of the total site area preserved under existing tree clusters, lakes, and ravines is **79%**



Hard paving reduced & landscape interspersed between the building clusters to reduce UHIE



Sustainable Urban Drainage Systems (SuDS) are implemented through the use of holding ponds to manage stormwater effectively



ENERGY-EFFICIENT DESIGN



Street lights designed to meet minimum lighting requirements & installed with automatic switches



Percentage of energy efficient buildings in project as compared to GRIHA LD base case in the project is **36%**



Percentage of energy efficient lighting as compared to GRIHA LD base case in the project is **48%**



image highlighting open corridors with strategically positioned louvres designed to provide shading and rain protection



SUSTAINABLE SITE PLANING MEASURES

RAVINES AND CONTOURS

- Prior to construction, the site's slopes and contours were analyzed, and areas vulnerable to soil erosion were identified. Based on the ravine depth and slope gradient, check dams were constructed in regions with greater vulnerability

- Contour bunds were installed at smaller contour sections to capture sediment runoff and prevent ravine erosion

EXISTING DRAINAGES ON SITE

- The site's zoning and phasing were designed with consideration for natural drainage patterns. As construction progresses, these natural drainage systems will be gradually integrated into the stormwater network. The site, initially a flat farmland, features gradual slopes leading to two seasonal ponds on the northern side.

RESTORING RAIN WATER HARVESTING



LAKES

- The major ridges and slopes on the relatively flat land were analyzed to determine the division of construction phases
- Natural slopes leading to seasonal lakes were preserved and enhanced to increase rainwater capture
- Rainwater from rooftops is collected and stored for use throughout the year, ensuring a sustainable water supply
- Water from surfaces such as pavements, pathways, and roads is directed into channels that lead to the lakes, following the land's natural slope. The water is filtered before being sent to the lakes, improving water storage capacity



Image showcasing use of light wells in the buildings for daylighting



LIFESTYLE & INNOVATION



100% Organic waste treated at site with organic waste composter of 700kg/ day capacity



Electric charging facility for 90 cars & 60 bikes has been proposed within the campus



Dedicated walking , cycling tracks & bicycle parking provided along all roads



WATER USE OPTIMIZATION



All fixtures throughout campus are low flow fixtures reducing water demand & usage

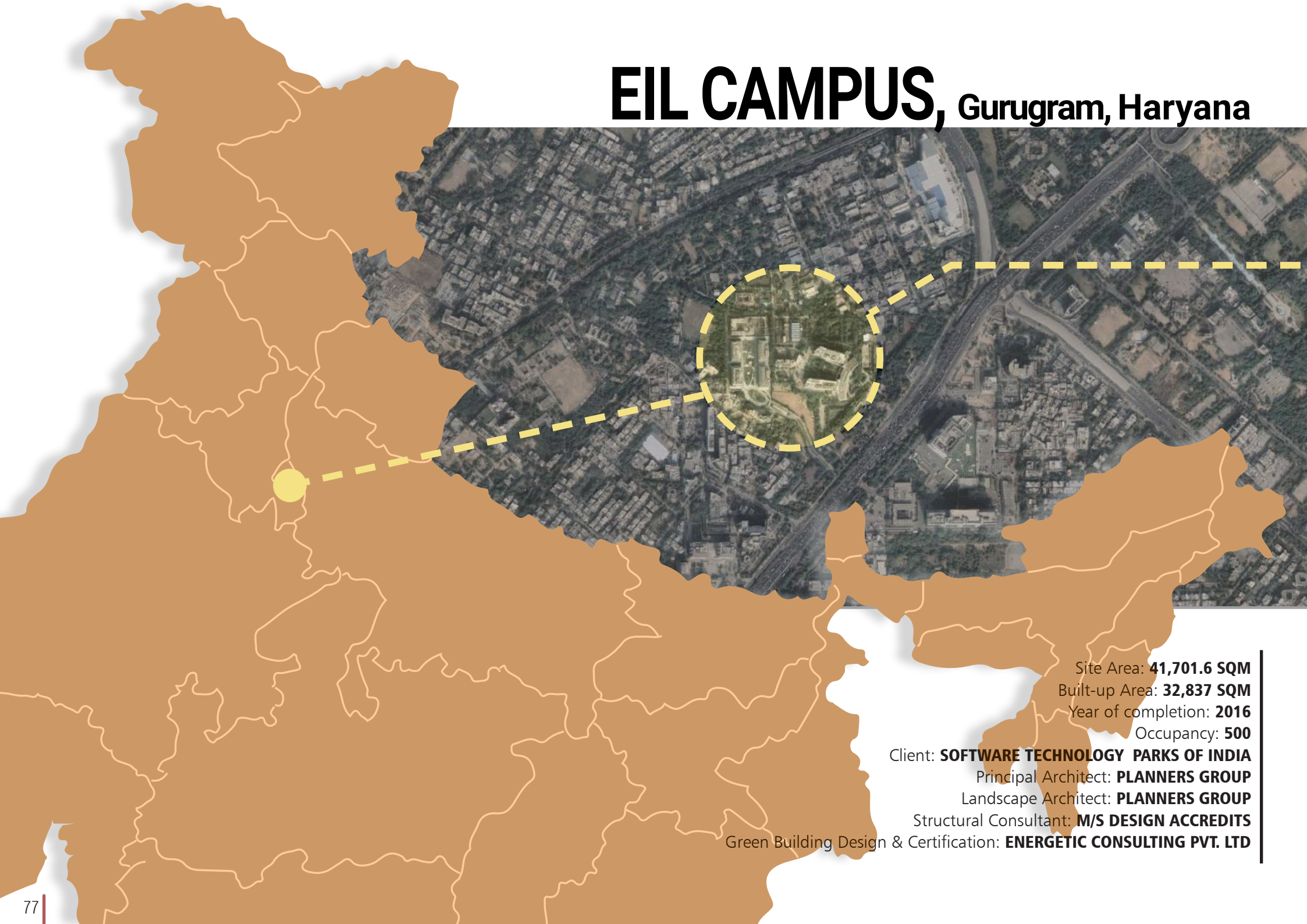


30% Annual water demand is reduced through the reuse of treated wastewater and captured rainwater



DEWATS (Decentralized Wastewater Treatment System) is installed to treat wastewater, enabling its reuse within the campus

EIL CAMPUS, Gurugram, Haryana



Site Area: **41,701.6 SQM**

Built-up Area: **32,837 SQM**

Year of completion: **2016**

Occupancy: **500**

Client: **SOFTWARE TECHNOLOGY PARKS OF INDIA**

Principal Architect: **PLANNERS GROUP**

Landscape Architect: **PLANNERS GROUP**

Structural Consultant: **M/S DESIGN ACCREDIT**

Green Building Design & Certification: **ENERGETIC CONSULTING PVT. LTD**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

56.03%

TOTAL
WATER DEMAND
REDUCTION

67.7%

TOTAL
NUMBER
OF TREES

1205

TOTAL
RENEWABLE
ENERGY CAPACITY

140
kW

CARBON OFFSET

16,78,049.5
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **50.1%**

Courtyard is integrated between blocks to promote natural wind flow and enhance the air tunnel effect for improved ventilation

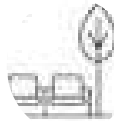
Number of new native trees of planted at site along the periphery is **1205**

ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **60.15%**

Reduction in embodied energy of the building using AAC blocks for walling & fly ash in concrete is **58%**

Percentage use of low environment impact materials like UPVC for door & windows in the building interiors is **90.94%**



Plan showing wind direction & courtyard used to create air tunnel & venturi effect to facilitate air ventilation & movement.



PASSIVE DESIGN STRATEGIES AT SITE

ORIENTATION

- The zoning of the blocks has been placed facing north-south orientation

- Service core areas provided on south face. Further, Screens have been provided on South to block the south sun. Also, cut-outs have been provided for the screens to get natural light and ventilation

- Greenbelt is proposed towards the highway, sensitively landscaped to provide a noise buffer yet give a presence of the campus on the highway

VENTILATION

- Courtyard space has been created between building blocks to facilitate wind flow through the spaces and create venturi effect/air-tunnel effect

- Further, fins and wind scoops are added along the prevailing wind direction to facilitate ventilation in the building and basement

ACTIVE DESIGN STRATEGIES FOR COMFORT

< 40%

window wall ratio(WWR) for all buildings

AUTOMATIC LIGHT SHUTOFF

- Occupancy sensors & daylight sensors have been installed

CONTROL IN DAY LIT AREA

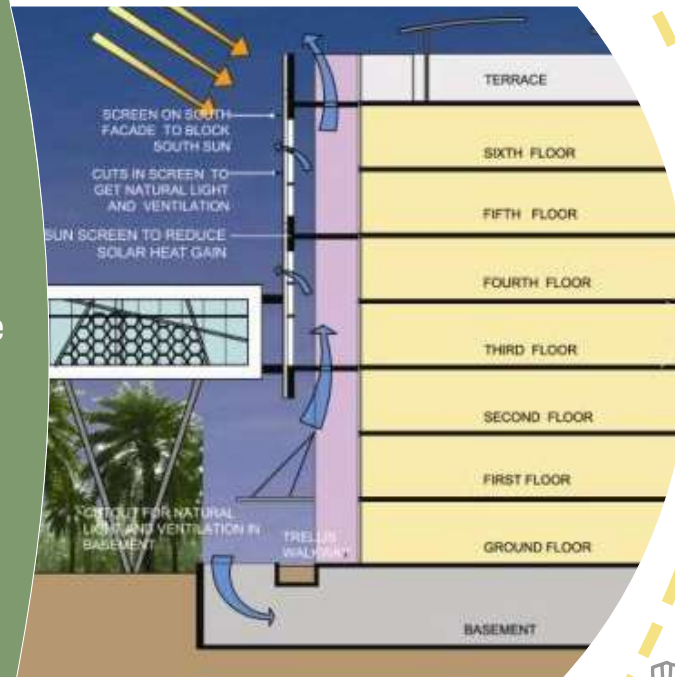
- Manual switches are provided in such areas

TIME CLOCK CONTROL

- Mechanical cooling, schedule fed into BMS system

TEMPERATURE CONTROL

- All cooling systems are temperature controlled through BMS system



Section showing jaalis used to provide shading to windows with air gap to facilitate air ventilation & reduce heat gain

LIFESTYLE & INNOVATION



Smart metering & monitoring installed for energy & water in irrigation, HVAC plant & lighting



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Awareness created among staff & provision for campus visits for awareness generation



WATER USE OPTIMIZATION



67.76% Reduction in water demand using low flow fixtures for kitchen & toilets

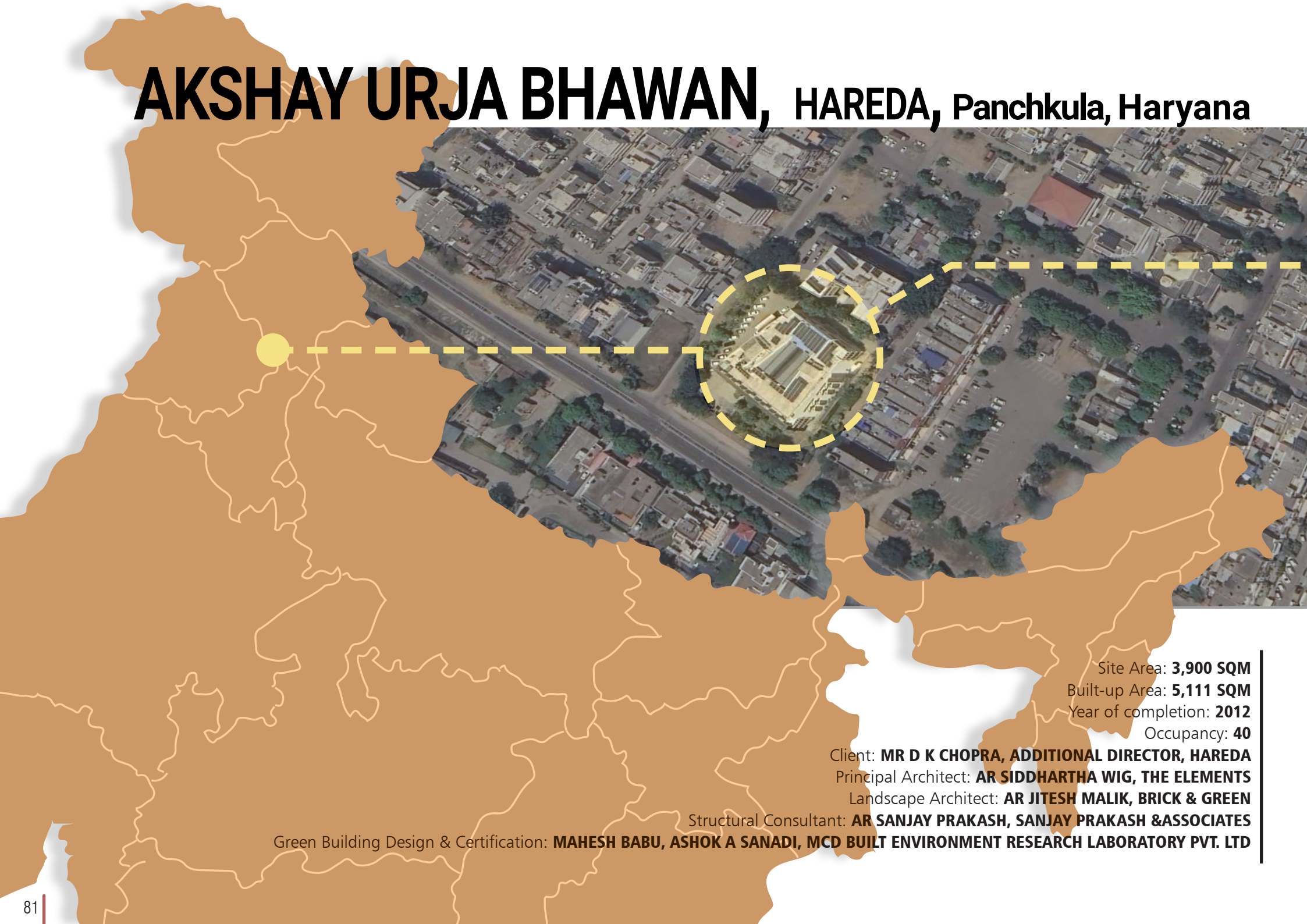


68.11% Reduction in annual landscape water demand using drip irrigation & micro sprinkler systems



41.2% Annual water reuse on site after treating from MBBR 225KLD STP for flushing & irrigation

AKSHAY URJA BHAWAN, HAREDA, Panchkula, Haryana



Site Area: **3,900 SQM**
Built-up Area: **5,111 SQM**
Year of completion: **2012**
Occupancy: **40**

Client: **MR D K CHOPRA, ADDITIONAL DIRECTOR, HAREDA**
Principal Architect: **AR SIDDHARTHA WIG, THE ELEMENTS**
Landscape Architect: **AR JITESH MALIK, BRICK & GREEN**

Structural Consultant: **AR SANJAY PRAKASH, SANJAY PRAKASH & ASSOCIATES**

Green Building Design & Certification: **MAHESH BABU, ASHOK A SANADI, MCD BUILT ENVIRONMENT RESEARCH LABORATORY PVT. LTD**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

61%

TOTAL
WATER DEMAND
REDUCTION

86%

TOTAL
NUMBER
OF TREES

56

TOTAL
RENEWABLE
ENERGY CAPACITY

48
kW

CARBON OFFSET

77,785.2
TON/ANNUM

STRATEGIC SITE PLANNING

Reduction in landscape water demand using drip irrigation & drought tolerant species is **85.9%**

Planting of high-foliage trees along the boundary reducing traffic noise and enhancing acoustic comfort

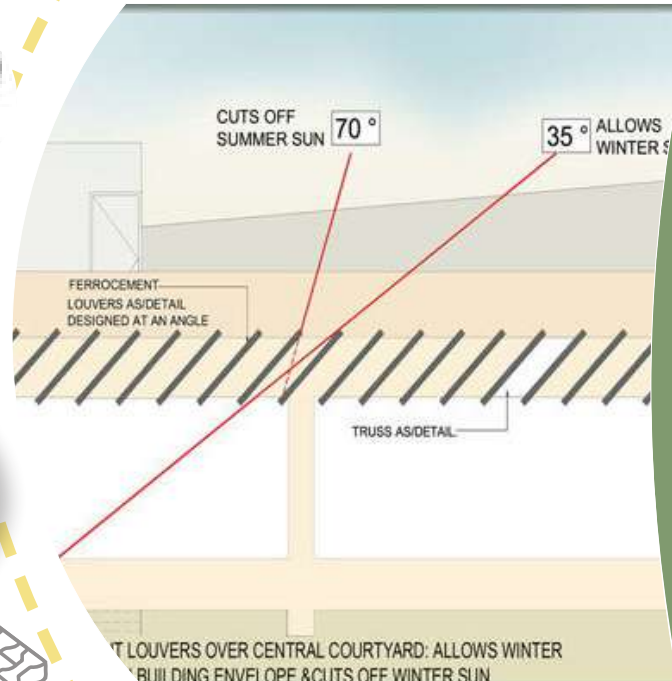
Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **49.6%**

ENERGY-EFFICIENT DESIGN

Reduction in embodied energy by utilization of fly ash in masonry is **40%**

Reduction in energy demand for Internal artificial lighting capacity on site, using renewables, of **32%**

Cement replaced with flyash in reinforced concrete & plaster masonry & AAC blocks with flyash in non structural application by **50%**



Section showing the angle of ferro cement louvers above the central atrium for maintaining shade in summer & sunlight in winter



PASSIVE DESIGN STRATEGIES AT SITE

ORIENTATION

- Well oriented site and building along cardinal directions. Glazing is coordinated to take advantage of building orientation. South glazing is provided with horizontal shades. Almost no east and west openings. Reasonable north glazing with vertical shading

- All workspaces of the building are daylit. Efficient lighting with 25% reduced lighting energy use

REDUCING HEAT GAIN

- The courtyard is covered with angled louvers that maximize winter sun on the south face of the north wing and shade the atrium in the summer while allowing diffused daylight in winter

- Cavity walls with PUF insulation with double glazed windows are provided in the envelope of the building to reduce heat gain

ACTIVE DESIGN STRATEGIES FOR COMFORT



VENTILATION

- The south face has solar chimneys to aid ventilation in some of the non-air-conditioned spaces which are cooled by misting installed in the central atrium

OTHER MEASURES

- Spaces divided into zones as per desired temperature set points. Thermal comfort conditions in apex zones are maintained through mechanical air conditioning. Controlled zones are cooled in summer & chilled in monsoon. Passive zones are cooled in summer & ventilated in monsoon

- SHGC is less than 0.25 (ECBC threshold)
- Automatic controls for HVAC systems & artificial lighting systems

- Solar water heater meets 100% of demand
- Meters & Sub-meters have been installed to monitor energy & water use



Central Atrium with louvers to provide shading & the courtyard above is misted to maintain thermal comfort



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Solar van stationed as an exhibition to create awareness on solar energy utilized at site



Dedicated resting areas and toilets for well being of all service staff



WATER USE OPTIMIZATION



ETP grey plant water installed on site to treat & reused for horticulture



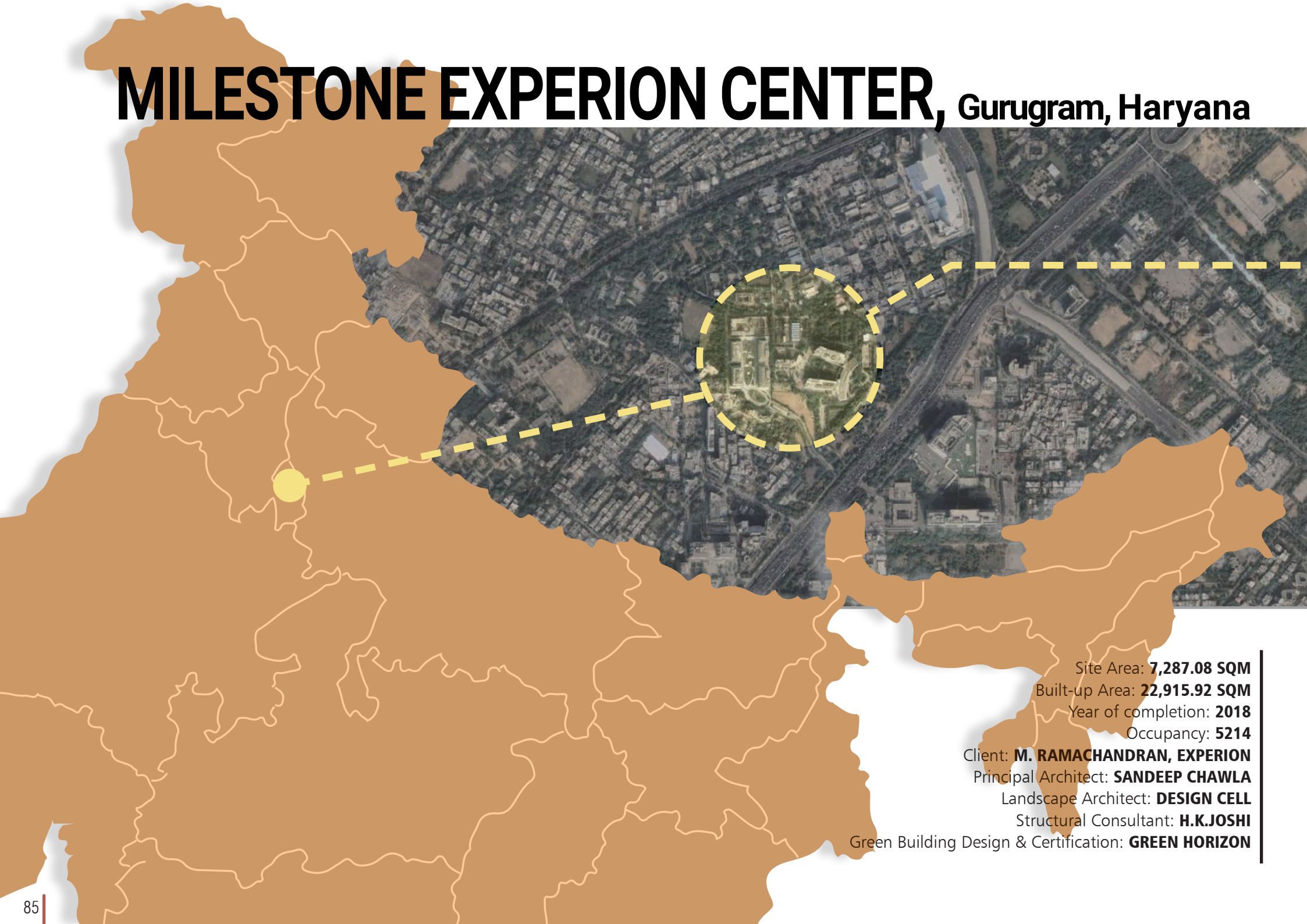
66.25%

Reduction in water demand using low flow fixtures for kitchen & toilets



Surplus rain water from soft paved surfaces is recharged into the aquifer using 22 percolation pits

MILESTONE EXPERION CENTER, Gurugram, Haryana



Site Area: **7,287.08 SQM**
Built-up Area: **22,915.92 SQM**
Year of completion: **2018**
Occupancy: **5214**
Client: **M. RAMACHANDRAN, EXPERION**
Principal Architect: **SANDEEP CHAWLA**
Landscape Architect: **DESIGN CELL**
Structural Consultant: **H.K.JOSHI**
Green Building Design & Certification: **GREEN HORIZON**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

50.3%

TOTAL
WATER DEMAND
REDUCTION

54.4%

TOTAL
NUMBER
OF TREES

1205

TOTAL
RENEWABLE
ENERGY CAPACITY

136
kW

CARBON OFFSET

12,77,040
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **50.1%**



Number of new trees of native species planted at site along the periphery is **1205**



Courtyard is provided between blocks for wind flow & create air tunnel effect for air movement



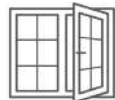
ENERGY-EFFICIENT DESIGN



Project is daylight and meets the daylight factor prescribed by NBC for total area of **34%**



Materials used in the building interiors are low energy materials such as UPVC for door & windows



Reduction in embodied energy of the building using AAC blocks for walling & fly ash in concrete is **73.17%**

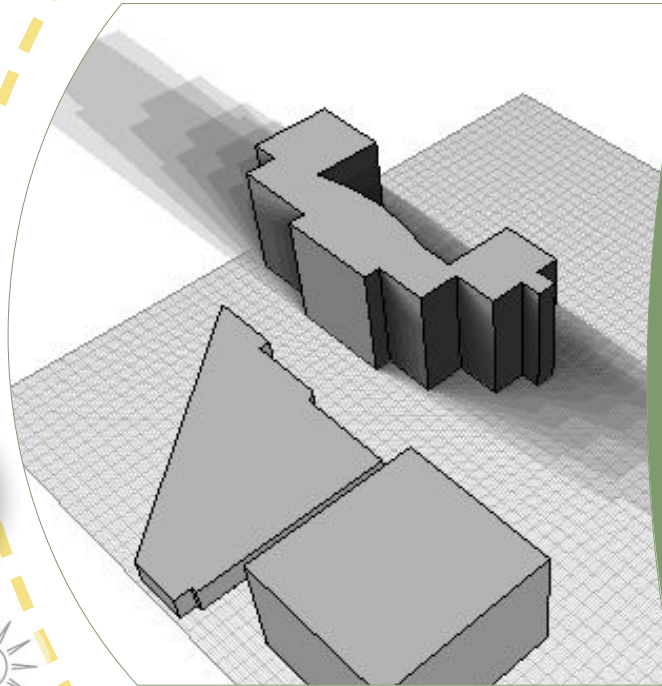


Image showing shadow analysis with central area in constant shade

BUILDING ENVELOPE PERFORMANCE



47%

window wall ratio(WWR) for all buildings

0.24 W/m²K U value

Building external walls provided with heat resistant tiles & efficient insulation

0.23 SHGC

40 % VLT

1.36 W/m²K U value

DGU unit for glazing in the project, complying to requirements of ECBC 2007

GREEN FEATURES OF BUILDING



ENERGY EFFICIENCY

The building is designed to reduce dependence on artificial lighting and cooling, resulting in significant energy savings. Energy-efficient lighting fixtures, along with air conditioners and fans, are installed to further enhance energy conservation. Additionally, solar PV panels are integrated to generate renewable energy, reducing the reliance on grid power.

WASTE MANAGEMENT

Effective waste management strategies are employed to reduce landfill contributions. Waste is segregated on-site and sent for recycling, while e-waste is responsibly handled by certified e-scrap vendors. These measures ensure minimal environmental impact and promote recycling practices.

ENVIRONMENTAL PRESERVATION

Preserving the natural environment is a priority for the project. Most existing trees are retained on-site, maintaining ecological balance and shade. Additionally, the premises are designated as a no-smoking zone, promoting a healthy and pollution-free environment.



Front elevation image of the building with the view of central shaded area



LIFESTYLE & INNOVATION



Smart metering & monitoring is done for energy, water in irrigation, HVAC plant & lighting



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Awareness created among staff & provision for campus visits for awareness generation



WATER USE OPTIMIZATION



66.31% Reduction in water demand using low flow fixtures for kitchen & toilets



41.2% Annual water reuse after treatment from MBBR system of 106KLD STP at site for irrigation & flushing



68.11% Reduction in annual landscape water demand using drip irrigation & micro sprinkler systems

KUTHAR TREASURY BUILDING, Solan, Himachal Pradesh



Site Area: **125.9 SQM**

Built-up Area: **276.95 SQM**

Year of Award: **2023**

Occupancy: **21**

Client: **TTREASURIES, ACCOUNTS & LOTTERIES, HIMACHAL PRADESH**

Principal Architect: **CHIEF ARCHITECT, PWD, HIMACHAL PRADESH**

Green Building Design & Certification: **DESIGN2OCCUPANCY SERVICES LLP**



CLIMATE
COLD



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

25%

TOTAL
WATER DEMAND
REDUCTION

37%

TOTAL
NUMBER
OF TREES

4

TOTAL
RENEWABLE
ENERGY CAPACITY

5
kW

CARBON OFFSET

2,699
TON/ANNUM



STRATEGIC SITE PLANNING



The building is designed to preserve natural contours, ensuring minimal disruption to the site's topography



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **50%**



Reduction in landscape water demand by planting native species is **79%**



ENERGY-EFFICIENT DESIGN



Percentage of Total living area is day lit & meets daylight factor prescribed by NBC is **85.6%**



LPD of the project is 2.56 which is lower than the ECBC specified LPD limit of 10.80 (W sq.m)



Reduction in embodied energy of the building using autoclaved AAC blocks & PPC for walling application is **40.06%**



Image showcasing horizontal shading of windows on facade

PASSIVE & ACTIVE DESIGN STRATEGIES AT SITE



PASSIVE ARCHITECTURAL DESIGN

- Horizontal shading devices are installed on windows to minimize heat gain during summers
- Multiple operable windows are strategically oriented to facilitate effective cross-ventilation throughout the building.

ACTIVE LOW-ENERGY COOLING AND HEATING SYSTEMS

- Energy-efficient fans are installed in office spaces to enhance air circulation and provide cooling during summers
- All appliances used in the building are BEE 5-star rated to ensure minimal energy consumption

REDUCING CARBON FOOTPRINT OF BUILDING



- Portland Pozzolana Cement with fly ash content was used in construction of the project
- Low energy flooring materials like Kota stone & vitrified tiles are used in the building
- All chairs & workstations procured for the project contain recycled content reducing environmental impact
- Adequate daylight in all areas, saving on energy load by reducing need for artificial lighting
- Solar PV panels are utilized to generate energy thus reducing energy demand of the project
- All organic waste is treated on site using an organic waste converter
- BEE 5- star rated appliance used in the project



External device for mechanical rain water filtration



LIFESTYLE & INNOVATION



All amenities are available nearby including bus stop, bank & post office reduction in travel



Dedicated charging points and parking are provided for electric vehicles



Environmental awareness signage is prominently displayed throughout the project site



WATER USE OPTIMIZATION



6KL rainwater recharge pit provided on site, along with filtration system, to recharge the ground water



27.14%

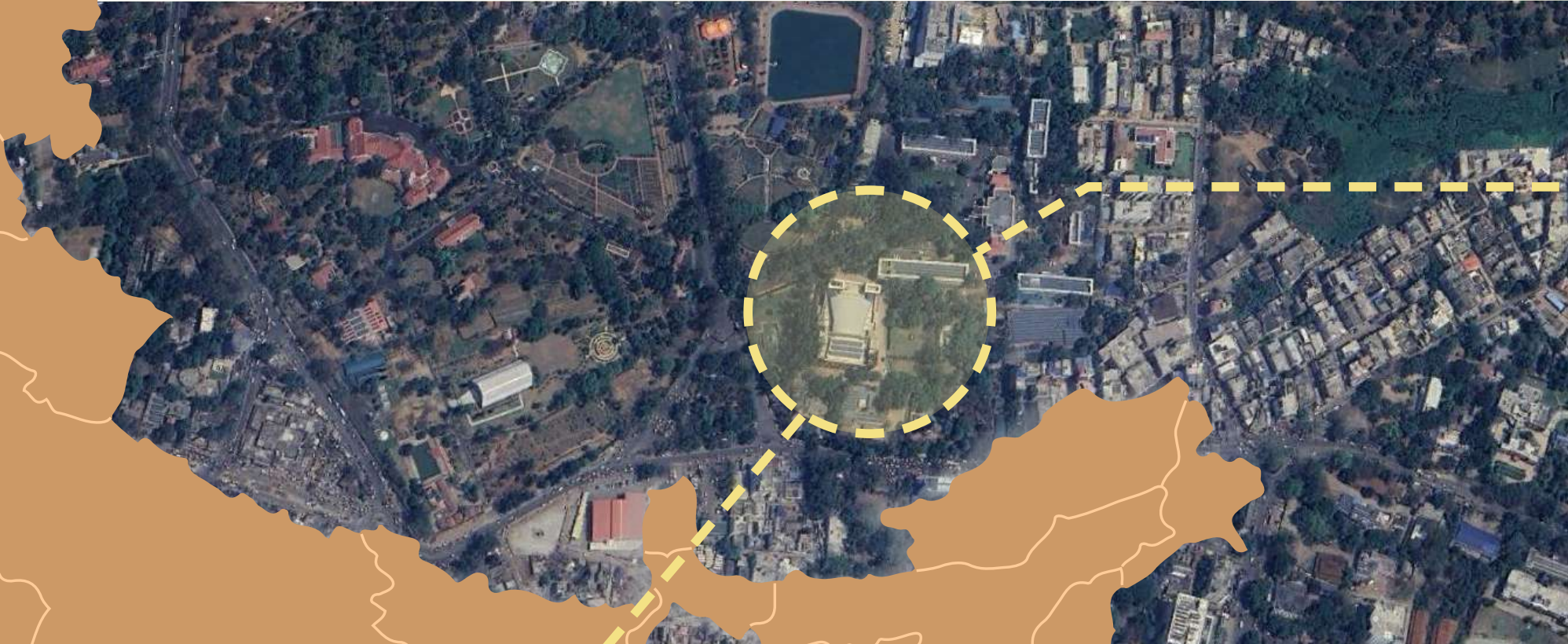
Reduction in water demand using low flow fixtures for kitchen & toilets



75%

of two day water demand can be met through 6000 litres of rainwater storage tank provided at site

CONVENTION CENTER COMPLEX, Ranchi, Jharkhand



Site Area: **14,100 SQM**

Built-up Area: **11,468.71 SQM**

Occupancy: **539**

Client: **INDIAN INSTITUTE OF TECHNOLOGY**

Electrical Consultant: **DESIGN CENTRE PCCEPL**

Green Building Design & Certification: **SCUBE SOLUTION**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

42%

TOTAL
WATER DEMAND
REDUCTION

98%

TOTAL
NUMBER
OF TREES

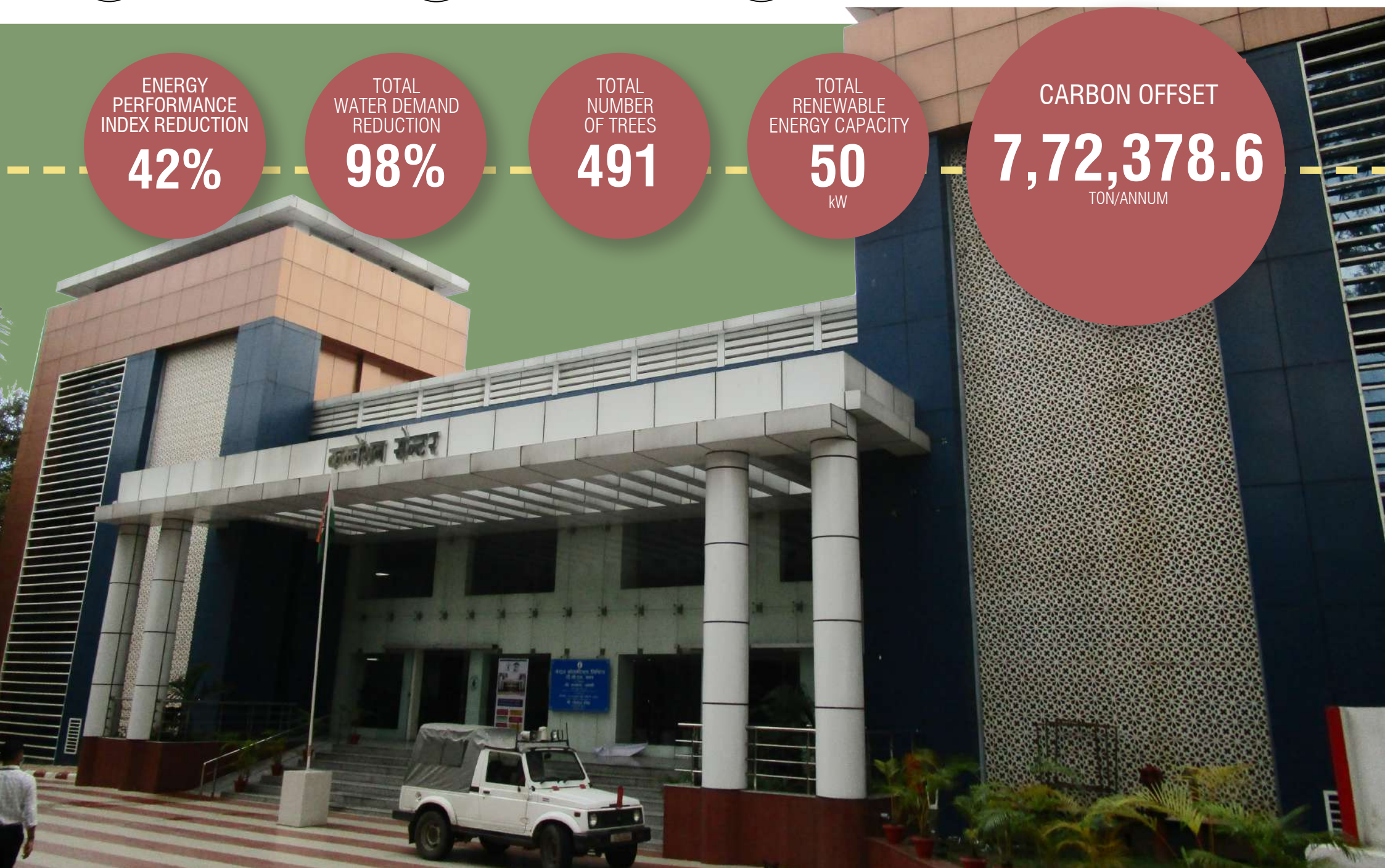
491

TOTAL
RENEWABLE
ENERGY CAPACITY

50
kW

CARBON OFFSET

7,72,378.6
TON/ANNUM



STRATEGIC SITE PLANNING



Central courtyard is integrated between the building blocks to harness and direct wind flow, generating an air tunnel effect that optimizes natural ventilation throughout the structure



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **50.1%**



Existing 42 trees were preserved & number of new trees planted at site is **445**



ENERGY-EFFICIENT DESIGN



Percentage of Total living area is day lit & meets daylight factor prescribed by NBC is **34%**



Reduction in embodied energy of the building using AAC blocks & fly ash in concrete is **73.17%**



Materials used in the building interiors, such as UPVC for doors and window frames, are all low environmental impact materials.



Image depicting tree-lined pathways providing shade along the natural periphery

PASSIVE DESIGN STRATEGIES



OPTIMIZED ORIENTATION FOR SOLAR CONTROL:

The building's orientation is carefully planned to minimize passive solar heat gain. The larger, daytime-operational sections of the building are aligned with their longer façades facing north and south, reducing exposure to harsh east and west sun. Specifically, the office block located behind the auditorium maximizes openings along the northern and southern façades, ensuring ample daylight while mitigating heat ingress.

SHADING THROUGH RECESSED WINDOWS:

All windows are designed as recessed box windows, providing inherent shading throughout the year. This design ensures that direct sunlight penetration is minimized, maintaining thermal comfort and reducing the cooling load across seasons.

OPTIMIZING SITE PLANNING

MINIMIZED FOOTPRINT WITH ENHANCED LANDSCAPING:

The building's footprint and the extent of hard-paved surfaces have been kept to a minimum, allowing for expansive landscaped courts on both sides of the structure. These green spaces not only enhance the aesthetic appeal but also contribute to microclimate regulation and stormwater management.

TREE-SHADED ROADS AND BUILDING FAÇADES:

The road network within the site is designed to be fully shaded by leveraging both existing mature trees and newly planted species. Additionally, the east and west façades of the building are shielded from direct sun exposure by mature trees, further improving thermal performance and integrating the built form seamlessly with the site's natural elements.



LIFESTYLE & INNOVATION



Smart metering and monitoring are implemented for energy & water usage in irrigation, the HVAC plant & lighting



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Guided tours for awareness among visitors are organized to exhibit green features



Image depicting recessed windows combined with jaali elements to create a self-shading façade



WATER USE OPTIMIZATION



66.31% Reduction in water demand using low flow fixtures for kitchens & toilets



82.2% Reduction in annual landscape irrigation demand by planting native species plants & drip irrigation



16.1% Annual water reuse after treatment from MBBR system of 25 KLD STP capacity for irrigation & flushing

TITAN CORPORATE CAMPUS, Bengaluru, Karnataka



Site Area: **25,992.95 SQM**

Built-up Area: **25,344 SQM**

Client: **TITAN COMPANY LIMITED**

Occupancy: **1100**

Principal Architect: **MINDSPACE ARCHITECTS**

Landscape Architect: **ONE LANDSCAPE DESIGN LIMITED**

Electrical Consultant: **SRIPEKSHA ENGINEERING CONSULTANCY SERVICES PRIVATE LIMITED**

Green Building Design & Certification: **EN3 SUSTAINABILITY SOLUTIONS PVT LTD.**



CLIMATE
WARM & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

30.4%

TOTAL
WATER DEMAND
REDUCTION

43%

TOTAL
NUMBER
OF TREES

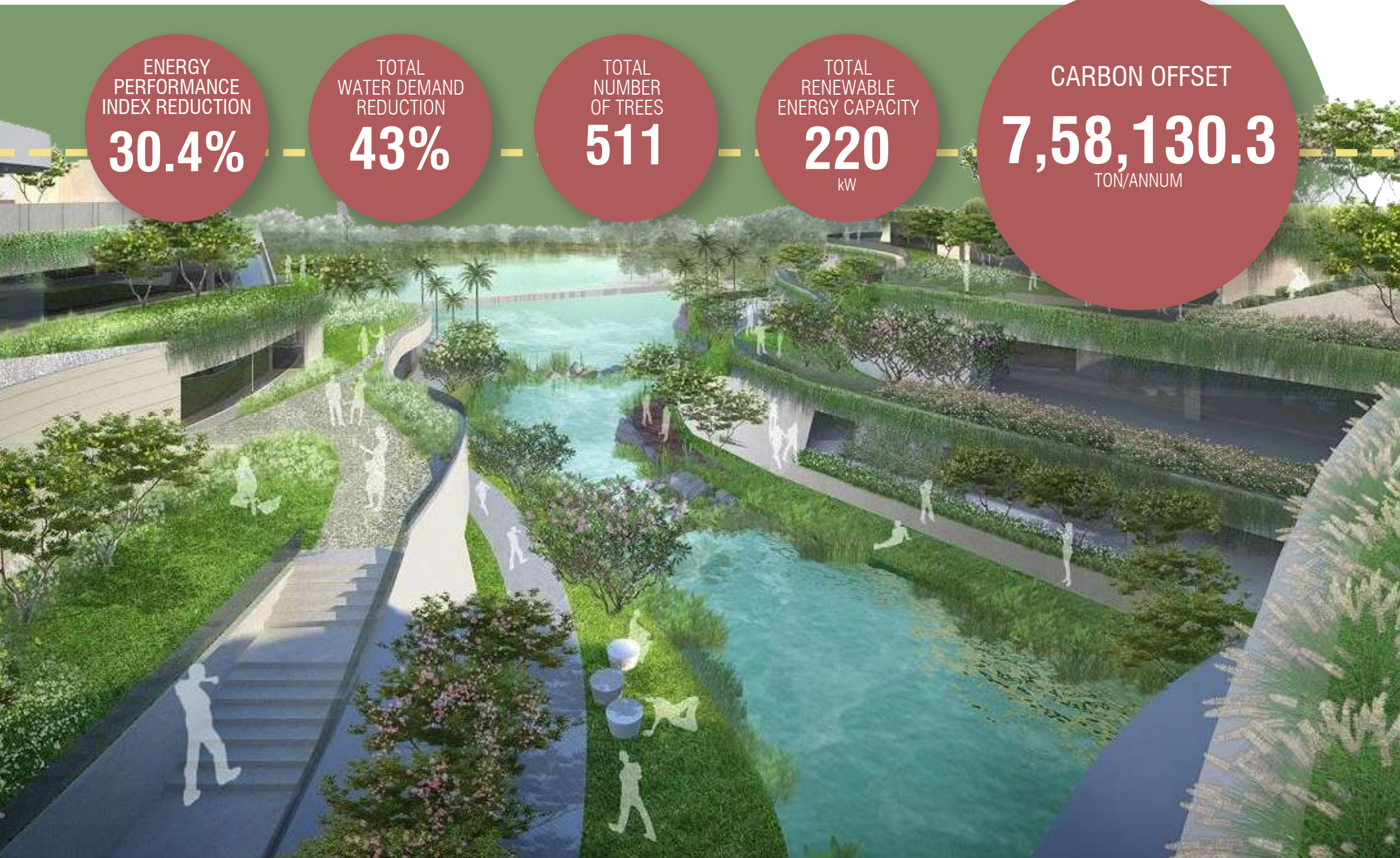
511

TOTAL
RENEWABLE
ENERGY CAPACITY

220
kW

CARBON OFFSET

7,58,130.3
TON/ANNUM



STRATEGIC SITE PLANNING



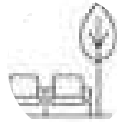
All existing trees were preserved & number of new trees planted at site is **441**



Reduction in landscape water demand using drip irrigation is **62%**



Dense vegetation cover is provided throughout site to moderate microclimate in the vicinity



ENERGY-EFFICIENT DESIGN



Percentage of interior lighting load offset by renewable energy generation at site is **100%**



Reduction of embodied energy of project using AAC blocks in the building is **84.32%**



Low energy materials used for doors, windows, frames, and flooring make up the total materials by **83.34%**



Section showing the working of gravents for ventilation in the building

ENVELOPE PERFORMANCE FOR COMFORT



29.9%
is the Window Wall Ratio of the Building

0.47 W/m²K
Uvalue of the external walls

60.96%
Total living area is day lit & meets prescribed day lit factor by NBC 2005

0.39 SHGC
36% VLT
5.15 W/m²K U value

for the facade glazing in the project, complying to requirements of ECBC 2007

PASSIVE DESIGN STRATEGIES



ORIENTATION

- Building is oriented with longer sides facing North-South direction to bring in glare free natural light & minimal heat gain

- The lake on the Eastern side of the site & extending the lake into the site as a bio pond has been driving core of this design. Porosity allows breeze to flow through the building atriums as shown in left figure. The project has designed atrium where the hot air inside the building escapes through gravents

VEGETATION

- Green wall on the western side shields the building from harsh western sun. Green buffer zone in between green wall & usable spaces further cuts of the radiation & prevents heat gain

SHADING

- The Landscaping along with the shading devices in the west direction, at each floor acts as buffer space to minimise the heat gain

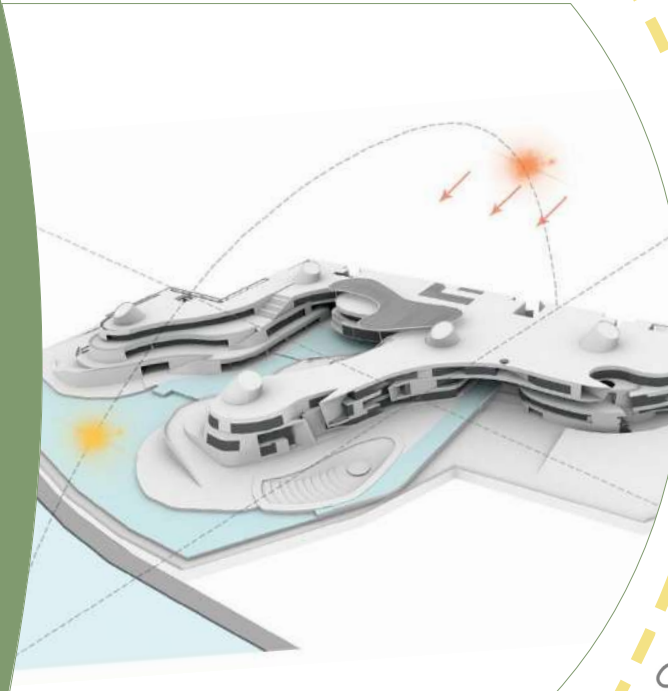


Diagram showing the sun path movement & shadows in the building.



LIFESTYLE & INNOVATION



Wet waste generated on site is treated in 2 Organic Waste Composter(OWC) installed at site



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Guided tours for awareness among visitors are organized to exhibit green features



WATER USE OPTIMIZATION



Three surface site wells with filtration provided recharge



59.45%

Reduction low flow water demand by using fixtures for kitchen & toilets



62.6%

Annual from water STP resuse for on site after & treatment irrigation

R&D ASTRA MICROWAVE PRODUCTS, Rajkot, Gujrat



Site Area: **20,234 SQM**

Built-up Area: **10,215 SQM**

Client: : **ASTRA MICROWAVE PRODUCTS LTD.**

Green Building Consultant : **THE ENERGY & RESOURCE INSTITUTE**



CLIMATE
HOT & DRY



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

69.4%

TOTAL
WATER DEMAND
REDUCTION

62.7%

TOTAL
NUMBER
OF TREES

3

TOTAL
RENEWABLE
ENERGY CAPACITY

15
kW

FROM ENERGY SAVINGS
CARBON OFFSET

6,85,516.39
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **96%**

Existing 3 mature trees on site were preserved & protected during construction

Topsoil was preserved during site construction & reused in landscape within site

ENERGY-EFFICIENT DESIGN

Building oriented to allow solar gain in winter & avoid solar heat gain in summer

Percentage reduction in embodied energy of the building using AAC blocks & fly ash in concrete is **54%**

Materials used in the building interiors, such as UPVC for doors and window frames, are all low environmental impact materials, making up **100%**



ENVELOPE PERFORMANCE FOR COMFORT

0.41 W/m²K

Uvalue of the external walls

< 32.11%

window wall ratio(WWR) for all buildings

0.38 SHGC

69 % VLT

1.64 W/m²K U value

for the facade glazing in the project, complying to requirements of ECBC 2007

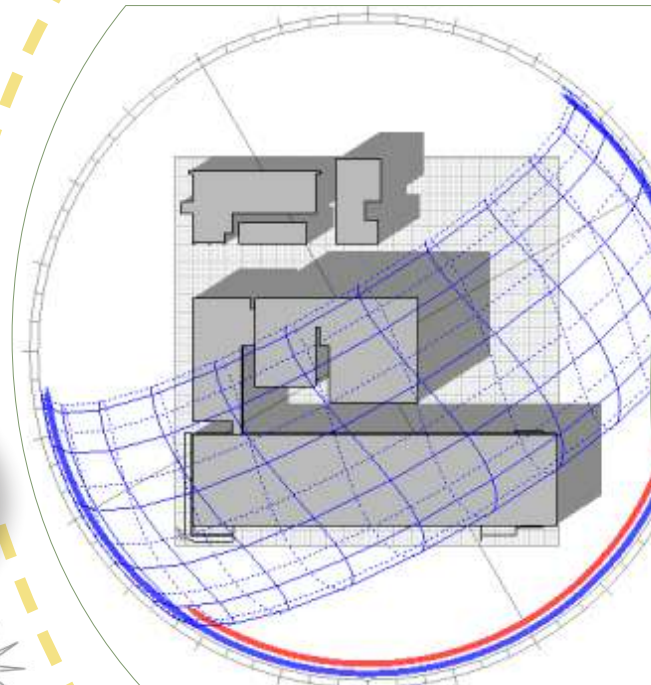


Diagram showing sun path above the building to create self shading among building blocks to reduce heat gain

MAINTAINING INDOOR COMFORT LEVEL



52.95%

of total living area is day lit & meets daylight factor prescribed by NBC

AUTOMATIC LIGHT SHUTOFF

- Exterior lighting is managed by automatic timer controls to enhance energy efficiency

CONTROL IN DAY LIT AREA

- Manual switches and occupancy sensors in toilets and corridors ensure optimal lighting in naturally lit areas

TEMPERATURE CONTROL

- Thermostats and remote controls enable precise regulation of room temperatures

- A Variable Refrigerant Volume (VRV) system is installed for efficient space conditioning



Diagram showing the shadows of the building to create self shading among building blocks to reduce heat gain



LIFESTYLE & INNOVATION



Universal accessibility implemented with measures of toilets, entrance ramps, lift with braille & dedicated parking spots



All wet waste generated on-site is composted into manure directly at the site



Posters showcasing the implemented green features are displayed on-site



WATER USE OPTIMIZATION



Six on-site recharge pits have been constructed to manage surplus rainwater



63.82%

Reduction in water demand using low flow fixtures for kitchen & toilets



62.51%

Reduction in annual landscape water demand by micro drip irrigation & multi sprinkler systems

Employee residential Building, **ITC MUDFORT**, Bengaluru, Karnataka



Site Area: **7,673.15 SQM**

Built-up Area: **13,875 SQM**

Occupancy: **352**

Client: **ITC LIMITED**

Principal Architect: **CNT ARCHITECTS**

Landscape Architect: **OIKOS STUDIOS**

Structural Consultant: **ISA –STRUCTURAL STUDIO**

Electrical Consultant: **AECOM**

Green Building Design & Certification: **ENVIRONMENT DESIGN CONSULTANT PVT. LTD**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

30.9%

TOTAL
WATER DEMAND
REDUCTION

98%

TOTAL
NUMBER
OF TREES

62

TOTAL
RENEWABLE
ENERGY CAPACITY

15
kW

CARBON OFFSET

9,44,901.3
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **96%**



Existing 42 trees were preserved & number of new trees planted at site is **22**



Sewer pipes are installed following the natural slope of the site eliminating need for pumping



ENERGY-EFFICIENT DESIGN



Building is oriented to maximize solar gain during winter while minimizing solar heat gain in summer



Percentage reduction in embodied energy of the building using AAC blocks & fly ash in concrete is **56%**



Materials used in the building interiors, such as UPVC for doors and window frames, are all low environmental impact materials, making up **100%**



Image showing vertical shading devices used on balconies at site to reduce heat gain



ENVELOPE PERFORMANCE FOR COMFORT



0.41 W/m²K

Uvalue of the external walls

14.65%

window wall ratio(WWR) for all buildings

0.5 SHGC

56 % VLT

5.6 W/m²K U value

for the facade glazing in the project, complying to requirements of ECBC 2007

OCCUPANT COMFORT STRATEGIES

68.5%

of total living area is day lit & meets daylight factor prescribed by NBC

AUTOMATIC LIGHT SHUTOFF

- Automatic timer control have been installed for all exterior lighting.

CONTROL IN DAY LIT AREA

- Manual switches are provided in all spaces to control comfort for occupants.

- 100% of the paints, adhesives & sealants are Low VOC.

- No smoking policy implemented at site to ensure no pollutants.



LIFESTYLE & INNOVATION



Universal accessibility implemented with measures of toilets, entrance ramps, lift with braille & dedicated parking spots



All organic waste produced is processed
int he 800 KG OWC installed at site



Posters on implemented green features are on display at site for awareness among visitors



WATER USE OPTIMIZATION



Six recharging pits for surplus rain
water have been constructed on site.



60%

Reduction water demand using low
flow fixtures for kitchen & toilets.



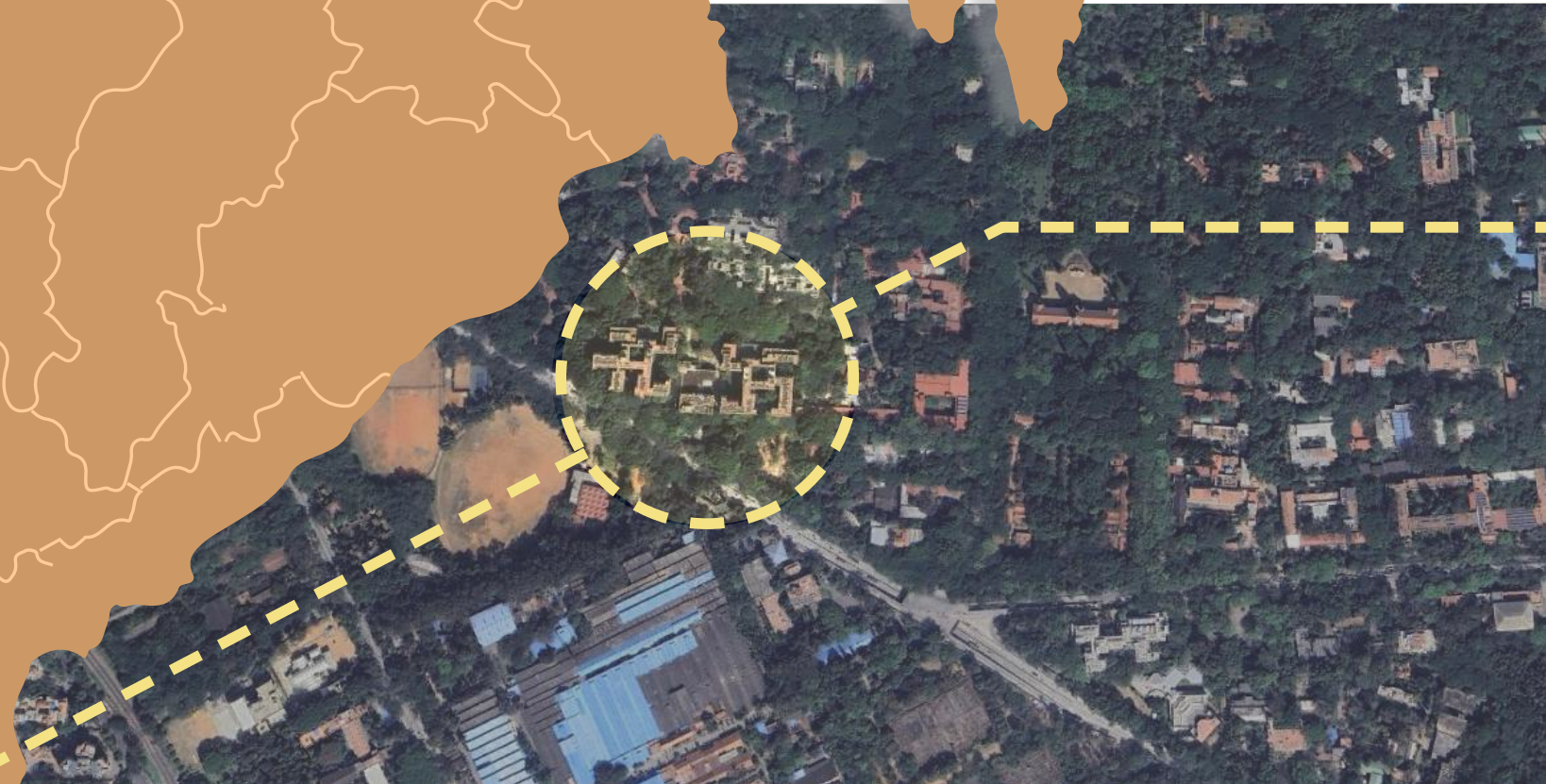
59%

Reduction in annual landscape water dem&using
micro drip irrigation & spray systems.



Louvers used to facilitate ventilation in stairwell & provide natural light to reduce energy load

LADIES HOSTEL, IISc, Bengaluru, Karnataka



Site Area: **3403 SQM**

Built-up Area: **5473.43 SQM**

Year of completion: **2022**

Client: **INDIAN INSTITUTE OF SCIENCE**

Integrated Design Team: **ADVANI ASSOCIATES**

Green Building Consultant: **MINDWAGON SUSTAINABLE DESIGN**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

60.5%

TOTAL
WATER DEMAND
REDUCTION

65.2%

TOTAL
NUMBER
OF TREES

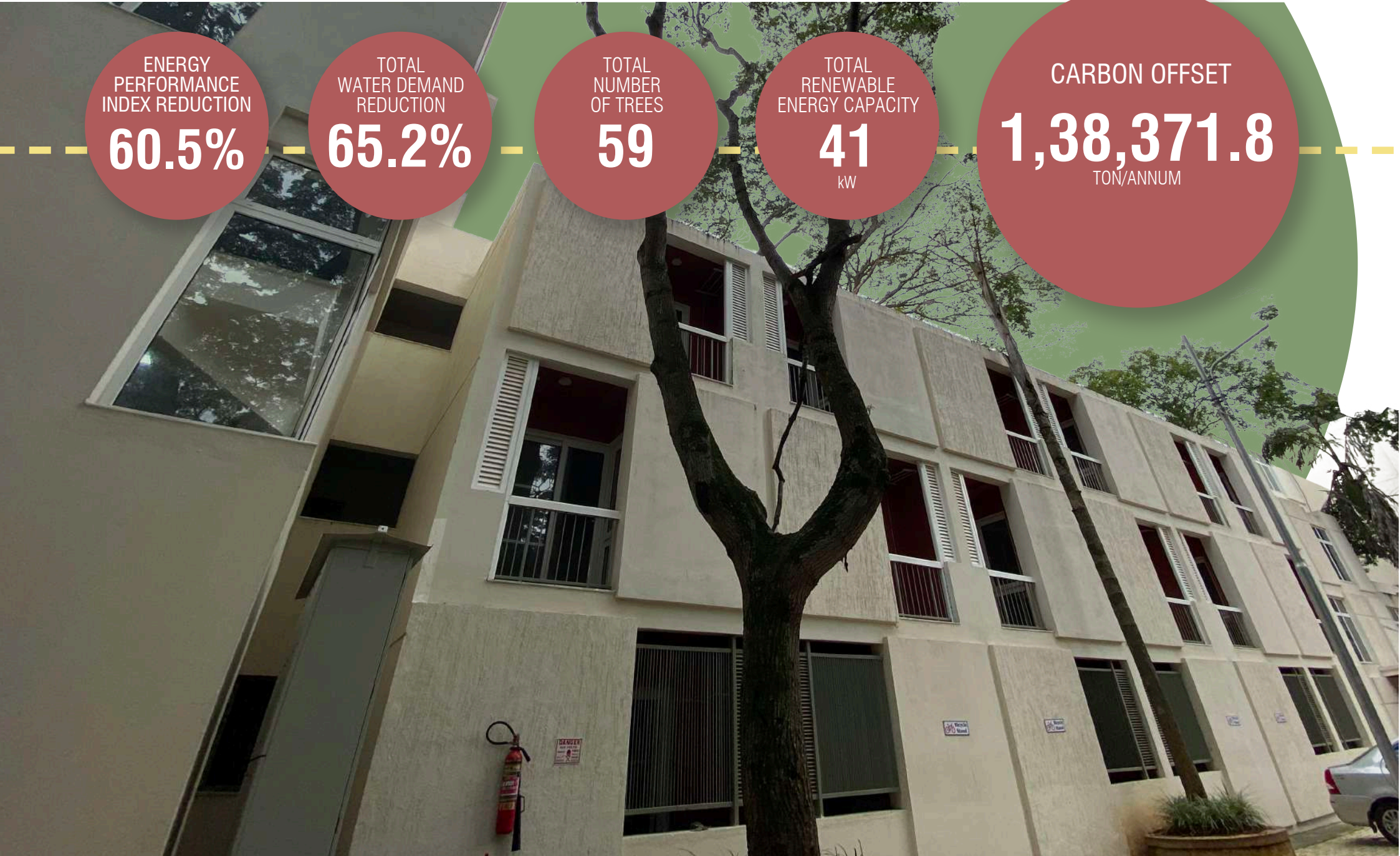
59

TOTAL
RENEWABLE
ENERGY CAPACITY

41
kW

CARBON OFFSET

1,38,371.8
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **51.7%**



Percentage reduction in landscape water demand by planting native species is **78%**



All 43 existing mature trees on the site preserved during construction



ENERGY-EFFICIENT DESIGN



Percentage of internal artificial lighting load & HVAC needs met by solar photo voltaic is **44.4%**



Percentage reduction in embodied energy of the building using AAC blocks & fly ash in concrete is **38%**



Materials used in the building interiors, such as UPVC for doors and window frames, are all low environmental impact materials, making up **100%**



Image showing extra horizontal shading devices on west face for reducing direct heat gain



ENVELOPE PERFORMANCE FOR COMFORT



> 90%

Total living area is day lit & meets prescribed day lit factor

< 40db

Average indoor noise level in building

< 0.45 SHGC

Effective facades of the project

OCCUPANT COMFORT STRATEGIES



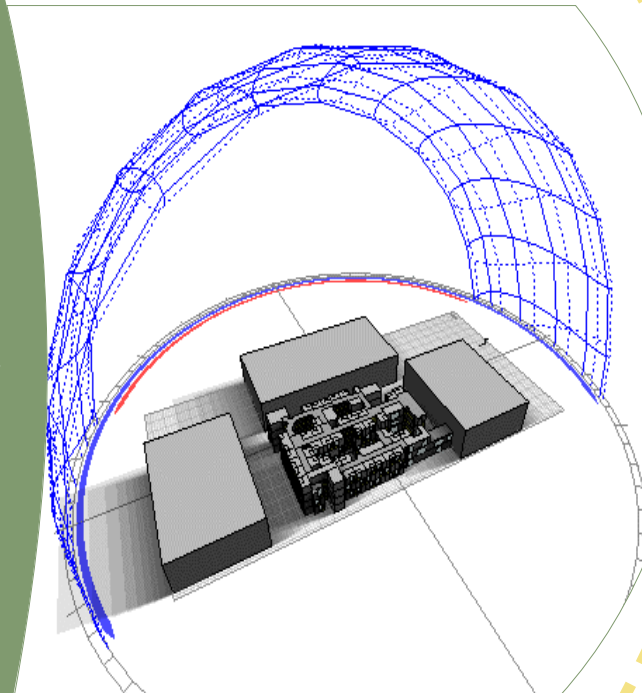
TEMPERATURE, RELATIVE HUMIDITY CARBON DIOXIDE

Sensors have been installed in the common areas of the project to monitor air quality

100%

Area of the project is naturally ventilated

Further 100% of the paint are all VOC free



Solar shading blocks path within diagram the staggered showing building design



LIFESTYLE & INNOVATION



Universal accessibility implemented with measures of toilets, entrance ramps, lift with braille & dedicated parking spots



Dedicated waste segregation & collection area with six types of multicolour bins provided at site



Dedicated resting rooms & toilets for support staff has been provided at site



WATER USE OPTIMIZATION



Rain water harvesting at site with six recharging pits with appropriate filtration constructed at site



64.7%

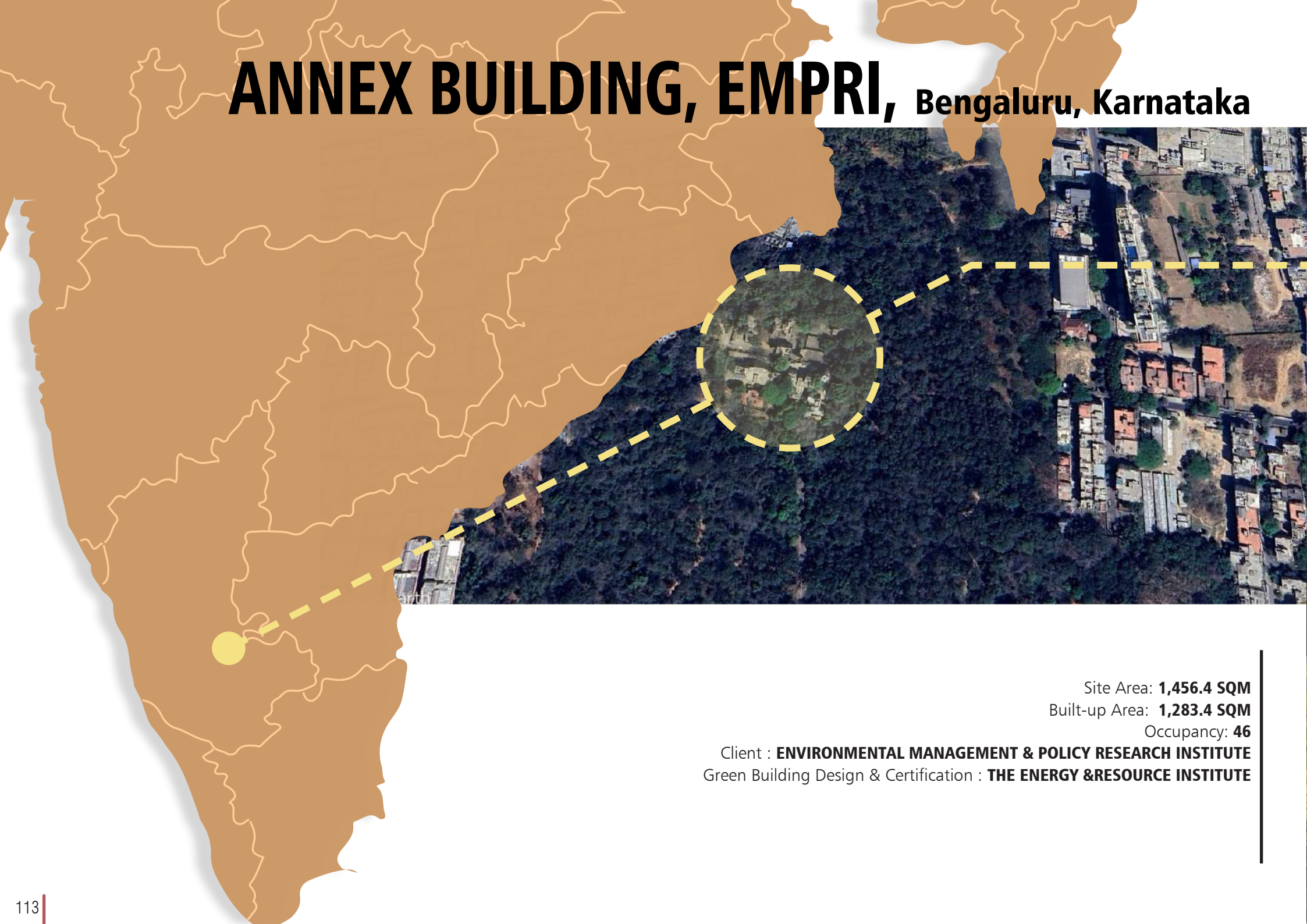
Reduction in water demand using low flow fixtures for kitchen & toilets



75.91%

Annual site water requirements met through on-site treated wastewater & harvested rainwater

ANNEX BUILDING, EMPRI, Bengaluru, Karnataka



Site Area: **1,456.4 SQM**

Built-up Area: **1,283.4 SQM**

Occupancy: **46**

Client : **ENVIRONMENTAL MANAGEMENT & POLICY RESEARCH INSTITUTE**
Green Building Design & Certification : **THE ENERGY & RESOURCE INSTITUTE**



CLIMATE
WARM & HUMID



TYPE
COMMERCIAL



RATING
SVA GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

27%

TOTAL
WATER DEMAND
REDUCTION

69.3%

TOTAL
NUMBER
OF TREES

27

TOTAL
RENEWABLE
ENERGY CAPACITY

2.2
kW

CARBON OFFSET

7,388.05
TON/ANNUM

STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **71.8%**



Buffer spaces are strategically placed on the eastern and western facades to minimize heat gain



Existing six trees were preserved & number of new native trees planted at site is **21**



ENERGY-EFFICIENT DESIGN



Percentage of Total living area is day lit & meets daylight factor prescribed by NBC is **34%**



Reduction in embodied energy using CSEB blocks & PPC for construction is **29.55%**



LPD (W/sqm) of the project, achieved using LEDs, lower than the ECBC specification is **3.29**



Image showing ventilators in the facade of the building with appropriate shading & showcasing the light coloured facade



OPTIMIZATION OF SITE USING PASSIVE DESIGN STRATEGIES



ORIENTATION

- The building open on three sides & all windows are oriented along the Northwest & North east façade for maximum exposure to wind & enhance ventilation.

- The interior layout of the building has integration of courtyard spaces, which are strategically placed for integration of daylight in the spaces.

- The building has buffer spaces of store room, toilets, & staircases in eastern, north eastern parts to reduce heat gain in regularly occupied spaces.

VENTILATION

- The predominant wind direction in Bangalore varies from West to North- Western Direction. The ventilation occurs through windows & ventilator above it.

125
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures

- Compressed Soil Earth Blocks (CSEB) for external & internal walling application.
- Light coloured exterior facade & high SRI tiles used on the roof to reduce heat gain through envelope
- 32.13% reduction in overall insolation achieved by project using shading for openings.



LIFESTYLE & INNOVATION



Efficient segregation & collection of waste generated using coloured bins on site



Environmental awareness initiatives through panels, brochures, magazines & newsletters at site



Dedicated resting rooms & toilets for support staff has been provided at site



WATER USE OPTIMIZATION



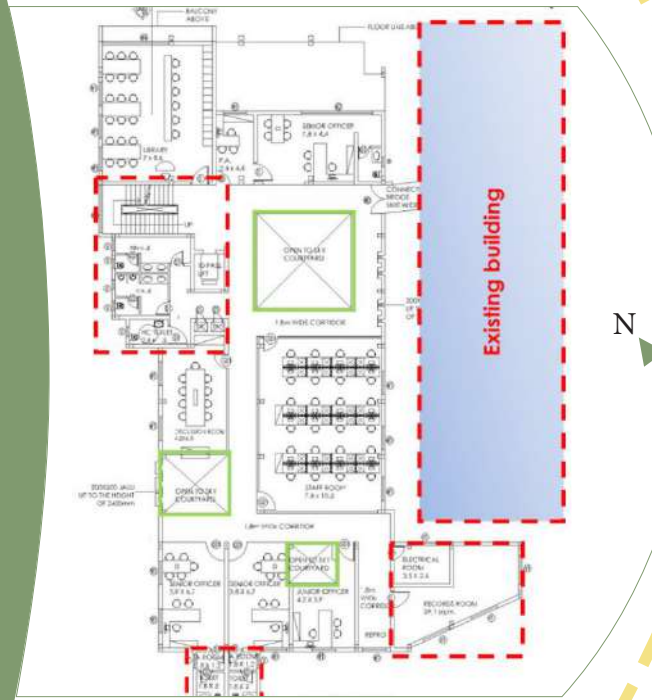
85.36% Annual water reuse in irrigation by harvesting rain water at site.



54.96% Reduction in water demand by using low flow fixtures for kitchen & toilets

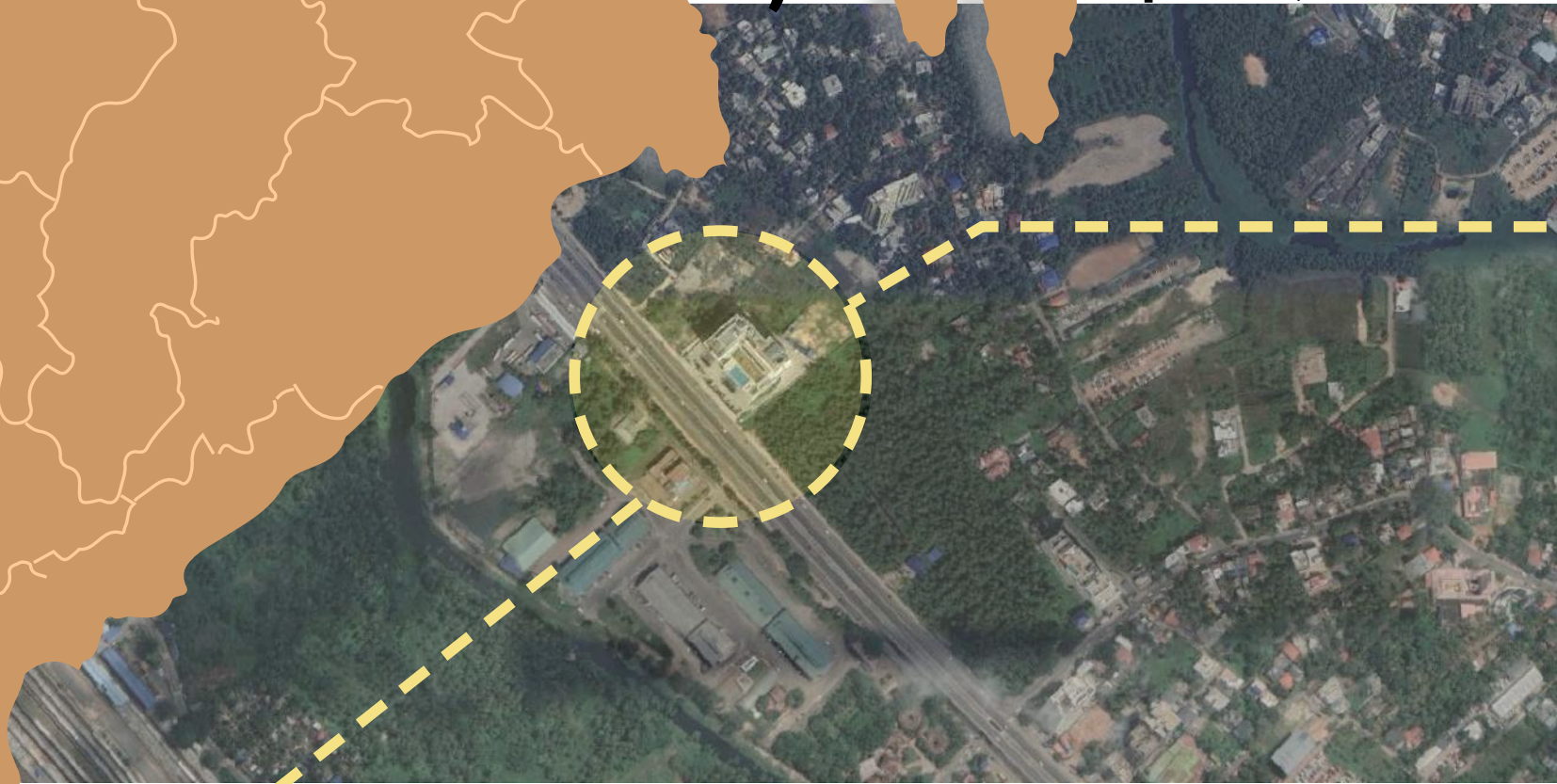


75% of the two-day water demand can be met with a rainwater storage tank of 13,592 liters at site



Plan showing the buffer areas marked in red & the courtyards marked in green in the building

O BY TAMARA HOTEL, Thiruvananthapuram, Kerala



Site Area: **5,849.12 SQM**

Built-up Area: **12,804.82 SQM**

Occupancy: **1730**

Client: **TAMARA GROUP HOTELS**

Principal Architect: **IYER & MAHESH**

Project management: **PROMAG**

HVAC Consultant: **ALEX SYRIAC ASSOCIATES**

Green Building Design & Certification: **TERRA VIRIDIS**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

69.8%

TOTAL
WATER DEMAND
REDUCTION

48.7%

TOTAL
NUMBER
OF TREES

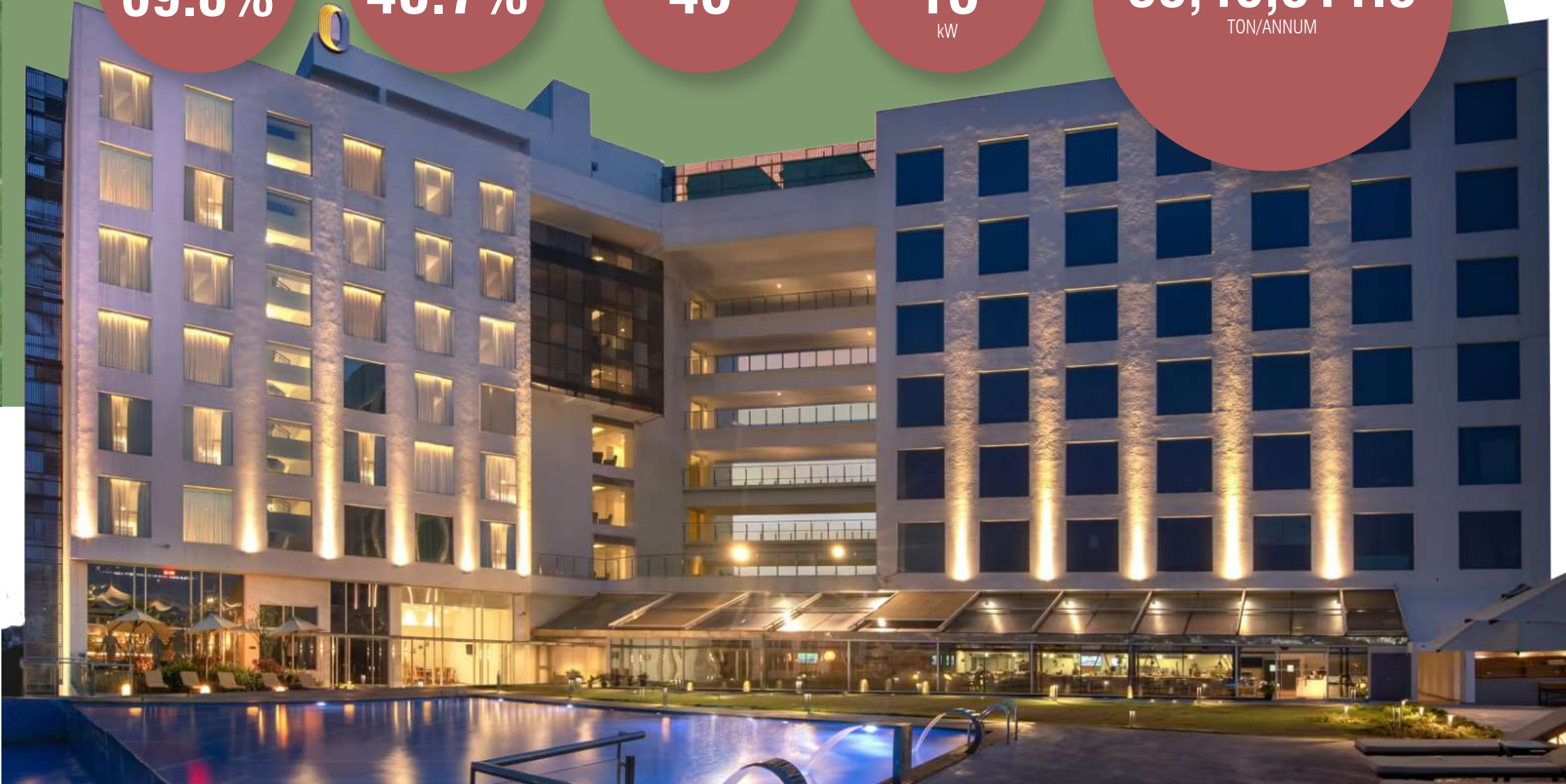
45

TOTAL
RENEWABLE
ENERGY CAPACITY

15
kW

CARBON OFFSET

35,40,511.5
TON/ANNUM



STRATEGIC SITE PLANNING

Reduction in annual irrigation demand using planting native species, drip & micro spray systems is **43.3%**



Utility corridors were strategically consolidated and aligned with pathways to enhance planning efficiency



Percentage of Site's outdoor lighting system is fully controlled by automatic controls to ensure efficiency, is **100%**



ENERGY-EFFICIENT DESIGN

Percentage of Total living area is day lit & meets daylight factor prescribed by NBC is **77.2%**



Reduction in embodied energy using AAC block in non structural construction application is **54.4%**



Materials used in the building interiors, such as UPVC for doors and window frames, are all low environmental impact materials, making up **90%**



Image showing jaali used for shading in the building



OPTIMIZING BUILDING DESIGN



ORIENTATION

- The building is a square plan, guest rooms are facing north-east, south-east, north-east & south-west based on the site to ensure no compromise for daylighting.

- The south-western façade is covered in Jalis used to screen the heat entering the banquet hall.

- The deck space is provided such that it is self-shaded by the two wings of the building.

FENESTRATION DESIGN

- Large windows are provided on the lower floors of the building with appropriate shading devices & high-quality glazing to decrease the heat gain.

- Windows in the guest rooms are reduced to optimum dimensions to reduce heat while ensuring optimum daylighting & fitted with low SHGC glass.

PASSIVE DESIGN FEATURES

1.62W/m²K

Uvalue of the external walls

2.3W/m²K

Uvalue of the Roof

20%

window wall ratio(WWR) for all buildings

0.23 SHGC

41 % VLT

1.4 w/m²K U value

for the facade glazing using Double glazed unit in the project, complying to requirements of ECBC 2007



LIFESTYLE & INNOVATION



Organic waste composter(OWC) of 400kg/day provided for wet waste generated at site



Meters were installed for Utility, HVAC , PV, Raw water tank & STP outlet for monitoring



Dedicated parking, toilets & room were provided for disabled accessibility



Image showing self shading of building through chosen design form



WATER USE OPTIMIZATION



45.7% Reduced water demand by using low flow fixtures for kitchens & toilets



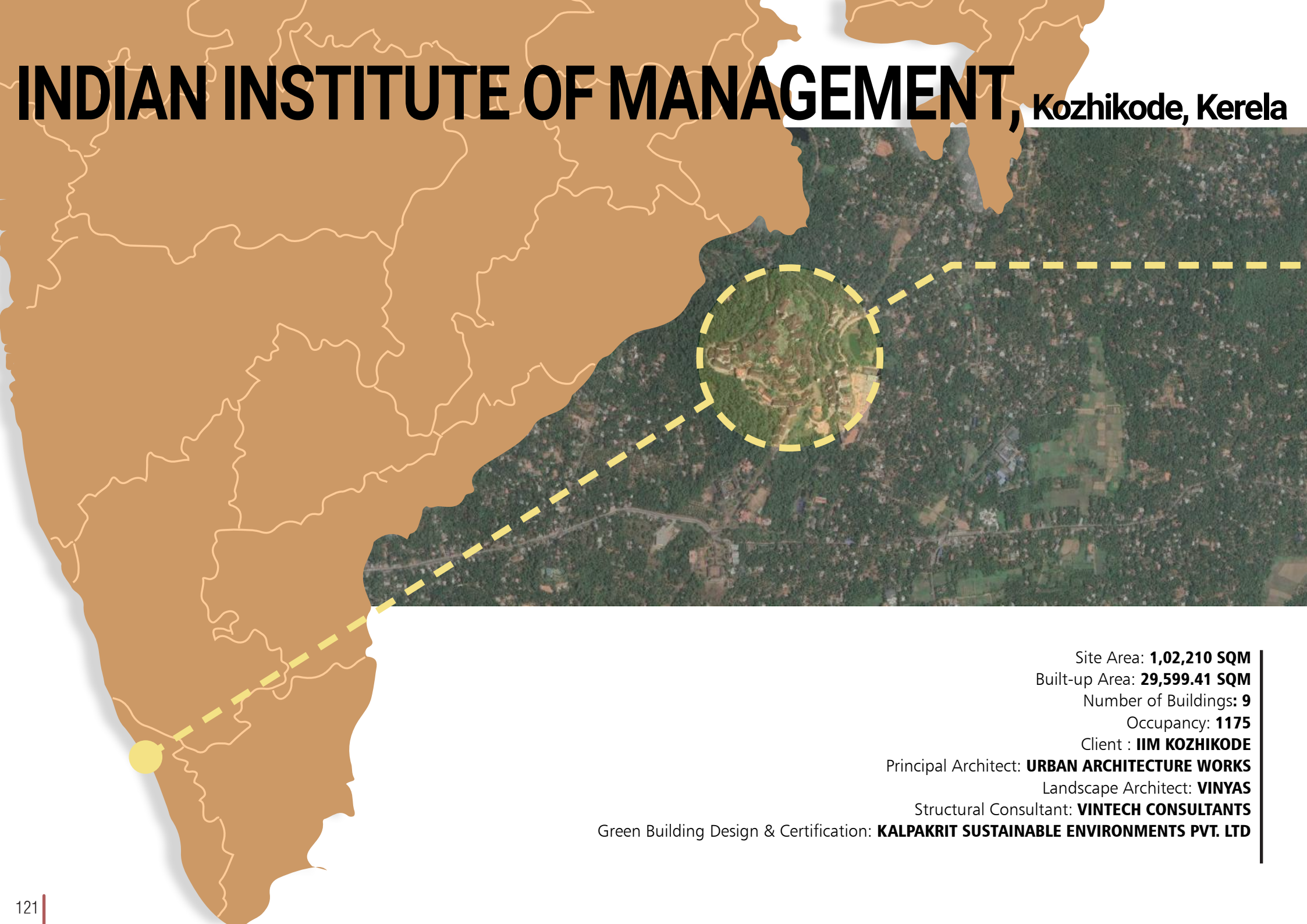
Rain water tank of 200KLD along with 10 percolation pits provided for rain water harvesting & recharge



47.3%

Annual water reuse on site for flushing & irrigation after treating from MBBR 150KLD STP

INDIAN INSTITUTE OF MANAGEMENT, Kozhikode, Kerala



Site Area: **1,02,210 SQM**

Built-up Area: **29,599.41 SQM**

Number of Buildings: **9**

Occupancy: **1175**

Client : **IIM KOZHICODE**

Principal Architect: **URBAN ARCHITECTURE WORKS**

Landscape Architect: **VINYAS**

Structural Consultant: **VINTECH CONSULTANTS**

Green Building Design & Certification: **KALPAKRIT SUSTAINABLE ENVIRONMENTS PVT. LTD**



CLIMATE
HOT & HUMID



TYPE
INSTITUTIONAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

66.1%

TOTAL
WATER DEMAND
REDUCTION

91.9%

TOTAL
NUMBER
OF TREES

1597

TOTAL
RENEWABLE
ENERGY CAPACITY

50
kW

CARBON OFFSET

29,19,863.3
TON/ANNUM

STRATEGIC SITE PLANNING

Pedestrian pathways in the project are fully shaded and covered, totaling **100%**

Percentage of the site area covered in landscape & green areas is **78.9%**

Existing 1012 trees were preserved & number of new trees planted at site is **585**

ENERGY-EFFICIENT DESIGN

Project is daylight and meets the daylight factor prescribed by NBC for total area of **52.3%**

Reduction of embodied energy of project using AAC blocks in the building is **40%**

Materials used in the building interiors for internal partitions, false ceiling & built furniture are low environment impact materials



INTEGRATED RAINWATER HARVESTING



Site plan showing the drain channels at site in blue, culverts in red & the location of reservoir at site

- Rainwater runoff from the whole site is directed to the reservoir at site through trenches/drain channels which are further connected to culverts

- Each building cluster has a rainwater recharge tank below the building for run off generated from roof tops & overflow

- Stored rainwater in recharge tank is treated & pumped to overhead tanks of the buildings for reuse

- The drainage pipes require no pumping as it is a gravity fed system, & the reservoir is located at the lowest point on site

- Excess over flow from the reservoir further collects into the retention pond at the site

PASSIVE DESIGN FEATURES



- Optimum orientation of buildings with longer facades facing north & South to avoid summer heat gain & allow maximum winter radiation, minimize east west sun.
- Adequately sized overhangs & effectively cut down summer radiations & rain lashians are used on southwestern side to prevent south sun.
- Entrances are sheltered from winds & direct radiation, & all walkways are covered to provide shelter to occupants
- Site designing is done to reduce cut & fill of natural slope during construction, thus reducing impact of building at site
- Thermal storage materials in glycol CTES system used for cooling



Image showing covered walkways marked in red & corridors with rain lashians



LIFESTYLE & INNOVATION



Dedicated & efficient waste segregation & collection area with six types of multicolored bins provided on-site



5%

Total car parking is dedicated to alternative fuel vehicles & EV vehicles



Green education program, including campus tours and informational posters, is organized for occupants



WATER USE OPTIMIZATION



59.2%

Reduction in water demand using low flow fixtures for kitchens & toilets



76.7%

Reduction in annual landscape irrigation demand by planting native species plants & drip irrigation



100%

Site water requirements met through 114.2 KL rain water reservoir & reuse of treated water from MBBR type 140KLD STP plant

ATULYA IT PARK, Indore, Madhya Pradesh



Site Area: **8,130 SQM**
Built-up Area: **14,050 SQM**
Year of completion: **2019**
Occupancy: **1450**

Client: **MP INDUSTRIAL DEVELOPMENT CORPORATION R. O. INDORE**
Principal Architect: **NINE SQUARE ARCHITECTS PVT. LTD.**
Landscape Architect: **NINE SQUARE ARCHITECTS PVT. LTD.**
Project management: **KUNAL STRUCTURE(INDIA) PVT. LTD.**
Green Building Certification: **TECTON PROJECT SERVICES PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

51%

TOTAL
WATER DEMAND
REDUCTION

55%

TOTAL
NUMBER
OF TREES

98

TOTAL
RENEWABLE
ENERGY CAPACITY

45
kWp

CARBON OFFSET

8,34,581.24
TON/ANNUM

STRATEGIC SITE PLANNING

Pedestrian pathways are partially shaded, with all utility corridors integrated along the pathways for efficient space utilization

Percentage reduction in landscape water demand utilizing sprinkler system is **55%**

Automatic timer-based controls have been provided for 100% street outdoor lighting

ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **56.2%**

Use of AAC blocks in non-structural applications has resulted in a reduction of embodied energy by **54 %**

Materials used for flooring on-site, including Kota stone, marble, granite, and vitrified tiles, are low-energy, accounting for **72%**

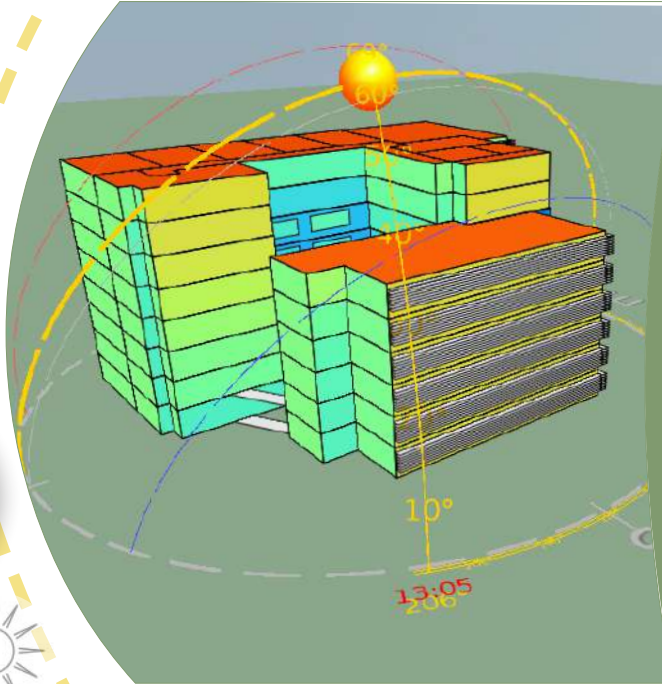


Image showing sunpath with heat gain on surfaces of the building with reduced surface heat gain in the courtyard because of shading



ENVELOPE PERFORMANCE FOR COMFORT

26.81%

Window Wall Ratio of the Building

0.22 SHGC

31% VLT

1.8 W/m²K U-value

Double Glazed units of above specifications installed in the building demonstrating the design for efficiency to reduce conventional energy demand in the building

PASSIVE DESIGN STRATEGIES



ORIENTATION

- The longer façade of the building is oriented in North-South direction; all the major active zones are provided in the North - South direction. The East- West face of the building houses service areas

- The building is designed with open corridors in the direction of prevailing wind to avail the channelization effect of wind, along the courtyards to reduce heat gain

SHADING

- During summers, the horizontal shading/ Louver devices do not allow direct sunlight to enter inside, therefore, the building does not receive any direct sunlight but reflected sunlight (glare free daylight)

- During winters, since the sun is at a lower angle, the building receives direct sunlight. Thus, the rooms are warm during the daytime



Close up image of horizontal louvers used installed at site to provide shading to the facade surfaces & reduce heat gain



LIFESTYLE & INNOVATION



Amenities such as a bus stop, bank, and post office are available within a ½ km radius of the project.



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Efficient waste segregation & collection area with six types of multicolored bins provided on-site



WATER USE OPTIMIZATION



Two rainwater recharge pits have been provided on-site to replenish the groundwater



54.6 %

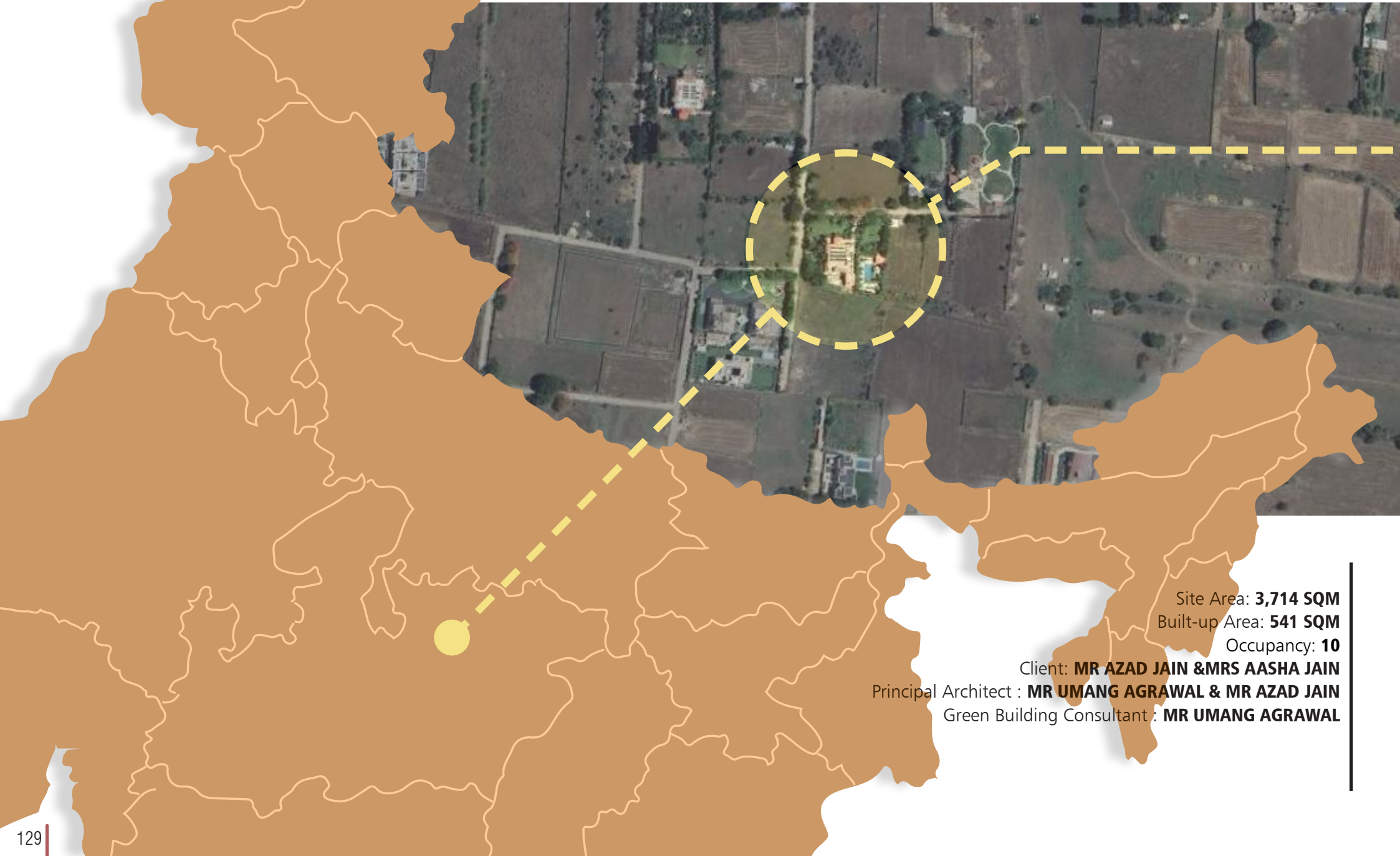
Reduced water demand by using low flow fixtures for kitchens & toilets



57%

Annual water reuse in the project using DAFF+PVA gel MBBR type STP of 60 KLD capacity

MR. AZAD JAIN RESIDENCE, Indore, Madhya Pradesh



Site Area: **3,714 SQM**

Built-up Area: **541 SQM**

Occupancy: **10**

Client: **MR AZAD JAIN & MRS AASHA JAIN**

Principal Architect : **MR UMANG AGRAWAL & MR AZAD JAIN**

Green Building Consultant : **MR UMANG AGRAWAL**



CLIMATE
COMPOSITE



TYPE
RESIDENTIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

22%

TOTAL
WATER DEMAND
REDUCTION

56.4%

TOTAL
NUMBER
OF TREES

36

TOTAL
RENEWABLE
ENERGY CAPACITY

2.2
kWp

CARBON OFFSET

1,987.41
TON/ANNUM



STRATEGIC SITE PLANNING

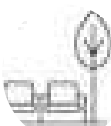
Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **57%**



Existing 2 trees were preserved & number of new trees planted is **34**



Dense vegetation cover and grass pavers are used to mitigate the Urban Heat Island Effect



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **91%**



Project achieves 3.13 LPD, which is significantly lower than the ECBC specified LPD limit of 10.80 W/sq.m, by using LED lights



The thermal efficiency of the building envelope is 119.63, effectively reducing heat gain and maintaining a low energy load.



Sketch showing courtyards with water feature for increasing day lighting & maintaining indoor comfort



VENTILATION THROUGH THE SITE

- The orientation of the building along east-west direction and the placement of openings on east west facades provided the opportunity to design the openings for enhanced cross ventilation
- The window openings are directly placed in the opposite directions of the rooms so that when the door-windows are opened, the air can flow from west-to-east
- With the predominant direction of incoming wind through the western façade of the building as per the wind rose diagram analysis, the wind ingress is tapped in by the western façade windows
- The air then flows from the western openings through the adjoining rooms before exiting from eastern façade
- This design thus promotes enhanced natural ventilation and contributes to effective architectural design for climate responsiveness

PASSIVE DESIGN FEATURES OF SITE



ORIENTATION

- The building is oriented east-west direction, thus increasing heat gain. This issue was mitigated by creating a dense vegetation cover on the west & east sides of the building

- With the presence of a number of trees, plants & shrubs in the vicinity of the building facades; the microclimate was affected to increase evapotranspiration & provide cooling effect. Also, with the presence of dense vegetation solar exposure of the incident wall is controlled

REDUCING HEAT GAIN

- Window overhangs have been designed to shade the window exposed to harsh west sun. Together with the use of DGU & adequately sized overhangs, the heat ingress is minimized from the west façade



Image showing grass pavers used on site & pergolas placed for shading



LIFESTYLE & INNOVATION



Organic waste generated on-site is treated through vermicomposting, converting it into manure



A dedicated kitchen garden is maintained to provide organically grown vegetables/fruits for residents



Dedicated resting rooms & toilets has been provided for support staff



WATER USE OPTIMIZATION



Waste water generated on the site is treated & reused in landscape irrigation using on site STP



56.48%

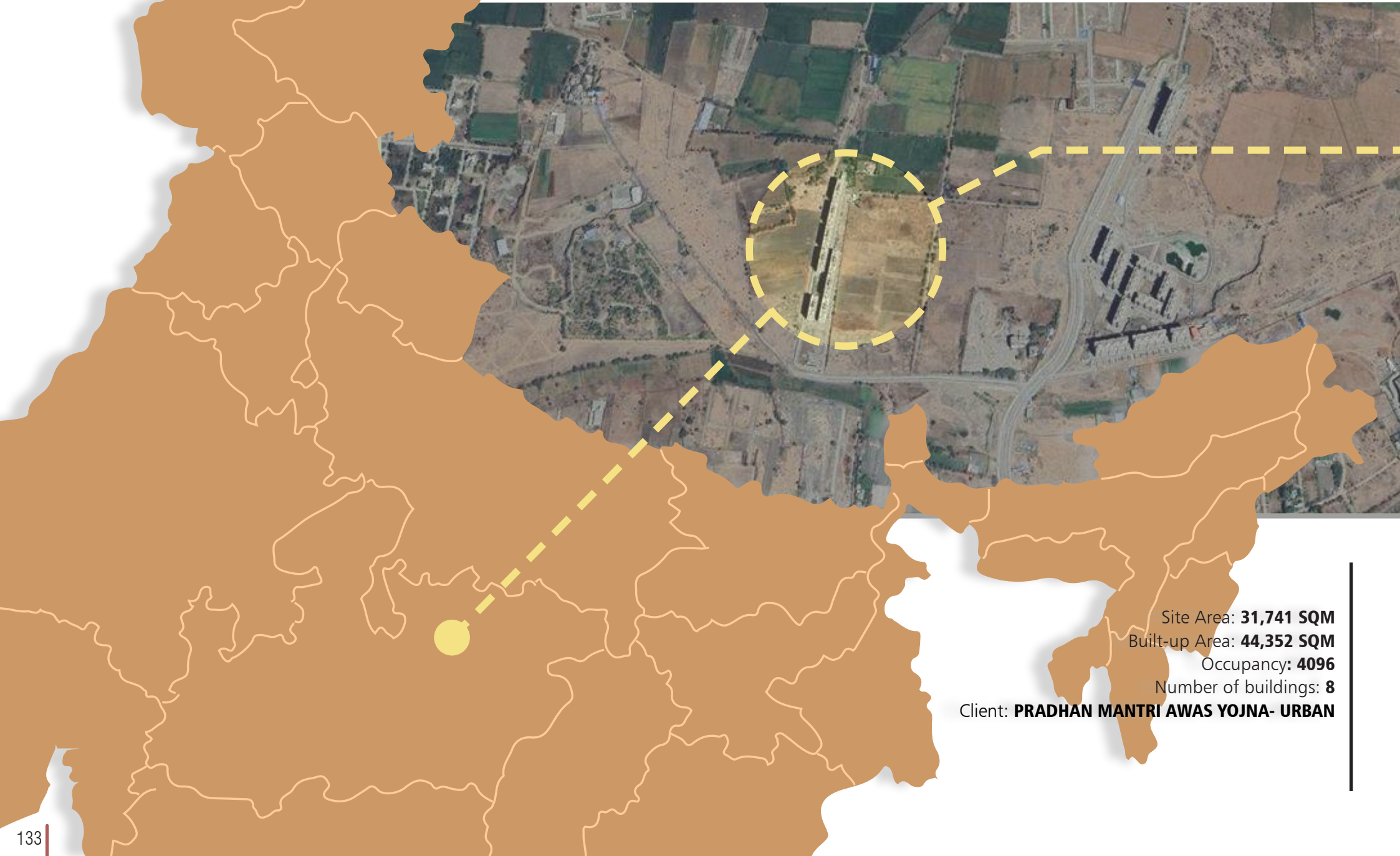
Reduced water demand by using low flow fixtures for kitchen & toilets



75.91%

Rainwater storage capacity of 13,592 liters has been provided to fulfill the water demand for two days,

LIGHTHOUSE PROJECT, Indore, Madhya Pradesh



Site Area: **31,741 SQM**

Built-up Area: **44,352 SQM**

Occupancy: **4096**

Number of buildings: **8**

Client: **PRADHAN MANTRI AWAS YOJNA- URBAN**



CLIMATE
COMPOSITE



TYPE
RESIDENTIAL



RATING
GRIHA AH



ENERGY
PERFORMANCE
INDEX REDUCTION

38%

TOTAL
WATER DEMAND
REDUCTION

41%

TOTAL
NUMBER
OF TREES

521

TOTAL
RENEWABLE
ENERGY CAPACITY

40
kW

CARBON OFFSET

11,76,954
TON/ANNUM



STRATEGIC SITE PLANNING



Reduction in irrigation water demand using sprinkler system and planting native species is **54%**



Number of new trees of native species planted at site along the periphery is **516**



Percentage of total site surface shaded &/or covered with high SRI paint is **53.2%**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **54%**



More than 25% OPC replaced with flyash used in structural construction to reduce environmental impact & embodied energy



Materials used for interiors are low energy comprising Kota stone, cermaic tiles, granite & vitrified tiles, accounting for **70%**



Photograph showcasing EPS cement sandwich panels for construction



OPTIMIZING BUILDING ENVELOPE TO REDUCE ENERGY DEMAND

EPS Cement sandwich panels for internal & external wall construction with U value of

$\geq 0.1 \text{ W/m}^2\text{K}$

6mm Single glazed unit for facade glazing in the project, complying to requirements of ECBC 2007 of following values

$5.3 \text{ W/m}^2\text{K}$ U value
 0.85 SHGC
 0.89 VLT

Reducing Peak heat gain of the building to 30.69 W/m^2 using these measures

ACTIVE AND PASSIVE LOW IMPACT DESIGN STRATEGIES



LIGHT COLOURED EXTERNAL SURFACES:

- Light colour scheme used for all external surfaces to reduce heat gain through walls, reducing heat gain from envelope

ORIENTATION:

- All service areas are provided in areas located in unfavourable orientation to give buffer areas from direct solar heat gain
- Chajja provided for shading of windows and inset balconies to reduce direct heat gain

ACTIVE FEATURES:

- BEE 3-star equivalent appliances were installed in the project
- Renewable Energy installed as solar panels on rooftop 964 sq. meter roof top is shaded
- Solar powered street lights have been installed



Photograph showcasing light-colored exteriors with windows and inset balconies for shading to reduce heat gain and sufficient daylighting



LIFESTYLE & INNOVATION



Smart metering is implemented for energy consumption, renewable system and common area lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Waste segregation is promoted on-site through dedicated chutes and separate coloured bins



WATER USE OPTIMIZATION



Water reuse at site after treatment from 440KLD Moving Bed Bio Reactor (MBBR) type STP for irrigation

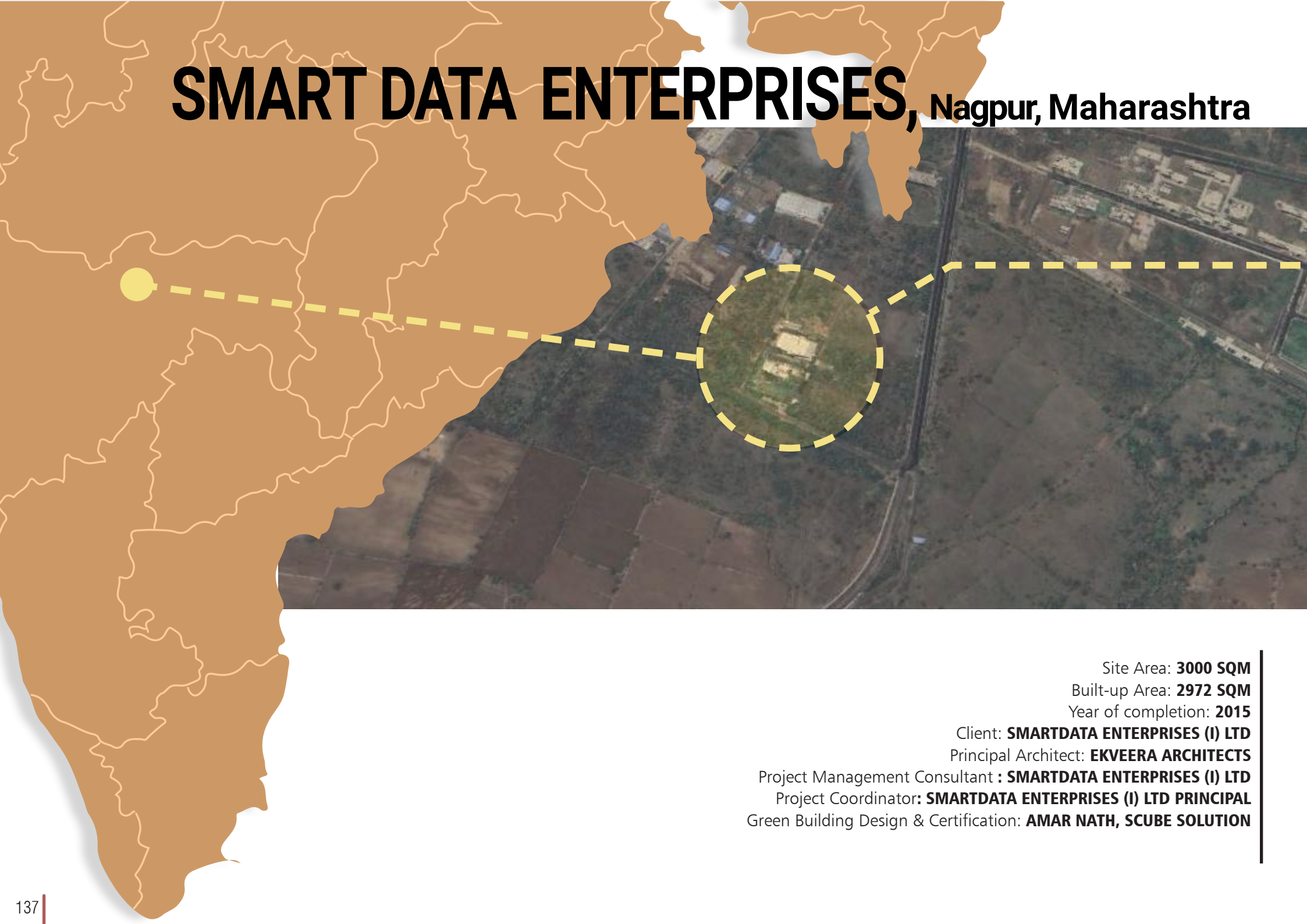


28.5% Reduction in water demand by using low flow fixtures for kitchen & toilets



Excess runoff managed on site through rainwater harvesting with storage capacity of 169.45 cubic meter

SMART DATA ENTERPRISES, Nagpur, Maharashtra



Site Area: **3000 SQM**

Built-up Area: **2972 SQM**

Year of completion: **2015**

Client: **SMARTDATA ENTERPRISES (I) LTD**

Principal Architect: **EKVEERA ARCHITECTS**

Project Management Consultant : **SMARTDATA ENTERPRISES (I) LTD**

Project Coordinator: **SMARTDATA ENTERPRISES (I) LTD PRINCIPAL**

Green Building Design & Certification: **AMAR NATH, SCUBE SOLUTION**



CLIMATE
HOT & DRY



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

54%

TOTAL
WATER DEMAND
REDUCTION

56.4%

TOTAL
NUMBER
OF TREES

36

TOTAL
RENEWABLE
ENERGY CAPACITY

2.2
kWp

FROM ENERGY SAVINGS
CARBON OFFSET

1,84,240.22
TON/ANNUM



STRATEGIC SITE PLANNING

Height of the building utilized to place wind turbine at roof level to generate renewable energy



Utility corridors were strategically consolidated and aligned with pathways to enhance planning efficiency



Existing 3 trees were preserved & number of new trees planted is

90



ENERGY-EFFICIENT DESIGN

Automatic timer installed for all outdoor lighting for enhancing efficiency of energy use.



Use of AAC & FlyAsh blocks in non-structural applications has resulted in a reduction of embodied energy by

69%



Materials used for flooring on-site, including Kota stone, marble, granite, and vitrified tiles, are low-energy, accounting for

100%



image showcasing the use of grass pavers for parking & rain water recharge pit constructed along it



ENVELOPE PERFORMANCE FOR COMFORT

12.57%

window wall ratio(WWR) for all buildings

85%

of total living area is day lit & meets daylight factor prescribed by NBC

0.23 SHGC

31 % VLT

1.76 w/m²K U value

for the facade glazing in the project, complying to requirements of ECBC 2007

PASSIVE DESIGN STRATEGIES



- The building is oriented along the Northeast–Southwest axis, following the plot orientation, with a compact square shape
- Services are placed towards the Southeast, acting as buffer spaces and preventing direct heat gain
- A corridor faces the southern side to reduce the direct impact of the sun on the workspace
- Each floor has a balcony facing Northeast, providing open air while avoiding the summer sun
- Open parking is placed on the Northeast side, with a green cover for shade
- The building also provides a natural canopy to shield from the Southwestern sun
- Vegetation is strategically planned to serve as a radiation-absorbent surface and for its evaporative cooling and shading properties



Image showing the wind turbine installed at the rooftop of the project for renewable energy generation



LIFESTYLE & INNOVATION



Smart metering and monitoring are implemented for energy & water usage in irrigation, the HVAC plant & lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Green building awareness is promoted through company memos and website campaigns.



WATER USE OPTIMIZATION



57.7% Annual water reuse on site using treated water from STP & harvested rain water



56.86% Reduced water demand by using low flow fixtures for kitchen & toilets

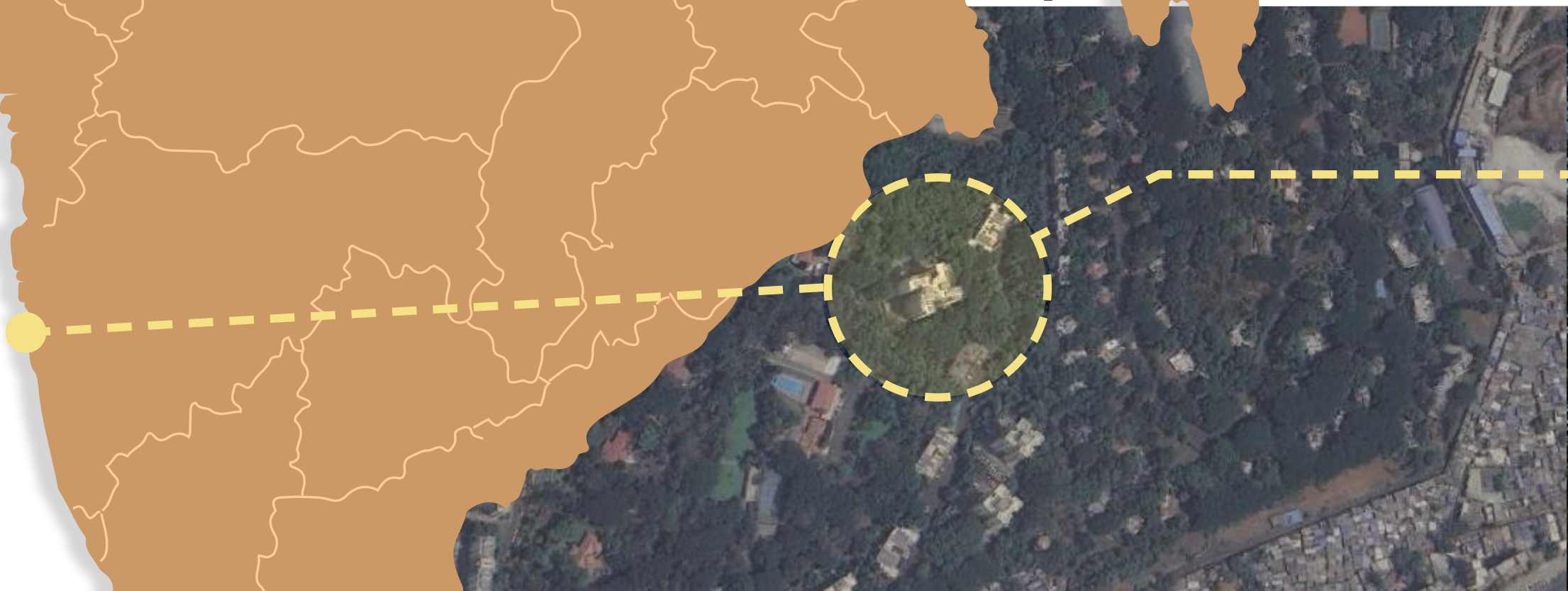


42%

Reduction in annual landscape water demand using drip irrigation & micro sprinkler systems

**BHARAT PETROLEUM
CORPORATION LTD.**

RESIDENTIAL BUILDING, Mumbai, Maharashtra



Site Area: **2,754 SQM**

Built-up Area: **6966 SQM**

Client: **BHARAT PETROLEUM CORPORATION LIMITED**

Principal Architect: **CNA ARCHITECTS**

Landscape Architect: **CNA ARCHITECTS**

Structural Consultant: **HDB DESIGN SERVICES**

Electrical Consultant: **NAT ENGG. CONSULTANT**

Green Building Design & Certification: **SURMOUNT ENERGY SOLUTIONS PVT. LTD. & CNA ARCHITECTS**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

71.4%

TOTAL
WATER DEMAND
REDUCTION

69%

TOTAL
NUMBER
OF TREES

89

TOTAL
RENEWABLE
ENERGY CAPACITY

15.8
kW

CARBON OFFSET

9,11,337.75
TON/ANNUM

STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **38.8%**



Sewage and stormwater drainage systems are designed to follow the site's natural slope



Existing 33 trees were preserved & number of new trees planted is **55**



ENERGY-EFFICIENT DESIGN



Percentage of Internal artificial lighting capacity & HVAC needs met by solar Photo Voltaic **20 %**



Use of AAC & FlyAsh blocks in non-structural applications has resulted in a reduction of embodied energy by **10.7%**



Materials used for flooring on-site, including Kota stone, marble, granite, and vitrified tiles, are low-energy, accounting for **80%**



Image illustrating a rooftop with high Solar Reflectance Index (SRI) tiles, effectively reducing heat absorption, while solar panels provide additional shading and generate renewable energy

ENVELOPE PERFORMANCE FOR COMFORT



23%

is the Window Wall Ratio of the Building

0.47W/m²K

Uvalue of the external walls

88%

Total living area is day lit & meets prescribed day lit factor by NBC 2005

0.42 SHGC
32 % VLT

The facade glazing in the project, complying to requirements of ECBC 2007

PASSIVE DESIGN STRATEGIES



- Building is irregularly shaped to accommodate the existing trees at site. Site disturbances were further minimized by reducing building footprint & maximizing open space
- Windows were provided in all directions to maximize ventilation & daylight in the interior spaces. Appropriate shading is provided to windows to reduce direct heat gain
- Hardscaped areas are kept to minimum to reduce urban heat island effect. The open area is covered with interlocking pavers & shaded by an existing cluster of mature trees at site
- Adequate ventilation is ensured in the open areas using stack effect to maintain optimal thermal comfort. Each flat receives minimum fresh air & ventilation as all windows have direct openings to the outdoors



image depicting the entrance of a building with a dedicated display showcasing and spreading awareness on building's green features



LIFESTYLE & INNOVATION



All organic waste generated on-site is processed through two vermi-composting pits



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Detailed leaflet is provided to visitors at the reception, highlighting the project's green feature



WATER USE OPTIMIZATION



Two rainwater recharge pits have been strategically constructed on-site to enhance groundwater replenishment



69%

Reduction in water demand by using low flow fixtures for kitchen & toilets



79%

Reduction in annual landscape water demand using micro drip irrigation & spray systems

ROYAL ORANGE COUNTY, Pune, Maharashtra



Site Area: **20,116.4 SQM**

Built-up Area: **23,967.53 SQM**

OCCUPANCY:

Client: **ECO SOLUTIONS**

Principal designer: **ABA ARCHITECTS**

Principal contractor: **HARIT DEVLOPERS**

Electrical Consultants: **VIRAJ ELECTRICALS**

Green Building Design & Certification: **ECO SOLUTIONS**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

65.7%

TOTAL
WATER DEMAND
REDUCTION

50%

TOTAL
NUMBER
OF TREES

242

TOTAL
RENEWABLE
ENERGY CAPACITY

151
kW

CARBON OFFSET

20,77,335.7
TON/ANNUM

STRATEGIC SITE PLANNING



Reduction in landscape water demand using drip irrigation and sprinkler systems is **50%**

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **54.8%**

Existing 3 trees were preserved & number of new trees planted is **239**

ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **73.7%**

Materials used in interiors on-site, including UPVC for doors & windows, are low-energy, accounting for **73.7%**

Use of AAC blocks & lime bricks in non-structural applications has resulted in a reduction of embodied energy by **25%**



Image showcasing inset windows and strategically designed shading balconies that minimize heat gain while enhancing natural ventilation



FENESTRATION DESIGN OF BUILDING

VENTILATION

- The narrow gap between buildings creates a high-pressure zone, while the open space on the other side forms a low-pressure zone, accelerating wind flow toward the next row of buildings.

- Balcony and terrace projections further reduce pressure, funneling wind and increasing velocity toward opposite terraces. The unobstructed gap ensures smooth airflow, enhancing natural ventilation.

SHADING

- Box projections on the north and south sides minimize direct solar penetration, while balconies act as external shading devices, reducing heat gain in summer.

- The facade is segmented into multiple elements, enhancing mutual shading. On the south, where heat gain is highest, balcony and facade projections further mitigate solar exposure.

PASSIVE DESIGN FEATURES OF SITE



ORIENTATION

- The building design is compact with a rectangular plan. The building orientation is optimum with respect to the orientation required in the tropics, which are longer sides along North South such that one face faces the North orientation.
- Buildings are planned such that there is unrestricted natural ventilation & re-radiate absorbed heat towards our site, thereby avoiding increased energy consumption.

VEGETATION

- The space on the periphery of the site is planted with various types of trees & shrubs to cool & filter the hot winds, before they enter the occupied interiors. More than 20% of the site area is under landscape. Hard paved area is Limited only for driveway for parking.
- Large evergreen trees are planted on the eastern boundary of the site, to deflect the winter winds. Tree shade provides comfort to the pedestrians.



Image highlighting buffer spaces, such as toilets, strategically placed on the west side of the building to reduce heat gain and enhance thermal comfort



LIFESTYLE & INNOVATION



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



User manual detailing the various sustainability measures implemented on-site is provided for awareness



100% Wet waste generated is treated through 300kg OWC on site



WATER USE OPTIMIZATION



Ten rainwater recharge pits with filtration systems have been constructed on-site to recharge groundwater



33.13% Reduction in water demand by using low flow fixtures for kitchen & toilets



27.37% Annual water reuse on site after treating from Phytorid system STP of 250KLD

GANDHI RESEARCH FOUNDATION, Jalgoan, Maharashtra



Site Area: **9,000 SQM**

Built-up Area: **6,000 SQM**

Occupancy: **118**

Client: **GANDHI RESEARCH FOUNDATION**

Principal Architect: **A MRIDUL**

Landscape Architect: **MR AJAY KALE**

Structural Consultant: **MR NARAYAN LALWANI**

Electrical Consultant: **MR VIKRANT BHANGALE**

Green Building Design & Certification: **MS DIPTI TALWAR**



CLIMATE
WARM & HUMID



TYPE
INSTITUTIONAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

65%

TOTAL
WATER DEMAND
REDUCTION

73%

TOTAL
NUMBER
OF TREES

25

TOTAL
RENEWABLE
ENERGY CAPACITY

20.2
kW

CARBON OFFSET

2,46,295.2
TON/ANNUM



STRATEGIC SITE PLANNING

Building is strategically positioned to preserve the site's natural stormwater flow, ensuring efficient drainage

Existing 4 trees were preserved & number of new native tree species planted is **21**

Basement is strategically placed in the low-lying areas of the contoured site, optimizing land use and minimizing excavation.

ENERGY-EFFICIENT DESIGN

Project is daylight and meets the daylight factor prescribed by NBC for total area of **85%**

Materials used in interiors on-site are low-energy such as Unpolished natural stone & Celluka sheets

Use of Fly ash blocks & lime plaster in non-structural applications has resulted in a reduction of embodied energy by **27.5%**



Image highlighting the use of natural slopes in landscaping, seamlessly integrated with water bodies to enhance drainage & water conservation



SITE PLANING STRATEGIES

- The site is contoured; hence planning is done in a way so that least cutting & filling is done. The low lying areas are used for constructing basement.
- Building has been designed to accommodate existing mature trees and to avoid cutting them.
- The site is naturally contoured & the building is placed on the ridge, not obstructing the natural storm water flow on the site. All the rain water has been diverted to an existing pond for collection through drain channels on site,
- The campus is planned for maximum pedestrian connectivity & the pathways are designed next to the building so that they remain shaded for most of the day.

PASSIVE DESIGN STRATEGIES



- The building's longer axis is oriented in the North – South axis in order to follow contours on site.

- The classrooms are inward facing with openings in North south directions, to increase the amount of natural daylight, with less heat & glare. This has direct effect on the reduction of energy consumption for artificial lighting & maintaining the comfort level in the rooms.

- A courtyard is designed in the centre of building to channelize air flow & break the mass of the building.

- Elongated eaves of the structure in the classroom & well recessed windows permits daylight & blocks the heat gain & glare.



Integration of water bodies on-site, along with minimal pervious paving, enhances natural drainage, mitigates heat buildup, and supports sustainability



LIFESTYLE & INNOVATION



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Efficient waste segregation and collection are ensured on-site through a color-coded bin system



Environmental awareness is promoted on-site through informational panels and brochures



WATER USE OPTIMIZATION



53.8%

Annual harvested water reuse in irrigation from



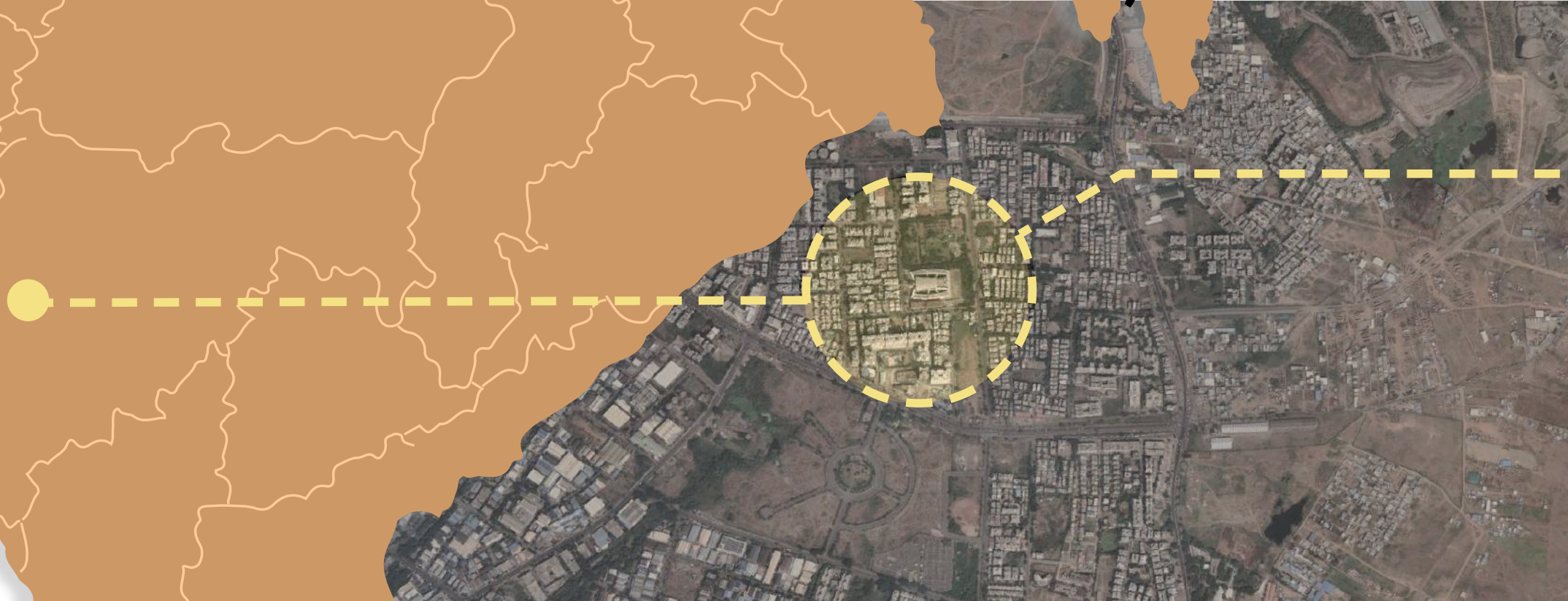
65%

Reduction in water demand by using low flow fixtures for kitchen & toilets



Rainwater is collected in natural ponds meets the annual water demand of the projects & cater to peak run-off from the site

PIMPRI CHINCHWAD NEW TOWN, Pune, Maharashtra



Site Area: **1,25,007.42 SQM**

Built-up Area: **53,173 SQM**

Number of buildings: **16**

Occupancy: **600**

Client: **PIMPRI CHINCHWAD NEW TOWN DEVELOPMENT AUTHORITY**

Principal Architect: **LANDMARK DESIGN GROUP**

Electrical Consultant: **FEDERAL CONSULTANT**

Interior design: **LANDMARK DESIGN GROUP**

Green Building Design & Certification: **THE ENERGY & RESOURCES INSTITUTE, NEW DELH**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

46%

TOTAL
WATER DEMAND
REDUCTION

65%

TOTAL
NUMBER
OF TREES

82

TOTAL
RENEWABLE
ENERGY CAPACITY

114.7
kW

CARBON OFFSET

1,24,374.35
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **43.5%**



Utility corridors are consolidated & strategically aligned with vehicular pathways for efficient planning



Reduction in annual irrigation demand by planting native species plants is **56.3%**



ENERGY-EFFICIENT DESIGN



Percentage of Fly ash content by weight in AAC blocks used to reduce embodied energy is **65%**



Percentage of indoor lighting and HVAC electricity needs met by the PV system is **82%**



Materials used in the building interiors for internal partitions, false ceiling & built furniture, are low-energy, accounting for **74%**



Image showcasing the terrace garden on the east side, shaded by PV panels and complemented by a water body for evaporative cooling
Source: Landmark Design Group



OPTIMIZING BUILDING ENVELOPE

FENESTRATION DESIGN

- Full length openings on the North West & South East facades facilitate cross ventilation in the direction of natural wind patterns of site. Horizontal louvers shade these openings to prevent direct radiation from these critical facades.

- Light shelves are provided in all workspace areas to maintain glare free daylighting. Workspaces are of narrow depth to ensure daylight throughout the depth of the building.

REDUCING ENERGY CONSUMPTION

- Air-conditioned spaces were avoided, & fans are used to provide thermal comfort along with natural ventilation.

- All spaces are equipped with BEE 5-star appliances.

PASSIVE DESIGN FEATURES



ORIENTATION

- The building is designed to maximize daylighting & natural ventilation, so all workstations are in the East, South & East west axis & northwest axis. - PV panels are provided in the east to shade the roof along with the terrace garden. Further a water body is also provided for evaporative cooling in east.

REDUCING HEAT GAIN

- Window to wall ratio of the project is 38% & skylight to roof ratio is 2%, thus reducing direct heat gain.

- The U value of wall is 1.77 W/sq.m.C while U value of roof is 2.09 W/sq.m.C to ensure appropriate insulation of the envelope of building.

- DGU unit of U value 1.7 W/sq.m.C & SHBC of 0.34 for air-conditioned spaces while SGU unit of U value 5.8 W/sq.m.C & SHGC 0.59 is utilized. .for non- air-conditioned spaces.



Image displaying a typical floor plan, with the narrow workspace design highlighted in yellow
Source: Landmark Design Group



LIFESTYLE & INNOVATION



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Organic waste is treated at site using 50kg/day biogas plant for reuse as LPG & manure.



Meters are installed for utilities, HVAC, PV, raw water tanks, and STP outlets for effective monitoring



WATER USE OPTIMIZATION



71.3% Reduction in water demand by using low flow fixtures for kitchens & toilets

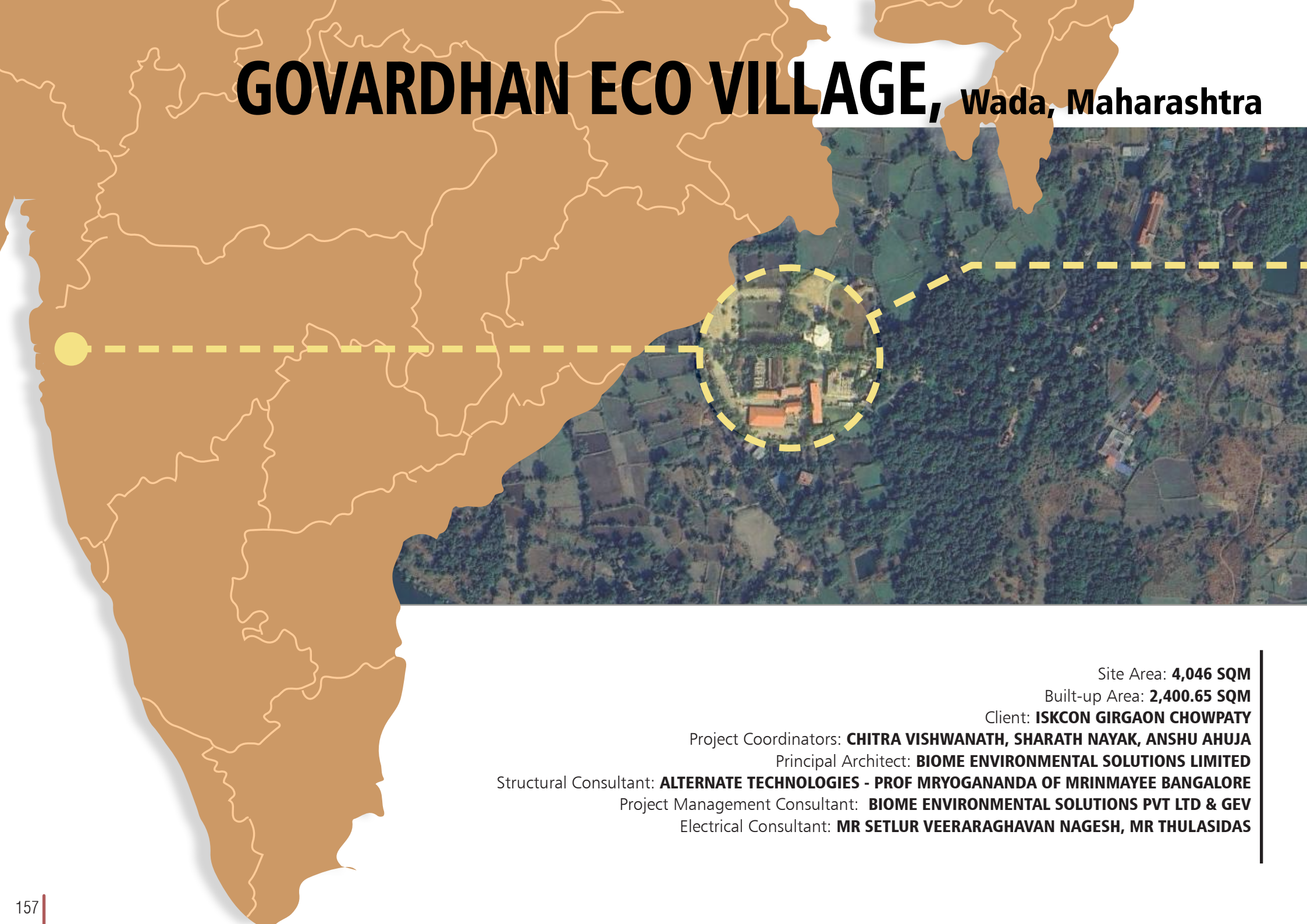


50.1% Annual water reuse on site after treating from MBR 24.3KLD STP for flushing & irrigation



100% Water on-site is efficiently treated and reused within the project, ensuring zero discharge and sustainable water management

GOVARDHAN ECO VILLAGE, Wada, Maharashtra



Site Area: **4,046 SQM**

Built-up Area: **2,400.65 SQM**

Client: **ISKCON GIRGAON CHOWPATY**

Project Coordinators: **CHITRA VISHWANATH, SHARATH NAYAK, ANSHU AHUJA**

Principal Architect: **BIOME ENVIRONMENTAL SOLUTIONS LIMITED**

Structural Consultant: **ALTERNATE TECHNOLOGIES - PROF MRYOGANANDA OF MRINMAYEE BANGALORE**

Project Management Consultant: **BIOME ENVIRONMENTAL SOLUTIONS PVT LTD & GEV**

Electrical Consultant: **MR SETLUR VEERARAGHAVAN NAGESH, MR THULASIDAS**



CLIMATE
WARM & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

57%

TOTAL
WATER DEMAND
REDUCTION

41%

TOTAL
NUMBER
OF TREES

1442

TOTAL
RENEWABLE
ENERGY CAPACITY

39
kW

FROM ENERGY SAVINGS
CARBON OFFSET

18,431.35
TON/ANNUM



STRATEGIC SITE PLANNING

buildings are thoughtfully planned to ensure minimal tree cutting and to preserve existing agricultural land, maintaining the site's natural ecology and sustainability

Buildings are strategically constructed on hard ground to enhance structural stability and reduce foundation costs, ensuring efficient and sustainable development

ENERGY-EFFICIENT DESIGN

Thermal comfort is ensured through double-tile roofing, along with shaded walls and openings, reducing heat gain

Locally sourced, low-energy materials are used in construction to minimize embodied energy and promote sustainability

Optimal window openings, light-colored flooring for better light diffusion, and soft landscaping to reduce reflected glare ensure visual comfort



Image showcasing GEV Biogas plant at site, used to convert all kitchen and landscape waste to bio gas for cooking, resulting in zero waste site



SUSTAINABLE MATERIALS UTILIZED

- Stabilized soil cement blocks are used for unplastered walls, and precast arch panels are utilized for roofs.

- The building blocks consist of stabilized mud blocks with a mixing ratio of 1:4:6 (cement/lime, quarry dust, soil) and an 80:20 cement-lime ratio. Soil replaces fly ash in the composite mortar, mixed in a 1:11 ratio (1 part cement to 11 parts site soil and stone dust/sand). This mortar is used throughout the construction, eliminating plastering and resulting in exposed stabilized mud block walls.

- Foundations feature stone walls built with composite mortar of cement, quarry dust, and soil.

- U-blocks are employed for sills and lintels, reducing the need for concrete. Intermediate roofs, except in toilets, consist of arch panels made of stabilized mud blocks, with precast concrete beams minimizing concrete usage in the buildings.

REDUCING EMBODIED ENERGY

- The final roofs of all buildings feature double-tiled sloping designs, eliminating the need for concrete, while steel members can be easily reused.
- The yoga hall is topped with a thatch roof made from sugarcane thatch, grown on-site, utilizing agricultural waste.
- Stabilized mud blocks are used for non-load-bearing walls, replacing fired clay bricks, with plastering avoided by using proper pointing and roof projections to prevent rain splashes.
- All doors and windows are crafted from reused wood sourced from old buildings. Floors are made from cow dung with a rammed earth subfloor. Locally available marble stone is used for flooring.
- A combination of flamed Sira stone, ceramic, and vitrified tiles has been utilized for flooring. Bison boards fixed on aluminum angles serve as false ceilings in the auditorium and toilets.



LIFESTYLE & INNOVATION



Biogas plant on-site processes food and animal waste, generating up to 30 cu.m of gas for cooking



The slurry produced after biogas extraction is used as a natural fertilizer for organic farming



Organic waste, including kitchen and horticultural waste, is collected and vermi-composted



WATER USE OPTIMIZATION



95%

Sewage water is treated using Soil Biotechnology, an eco-friendly sewage management technology, and reused for landscaping



Image highlighting natural building materials, featuring a rain chain that directs water from the roof to a sump for efficient rainwater management

A one acre pond is created for rainwater storage, with the layout designed based on hydrogeological survey inputs to protect water recharge and discharge zones

GRAPE COUNTY RESORT, Nasik, Maharashtra



Site Area: **21,433 SQM**

Built-up Area: **1475 SQM**

Occupancy: **72**

Client: **GREEN SPACES REALTORS, NASHIK**

Principal Architect: **AR. SANJAY PATIL & AR. SHABBIR UNWALA**

Green Building Design & Certification: **VK:E ENVIRONMENTAL LLP, PUNE**



CLIMATE
HOT & DRY



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

33%

TOTAL
WATER DEMAND
REDUCTION

58%

TOTAL
NUMBER
OF TREES

7025

TOTAL
RENEWABLE
ENERGY CAPACITY

3.7
kW

CARBON OFFSET

9216.03
TON/ANNUM



STRATEGIC SITE PLANNING



Reduction in landscape water demand using sprinkler systems & planting native species is **79%**



Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **61%**



Existing 50 trees were preserved & number of new trees planted is **6975**



ENERGY-EFFICIENT DESIGN



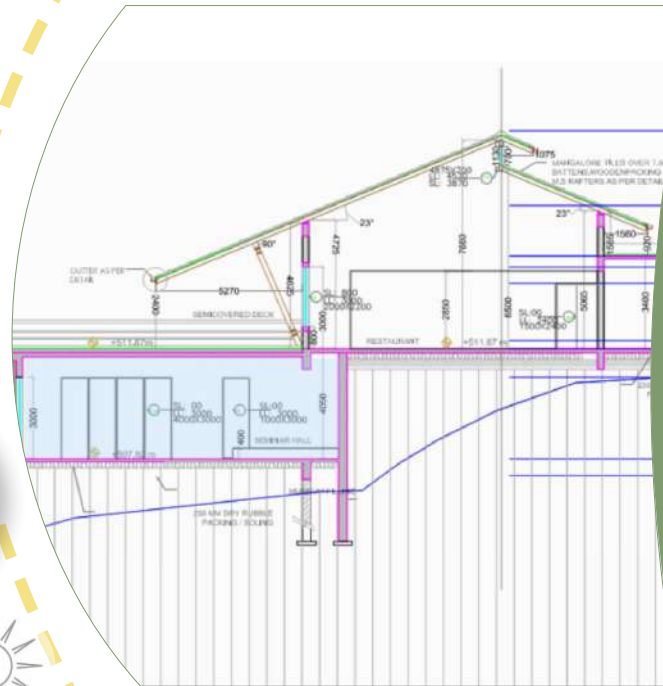
Project is daylit and meets the daylight factor prescribed by NBC for total area of **73.2%**



Project has a Lighting Power Density (LPD) of 3.18 W/sq.m, significantly lower than the ECBC-specified limit of 10.80 W/sq.m



Reduction in embodied energy using AAC blocks, Godhra bricks, Basalt stone & PPC for walling application, is **67.7%**



Building section highlighting areas with earth berm construction, marked in blue, showcasing enhanced insulation and thermal stability

OPTIMIZATION OF SITE USING PASSIVE & ACTIVE DESIGN STRATEGIES



- In the project, earth berming is done for Seminar Hall area & the adjacent zones. Considering the hot & dry climatic conditions of Nashik where the project is located, the earth berming will help in reducing the indoor temperature & reduce the cooling loads for the occasional operation of AC.

- Each of the dwelling units have window areas more than 14% of their respective carpet areas with overall insolation of 55%.

- The windows in both Cottages & the Restaurant building are facing the Windward side of the site. Also, the longer side of the building face the windward side.

- The cottages are two storied & have simple linear plans with decks facing the windward side.

- The shallow plans & large shaded windows & provision of ventilators allow for good cross ventilation.

REDUCING CARBON EMISSIONS OF BUILDING



- The buildings are placed in the ridge across the slope facing where the longer sides of the buildings are facing the Western (windward side) of the site because of the direction of slope towards west.

- Though the longer side of the building face the Western & the Eastern side, these facades are considerably shaded by the deep overhang.

- A reservoir has been created on the North-Western side of the building & the landscape is so designed to have vegetation on the Western side of the site along the valley. This enables evaporative cooling. Also, as per the contour of the site, the rainwater is channelized & finally collected in this reservoir for water harvesting.

- To reduce the solar heat gain due to direct solar radiations on Eastern facade, buffer spaces are provided in the form of store room & loading & unloading bay.



Image showcasing a deep overhang on the west-facing facade, effectively providing shade and reducing heat gain



LIFESTYLE & INNOVATION



Project's proximity to amenities such as a bus stop, bank, and post office helps reduce car dependence



Handbook on environmental awareness is provided to visitors, detailing the project's sustainability measures



Dedicated resting rooms & toilets for support staff has been provided in the project



WATER USE OPTIMIZATION



Rainwater is harvested through on-site reservoirs, eliminating dependency on external water supply



57.95%

Reduction in water demand by using low flow fixtures for kitchen & toilets



100%

Annual water reuse on site after treating using reed bed based STP for irrigation & washing.

VVIP CIRCUIT HOUSE, Pune, Maharashtra



Site Area: **9584.24 SQM**

Built-up Area: **4886.9 SQM**

Occupancy: **119**

Client: **PWD PUNE PROJECT COORDINATOR**

Principal Architect: **AR. SUNIL PATIL**

Landscape Architect: **AR. SUNIL PATIL**

Project management consultant: **PWD**

Structural Consultant: **DR. A. B. KULKARNI & ASSOCIATES**

Green Building Design & Certification: **ENVIRONMENTAL DESIGN SOLUTIONS PVT LTD**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

42%

TOTAL
WATER DEMAND
REDUCTION

50.8%

TOTAL
NUMBER
OF TREES

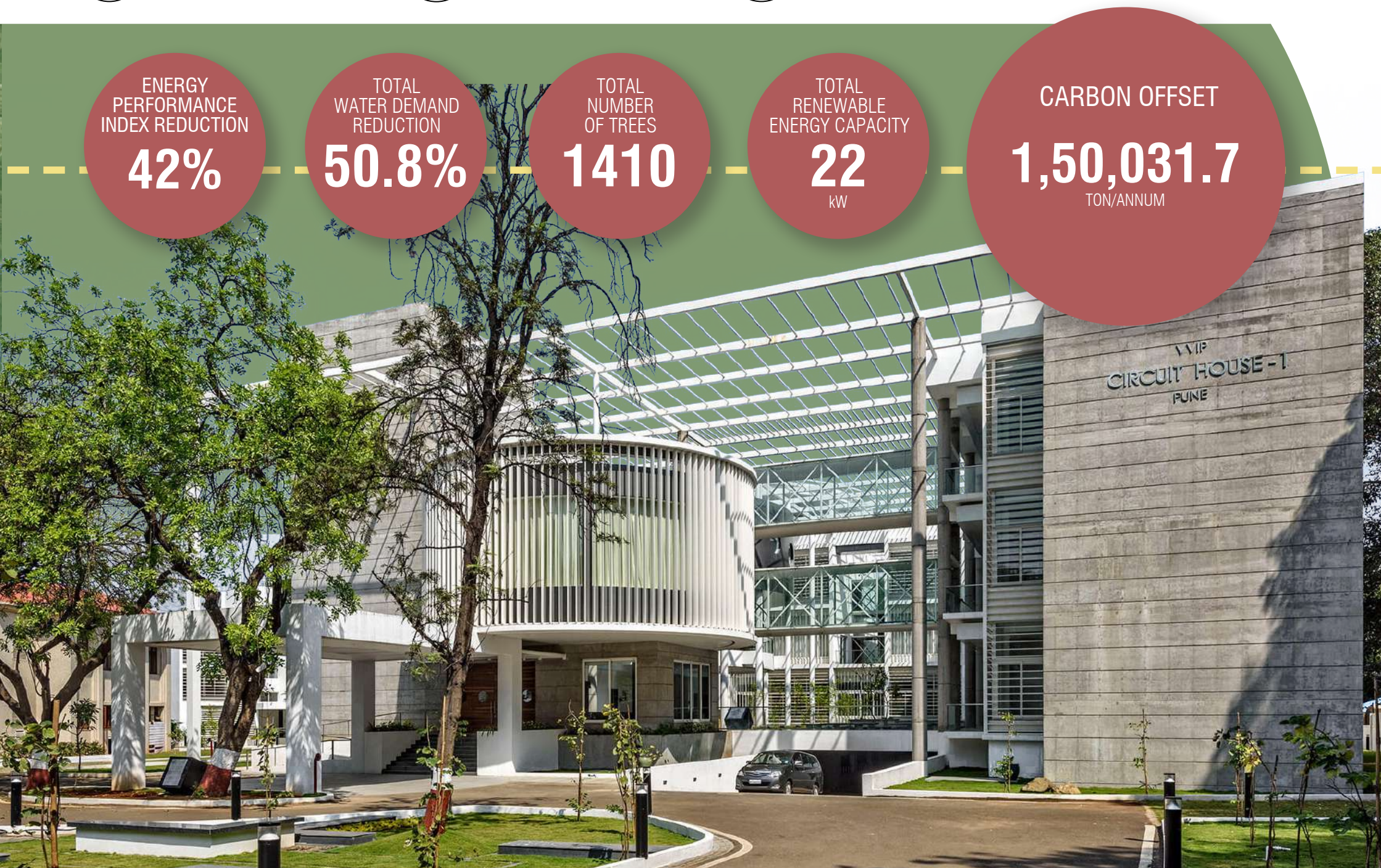
1410

TOTAL
RENEWABLE
ENERGY CAPACITY

22
kW

CARBON OFFSET

1,50,031.7
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total paved site surface shaded &/or covered in high SRI tiles is **50%**



Total site area is paved area, maximixing landscape & green areas. **21.3%**



Exisiting trees were preserved & number of new trees planted is **1410**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **80%**



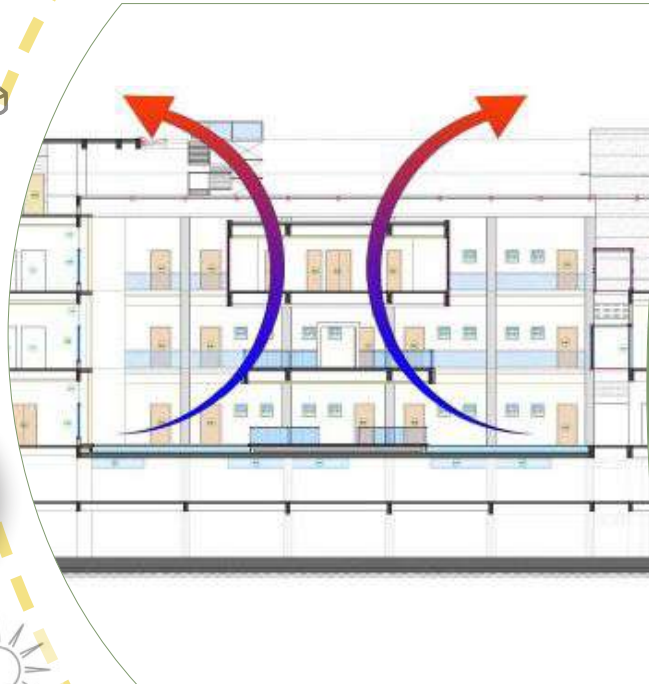
Fly ash content by volume flyash bricks used in walling to reduce embodied energy. **40%**



Materials used in the building interiors for ineternal partitions, false cieling & built furniture, are low-energy, accounting for **32%**



A building section illustrating the courtyard and the stack ventilation effect, highlighting natural airflow and passive cooling



OPTIMIZING BUILDING ENVELOPE

FENESTRATION DESIGN

- The location & size of apertures increases daylighting levels, causes cross ventilation & connect outer environment.

- Daylighting is studied to efficiently decreases the expenses on the electrical energy during the daytime. At the same time, controlled solar access with the help of shading devices reduces cooling load.

VENTILATION

- The building is designed with a courtyard in the center with water bodies to cool temperatures with evaporative cooling, reducing urban heat isl&effect. The court also works for stack ventilation & improves cross ventilation.

- All the Services & corridors & waiting areas are naturally ventilated which effectively decreases the cooling load

PASSIVE DESIGN FEATURES



ORIENTATION

- Site is proportionate along east west axis. This allows building layout to be elongated along North- South face to have maximum day lighting, solar access in winters at the same time adequate sun protection & ventilation in summer.
- Designed to create an organized pattern of roads, open spaces, paths & activities creating compact pedestrian friendly development.
- All services are planned for the east- west side. These spaces act as buffer spaces to habitable spaces in the building.
- All the suites are planned on the north & south face of the building, ensuring daylighting.

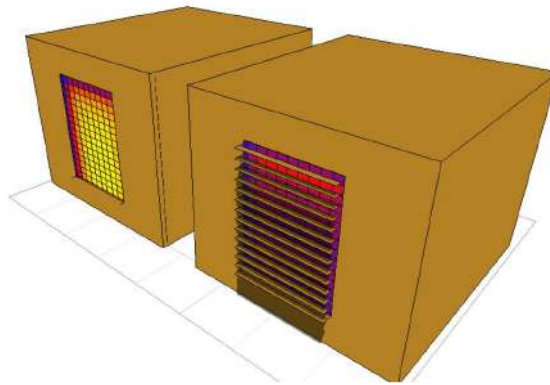


Image showcasing simulation study used to design shading devices for fenestrations, optimizing solar control and energy efficiency



LIFESTYLE & INNOVATION



Efficient waste segregation of waste at site with multiple-colored bins & dedicated waste sorting area



Designated electrical vehicle parking & charging points provided in basement parking



Public tour showcasing the building's green features is conducted for visitors, promoting awareness and sustainability



WATER USE OPTIMIZATION



53.1% Reduced water demand by using low flow fixtures for kitchens & toilets.



48.6% Reduction in annual landscape irrigation demand by planting native species plants & drip irrigation system



42% Annual water reuse on site after treating from Phytorid technology 25KLD STP & 35 KL rainwater storage tank for flushing & irrigation

VASTUKAR DESIGN STUDIO, Bhubaneswar, Odisha



Site Area: **308 SQ M**

Built-up Area: **453 SQ M**

Occupancy: **35**

Client: **PROFESSOR S.S. RAY, PRESIDENT & FOUNDER, VASTUKAR FOUNDATION**

Principal Architect: **S.S. RAY, DIRECTOR, VASTUKAR DESIGN STUDIO**

Green Building Certification: **SUDIPTA SINGH, SUSTAINABLE BUILDINGS & HABITAT, ODISHA**



CLIMATE
WARM & HUMID



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

32%

TOTAL
WATER DEMAND
REDUCTION

50%

TOTAL
NUMBER
OF TREES

3

TOTAL
RENEWABLE
ENERGY CAPACITY

15.8
kW

CARBON OFFSET

3,198.27
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total paved site surface shaded &/or covered in high SRI tiles is **35%**



Reduction in landscape water demand by planting native plant species is **50.7%**



Green roofs and vegetative pergolas help moderate the microclimate and mitigate the Urban Heat Island Effect



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **88%**



Project has a LPD of 2.19 W/sq.m, significantly lower than the ECBC-specified limit of 10.80 W/sq.m, ensuring energy efficiency



Reduction in embodied energy using autoclaved AAC blocks & PPC for walling application. **40.06%**



Sketch illustrating direct evaporative cooling on-site, highlighting the strategic placement of water bodies and the role of natural ventilation in enhancing thermal comfort

OPTIMIZATION USING PASSIVE & ACTIVE DESIGN STRATEGIES



PASSIVE DESIGN FEATURES

- The internal spatial layout is carefully planned to position buffer zones such as storerooms, staircases, and toilets along the eastern and western facades, effectively minimizing heat gain and enhancing indoor thermal comfort.

- A portion of the roof is designed as a green roof, providing additional insulation, reducing heat absorption, and contributing to improved microclimatic conditions.

ACTIVE LOW-ENERGY COOLING/HEATING

- Ceiling fans are strategically installed in office spaces to enhance air circulation, improve occupant comfort, and support energy-efficient cooling.

- Direct evaporative cooling is facilitated by a water body thoughtfully integrated at the building's entrance, helping to lower ambient temperatures and improve thermal comfort.

ENVELOPE PERFORMANCE FOR COMFORT

105
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures:

- Single glazed unit glass window of VLT 6%, SHGC of 0.16 & U-value of 3.16 W/m²K.
- Further glazing coated with High performance solar film to reduce direct heat gain.
- Window to Wall ratio of 24% to maintain balance between daylighting & heat gain to maintain comfort.



LIFESTYLE & INNOVATION



Project's proximity to amenities such as a bus stop, bank, and post office helps reduce car dependence



Books available in the office library to promote awareness of sustainable building practices



Dedicated resting rooms & toilets for support staff has been provided in the project



WATER USE OPTIMIZATION



Rainwater recharge pit provided on site, along with filtration system, to recharge the ground water



39.86%

Reduction water demand by using low flow fixtures for kitchen & toilets.



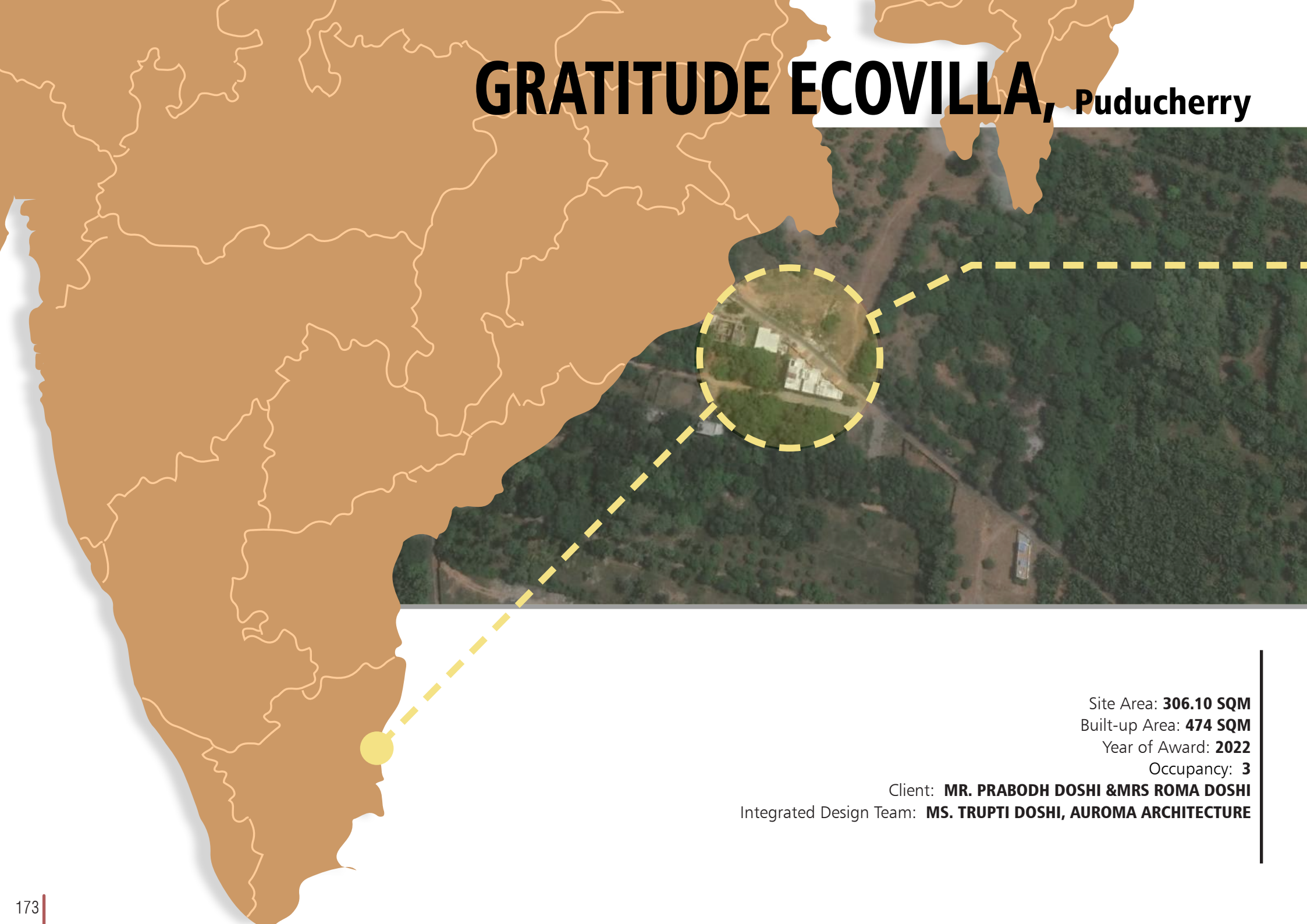
75%

13,592-litre rainwater storage & harvesting tank is installed to meet the site's water demand for two days



A 3D view showcasing the shading of hardscaped areas through vegetative pergolas, enhancing thermal comfort and reducing heat buildup on-site

GRATITUDE ECOVILLA, Puducherry



Site Area: **306.10 SQM**

Built-up Area: **474 SQM**

Year of Award: **2022**

Occupancy: **3**

Client: **MR. PRABODH DOSHI & MRS ROMA DOSHI**

Integrated Design Team: **MS. TRUPTI DOSHI, AUROMA ARCHITECTURE**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
SVA GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

24%

TOTAL
WATER DEMAND
REDUCTION

50%

TOTAL
NUMBER
OF TREES

2

TOTAL
RENEWABLE
ENERGY CAPACITY

1.4
kW

FROM ENERGY SAVINGS
CARBON OFFSET

1,663.55
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface softscaped &/or covered in high SRI tiles is **83.25%**



Reduction in irrigation demand using native species of plants is **76.7%**



Green roofs and vegetative pergolas help moderate the microclimate and mitigate the Urban Heat Island Effect



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **92.8%**



Project has a LPD of 3.22 W/sq.m, significantly lower than the ECBC-specified limit of 10.80 W/sq.m, ensuring energy efficiency



Percentage reduction in the embodied energy of project using AAC blocks for non structural application accounts for **41.35%**



A sectional view illustrating the strategic placement of buffer spaces in unfavorable directions, minimizing heat gain and enhancing thermal comfort in occupied areas



OPTIMIZING BUILDING ENVELOPE TO REDUCE ENERGY DEMAND

450.22
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures:

-Single glazed unit(SGU) with SHGC of 0.68 were installed in the project.

-AAC blocks were used for walling. Also, rat trap bond was used in the project to provide air gap in the envelope providing insulation.

-Roof of the project was insulated & high SRI roof tiles were installed to reduce heat gain.

ACTIVE AND PASSIVE LOW IMPACT DESIGN STRATEGIES



INTERNAL DISTRIBUTION OF SPACES:

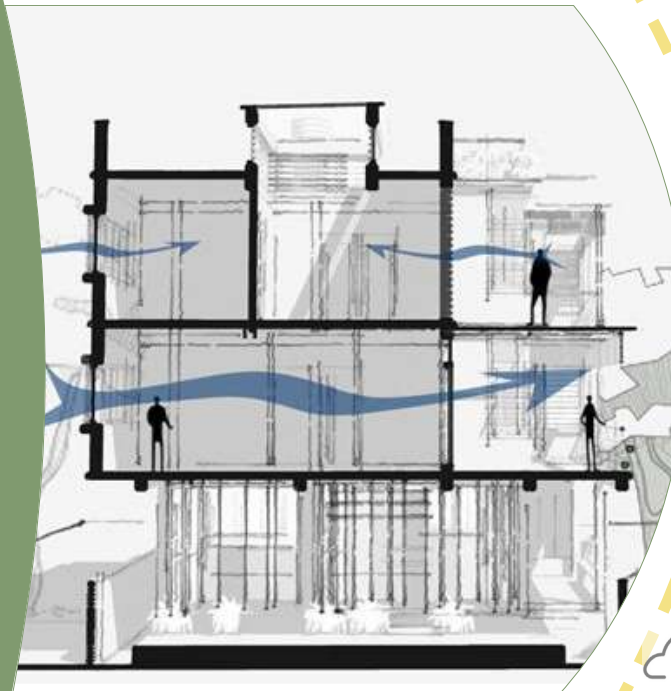
Buffer zones, including storages, bathrooms, walk-in closets, and staircases, are strategically placed along critical orientations such as the west and east facades to minimize heat gain. This is illustrated in the project sketch on the left.

CROSS VENTILATION:

Windows are positioned on opposite sides of interior spaces to enable effective cross-ventilation, enhancing natural airflow and thermal comfort. This is depicted in the project sketch on the right.

ACTIVE FEATURES:

High-efficiency BEE 5-star equivalent fans are installed to improve air circulation and reduce energy consumption.



A sectional view illustrating the integration of cross ventilation and stack ventilation strategies within the project, enhancing natural airflow and indoor thermal comfort



LIFESTYLE & INNOVATION



100% of the organic waste generated is treated in composting drums, ensuring sustainable waste management



Environmental awareness signage and banners are prominently displayed on-site to promote sustainability



Dedicated resting rooms & toilets for support staff has been provided in the project



WATER USE OPTIMIZATION



A rainwater recharge pit with a proper filtration system is provided to replenish the groundwater aquifer efficiently.



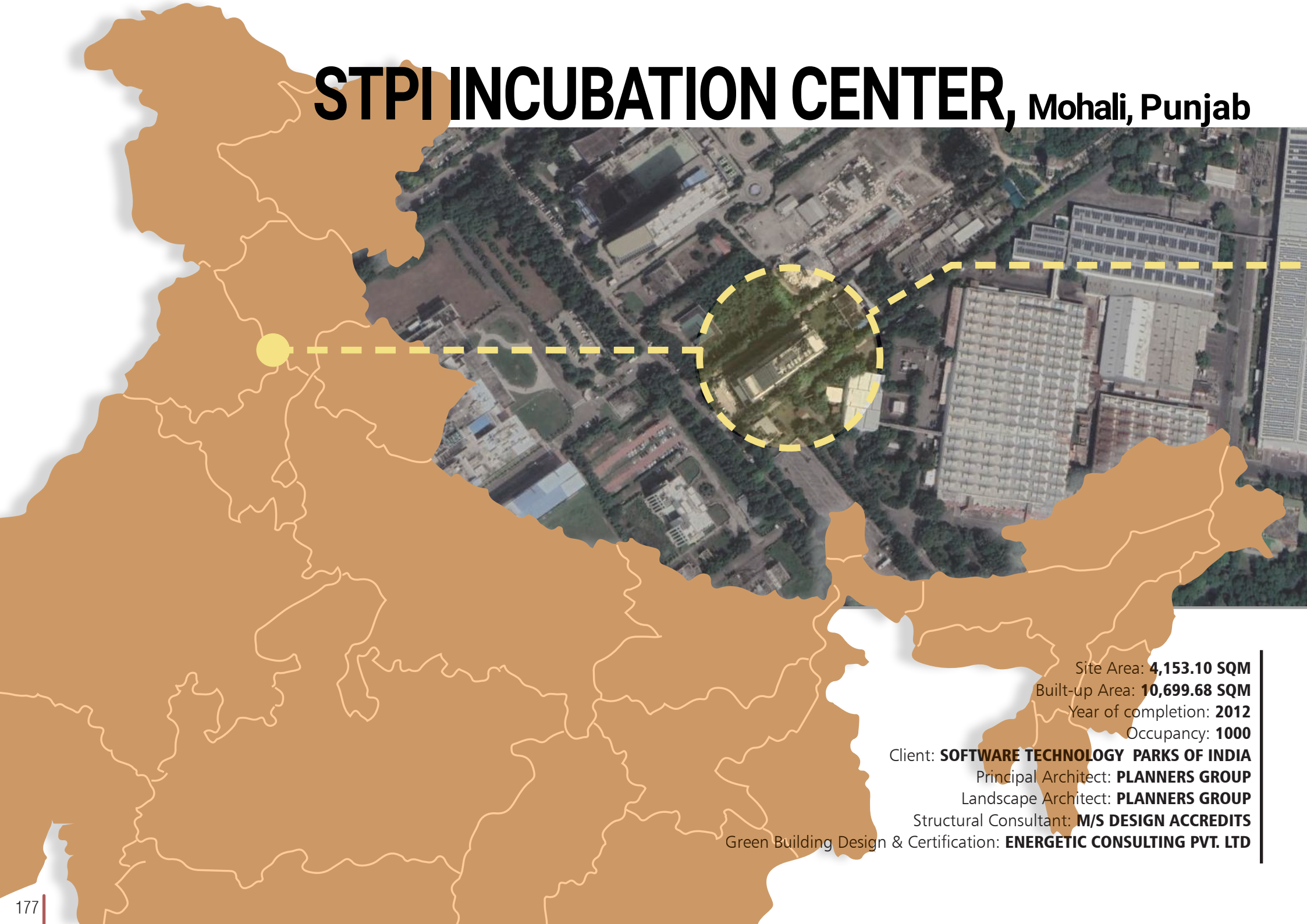
50.19% Reduction building water consumption by use of water efficient & low flow fixtures



75%

30% of the two-day building water demand is met through a 1,120-liter rainwater storage system for reuse within the building

STPI INCUBATION CENTER, Mohali, Punjab



Site Area: **4,153.10 SQM**

Built-up Area: **10,699.68 SQM**

Year of completion: **2012**

Occupancy: **1000**

Client: **SOFTWARE TECHNOLOGY PARKS OF INDIA**

Principal Architect: **PLANNERS GROUP**

Landscape Architect: **PLANNERS GROUP**

Structural Consultant: **M/S DESIGN ACCREDITS**

Green Building Design & Certification: **ENERGETIC CONSULTING PVT. LTD**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

50.7%

TOTAL
WATER DEMAND
REDUCTION

72%

TOTAL
NUMBER
OF TREES

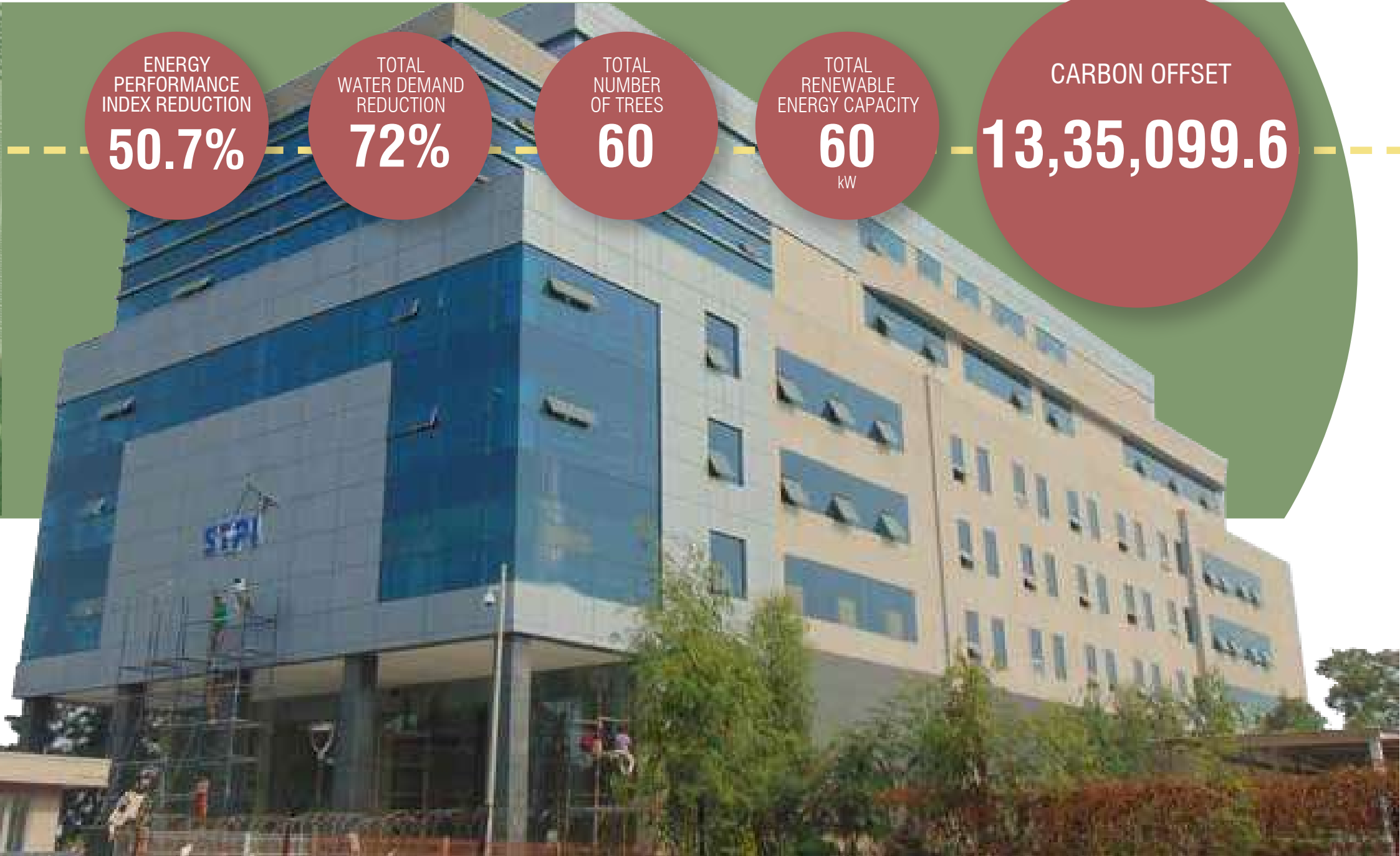
60

TOTAL
RENEWABLE
ENERGY CAPACITY

60
kW

CARBON OFFSET

13,35,099.6



STRATEGIC SITE PLANNING

Percentage of total site surface softscaped/ shaded &/or covered in high SRI tiles is **63.5%**



Number of new trees of native species planted at site along the periphery to reduce traffic noise is **60**



The impervious factor of the site prescribed by NBC 2005 is **87.4%**



ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **75.7%**



Percentage reduction in the embodied energy of project using AAC blocks for non structural application accounts for **21.56%**



Materials used in the building doors & windows are low environment impact materials like UPVC. **90.94%**



OPTIMIZATION ENVELOPE PERFORMANCE WITH GLAZING

119.63
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures:

- Double glazed unit glass window of VLT 32%, SHGC of 0.2 & U-value of 1.5 W/m²K.
- Further glazing coated with reflective external coating of 10% to reduce heat gain.
- Window to Wall ratio of 38.8% to maintain balance between daylighting & heat gain to maintain comfort.



Image showcasing high-reflective DGU glass used for external glazing, effectively reducing heat gain and improving energy efficiency

STRATEGIES FOR MAINTAINING INDOOR COMFORT LEVEL



- MERV13 filters are installed in the ventilation system of the building.

- On site testing report demonstrated that

PM1 - 0:4 ug/m³

PM2 - 5:4 ug/m³

PM5 - 0:4 ug/m³

Indoor air quality levels under acceptable under CPCB National Ambient Air Quality Standard(NAAQS)

- Sensors installed at AHU level via BMS in conditioned spaces to monitor

CO2

Temperature

Relative humidity

- 100% of the paints, adhesives & sealants are Low VOC



image showcasing the shading of the roof with installed solar panels, effectively reducing heat gain and enhancing energy efficiency on-site



LIFESTYLE & INNOVATION



Smart metering and monitoring systems are implemented for energy and water usage across irrigation, the HVAC plant, and lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Provision for campus visits is made to generate awareness and promote sustainable practices



WATER USE OPTIMIZATION



72.67%

Reduction in water demand by using low flow fixtures for kitchen & toilets.



Two aquifer recharge pits with a proper filtration system are provided to enhance groundwater recharge



65.51%

Reduction in annual landscape water demand using drip irrigation & planting native species of plants

BHAMASHAH DATA CENTRE, Jaipur, Rajasthan



Site Area: **13,187.43 SQM**

Built-up Area: **23,920 SQM**

Year of completion: **2020**

Occupancy: **1600**

Client: **DEPARTMENT OF INFORMATION TECHNOLOGY & COMMUNICATION**

Principal Architect: **AXES ARCHITECTURE, JAIPUR**

Landscape Architect: **AXES ARCHITECTURE, JAIPUR**

Structural Consultant: **AXES ARCHITECTURE, JAIPUR**

Electrical Consultant: **STERLING & WILSON**

Green Building Design & Certification: **ECO ENERGY EXPERT SERVICES LLP, NEW DELHI**



CLIMATE
HOT & DRY



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

40.1%

TOTAL
WATER DEMAND
REDUCTION

52.2%

TOTAL
NUMBER
OF TREES

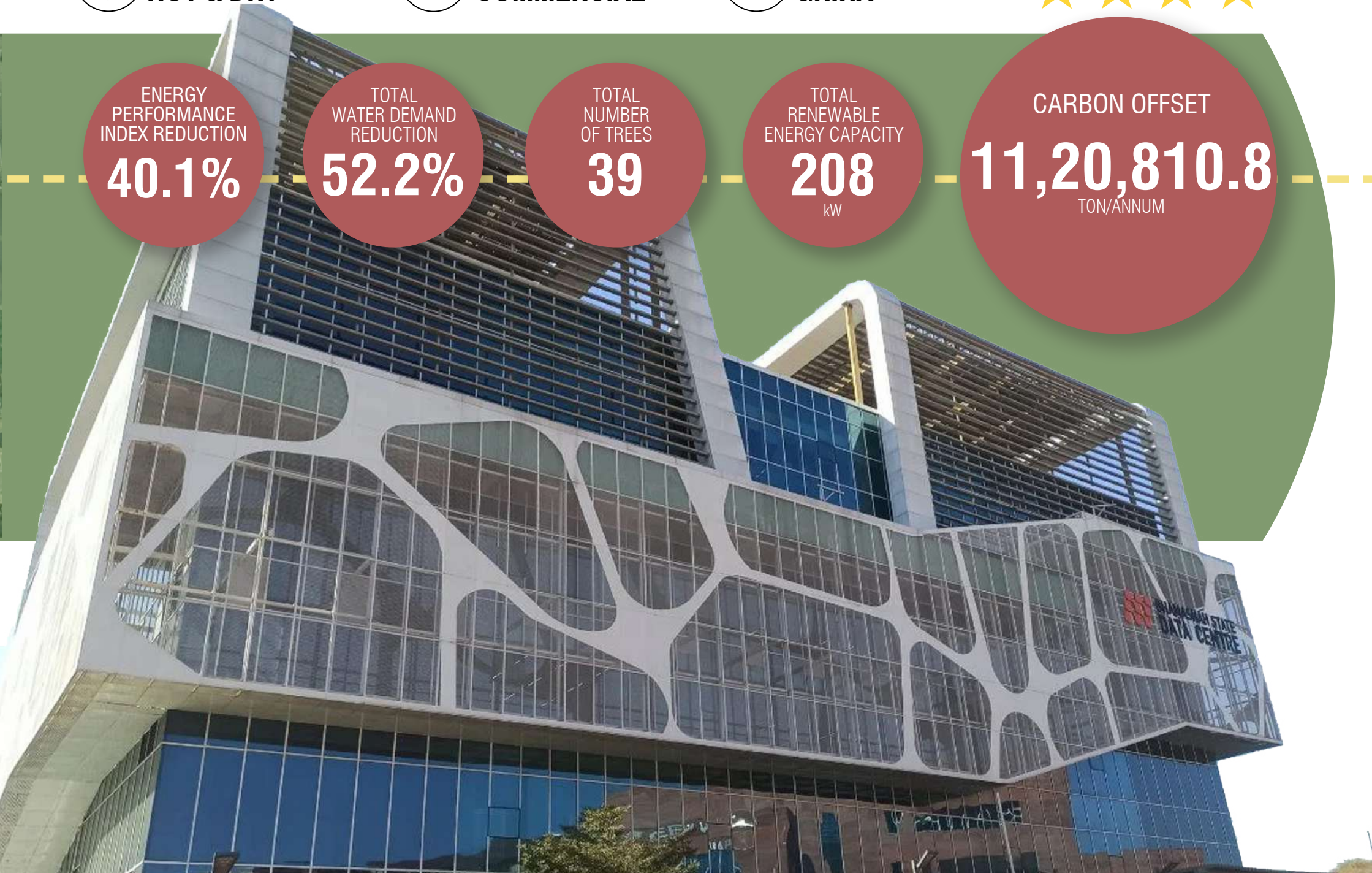
39

TOTAL
RENEWABLE
ENERGY CAPACITY

208
kW

CARBON OFFSET

11,20,810.8
TON/ANNUM



STRATEGIC SITE PLANNING

Pedestrian pathways connecting the two buildings and surface parking areas are fully shaded, enhancing thermal comfort and reducing heat buildup



Percentage reduction in landscape water demand by planting native species of plants is

60.7%



Percentage of construction waste repurposed and diverted from landfills is

82.5%



ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of

39.2%



Materials used for flooring on site are low energy comprising Kota stone, marble, granite & vitrified tiles, accounting for

88.54%



Percentage reduction in the embodied energy of project using AAC blocks for non structural application accounts for

25.8%



Image showcasing roof pergolas supporting solar panels, which also provide shade to the services and roof below, effectively reducing heat gain



ENVELOPE PERFORMANCE FOR COMFORT

0.61 W/m²K

U-value of the external walls

19.91%

Window Wall Ratio(WWR) for all buildings

0.23 SHGC

42% VLT

1.5 W/m²K U value

for the facade glazing in the project, complying to requirements of ECBC 2007.

PASSIVE & ACTIVE DESIGN STRATEGIES



PASSIVE STRATEGIES:

- A solar PV system is installed after analyzing the sun-path pattern, with solar arrays strategically arranged to maximize electricity generation
- Water drainage follows the natural slope of the site, utilizing gravity for efficient movement

ACTIVE STRATEGIES:

- Outdoor lighting is controlled through automatic shutoff using microprocessor-based and digital timer controls
- Interior lighting is managed with manual switches and occupancy sensors for energy efficiency
- A BMS system is implemented for localized temperature control, while a VRV system with chillers (COP 3.61) is used for space conditioning



Image showcasing the shading devices integrated into the building façade, effectively minimizing direct heat gain and enhancing energy efficiency



LIFESTYLE & INNOVATION



Smart metering and monitoring systems are implemented for energy and water usage across irrigation, the HVAC plant, and lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Online monitoring of the PV system is implemented, with real-time performance details displayed at the building entrance



WATER USE OPTIMIZATION



50.4% Reduction in building water consumption by use of water efficient & low flow fixtures

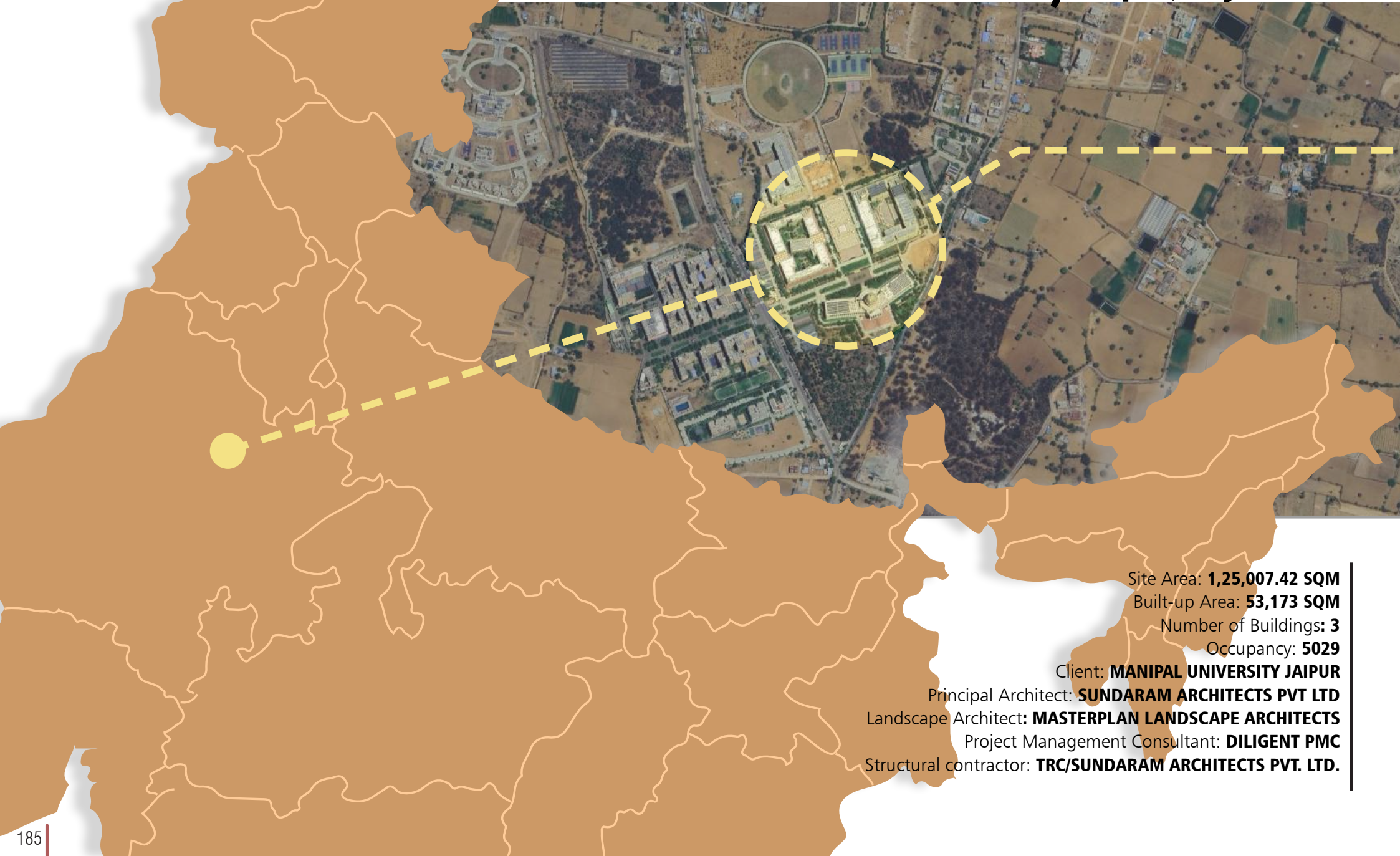


Two Fluidized Bed Reactor (FBR) type STPs with a capacity of 90 KLD each are installed on-site for efficient wastewater treatment



47.95% Annual water reuse on-site is achieved for flushing and irrigation demand through treated water from the STP

MANIPAL UNIVERSITY CAMPUS, Jaipur, Rajasthan



Site Area: **1,25,007.42 SQM**

Built-up Area: **53,173 SQM**

Number of Buildings: **3**

Occupancy: **5029**

Client: **MANIPAL UNIVERSITY JAIPUR**

Principal Architect: **SUNDARAM ARCHITECTS PVT LTD**

Landscape Architect: **MASTERPLAN LANDSCAPE ARCHITECTS**

Project Management Consultant: **DILIGENT PMC**

Structural contractor: **TRC/SUNDARAM ARCHITECTS PVT. LTD.**



CLIMATE
HOT & DRY



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

76.1%

TOTAL
WATER DEMAND
REDUCTION

71.5%

TOTAL
NUMBER
OF TREES

89

TOTAL
RENEWABLE
ENERGY CAPACITY

270
kW

CARBON OFFSET

37,54,556.16
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface softscaped/
shaded &/or covered in high SRI tiles is **63.7%**



Landscaping is designed to minimize the urban heat island effect, guided by irradiation and wind studies



Reduction in annual irrigation demand
by planting native species plants is **84.2%**



ENERGY-EFFICIENT DESIGN



Fly ash content by weight AAC blocks have
been used to reduce embodied energy. **50%**



Materials used in the building doors & windows are low environment
impact materials like compressed wood, veneer wall & gypsym partitions



Percentage reduction in the embodied energy of project
using AAC blocks for non structural application accounts for **43.3%**



Image showing external façade of the building with shaded walkways along the edge of the building & extensive jalis to provide shade to windows



OPTIMIZING DESIGN FOR REDUCED HEATGAIN

- Covered pathway was provided all along the perimeter of building block for higher pedestrian comfort

- One large courtyard is broken up into two small ones to improve the self-shading of the blocks With max amount of thermal mass on external walls & courtyard facing walls

- Irradiation mapping was used to arrive at areas that require dense vegetation to minimise urban heat island effect. The intent was also to ensure that spaces between building had enough shade so the pedestrians can walk under the shade

- Both external walls & internal walls are well buffered either with corridors or jalis to offset heat gain. On south face window massing was done to shade the window area. On west façade jaali's were used to shade the exposed window areas to provide effective shade against afternoon sun

OPTIMIZATION PASSIVE DESIGN FEATURES IN PROJECT

ORIENTATION

- The massing of this building is done in response site contours such that uniform plinth level is maintained across the length of building. This configuration allowed for use of minimal amount of cut & fill on site.
- The building has two parts- one oriented north-south & other oriented north-west & south east for favourable conditions

VENTILATION

- Design has considered the direction of day & night wind patterns. The primary wind direction in Jaipur is West to East
- The large lobby openings on the east & west, along with the open food court along the east & west access allows for free flow of through the courtyard, & around the building.
- The free wind flow through the space along with the lush green vegetated courtyard acts as a cool air pond, helping in the natural cooling of the building



LIFESTYLE & INNOVATION



Smart metering and monitoring systems are implemented for energy and water usage across irrigation, the HVAC plant, and lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Organic waste treated at site using 500 kg/day biogas plant for reuse as LPG & manure



WATER USE OPTIMIZATION



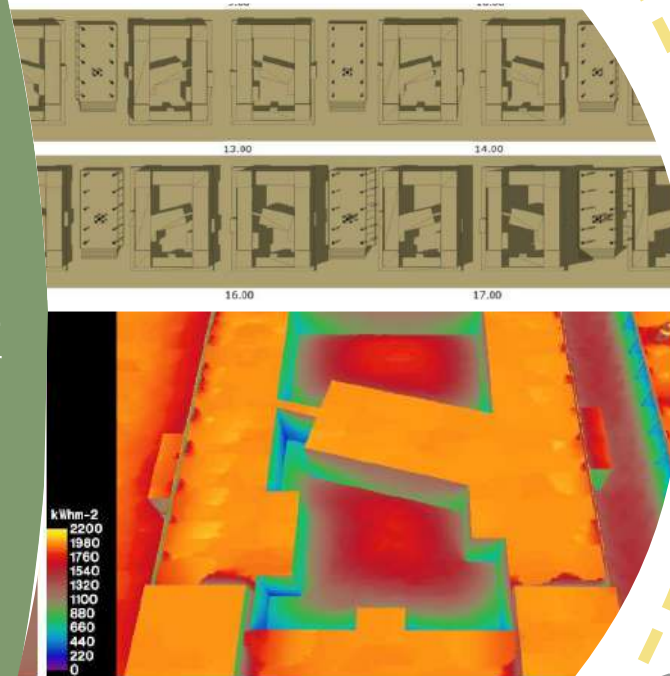
58.7% Reduction water demand by using low flow fixtures for kitchens & toilets



79.4% Annual water reuse on site after treating from MBR 150 KLD STP for flushing & irrigation



Surface rainwater runoff is collected in tanks for reuse, while stormwater is managed through swales for effective groundwater recharge



Solar shading study & irradiance mapping of the courtyard to understand shading patterns. Further also find appropriate areas need for passive cooling

Singareni power
project 2x600 MW

SERVICE BUILDING, Pegadapalli, Telangana



Site Area: **1,905 SQM**

Built-up Area: **6,086.5 SQM**

Occupancy: **500**

Client: **THE SINGARENI COLLIERIES COMPANY LTD. (SCCL-STPP)**

Principal Architect: **M/S GREENTREE BUILDING ENERGY PVT. LTD. & BHARAT HEAVY ELECTRICAL LTD. (BHEL)**

Landscape architect: **M/S GREENTREE BUILDING ENERGY PVT. LTD.**

Project management: **BHARAT HEAVY ELECTRICAL LIMITED (BHEL)**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

47.8%

TOTAL
WATER DEMAND
REDUCTION

57.6%

TOTAL
NUMBER
OF TREES

97

TOTAL
RENEWABLE
ENERGY CAPACITY

10
kW

CARBON OFFSET

40,17,959
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface softscaped/shaded &/or covered in high SRI tiles, to reduce UHIE is **51%**



Excavated topsoil was systematically preserved and effectively reused for landscaping within the site



Number of new trees of native species planted at site along the periphery to reduce traffic noise is **97**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **62.9%**



Percentage reduction in the embodied energy of project using AAC blocks for non structural application is **30%**



Materials used in the building interiors are low environment impact materials like pressed WPC for door & windows, stone for flooring & counters and, tiles, accounting for **100%**



Image showcasing a polycarbonate-covered courtyard designed to maximize natural daylighting within the building

OPTIMIZATION OF BUILDING USING PASSIVE DESIGN STRATEGIES



FENESTRATION DESIGN

- Windows of the building have been placed on all four sides with adequate provision for shading to prevent heat gain

- All the regularly occupied spaces are day-lit properly as the window openings are free from any obstructions that may block a clear view of the sky from them

- The Central space of the building have adequate natural daylight as the atrium has been designed which is covered from the top

REDUCING ENERGY CONSUMPTION

- All sewage from the building is directed to a Sewage Treatment Plant through a network of gravity-fed sewer pipes reducing energy need for pumps

- All the regularly occupied spaces are day-lit properly reducing energy load from electrical lighting

OPTIMIZING DESIGN FOR REDUCING HEAT GAIN



ORIENTATION

- The longer axis of the building is facing the north-south direction. West direction receives maximum solar radiation during summer; therefore, the building is oriented to minimize west facing façade

REDUCING HEAT GAIN

- The façade also has been designed in various levels for aesthetic as well as for minimizing the heat & glare effect through shading of windows

- Façade with cavity walls has been utilized to ensure insulation from heat gain from walls in the façade

- Pergolas have been provided on the rooftop of the building which adds on the building to look more appealing & shade the façade. This minimizes the heat gained from windows & facade



Close-up image of the façade highlighting window shading and self-shading achieved through varied building levels



LIFESTYLE & INNOVATION



Smart metering and monitoring systems are implemented for energy and water usage across irrigation, the HVAC plant, and lighting



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Signages have been installed at multiple locations across site to highlight the green measures implemented



WATER USE OPTIMIZATION



58.2% Reduction in water demand by using low flow fixtures for kitchen & toilets



56% Reduction in landscape water demand using drip irrigation, native tree plantation & reduced turf area.

ITC KOHENUR, Hyderabad, Telangana



Site Area: **20,257 SQM**

Built-up Area: **49,594.99 SQM**

Occupancy: **1400**

Client: **ITC LIMITED**

Integrated design team: **ATKINS GLOBAL, DUBAI**

Green Building Design & Certification: **ENVIRONMENTAL DESIGN SOLUTIONS PVT. LTD.**



CLIMATE
WARM & HUMID



TYPE
RESIDENTIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

82.2%

TOTAL
WATER DEMAND
REDUCTION

58%

TOTAL
NUMBER
OF TREES

258

TOTAL
RENEWABLE
ENERGY CAPACITY

6
kW

CARBON OFFSET

1,50,52,406
TON/ANNUM



STRATEGIC SITE PLANNING



Basic amenities are located within a 0.5 km radius of the project, minimizing transportation needs and reducing the carbon footprint.



Reduction in landscape water demand using efficient irrigation is **63.8%**



Number of new trees of native species planted at site is **258**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **83.4%**



Reduction in embodied energy replacing brick with concrete block & drywall for interior partitions is **68%**



Materials used in the building interiors for false ceiling, internal partitions & paneling are low environment impact materials like , accounting for **71%**

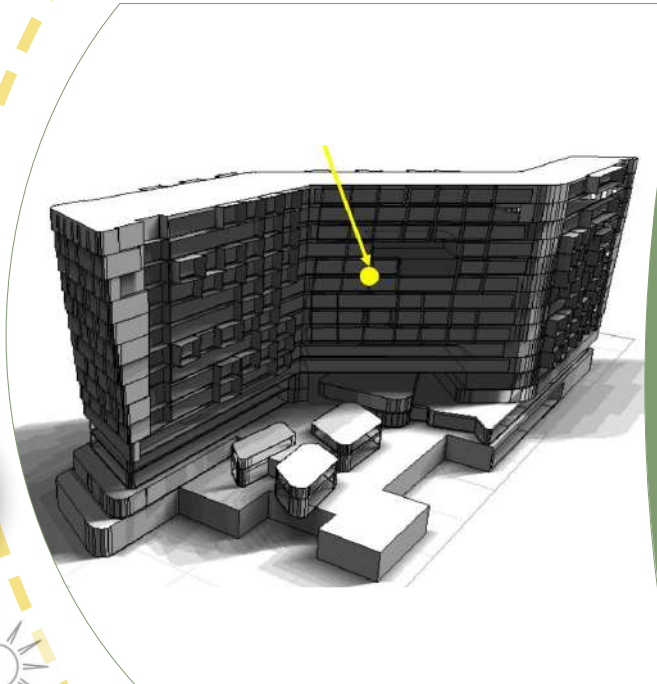


Image showcasing the shadow study conducted to optimize shading strategies for different facades based on solar angles



PASSIVE DESIGN STRATEGIES AT SITE

- The tower design is rotated to align it with the optimum orientation defined by the sun angles which is 93 degrees from North. This enables minimum solar gain in summer & highest in winter

- Adequate provision of shading has been done on the Eastern facade & the western facade to prevent heat gain. Also, East & West facades have vertical shading devices according to the low sun angle

- All the windows in the facades are recessed with overhangs & with vertical louvers, which make them completely shaded

INTEGRATED LANDSCAPE DESIGN REDUCING UHIE EFFECTS



- The site slopes have been judiciously used for rain water drainage by gravity, ensuring no expenditure on the energy consumption.

- Trees & shrubs have been planted throughout the site that provide some shade to the building's exterior, roads & hard paving surface. The paved areas/roads are of grass pavers to minimize hardscape UHIE

- The mass of the building is folded to fit within the allowable setbacks, as well as maximize the views toward the lake. Also it is tapered downwards to further reduce solar heat gain on East & West facades. The podium greens creating a clear canvas of green landscape in the building



Close-up image of the facade highlighting diverse shading strategies tailored to different orientations



LIFESTYLE & INNOVATION



Biodegradable waste generated is treated on site through 300kg Organic Waste Composter



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



8% of parking spaces in project are dedicated to carpooling vehicles



WATER USE OPTIMIZATION



53.9% Reduction in water demand by using low flow fixtures for kitchen & toilets



Rainwater storage of 192 KLD provided at site along with desilting chambers & grease traps



46.5%

Annual water reuse on site after treating from FBR type STP of 320 KLD for irrigation & flushing purpose, the remaining sludge will be used as manure

AIRPORT TERMINAL BUILDING, Agartala, Tripura



Site Area: **1,13,835 SQM**

Built-up Area: **53,173 SQM**

Occupancy: **6032**

Client: **AIRPORT AUTHORITY OF INDIA**

Integrated design team: **CREATIVE GROUP LLP**

Green Building Design & Certification: **DESIGN2OCCUPANCY SERVICES LLP**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



(PROVISIONAL)

ENERGY
PERFORMANCE
INDEX REDUCTION

46.4%

TOTAL
WATER DEMAND
REDUCTION

64%

TOTAL
NUMBER
OF TREES

1,117

TOTAL
RENEWABLE
ENERGY CAPACITY

250
kW

CARBON OFFSET

6,21,176
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface softscaped/ shaded &/or covered in high SRI tiles, is **77.5%**



Net impervious factor of the project, reducing run off of storm water is **70.5%**



Exisiting 171 trees were preserved at site & number of new native trees planted is **946**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **93%**



Materials used in the building interiors are low environment impact materials, accounting for **75%**



Reduction in embodied energy through the use of Fly Ash and AAC blocks in wall construction accounts for **70%**



Rendered image showcasing extensive shading on the east-facing front façade

ACHIEVING & MAINTAINING COMFORT FOR OCCUPANTS



- Various shading devices are provided to reduce exposure to radiant heat gain.

- The overall Window Wall Ratio (WWR) is 88%, ensuring that 93% of total habitable area is under recommended daylighting factor.

- The artificial lighting in the project meets the minimum required lux levels criteria and also meets the uniformity ratio of 0.4 as specified in NBC 2005.

- The project has installed Double Glazed Glass with SHGC of 0.2 for all the fenestrations in the East, West, South, and North Direction to reduce heat gain while ensuring daylighting.

- Relative humidity and temperatures are monitored through BMS system to ensure thermal comfort of occupants.

OPTIMIZATION PASSIVE DESIGN FEATURES IN PROJECT



- The Terminal Building plan is rectangular, because of site constraints (i.e., already existing runway) building a longer facade is oriented on the East-West axis which could lead to heat gain. Therefore, to mitigate unfavorable orientations like West, all the regularly occupied spaces such as ticket counters, immigration, & security hold areas are located on the east side of the ground floor.
- More than 50% of the unfavorable orientations are abutted with buffer zones & service areas such as restrooms, stairwells, & baggage segregation areas
- Along with buffer spaces, East & West facades are shaded by a projection of more than 11m which will reduce solar gain & will increase the amount of diffused daylighting.

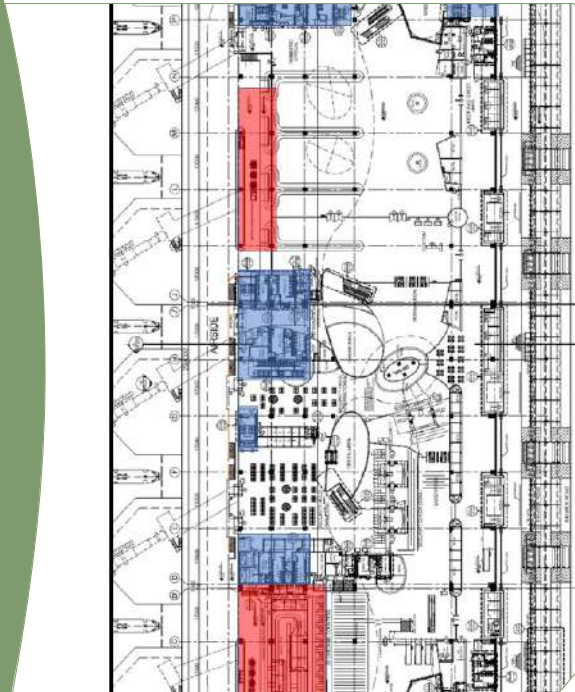


Image showcasing the ground floor plan with buffer spaces clearly highlighted



LIFESTYLE & INNOVATION



Smart metering and monitoring systems are implemented for energy and water usage across irrigation, the HVAC plant, and lighting and relative humidity, CO₂ & temperature



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Dedicated electric vehicle parking and charging stations are provided for up to eight vehicles



WATER USE OPTIMIZATION



57.2%

Reduction in annual landscape irrigation demand by planting native species plants



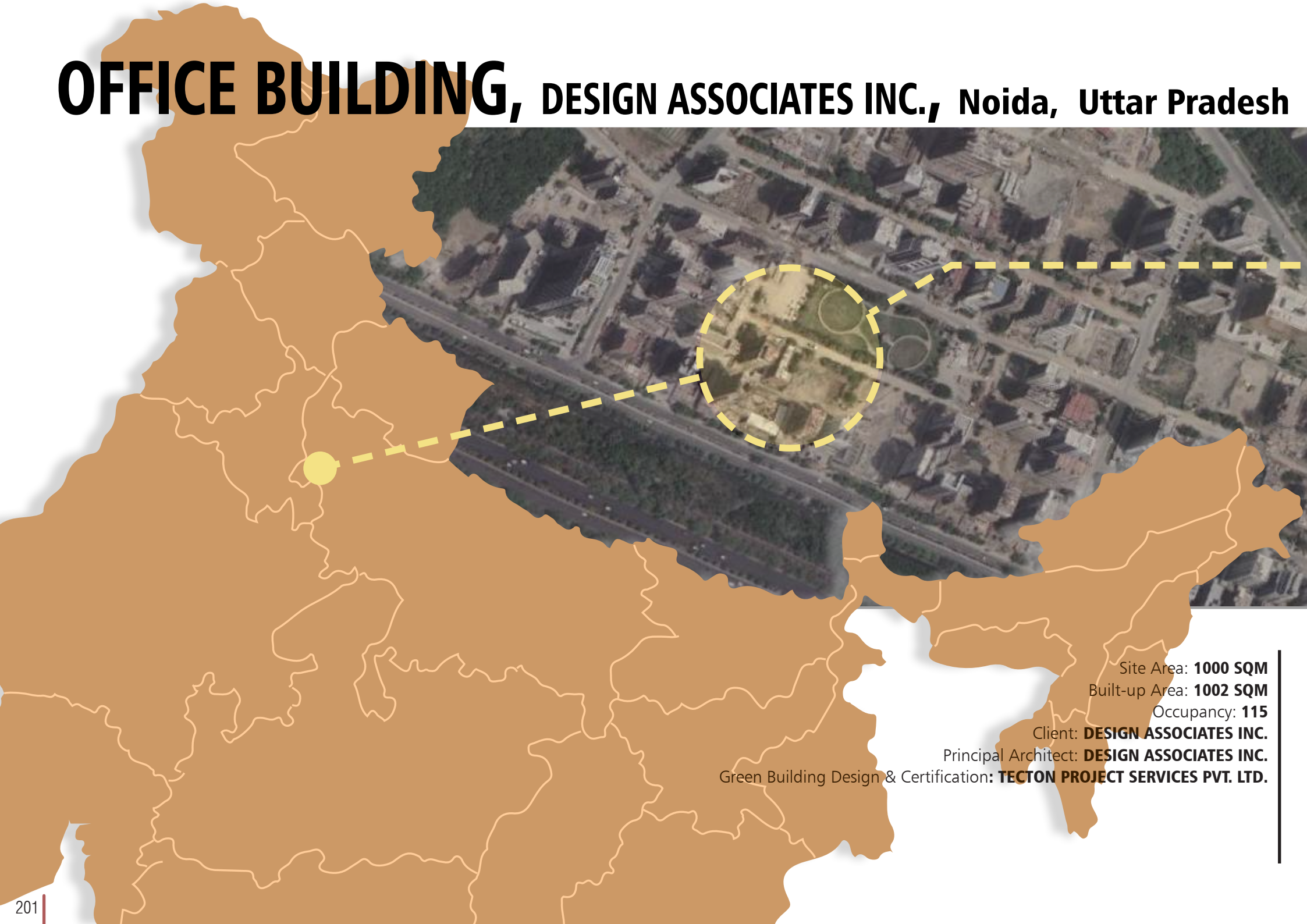
70.9%

Annual water reuse on site after treating from FAB type 440KLD STP for flushing & irrigation



Shallow drainage channels (swales) are constructed on-site to reduce and store surface runoff while filtering out organic waste and sediments

OFFICE BUILDING, DESIGN ASSOCIATES INC., Noida, Uttar Pradesh



Site Area: **1000 SQM**
Built-up Area: **1002 SQM**
Occupancy: **115**

Client: **DESIGN ASSOCIATES INC.**

Principal Architect: **DESIGN ASSOCIATES INC.**

Green Building Design & Certification: **TECTON PROJECT SERVICES PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

33%

TOTAL
WATER DEMAND
REDUCTION

37.7%

TOTAL
NUMBER
OF TREES

37

TOTAL
RENEWABLE
ENERGY CAPACITY

3
kW

FROM ENERGY SAVINGS
CARBON OFFSET

5,924.02
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered with high SRI tiles is **43.4%**



The carbon footprint is reduced by offering accessible basic amenities nearby, thereby reducing car dependence



Pervious landscaping has been incorporated to minimize runoff and reduce the UHIE in the project



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **94.9%**



The LPD of the project is 3.59 W/sq.m., which is below the ECBC-specified LPD limit of 10.80 W/sq.m.



Embodied energy is reduced throughout the entire construction of the project by using Portland Pozzolana Cement (PPC)



Images showing various greening & paving strategies used at site for landscaping



PASSIVE DESIGN STRATEGIES IN PROJECT



- Space planning is such that all services, non-regularly occupied areas such as staircases & toilets are in south & west orientations. Acting as buffer spaces & reducing heat gain in regularly occupied areas

- The size of openings & glazing is judiciously planned i.e. minimum opening/ glazing on the west & south façade to minimize solar heat gain & maximize daylight in regularly occupied areas. Further inset windows, horizontal & vertical shading is provided to ensure reduced heat gain from windows

- Light shelves provided in all office spaces ensuring glare free diffused daylight for all depth of office, ensuring reduced heat gain from light & reduction of energy load

- Dense vegetation planted & water body proposed to moderate site microclimate & reduce effects of Urban heat island effect

ENVELOPE PERFORMANCE FOR COMFORT



114.38
W/sqm.

The thermal efficiency of the building envelope by providing following measures:

- Cavity wall constructed with 230mm air gap & 230 mm clay bricks on exterior & 115 mm clay brick wall in interior in all directions of the project except the north.
- Single glazing unit with low-e coating of SHGC 0.28 is used in the building
- Overall insolation reduction by 63.2% achieved in the project by appropriate window sizing according to orientation & providing shading to windows



Image showing vertical fins for shading windows & natural light in the office space.

LIFESTYLE & INNOVATION



maintained kitchen garden is cultivated on-site to grow fruits and vegetables for use within the project



Dedicated toilets and resting rooms are provided on-site for service staff comfort



WATER USE OPTIMIZATION



57% Percentage reduction in landscape water demand by planting native species



70.6% Reduction in water demand by using low flow fixtures for kitchen & toilets



75% Two day water demand can be met through 6380 litres of rainwater storage tank & 5000 litre open to sky waterbody

Hindustan Petroleum
Corporation Ltd

ADMINISTRATIVE BLOCK, Kanpur, Uttar Pradesh



Site Area: **10169 SQM**

Built-up Area: **1875 SQM**

Occupancy: **51**

Client: **HINDUSTAN PETROLEUM CORPORATION LIMITED**

Developer: **HINDUSTAN PETROLEUM CORPORATION LIMITED**

Green Building Design & Certification : **M/S MECON LIMITED**



CLIMATE
COMPOSITE



TYPE
COMMERCIAL



RATING
SVAGRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

43%

TOTAL
WATER DEMAND
REDUCTION

36.2%

TOTAL
NUMBER
OF TREES

151

TOTAL
RENEWABLE
ENERGY CAPACITY

7
kW

CARBON OFFSET

1,957.766
TON/ANNUM



STRATEGIC SITE PLANNING

Percentage of total site surface soft paved, shaded &/or covered in high SRI tiles is **23%**



Number of new native trees planted in the project all around the site is **151**



Septic tank is provided within the project boundary to treat sewage generated



ENERGY-EFFICIENT DESIGN

Project is daylit and meets the daylight factor prescribed by NBC for total area of **83%**



The LPD of the project is 6.68 W/sq.m., which is below the ECBC-specified LPD limit of 10.80 W/sq.m.



The reduction in embodied energy for non-structural applications is achieved by using AAC blocks, resulting in decrease of **56%**

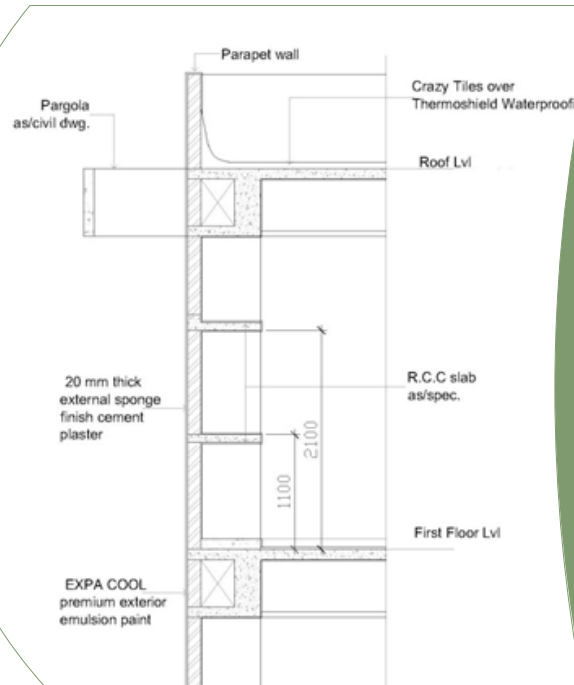


ENVELOPE PERFORMANCE FOR COMFORT

304.87
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures:

- Double glazed unit (DGU) with SHGC of 0.35 were installed in the project
- Horizontal & vertical shading provided for each window
- 72% reduction in overall insoaltion achieved in the project using shading of windows



Sketch showing section through external envelope with shading pergolas

PASSIVE & ACTIVE DESIGN STRATEGIES



PASSIVE ARCHITECTURAL DESIGN MEASURES:

- Cool roofs have been implemented as a passive design strategy to minimize direct heat gain from the roof

- Buffer spaces on the eastern and western facades help reduce direct heat gain, thereby lowering the cooling load

ACTIVE FEATURES:

- BEE 5-star equivalent fans have been installed to enhance energy efficiency throughout the building

- Fans have been strategically placed in office areas to improve air circulation and provide better cooling



Image showing roof placed with high SRI tiles mosaic to reduce heat gain & solar panels



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Building's green features have been prominently displayed to raise awareness among occupants and visitors



Dedicated toilets & resting rooms are provided on-site for the comfort of service staff



WATER USE OPTIMIZATION



25%

Reduction in landscape water demand by planting native species



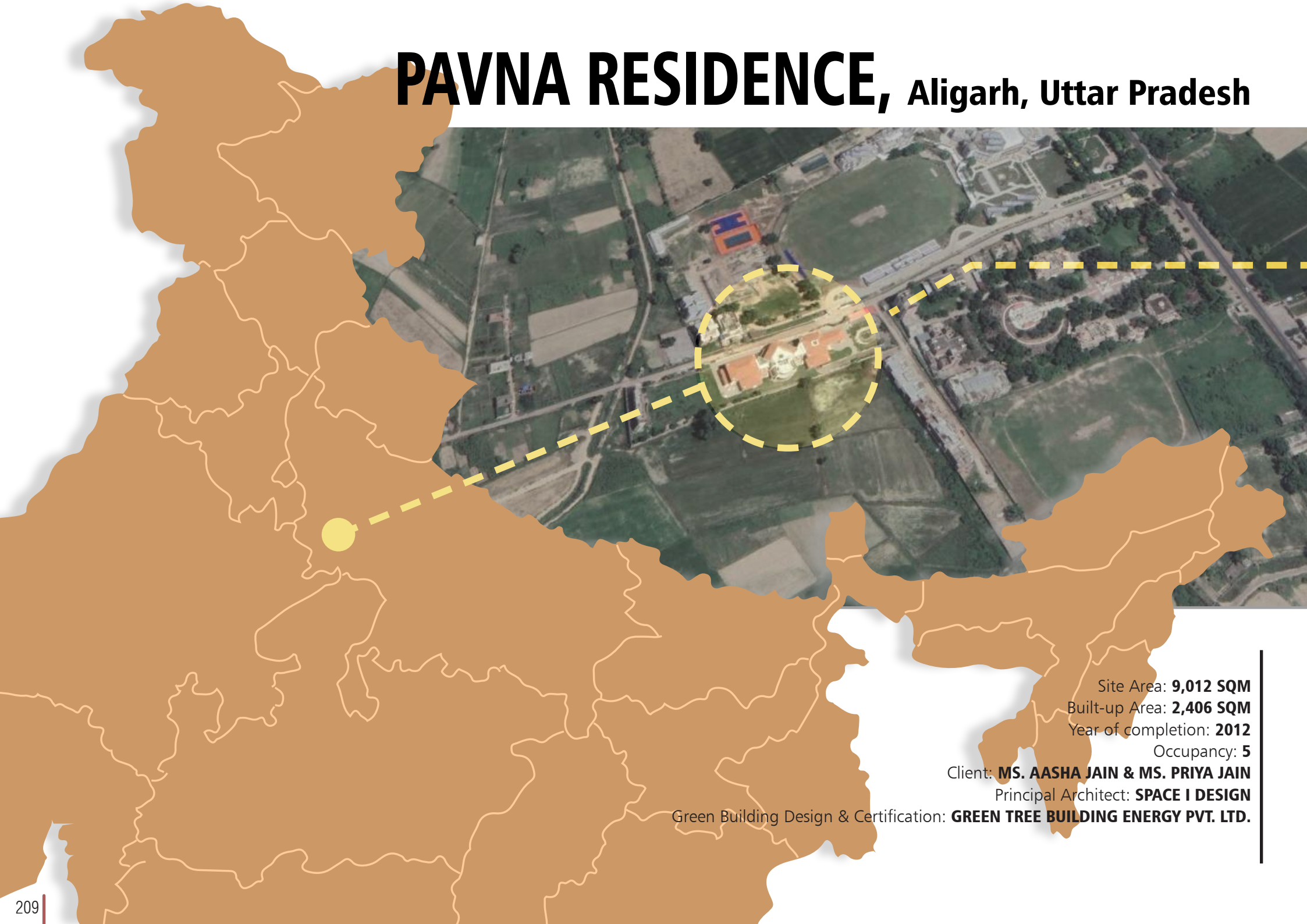
47.41%

Reduction in building water demand by use of water efficient & low flow fixtures



Rainwater storage tank with a capacity of 15,000 liters and a recharge pit have been constructed on-site to collect and recharge rainwater

PAVNA RESIDENCE, Aligarh, Uttar Pradesh



Site Area: **9,012 SQM**

Built-up Area: **2,406 SQM**

Year of completion: **2012**

Occupancy: **5**

Client: **MS. AASHA JAIN & MS. PRIYA JAIN**

Principal Architect: **SPACE I DESIGN**

Green Building Design & Certification: **GREEN TREE BUILDING ENERGY PVT. LTD.**



CLIMATE
COMPOSITE



TYPE
RESIDENCE



RATING
SVA GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

32%

TOTAL
WATER DEMAND
REDUCTION

75%

TOTAL
NUMBER
OF TREES

61

TOTAL
RENEWABLE
ENERGY CAPACITY

3.5
kW

CARBON OFFSET

2,919.92
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered with high SRI tiles is **84.2%**



The carbon footprint is reduced by offering accessible basic amenities nearby, thereby reducing vehicle dependence



Number of new native trees planted in the project all around the site is **61**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of **83.25%**



The LPD of the project is 6.02 W/sq.m., which is below the ECBC-specified LPD limit of 7.5 W/sq.m.



The reduction in embodied energy for non-structural applications is achieved by using AAC blocks, resulting in decrease of **43.84%**



Image showing ventilators used for lighting & ventilation in double height space

ENVELOPE PERFORMANCE FOR COMFORT



405.06
sq. ft./TR

The thermal efficiency of the building envelope by providing following measures

- Double glazed unit(DGU) with SHGC of 0.32
- 63.2% reduction in overall insolation achieved in the project using shading of windows
- AAC (Autoclaved Aerated Concrete) Blocks used in the entire construction of the project

PASSIVE DESIGN STRATEGIES UTILIZED



- The design emphasizes the integration of natural sunlight and ventilation through carefully considered fenestration to enhance the indoor environment
- Skylights and ventilators are strategically incorporated to maximize natural daylight and reduce the reliance on electrical lighting
- Windows are placed on alternate or opposite walls to facilitate optimal cross-ventilation in rooms
- The living room and multipurpose halls feature double-height ceilings with skylights, enhancing daylight penetration
- High Solar Reflective Index (SRI) tiles are used on exposed roof surfaces to minimize heat gain through the albedo effect



Image showing shaded ventilators & light coloured exterior to reduce heat gain in interiors



LIFESTYLE & INNOVATION



Building's green features have been prominently displayed to raise awareness among occupants and visitors



Dedicated toilets & resting rooms are provided on-site for the service staff



Dedicated electric vehicle parking and charging stations are provided for vehicles



WATER USE OPTIMIZATION



A rainwater recharge pit has been created on-site, complete with a filtration system, to replenish the groundwater table

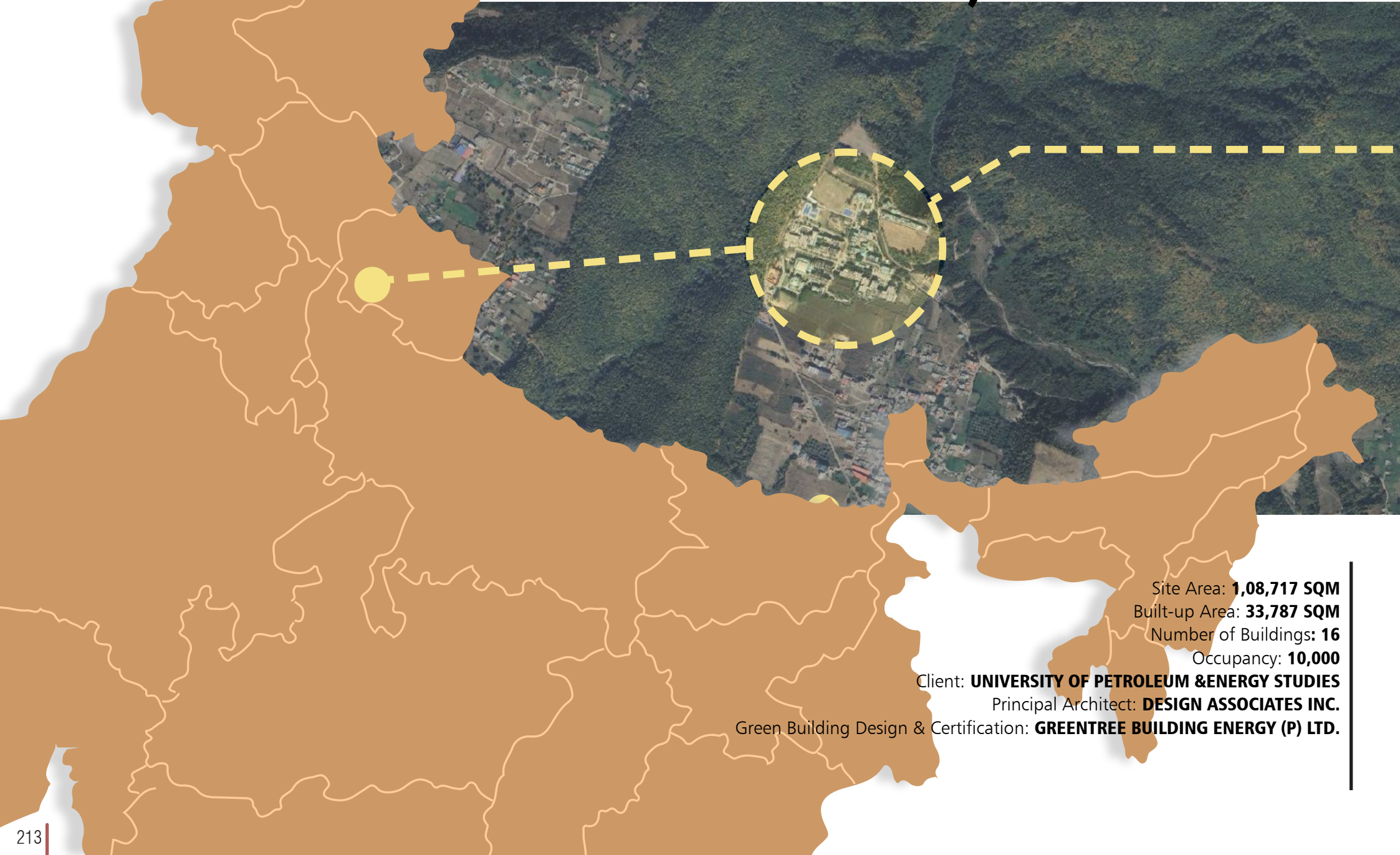


36.21% Reduction in water demand by using low flow fixtures for kitchen & toilets



75% Project's water demand is met through rainwater harvesting and the storage of runoff water

UNIVERSITY OF **PETROLEUM & ENERGY**, Dehradun, Uthrakhand



Site Area: **1,08,717 SQM**
Built-up Area: **33,787 SQM**
Number of Buildings: **16**
Occupancy: **10,000**

Client: **UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

Principal Architect: **DESIGN ASSOCIATES INC.**

Green Building Design & Certification: **GREENTREE BUILDING ENERGY (P) LTD.**



CLIMATE
COLD



TYPE
INSTITUTIONAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

45%

TOTAL
WATER DEMAND
REDUCTION

41%

TOTAL
NUMBER
OF TREES

1,410

TOTAL
RENEWABLE
ENERGY CAPACITY

100
kW

CARBON OFFSET

8,11,577.02
TON/ANNUM



STRATEGIC SITE PLANNING



Percentage of total site surface soft paved, shaded &/or covered with high SRI tiles is **50%**



Site is designed to reduce stormwater runoff with a net impervious factor of **70.5%**



Number of new native trees planted in the project all around the site is **1410**



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total habitable area of **45%**



Percentage of fly ash content by volume in fly ash bricks used for walling to reduce embodied energy is **40%**



The materials used for internal partitions, false ceilings, and built-in furniture in the building are selected for their low environmental impact



Image showcasing the recessed box windows in facade of buildings in project



OPTIMIZING BUILDING ENVELOPE & DESIGN

- The building's orientation is carefully designed to minimize passive solar heat gain. The larger sections, primarily used during the day, feature longer sides facing the north and south
- The office building, located behind the auditorium, is designed with maximum openings on the northern and southern facades for optimal daylight penetration.
- All windows are recessed box windows, ensuring the openings remain shaded throughout the year
- The building's design minimizes the footprint and hard-paved areas, allowing for expansive landscaped courtyards on both sides of the structure.

PASSIVE DESIGN STRATEGIES



-The roads are fully shaded due to the presence of existing trees and newly planted ones across the site. Additionally, the building walls are shaded by mature trees positioned on the east and west sides of the structure

- A double-skin façade has been incorporated across the entire building façade to enhance thermal performance

- The microclimate around the building has been improved through the installation of a water fountain and the planting of dense, tall trees on the south and west sides

- Heat gain has been carefully addressed in the planning process by placing the service core on the south and west sides of the building, preventing direct heat exposure to the office areas



Image showcasing the integrated green cover with trees along all buildings



LIFESTYLE & INNOVATION



Universal accessibility provided with toilets, entrance ramps, lift with braille & dedicated parking spots



Organic waste generated in the project is treated on-site to produce biogas and manure



Only electrical & bio diesel vehicles provided for transport within the campus



WATER USE OPTIMIZATION



50% Reduced water demand by using low flow fixtures for kitchens & toilets



33.1% Reduction in annual landscape irrigation demand by planting native species plants



25% Annual water reuse on site after treating from MBBR type 200 KLD STP, for flushing & irrigation

Office Complex for **COAL INDIA LIMITED**, Kolkata, West Bengal



Site Area: **20,235 SQM**

Built-up Area: **13,892 SQM**

Occupancy: **900**

Year of completion: **2014**

Client: **COAL INDIA LIMITED**

Principal Architect: **RAJ REWAL ASSOCIATES + URBAN DESIGN CONSULTANTS**

Project Management Consultant: **NBCC LIMITED**

Structural consultants: **ACME CONSULTANTS**

Landscape consultants: **RAJ REWAL & ASSOCIATES**

Green Building Design & Certification: **ELA GREEN BUILDING & INFRASTRUCTURE CONSULTANTS**



CLIMATE
HOT & HUMID



TYPE
COMMERCIAL



RATING
GRIHA



ENERGY
PERFORMANCE
INDEX REDUCTION

37.9%

TOTAL
WATER DEMAND
REDUCTION

50.1%

TOTAL
NUMBER
OF TREES

198

TOTAL
RENEWABLE
ENERGY CAPACITY

140
kW

CARBON OFFSET

11,11,610
TON/ANNUM



STRATEGIC SITE PLANNING



The building is designed to harmonize with the natural contours, minimizing cut and fill



Utility corridors were aggregated with aligned with pathways & existing slope to enhance efficiency



Outdoor lighting is controlled by an automatic timer-based system, ensuring efficiency of

100%



ENERGY-EFFICIENT DESIGN



Project is daylit and meets the daylight factor prescribed by NBC for total area of

82%



Reduction in embodied energy of the structure by use of coffered slab reducing the material utilized in construction



Low-energy materials, such as natural stone, vitrified tiles, & hardonite tiles with recycled content, are used for interior flooring upto

85%



Image of the building showcasing BIPV along the stepped levels



OPTIMIZING BUILDING ENVELOPE

40%

the Window Wall Ratio of the Building

0.47W/m²K

Uvalue of the external walls

0.25 SHGC
32% VLT

The facade glazing in the project, complying to requirements of ECBC 2007

PASSIVE DESIGN STRATEGIES



- The project has provided for North lighting with toilets arranged on the east & west facades of the building. This allows for maximum daylighting & views with minimal heat ingress
- Location of windows & shading elements: Majority of windows are located on the North & south facades to provide adequate shading elements
- The building has been designed to allow for internal courtyards spaces to bring in maximum daylight & provide shading
- The floor plate of office is designed to allow light penetration to the whole area
- Innovative design of Building integrated photovoltaics (BIPV) approach adopted in the building to ensure maximum solar generation



Close up image of facade of building showcasing shading of glazing



LIFESTYLE & INNOVATION



Greywater is sent to the municipal water treatment plant, and the recovered sludge is used as manure for landscaping



Universal accessibility implemented with toilets, entrance ramps, lift with braille & dedicated parking spots



Green features of the building have been displayed & guided tours of building for visitors



WATER USE OPTIMIZATION



78%

Reduced water demand by using low flow fixtures for kitchens & toilets



50.1%

Reduction in annual landscape irrigation demand by planting native species plants



Runoff rainwater is stored for reuse in a 4,501 cu.m. tank, with the rest used for recharge after appropriate filtration



ABOUT TERI

We are an independent, multi-dimensional organization with capabilities in research, policy, consultancy, & implementation. We are innovators & agents of change in energy, environment, climate change & sustainability space, having pioneered conversations & action in these areas for over four decades.

We believe that resource efficiency & waste Management is the key to smart, sustainable, & inclusive development. Our work across sectors is focused on

- Promoting efficient use of resources
- Increasing access & uptake of sustainable inputs & practices
- Reducing the impact on the environment & climate

Our research & research-based solutions have had a transformative impact on industry as well as communities. We have fostered international collaboration on sustainability action by creating a number of platforms & forums. We do this by translating our research into technology products, technical services, as well as policy advisory & outreach.

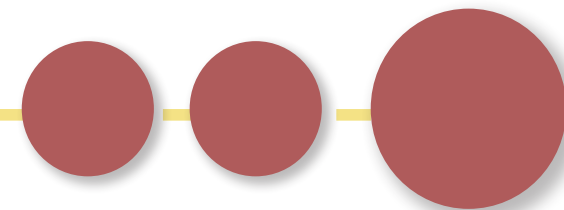
Headquartered in New Delhi, we have regional centres & campuses in Gurugram, Bengaluru, Guwahati, Mumbai, Panaji, & Nainital. Our 750-plus team of scientists, sociologists, economists & engineers delivers insightful, high-quality action-oriented research & transformative solutions supported by state-of-the-art infrastructure.

MISSION

Our mission is to serve as innovators & agents of change to enable policies & practices for an equitable & sustainable future through conservation & efficient use of energy & other resources.

AREAS OF EXPERTISE

A multi-dimensional organization, TERI functions across domains of policy, technology development, consultancy, & implementation. Working tirelessly to find solutions for the ailing planet, TERI's myriad areas of expertise range from engagement in clean energy transitions, advanced biofuels, climate change, sustainable use of land & water, sustainable agriculture, transport, & buildings.



KEY GOALS

- Enhance access to clean energy for all
- Enable a just transition to renewable energy pathways
- Enhance energy efficiency in industries, public utilities, & buildings
- Facilitate efficient use of materials, especially iron, steel, & cement
- Enable sustainable food production through smart agri inputs & nutritional security
- Enhance ecosystem services, especially in forestry & biodiversity
- Enhance conservation, utilization of, & access to water, including watershed management
- Develop innovative solutions for clean air, regionally & in cities
- Enable planning & governance of environmentally sustainable cities
- Build resilience to adverse impacts of climate change
- Accelerate pollution abatement
- Develop technologies for generation of advanced biofuels & value-added biocommodities
- Develop the regulatory framework & alternate technology adoption roadmap for green shipping in India
- Enhance livelihood through nature-based solutions under carbon finance mechanism
- Development of innovative solutions by use of microbes for environmental protection

KEY AREAS



ABBREVIATIONS

EPI	Energy Performance Index
LPD	Litres Per Day
WWR	Window to wall ratio
VOC	Volatile organic component
CO2	Carbon dioxide
PM	Particulate matter
HVAC	Heating Ventilation & Air Conditioning
CPCB	Central Pollution Control Board
MERV	Minimum Efficiency Reporting Value
BMS	Building Management System
KLD	Kilo Litre Per day
STP	Sewage treatment plant
kW	Kilo Watt
kWh	Kilo-Watt-hour
SHGC	Solar heat gain coefficient
VLT	Visible light transmittance
ETP	Effluent treatment plant
OWC	Organic waste composter
NBC	National Building Code
ECBC	Energy conservation building code
ECBC-R	Energy conservation building code for residential
VRV	Variable refrigerant volume
TR	Tonne of Refrigeration
AAC	Autoclave aerated concrete
UPVC	Unplasticized polyvinyl chloride
UHIE	Urban Heat Island Effect

DEFINITIONS

CARBON OFFSET: A carbon offset is a reduction or removal of emissions of carbon dioxide or other greenhouse gases made to compensate for emissions made elsewhere.

ENERGY PERFORMANCE INDEX (EPI): As per ECBC, The Energy Performance Index (EPI) of a building is its annual energy consumption in kilowatt-hours per square meter of the building. While calculating the EPI of a building, the area of unconditioned basements shall not be included.

WINDOW TO WALL RATIO (WWR): The Window-to-Wall Ratio (WWR) is a percentage metric representing the proportion of a building's façade composed of windows compared to solid walls. It is calculated by dividing the total window area by the total wall area on a specific façade.

SOLAR CHIMNEY: A solar chimney is a way of improving the natural ventilation of buildings by using convection of air heated by passive solar energy. It is an open-ended vertical shaft utilizing solar energy to enhance the natural stack ventilation through a building.

SHADING COEFFICIENT: It is the ratio of solar heat gain through glazing due to solar radiation at normal incidence to that occurring through 3 mm thick clear, double-strength glass. The shading coefficient, as used herein, does not include interior, exterior, or integral shading devices.

SOLAR HEAT GAIN COEFFICIENT (SHGC): SHGC is defined as the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat & absorbed solar radiation, which is then reradiated, conducted, or convected into space.

U VALUE: U-value defines the amount of heat that gets transmitted through a unit area of a material for a unit difference in temperature. The U-value is therefore also called thermal transmittance. Determining the U-value is particularly important for the building's envelope.

RELATIVE HUMIDITY: Relative Humidity is defined as a percentage ratio of the quantity of atmospheric moisture present to the amount that would be present if the air was saturated. It is typically stated as a percentage.

SET POINT: The desired temperature (°C) of the heated or cooled space that must be maintained by mechanical heating or cooling equipment.

UNCONDITIONED BUILDINGS: Buildings in which more than 90% of spaces are unconditioned spaces (ECBC 2017).

CARPET AREA: It is defined as the net area measured between external walls, from the inner faces of walls. The thickness of internal or partition walls is excluded

BUILT UP AREA (BUA): Sum of the covered areas of all floors of a building, other than the roof, & areas covered by external walls & parapets on these floors.



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