Attached Housing

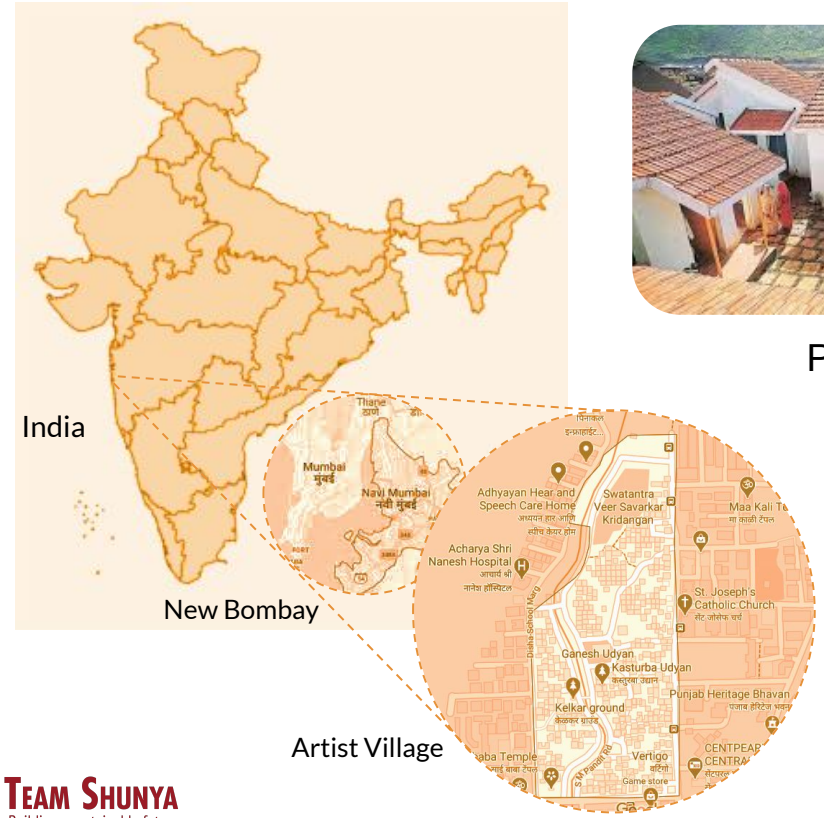
PROJECT DAKSH

Indian Institute of Technology, Bombay
National Institute of Design, Ahmedabad

TEAM SHUNYA
Building a sustainable future

U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

EVOLUTION OF ARTIST VILLAGE, BELAPUR



Past 1978

Present 2020

Future

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RESIDENT'S PAIN POINTS

No vehicle access in case of emergencies

Flooding and waterlogging during monsoon

Lack of dedicated parking spaces

Reduced natural lighting and ventilation

CONCEPTUAL STRATEGY

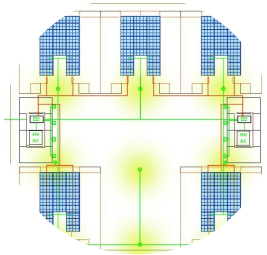
Community living

Compact and functional

Scalable design

Customisable design

Future provisions



Resource sharing

ATTACHED HOUSING

BHK- Bedroom Hall Kitchen

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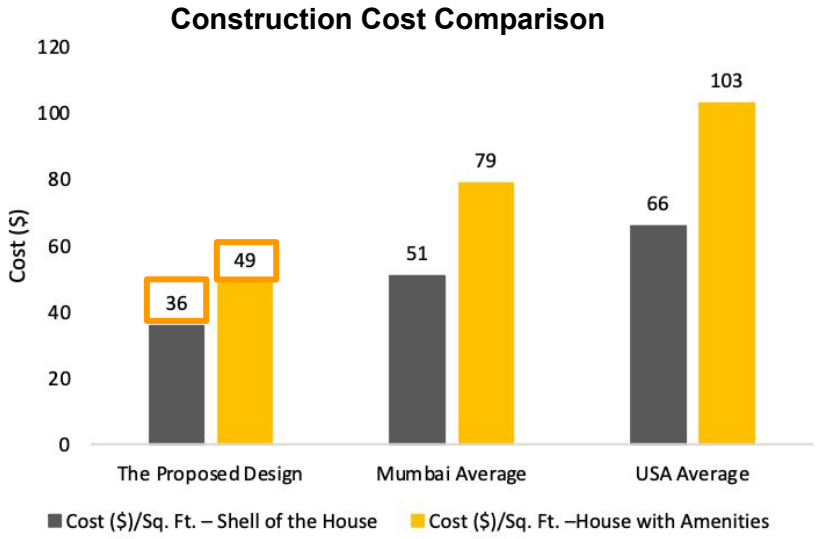
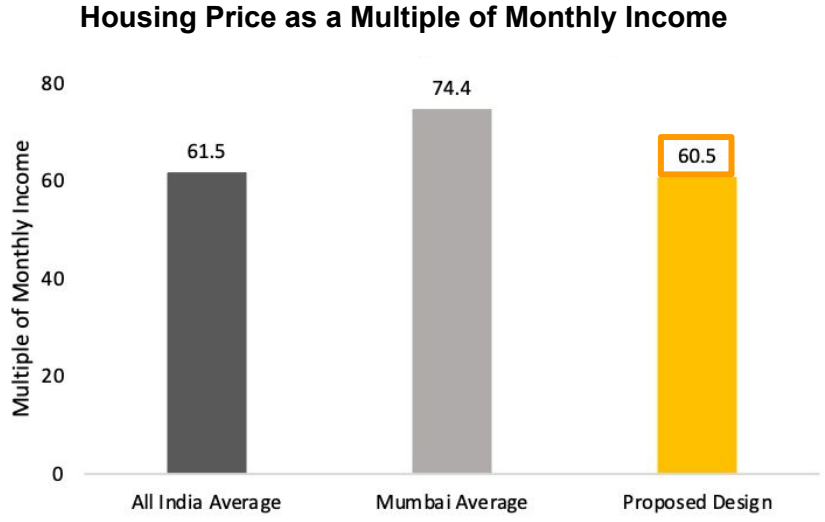
AFFORDABLE SOLUTION





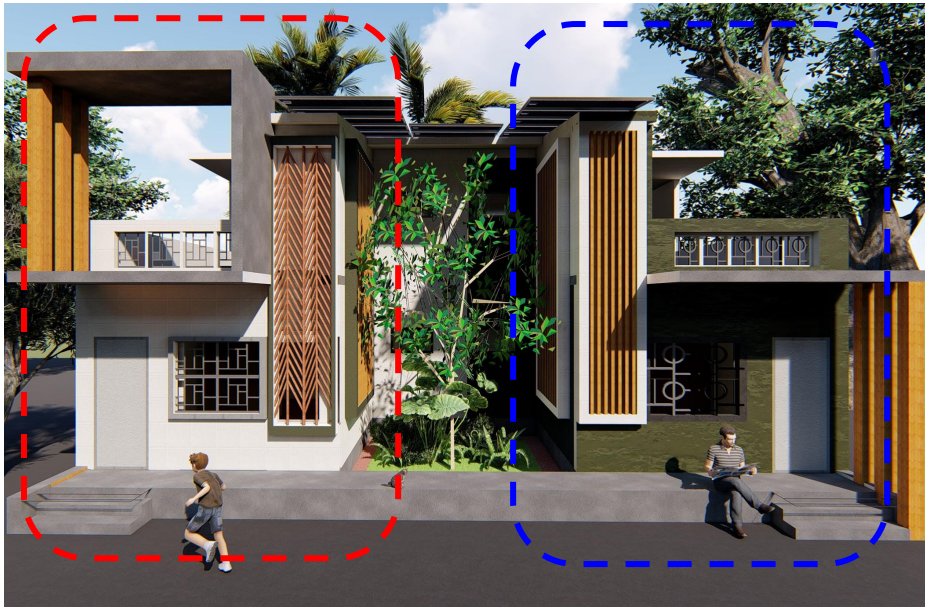
Competitive and affordable pricing

UNIQUE CUSTOMIZABLE SOLUTION

Exterior colour schemes

Flooring

Bamboo jali

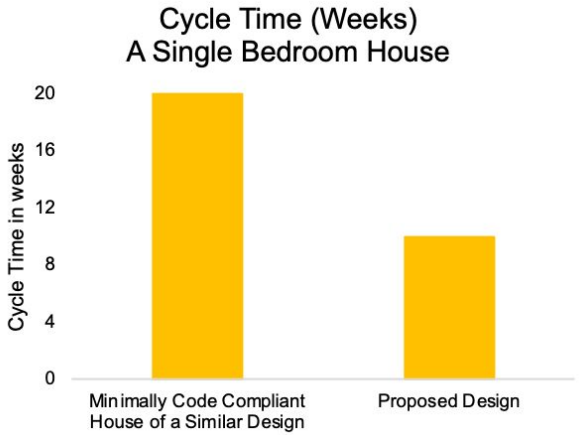


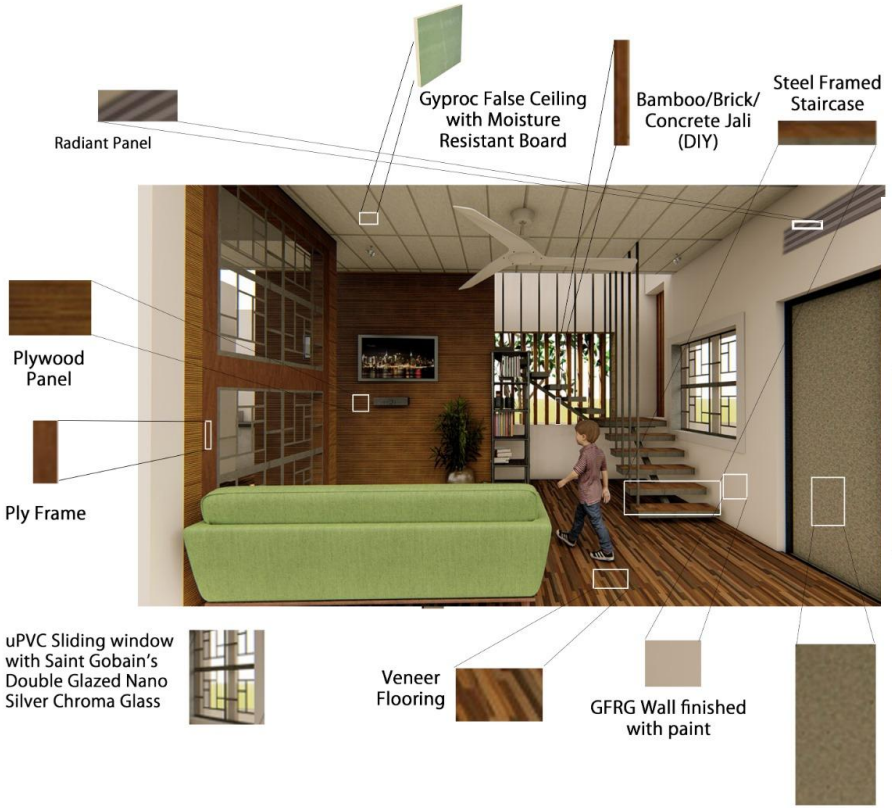
Window grills

Railings

Elevational elements

QUICKER CONSTRUCTION





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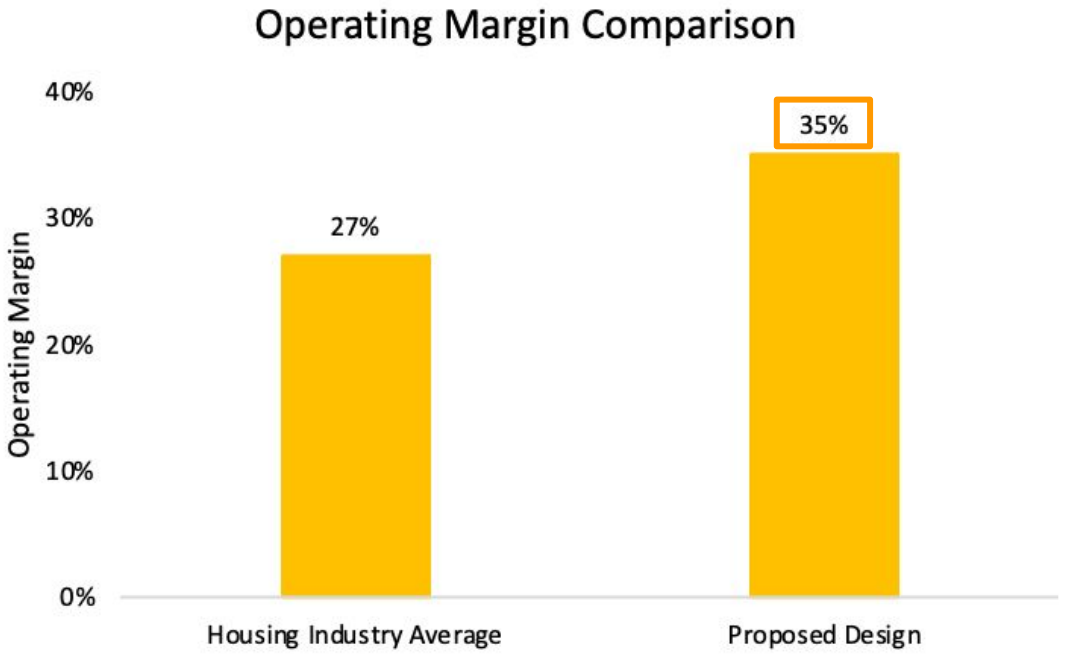
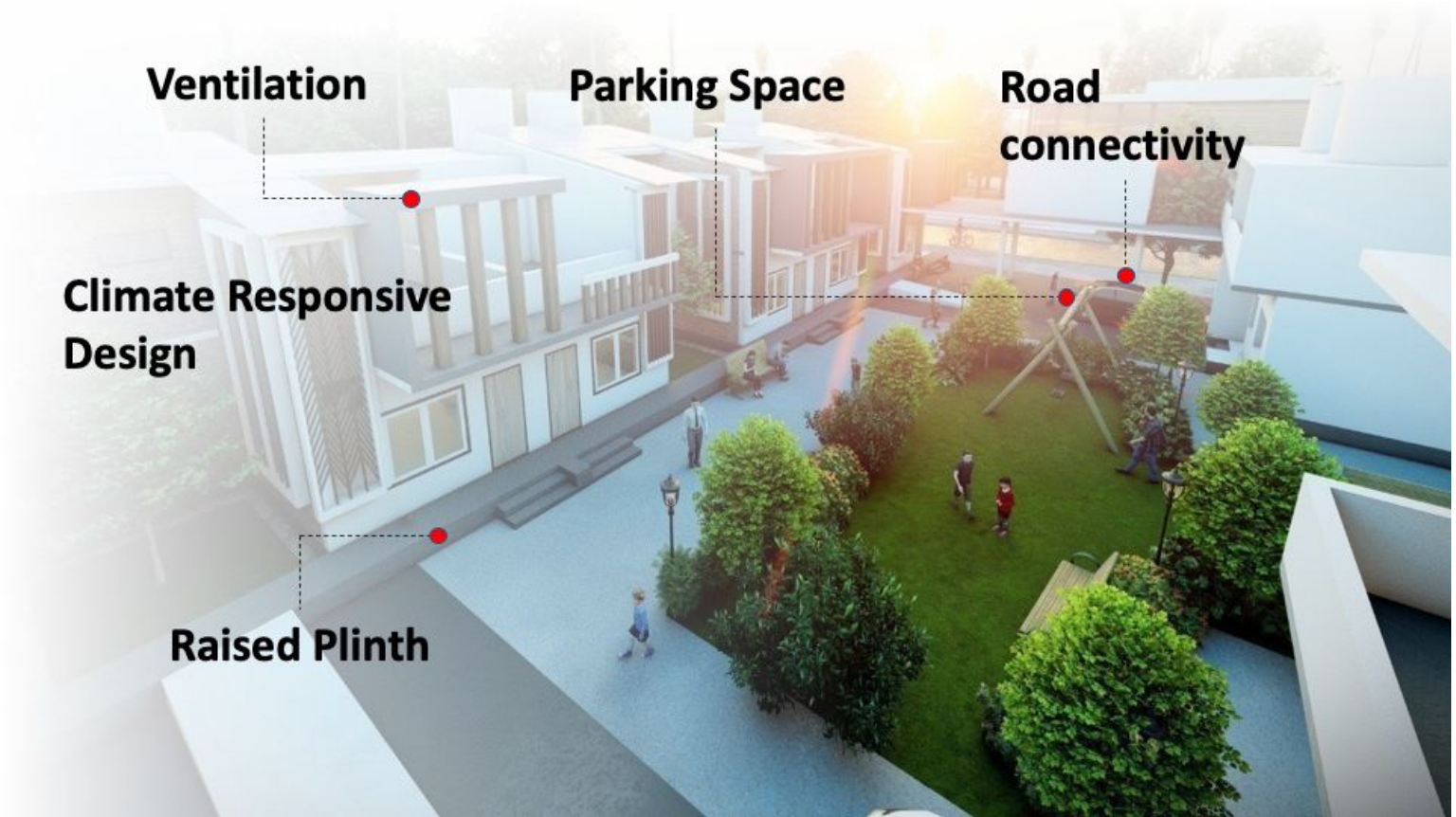
PROFITABLE CONSTRUCTION



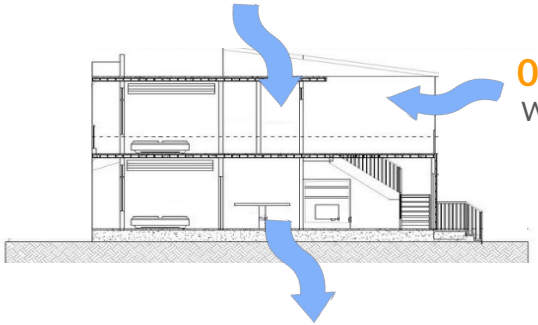
More latitude for companies to adjust operating margins

DESIGN BENEFITS



HVAC System

0.063 Btu/hr/sqft/°F
Roof Assembly u-value

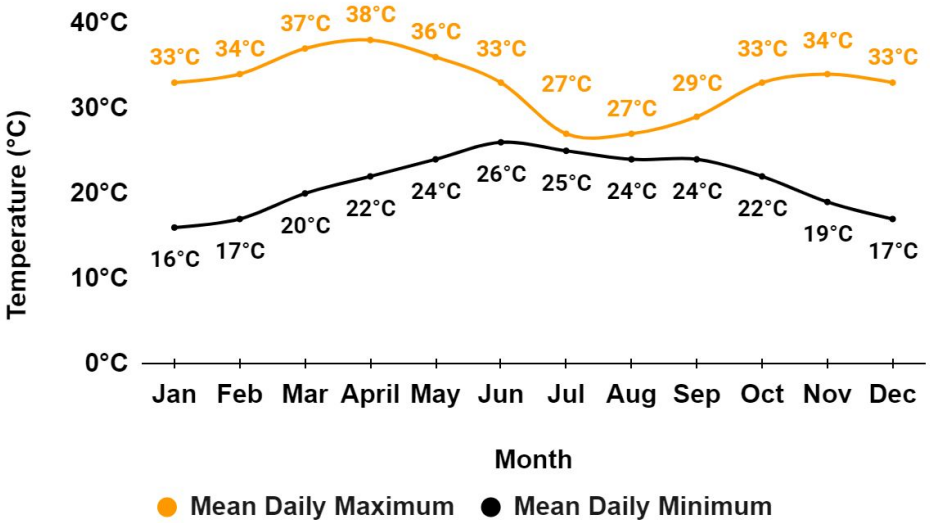


0.161 Btu/hr/sqft/°F
Wall Assembly u-value

0.043 Btu/hr/sqft/°F
Floor Assembly u-value

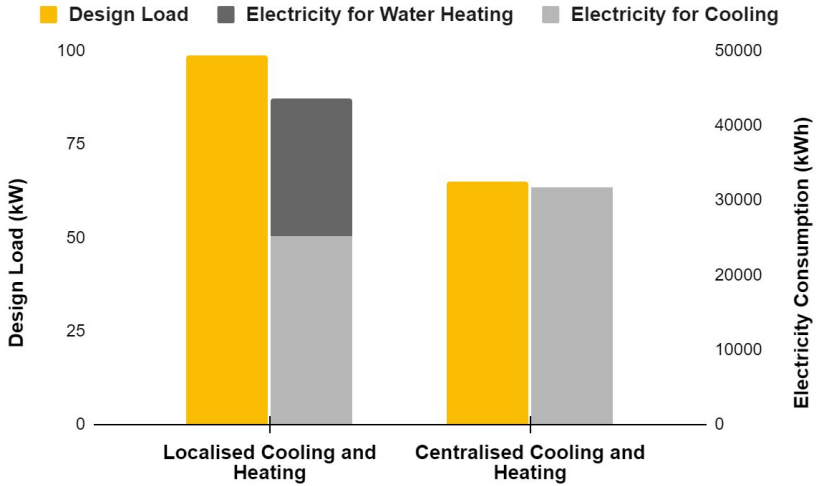
- **Highlights:**
  - Centralised HVAC
  - Thermal Energy Storage
  - Radiant Cooling and Dehumidification Panels (RC&DP)

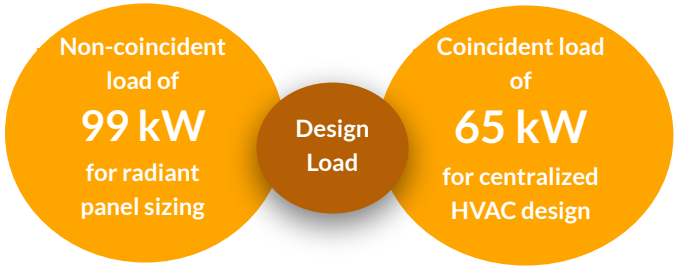
- **Climate Zone:** Warm and Humid (3A)
- **Maximum Temperature:** 38 ℃
- **Minimum Temperature:** 16 ℃



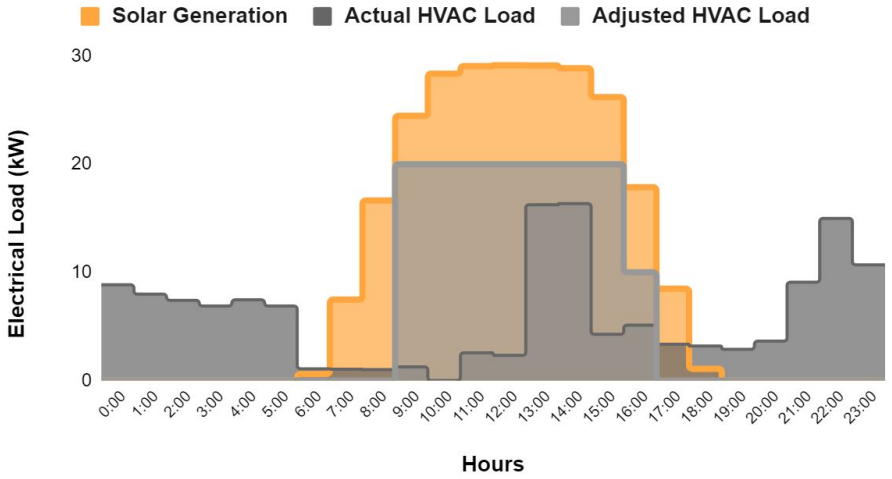
Temperature Profile for Project Site

CENTRALIZED HVAC & THERMAL STORAGE





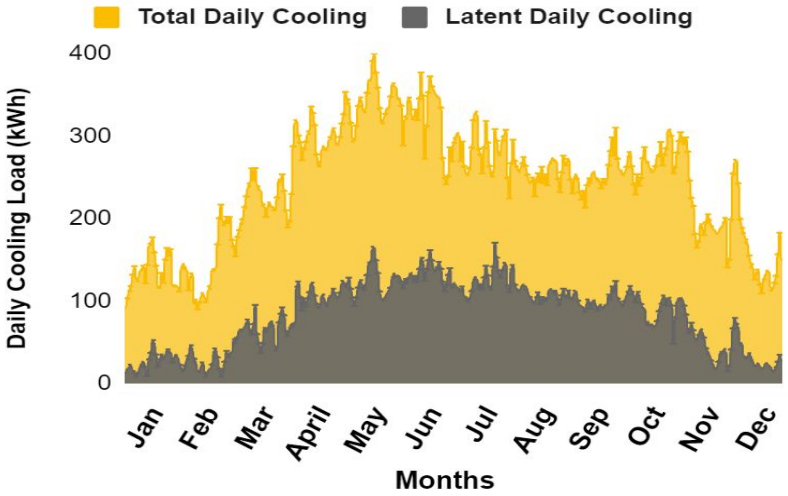
- **Thermal Storage System:**
  - **Hot Water:** 60 ℃
  - **Chilled Water:** 15 ℃



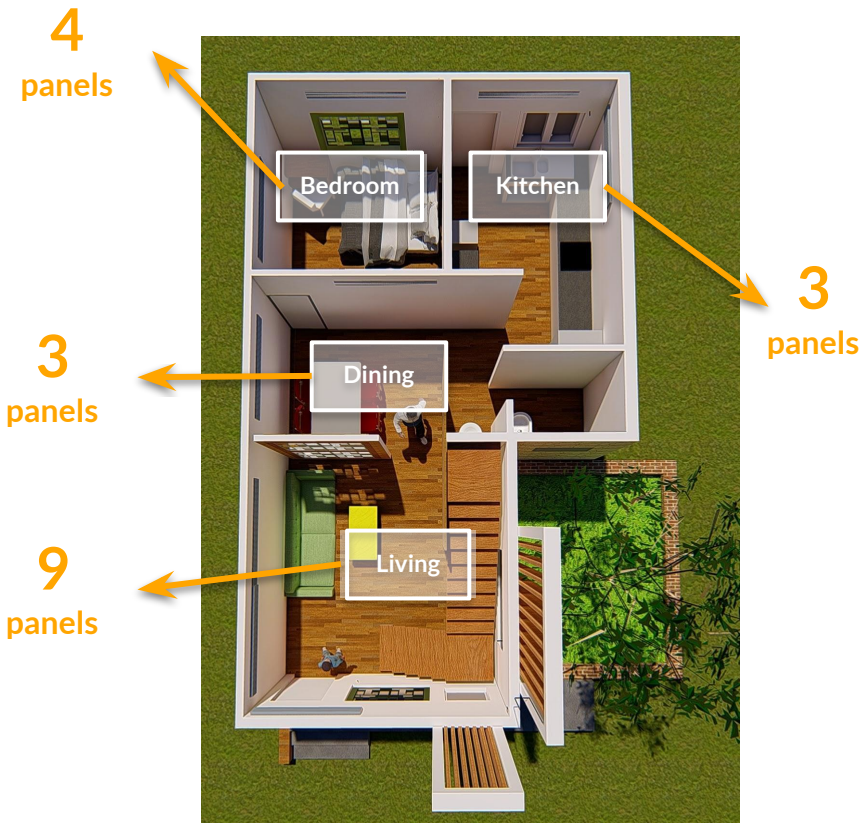
Generation and HVAC load with Thermal Storage

RADIANT PANEL

- Developed at the Heat Pump Laboratory of IIT Bombay
- Specially designed for warm & humid climate (Mumbai)
- Radiant panel can take sensible and latent load



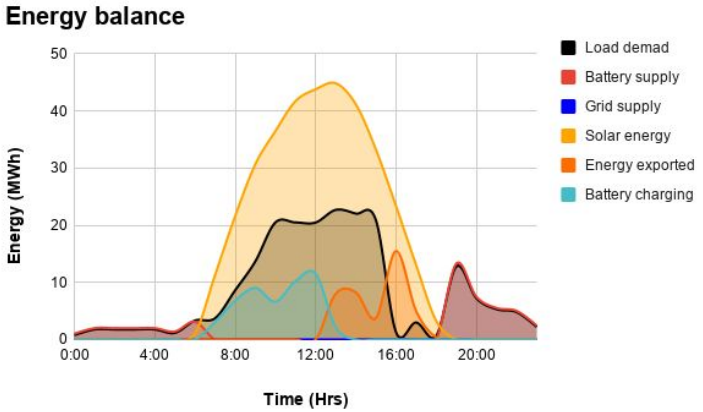
Daily cooling load profile for a year for the project

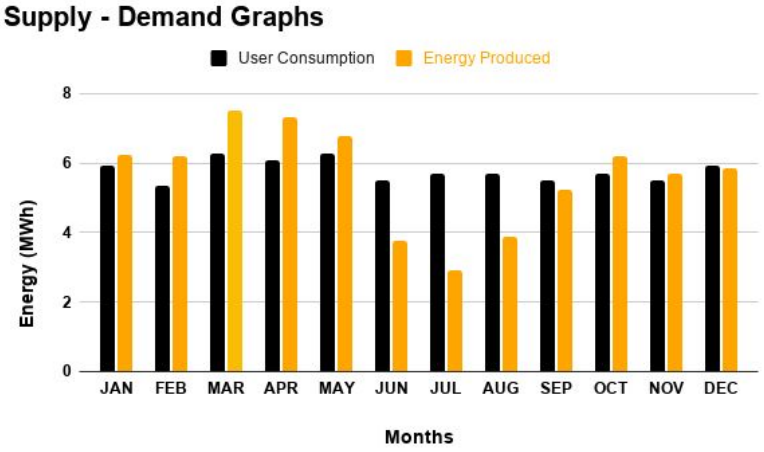


ENERGY BALANCE - CLUSTER

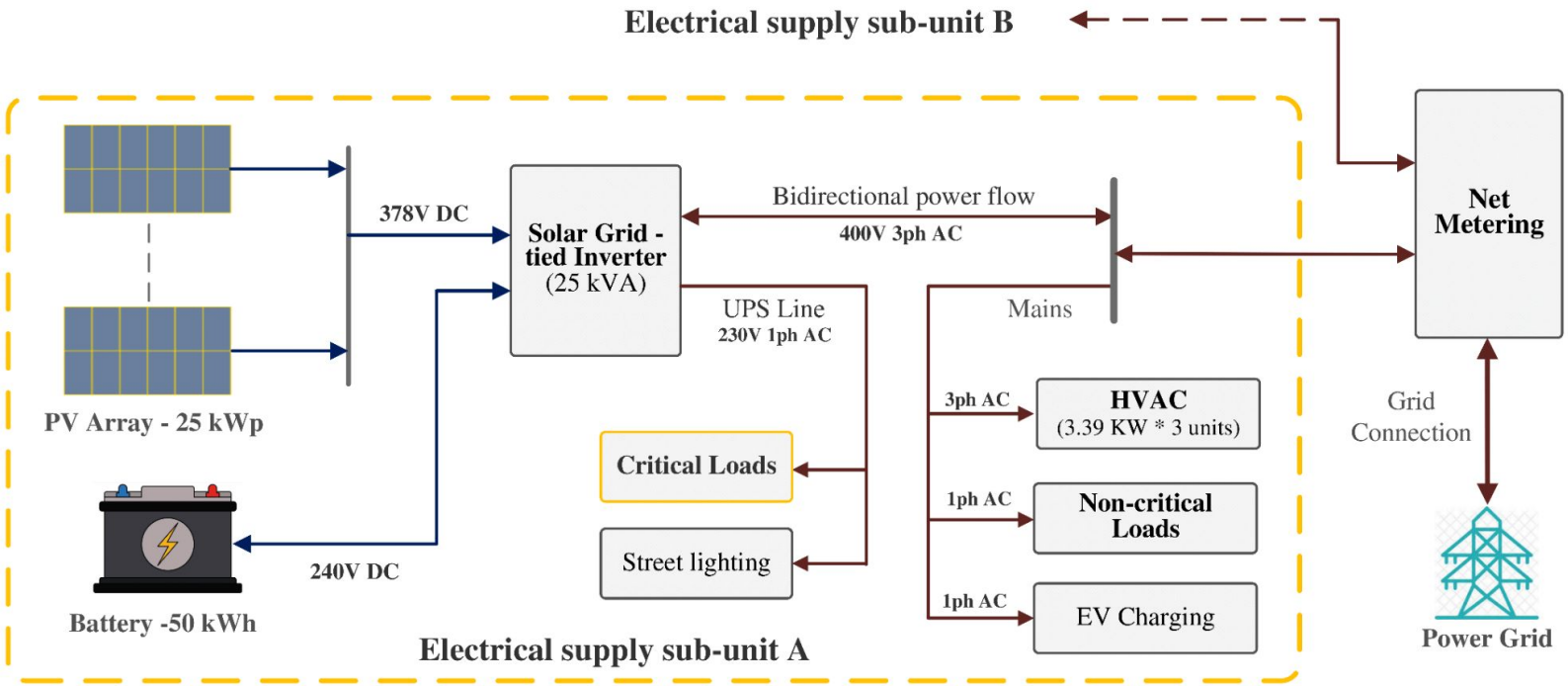
- **Saved CO_2 Emissions:** 1210.4 tCO_2/yr
- **Cost of Energy:** 0.076$/kWh

  (44.5% decrease)
- **Excess Energy:** 2.3MWh/yr
- **EUI:** 25.5 kBtu/sqft.yr





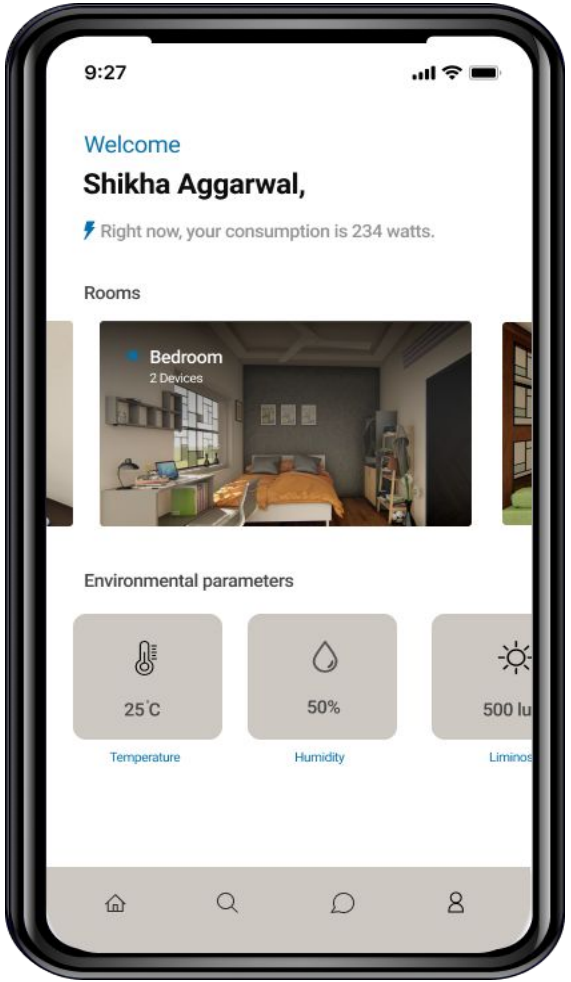
ELECTRICAL SUB-UNIT PLAN



Cluster Specifications: 50 kWp of PV, 100 kWh of Battery, 50 kVA of Inverter

HOMES AUTOMATION SYSTEM

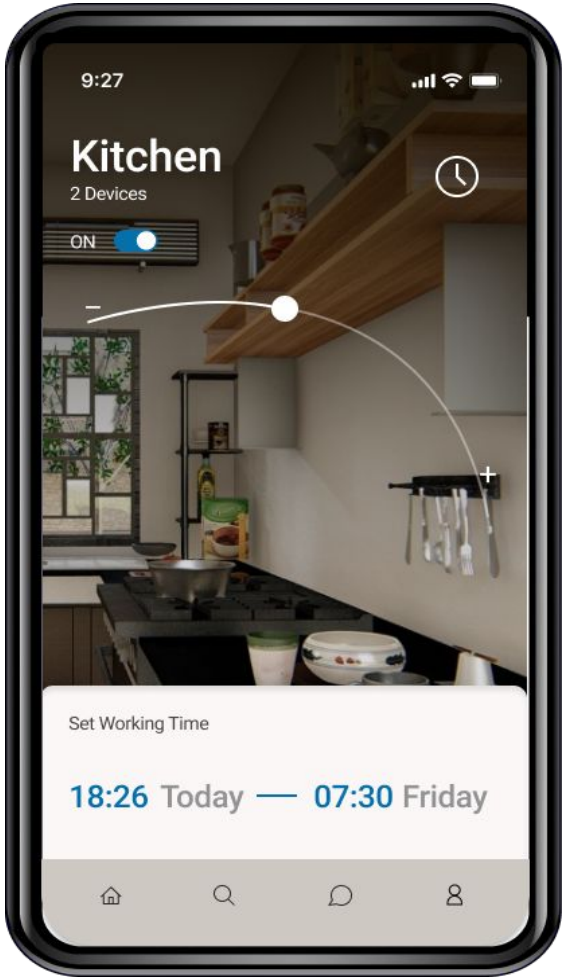
- Sensor Node
- Actuation Unit
- Home Security Unit
- Smart Meter
- Surveillance Camera



Efficient Homes is an in-house automation system designed with a user-friendly app.

CONTROL STRATEGIES

- Scheduling Appliances
- Occupant Comfort
- Smart Lighting system



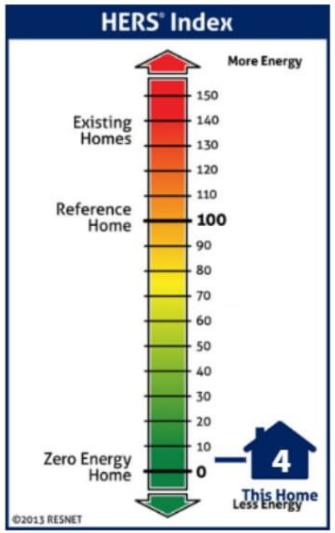
Efficient Homes is an in-house automation system designed with a user-friendly app.

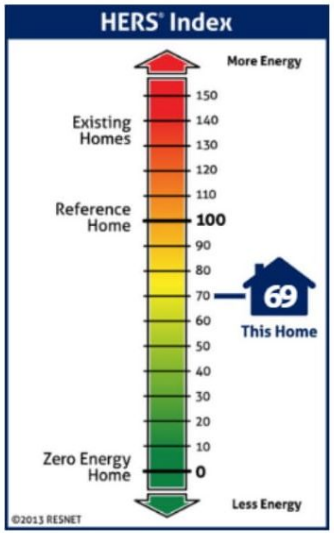
HERS INDEXES

HERS	1BHK	2BHK	3BHK
Without Solar PV	69	70	75
With Solar PV	4	13	24

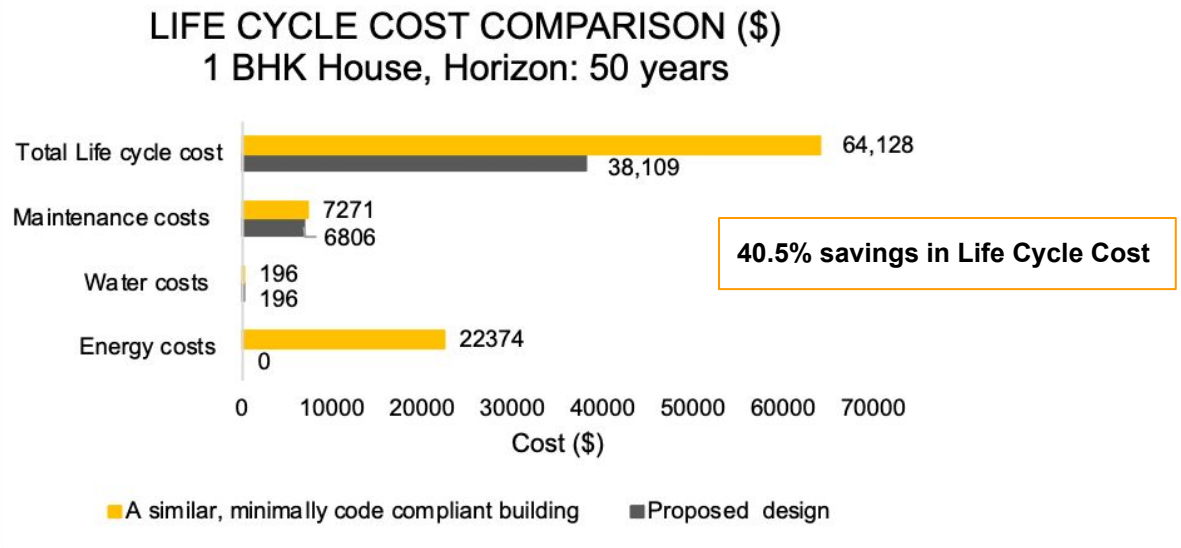
Reasons:

- ➔ Heating is not required for the location
- ➔ Variation in HVAC Load
- ➔ Nearest Climatic Conditions (i.e. Charleston)



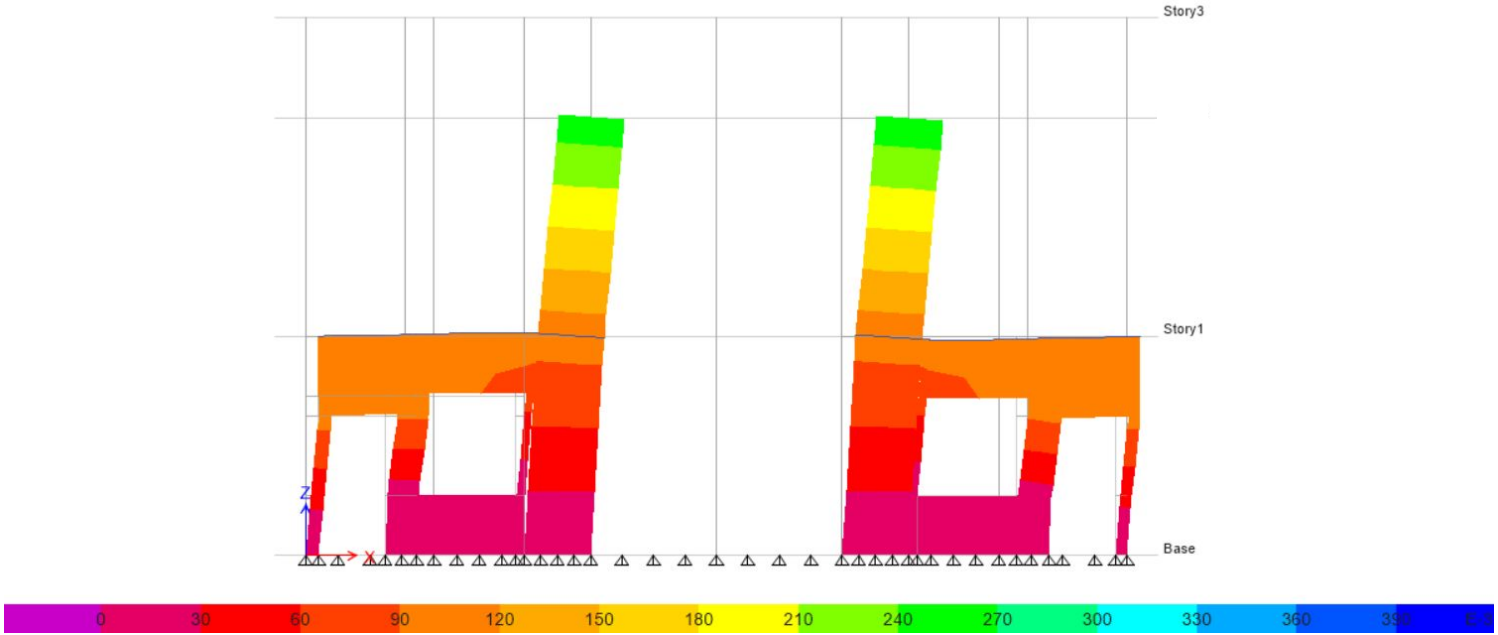


LOWER LIFE CYCLE COST



40.5% savings in Life Cycle Cost

EARTHQUAKE LOADING SIMULATION



Maximum Lateral Drift-**0.38m**

INTERIOR VIEWS

CONCLUSION

- ✓ Passive techniques
- ✓ Affordability
- ✓ Resilience
- ✓ Thermal Comfort
- ✓ Net Positive Cluster
- ✓ Future ready

TEAM

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Team Leader

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Athira

Satya

Yashu

CIVIL

Shyopal

Owais

Mayank

Vaishnavi

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Ankush

Saif

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Prabhat

Srihari

Ayush

Aneri

ELECTRICAL

Manikanta

Akhila

Sakshi

Harshvardhan

Shivam

Malhar

Samarth

MEDIA & DESIGN

Vamika

Ankita

Keerthi

Suyash

Sushrut

MARKET ANALYSIS

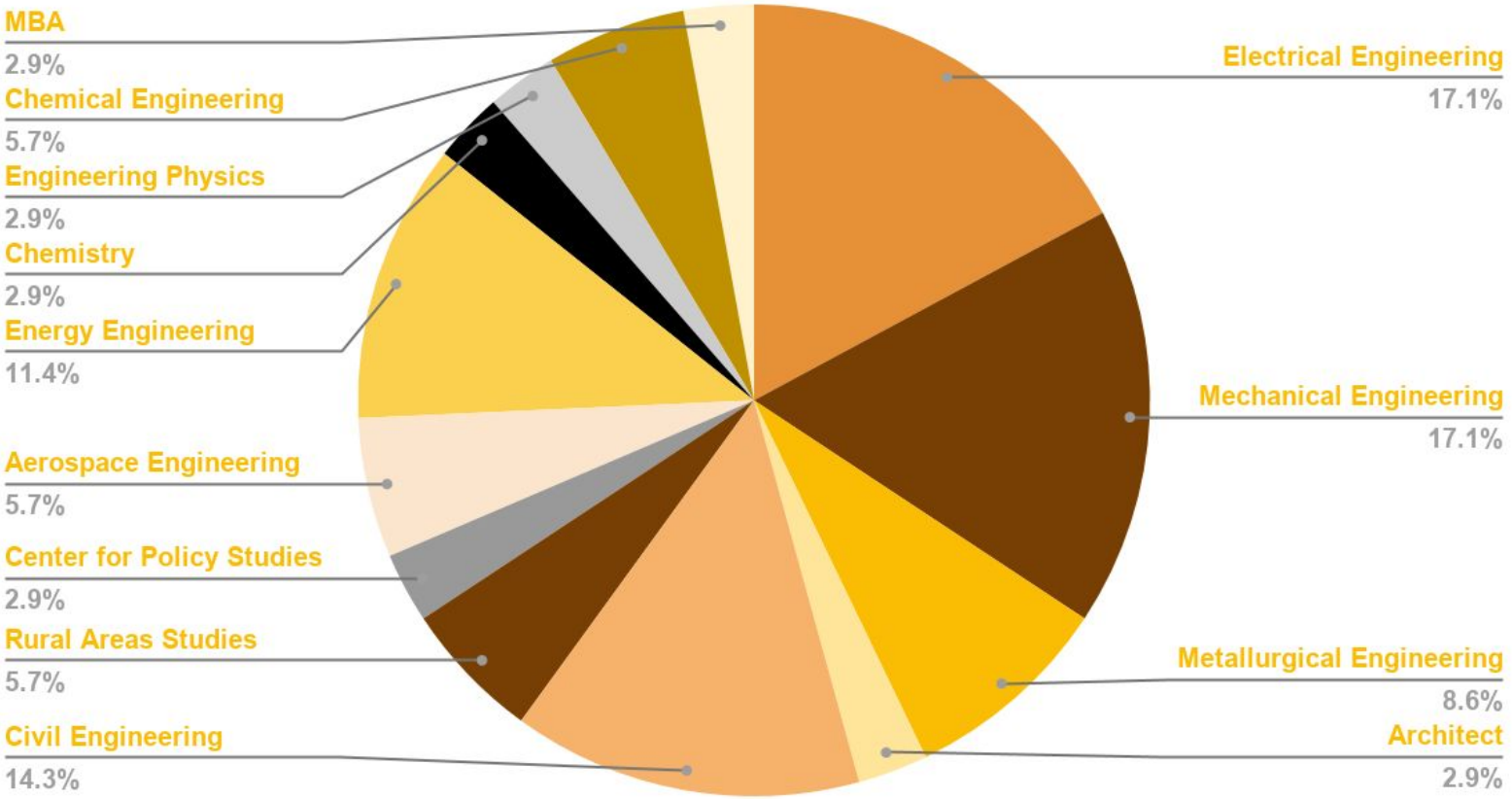
Col Kaushik

Harshit

Shamanth

TEAM

STUDY DEPARTMENTS OF TEAM MEMBERS



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Prof. Arnab Jana

(Centre for Urban Science & Engineering)

Prof. Venkata Santosh

(Civil)

Prof. Anupama Kowli

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Industry Partners

DesignBuilder

Provides exceptional value to the building performance simulation community

Mayur Sanap

Automation Project Research Assistant, IIT Bombay

Kedar

Certified Energy Auditor, Senior Research Fellow, NCPRE, IIT Bombay

THANK YOU