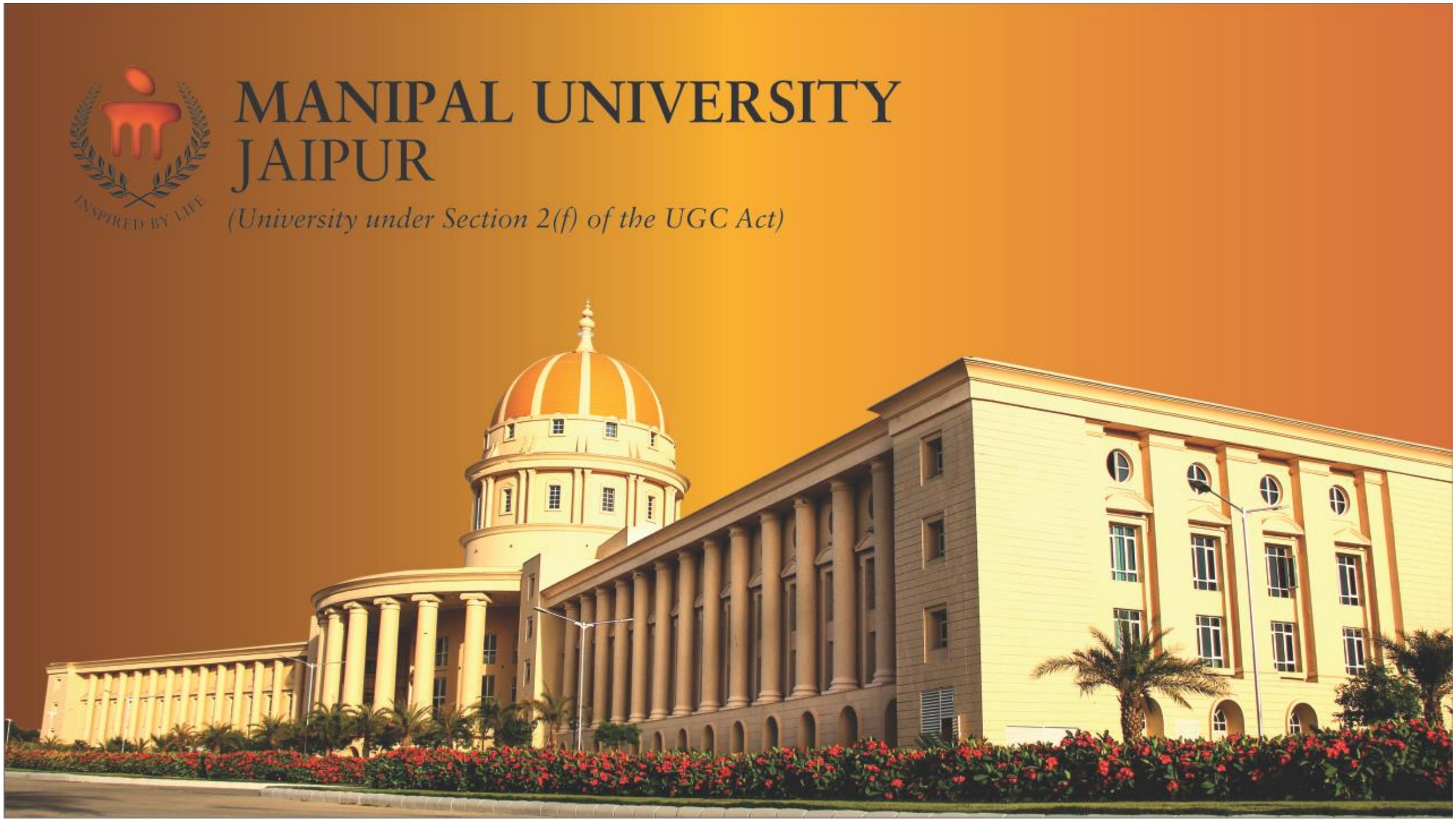
GRIHA Exemplary Performance Awards



Name of Project - **Manipal University Jaipur**
Project Location - **Jaipur, Rajasthan-303007**

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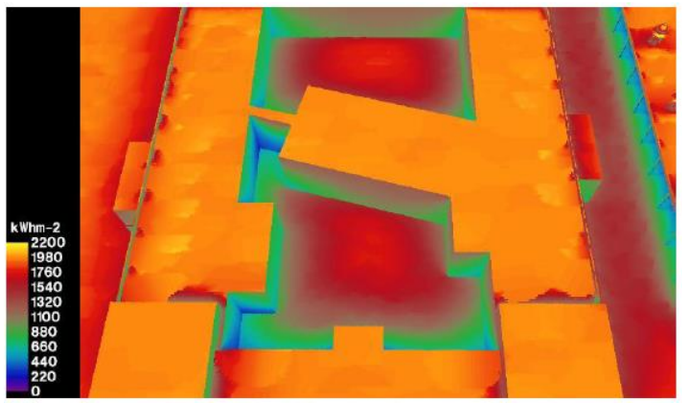
Project brief

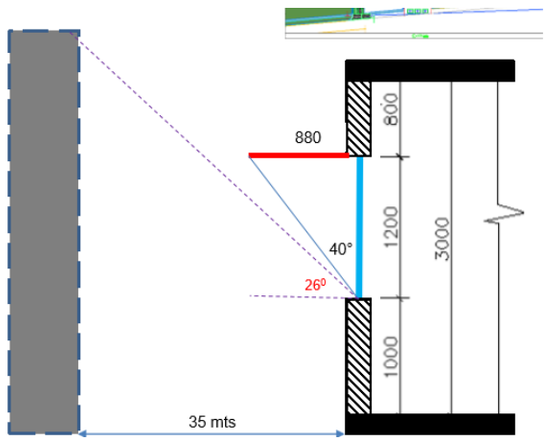
- Project name – Manipal University Jaipur
- GRIHA project code – 11GR0065 & 15GR0063
- Location – Jaipur, Rajansthan-303007
- Site area – 6,23,216 m²
- Built up area – 215395 m²
- No. of storey – 3 Nos. of G+3 and 11 Nos. of G+5
- No. of building blocks – 2 Academic, 1 administrative & 11 Hostel blocks.
- Typology – Institution

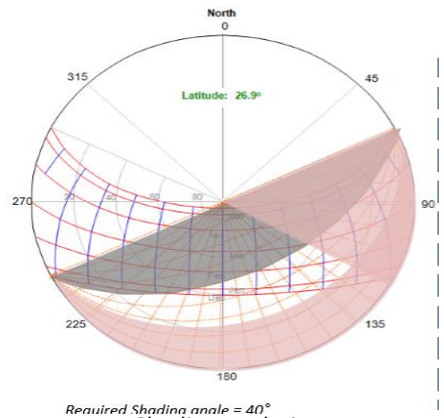
PASSIVE DESIGN FEATURES

The Manipal University campus deploys many passive strategies that aid in reducing the overall load on artificial lighting and mechanical cooling/ventilation. This includes form optimization, optimization of openings to improve daylight and ventilation, and reduction of solar gains through shading.

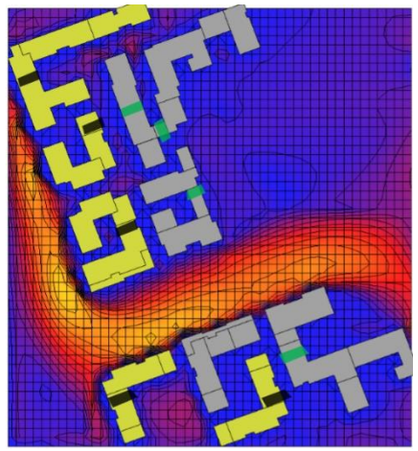


Irradiation mapping (source: Ecotect)





Shading analysis



Wind flow analysis (source: Ecotect)

NCREASED SITE VEGETATION TO REDUCE UHIE: Irradiation mapping was used to arrive at areas that require vegetation & shading in order to minimize UHIE. The intent was to ensure that spaces between buildings had enough shade so that occupants can walk. In open areas where building volumes alone were not enough to provide shading .tree canopy covers were recommended to shade.

SOLAR CONTROL & THERMAL MASS: In university blocks, large courtyards are broken into two small ones to improve the self-shading. With the maximum amount of thermal mass on external walls and courtyard facing walls both external and internal walls are well buffered with corridors & jaalis.
Jaalis were designed based on daylight simulation to ensure that opening percentage brought in the necessary amount of daylight within the space while providing adequate shading.

Hostel block buildings are clustered which leads to several small courtyards, these building have varied heights results into self-shading. Thus reducing direct gain. Shading provided for windows are different for different orientations to court direct sunlight entering the buildings. The width of the streets connecting the buildings are adequately provided such that the intense solar radiation during late mornings and early afternoons is avoided

SHADING ANALYSIS: Shading analysis was done as per sun path, after a conscious study, straight projection from the wall surface was used as a shading device for hostel buildings. and Jaali's were used as shading for University buildings. The shading sizes are optimized to provide thermal control and in effect shade space from March to October for a time of 10 am to 3 pm

WIND ASSISTED COOLING: The primary wind direction in Jaipur is West to east. At University blocks, large lobby openings are on the east and west which allows free flow of wind through courtyards around the buildings. The courtyard areas have been planted with lush green cover, this vegetation is predicted to act as cool air pond helping in the natural cooling of the building

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PASSIVE DESIGN FEATURES TO REDUCE LOAD ON ARTIFICIAL COOLING AND LIGHTING:

Approach:

Several passive measures have been implemented in the Academic block, admin block and hostel phases at MUJ to optimize and reduce energy consumption. The following strategies have been adopted:

- WWR has been minimized given that Jaipur is a hot and dry climate. All windows are well shaded from 9 am to 4 pm throughout the year and high-performance glazing has been used. In cases where structural shading proved to be inadequate, jaalis have been used to cut solar radiation.
- Thermal mass and good insulation have been used to maximize thermal lag in the building. The building has a high-performance envelope which cuts the cooling load of the building with optimized shading, glazing, and insulation of walls and roof.
- Daylighting is used to a great extent, thereby reducing the artificial lighting related internal load.
- Furthermore, the Academic block has been designed to be cooled via natural ventilation and with Air-conditioning, i.e. mixed-mode. Windows are also split into higher and lower sections that can be opened independently in order to assist both stack and cross ventilation. The building has been designed to run on natural ventilation for 4 to 5 months a year from mid-October to mid-March. The opening proportion and operability of the panes have been studied and optimized with the help of thermal simulations.

Projections & results:

The following are the adopted U-factor for various building elements in the Academic and admin blocks. They all lie below the maximum prescribed GRIHA limit:

Building element	U factor (W/sq.m/K)	
Glazing	1.04-1.77	(SHGC – 0.25)
External walls	0.422	
Roof	0.39	

The total window to glass ration is less than 25% as per design. The WWR for various is well under the maximum allowable limit. The window to wall ratio for various blocks is as follows:

Space/area	Window to wall ratio (%)
Academic/admin blocks_Phase 1a,b & c	23%
MUJ_hostel (phase 1)	8.52%
MUJ_hostel (phase 2)	9.76%
MUJ_hostel (phase 3)	11.17%

The daylight levels as assessed by calculating the percentage of day lit area of the total living area. The percentages of various day lit spaces are as follows:

Space/area	Total % of day lit area
Academic/admin blocks_Phase 1a,b	32%
Academic/admin blocks_Phase 1c	27.83%
MUJ_hostel (phase 1)	64.60%
MUJ_hostel (phase 2)	73.67%
MUJ_hostel (phase 3)	86.93%

The percentage reduction in energy consumption as compared to the prescribed benchmark in GRIHA is listed below.

Space/area	% reduction in energy consumption
Academic/admin blocks_Phase 1a,b & c	56.2%
MUJ_hostel (phase 1,2 & 3)	48.3%

ENERGY MANAGEMENT

ENERGY MANAGEMENT AT MANIPAL UNIVERSITY JAIPUR

MUJ follows a proactive, organized and systematic management of energy use in all of the campus and hostel buildings to satisfy both environmental and economic requirements.

Protocols followed in MUJ for an efficient energy management:

- All the buildings in MUJ are equipped with energy meters so that building specific energy usage can be monitored on regular basis.
- All the commissioned systems in MUJ undergo periodic checks to ensure that they are working as per the design.
- Issues with regard to equipment/systems operation and efficiency losses are immediately reported to concern parties and they are rectified
- Periodic energy audits are carried out for all the buildings in MUJ

Key implementations at MUJ to reduce energy demand and increase energy conservation:

- The building fenestration optimization was done to reduce the fabric gains of the space by using energy efficient glazing along with optimized shading to reduce solar gains
- All external wall of University buildings use thermally insulated blocks & Hostel walls have air cavity to accommodate insulation
- The HVAC of hostels and university are designed as per the compliance of ASHRAE, NBC & ECBC
- LED's are used for the majority of internal lightings
- LED light fixtures are used for all external street lighting, and these are equipped with astronomical timers
- Solar based water heaters are equipped in hostels to meet the hot water demand.
- All the chillers have an inbuilt timer based controls to maintain operation timings

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OPTIMISING ENERGY CONSUMPTION IN BUILDINGS

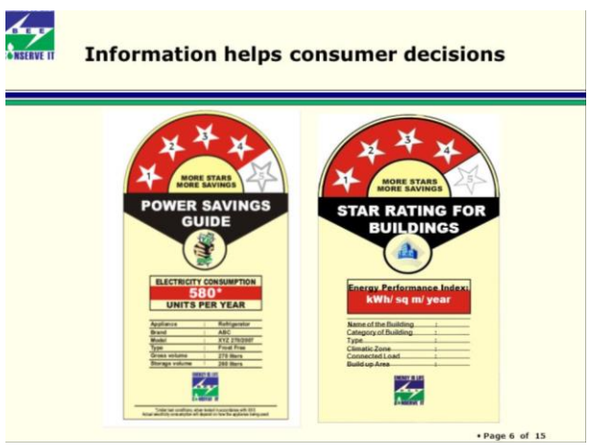
Building energy efficiency is strongly linked to the operations and control systems, together with the integrated performance of passive and active systems. Energy consumption at MUJ is regulated by following both passive and active methodologies. multiple analysis were run for all the buildings to determine their energy usage, indoor comfort levels, daylight allowance etc. based on the results from analysis systems are designed..

Optimisation through efficient HVAC:

- All the mechanical equipment used for MUJ hostels and University building are compliant with ECBC
- chillers installed in hostel blocks is COP-3.23 in cooling mode and COP-2.64 in heating mode
- chiller installed in University buildings has COP-3.11, 3.02 in cooling mode and COP-3.08 in heating mode
- All chiller has inbuilt timer controls to operate only in specified durations
- R- value of the pipe insulation of cooling systems is 1.5(m2-k/w)
- Thermal conductivity of duct insulation used is .040w/m k

Optimization through efficient Equipment:

- The Motor efficiency of pumps installed in MUJ is 81%
- Automatic capacitors are added in the circuit and power factor is maintained at ≥ 0.95. this is monitored on day to day basis
- Adequate Cable length of 157mtrs is used and power losses are maintained less than 1%
- Solar hot water systems with a system efficiency of 40.7% are installed in Hostel blocks
- BEE Energy star rated equipment's are used in the project

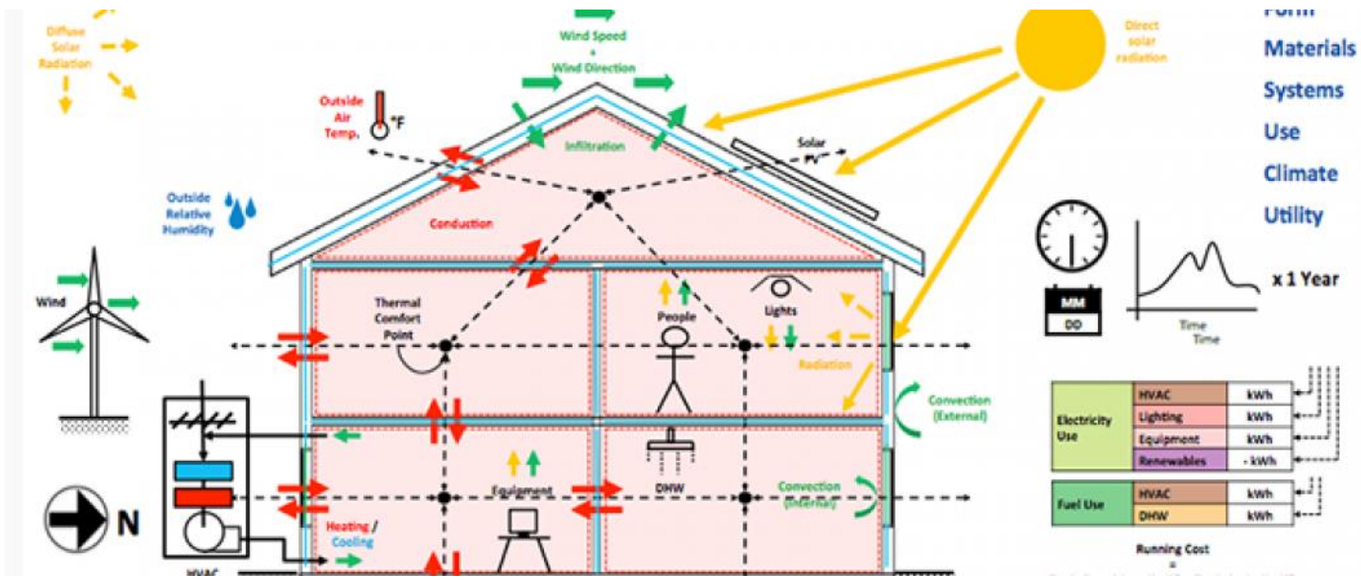


Optimization through efficient Lighting:

- LED'S are used for all the external street lightings which have a power requirement of 90w and luminous efficacy of 110lum/w
- LPD achieved for the project is not more than 0.35w /sqm
- All external pole and garden lightings also has LED source with a power requirement of 36w, these lights have a luminous efficacy of 128lum/w
- All street lights in MUJ are controlled with astronomical timers

Optimization through Building Envelope:

- U-factor Glazed units in MUJ buildings are in the rage of 1.04 W/m2K to 1.77 W/m2K . & SHGC of the view pane is 0.24
- All walls in MUJ campus buildings has a u-factor of 0.422 W/m2ºC
- All walls in MUJ Hostel buildings has a u-factor of 0.62 W/m2ºC
- U factor of roof in MUJ University buildings is 0.391w/m2ºC
- U factor of roof in MUJ hostels is 0.391w/m2ºC



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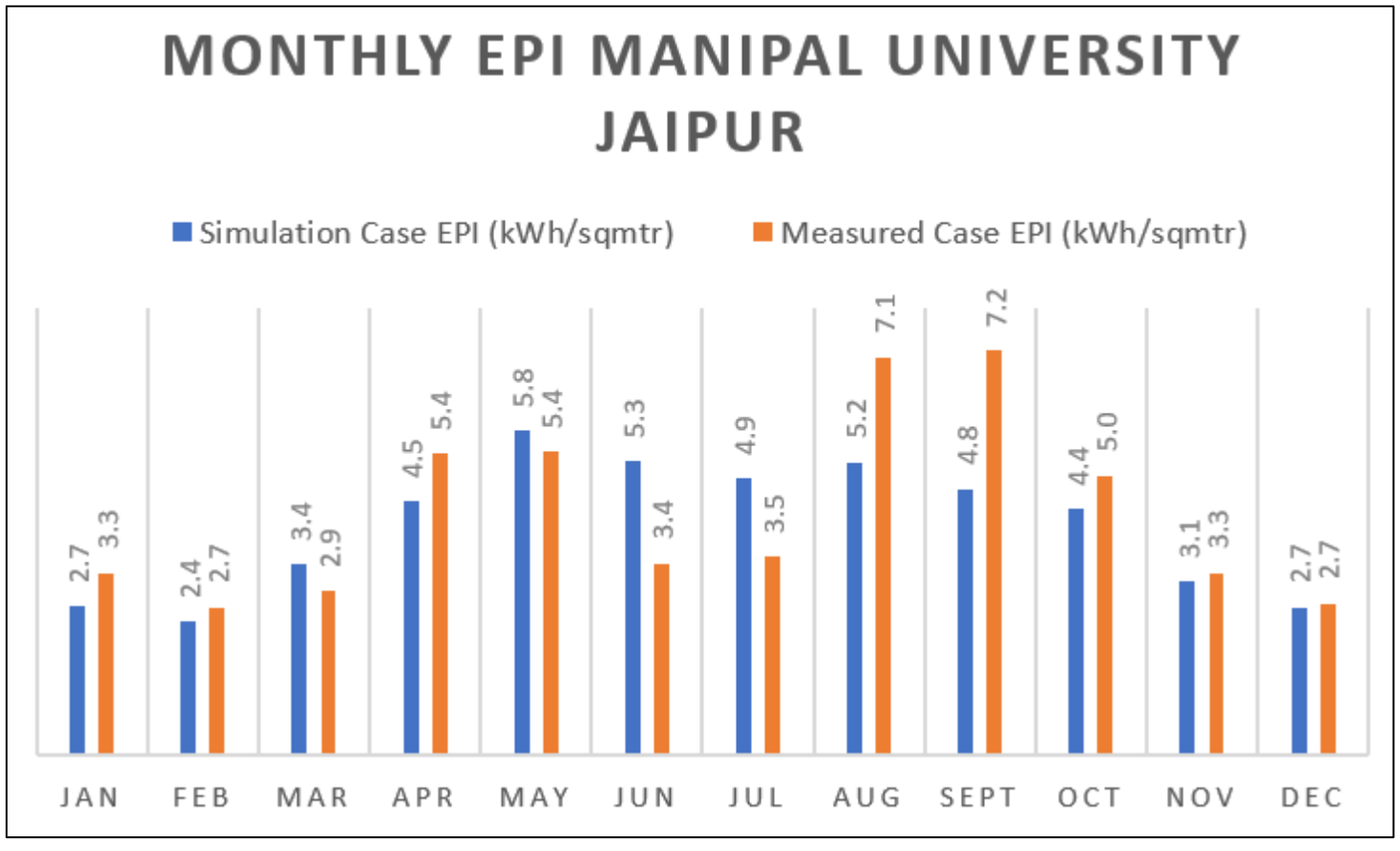
Projections:

- Based on the simulation reports documented for GRIHA, Total energy consumption of MUJ Hostels & MUJ university buildings are as follows
  - MUJ UNIVERSITY=16,20,606 kWh/year
  - MUJ HOSTELS = 56,93,467 kWh/year
- EPI achieved for whole project is 49.16kWh/sqm/year
- Total energy savings documented is 50.84% for whole project

Results:

- From the meter readings energy consumption of MUJ Hostels and university buildings are as follows
  - MUJ UNIVERSITY=12,99,920 kWh/year
  - MUJ HOSTELS = 64,38,740 kWh/year
- EPI achieved for whole project is 52.0 kWh/sqm/year
- Total savings achieved when compared with benchmark savings is 48% for whole project



INTEGRATED WATER MANAGEMENT AT MANIPAL UNIVERSITY

SUSTAINABLE INTEGRATED WATER MANAGEMENT AT MANIPAL UNIVERSITY JAIPUR

Integrated Water management strategies that are implemented & designed for Manipal University Jaipur mainly focus on triple bottom line benefits i.e social, economic and environmental benefits. This creates a flexible, resilient water infrastructure which helps us progress towards NET ZERO/ WATER NEUTRALITY.

Some of the key highlights of sustainable water management at MUJ:

- Potable water use reduction by using water efficient fixtures
- Recycling 100% of waste water generated on site.
- Use of treated water for non-potable water requirement
- Reduction in landscape water use by choosing right species of plants which are regional and adaptable to location conditions
- Use of Highly efficient Irrigation equipment for landscape needs
- A well-developed stormwater management infrastructure to capture and use rainwater

WATER USE REDUCTION WITH WATER EFFICIENT FIXTURES:

Approach:

Manipal University Jaipur (Hostels & University blocks) has dual plumbing systems for all its buildings, this helps in efficiently separating the potable water from reclaimed water for building use.

- To reduce the water usage, all the building toilets in MUJ are equipped with automatic, low flow fixtures and low flush fixtures. These fixtures when compared with conventional fixtures, can save a significant amount of water.
- 100% wastewater is treated on site and used for flushing purposes within the building .

FIXTURE TYPE	CONVENTIONAL FLOW/FLUSH FIXTURE(base case) FLOW RATE LPF/LPM	FIXTURE FLOW RATES INSTALLED IN MUJ (design case) LPF/LPM
WC Flush	≤ 6 LPF	3 & ≤6 LPF
Sensor Urinals	≤ 3.8 LPF	≤ 0.5 LPF
Restroom Faucets	≤ 9.4 LPM	≤ 2.75 LPM
Pillar cock	≤ 9.4 LPM	≤ 2.75 LPM
Health faucet	≤ 9.4 LPM	≤ 6.4 LPM
Kitchen Faucet	≤ 9.4 LPM	≤ 7.5 LPM

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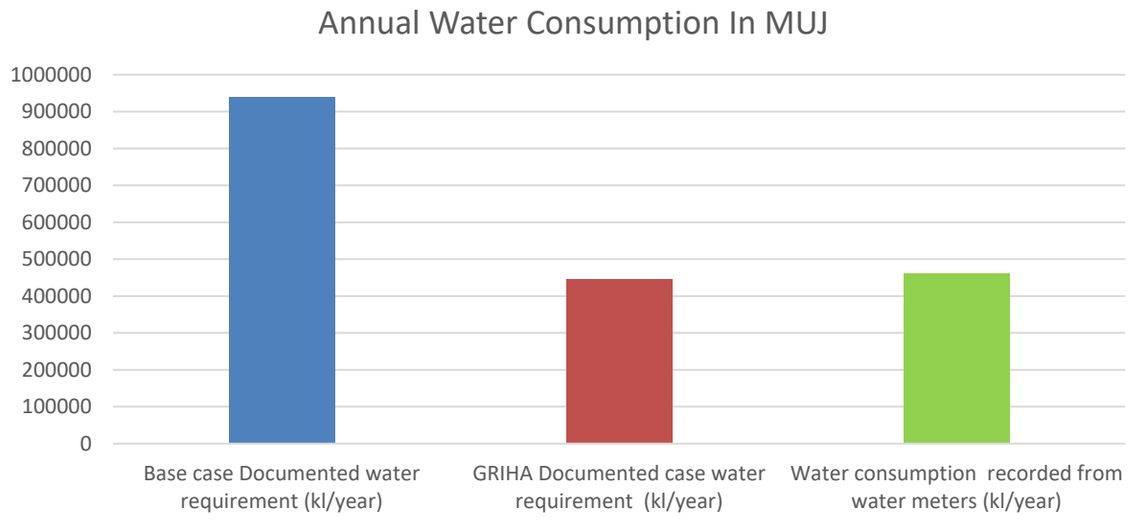
Projections:

- Based on calculations, performed for GRIHA, MUJ will require **14,988.79 Kl/year** of water annually for university blocks. & **4,29,365.9 Kl/year** for hostel blocks
- Total water consumption documented & predicted is **4,44,353.75 Kl/year**
- Based on our design case implementations which were documented for GRIHA rating, we have anticipated a minimum of 40% water saving through efficient fixtures.

Results:

- As per the recorded data from water meters, University blocks currently use **20,412.10 Kl/year** & Hostel blocks use **4,40,500 Kl/year.**
- Total water consumption of the project is about **4,60,912 Kl/year**
- The water usage in performance case is a little high than design case is due to the usage patterns of occupants



POTABLE WATER USE REDUCTION FOR LANDSCAPE

Manipal University Jaipur has a green cover of about 66065sqm, this accounts almost 53% of total site area. Since the project location is declared as the notified area by Central Ground Water Authority, MUJ strictly implemented plans to manage water efficiently and recharge groundwater. The whole system has been designed to be a zero discharge stormwater and wastewater from the site.

Approach:

- Native and adaptive plant species with larger canopy cover are chosen & lawn areas are reduced wherever possible in landscape design.
- Water efficient irrigation systems are used for landscaping which comprises of micro drips and highly efficient sprinklers. The irrigation efficiency of the systems used for landscape watering is less than 0.75
- Wastewater is treated to termitary standards and used for landscaping need along with collected rainwater

Projections & Results:

- Estimated water requirement for landscape needs in MUJ through calculations is 123026 kl annually.
- When compared to base case design which was documented for GRIHA, the project could achieve nearly 50.26% water savings by using efficient irrigation equipment and native and adaptive species in the landscape.
- Roughly 72.3% of the annual landscape water demand after savings is met by Treated waste water and collected rain water together.

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WASTE WATER TREATMENT

Manipal University Jaipur has zero discharge waste water policy. Hence 100% of the wastewater generated on site will be treated to tertiary standards and reused within the campus for various purposes like Flushing, cooling tower makeup, Horticulture etc.

Approach:

- MBR Type STP with a capacity of 600kld is commissioned at MUJ university campus considering the future developments & excess wastewater from hostels
- A standalone 350kld STP is commissioned to serve only the Hostel blocks, excess wastewater is sent to University STP.
- Wastewater treated on site will have projected water quality standards meeting CPCB norms

Projections & Results:

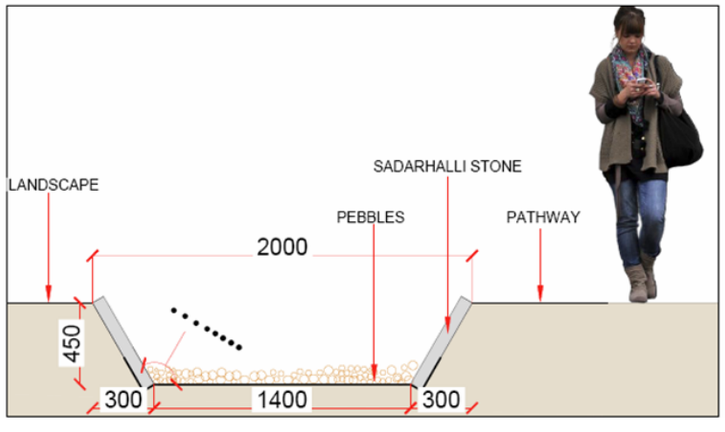
- Annually 98897.1 kl of treated water is available for building and landscape uses
- 30339 kl/year i.e. 30.6% of total available treated wastewater is used for non potable uses in all the buildings.
- 68558 kl/ year i.e. 69.4% of total available treated wastewater is used for landscape requirement in both hostels and university campus.

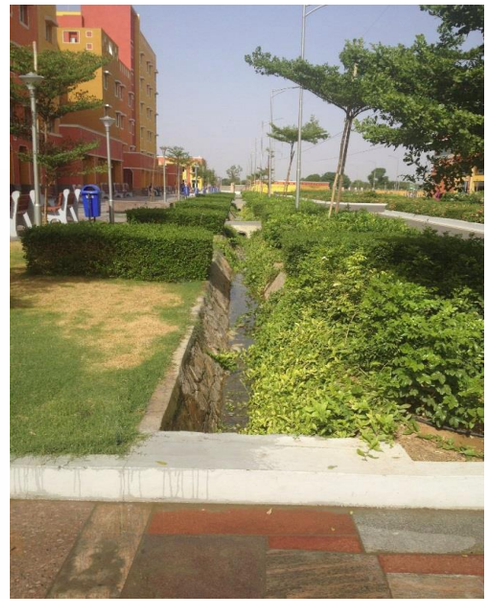
STORM WATER MANAGEMENT AND RAIN WATER REUSE

Stormwater from building rooftops will be collected in rainwater collection tanks These tanks are connected to the WTP.

Storm water from the site is collected in swales. Part of this water is diverted to a collection tank that also works as a sedimentation pit. The rest of the stormwater is diverted to 3 recharge pits located in the lowest part of the site. The collection tank is in turn connected to the WTP.

- Rainwater holding capacity at MUJ Hostel blocks 670kl & University blocks is 490kl
- Annually available rainwater at overall MUJ is 68599 kl/year in which 29.8% i.e. 20492 kl/year is used for the project requirements & 60.2% i.e. 41278.5 kl/year is recharged into the ground
- Collected rain water from roofs is treated with WTP on site and conveyed to the various buildings in Manipal University Jaipur
- Rain water from different areas on site is conveyed to ground water recharge pits through percolation swales. These swales reduce the rate of flow during conveyance and allow stormwater to percolate into the ground as it reaches the recharge pits





RENEWABLE ENERGY UTLIZATION AT MANIPAL UNIVERSITY JAIPUR

RENEWABLE ENERGY AT MANIPAL UNIVERSITY JAIPUR

Renewable energy Utilization is an important part of the design and development at Manipal University Jaipur. as part of this, solar p.v arrays are set up on the rooftops across multiple buildings in the University.

As a part of the initial design, a total of 700kWp solar power PV systems are set up on different building roof tops to serve various buildings in MUJ, in the second stage additional 150kwp is added. now the total capacity is upgraded to 1485kWp for future buildings. Total estimated future energy generation annually including the new installments is 22,84,748 kWh/year

The power generated will be the generic power that is not directed to a specific building but will be directed to the grid. Therefore the power reaching all the buildings will be a result of solar power generated and directed

From the initial solar PV installment of 700kWp, university blocks are catered 270kWp and all the hostel blocks are catered 310kWp.

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USE OF RENEWABLE ENERGY IN MANIPAL UNIVERSITY

MUJ has opted to go for solar energy systems because the potential to generate energy from solar in a region like Jaipur is high, also harnessing solar energy reduces dependence on the electric power grid, substantial energy savings are achieved by lower demand and operating charges.

Manipal University mainly focus on increasing its renewable energy generation to make the project self sufficient and progress towards net-zero & net positive in near future. As a part of this plan, Manipal university is increasing the size of the solar PV plant to 1485kwp

Approach:

Energy generated from the installed solar pv is intended to offset energy requirements of external and inter lighting, space conditioning and water heating

- Size of the solar power plant installed & serving the project in the current stage is 850kWp
- Efficient solar panels with a cell efficiency of up to 17% are used in setting up solar PV.
- An additional 625kWp will be installed and commissioned in the future.

Projections:

- It is estimated that on-site generated solar energy would offset a minimum of 30% total lighting load of both hostels and university blocks.
- At least 1% of the connected load of the project is offset by solar power generated
- Estimated total energy generated by the installed solar PV at MUJ which is documented for GRIHA rating is 10,43,689 kWh/annually

Results:

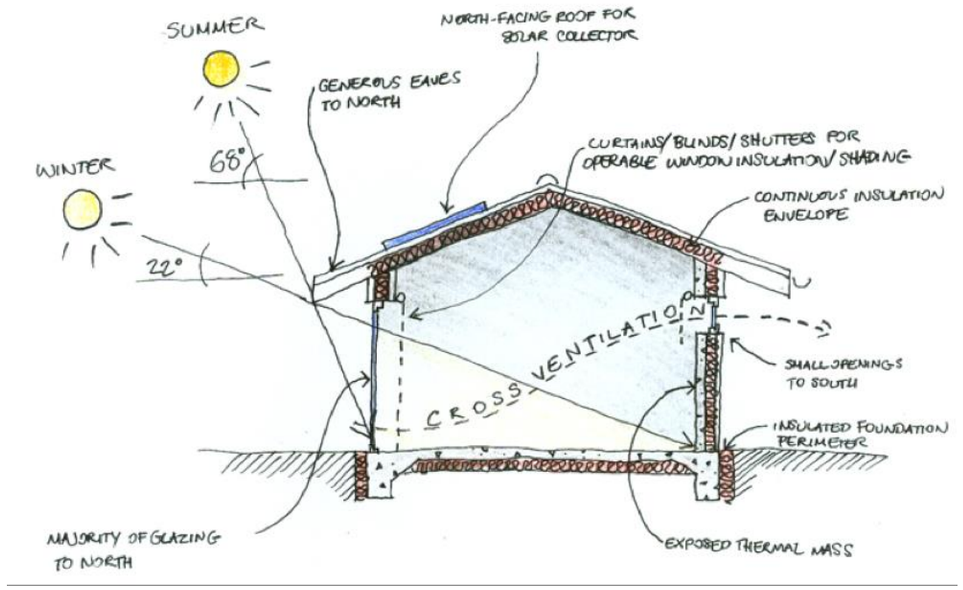
- Based on the data recorded on site, total energy generation on site is 12,86,856kwh/year
- 19.9% increase in the energy generation in the performance case when compared with the design case which was documented to GRIHA.
- 100% of the lighting energy requirement is met with energy generated from solar PV.
- 31.1 % of the connected load from lighting and space conditioning is met with installed solar PV

	Energy required for lighting (Internal) kWh/year	Energy required for space conditioning KWh/year	Total energy generated from solar in documented case	Total energy generated based on energy meter readings
MUJ hostels	7,24,279	21,29,288	**10,43,689**	**12,86,856**
MUJ university blocks	4,06,775	8,74,884		
Total	11,31,054	3004172		
Total connected load (lighting + space conditioning)	41,35,226			

SUMMARY

PASSIVE ARCHITECTURE DESIGN

- Wind flow analysis to optimize the position and size of openings.
- Shading studies for the optimization of glazing. This included the analysis of self shading due to the location of the blocks, shading due to structural elements and identification of any additional shading that maybe required.
- Irradiation mapping for solar PV placement.
- Thermal analysis for form studies based on solar gains due to position and orientation.



ENERGY MANAGEMENT

ENERGY REDUCTION STRATEGIES:

- Building walls and roofs are well insulated to cut down heat gains through the envelope
- Use of energy efficient HVAC systems for all the buildings. All chillers in MUJ has a minimum COP 3 in cooling mode.
- Timer based controls are used for all chillers & external street lightings to operate in specified timings
- Improve operations and maintenance practices by regularly checking and maintaining equipment to ensure it's functioning efficiently.
- maximized daylight areas in the buildings to reduce the use of artificial lighting during daytime operation
- All the buildings are equipped with energy meters to measure real-time data on a regular basis
- LPD achieved for the buildings is 0.35w/sqm

REDUCTION OF ENERGY CONSUMPTION:

- GRIHA documented energy consumption reduction: 50.84%
- Energy consumption reduction based on meter readings: 48% **(savings achieved in performance case is less because of occupant usage patterns)**

BENCHMARK EPI: 100 KWh/ m^2/year
PROPOSED EPI: 49.16KWh/ m^2/year
ACHEIVED EPI :52.0KWh/ m^2/year

Manipal University Jaipur

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GRIHA

INTEGRATED WATER MANAGEMENT

WATER MANAGEMENT : To develop a sustainable water management structure, MUJ has mainly focused on water demand reduction, both for buildings and Landscapes. and offset water demand with treated waste water & collected rainwater for potable and non-potable use.

- Dual plumbing system is installed in all the buildings
- Use of water efficient flush and fixtures in all the buildings
- Native and adaptive plant species are used in landscaping as they require minimum to no water to thrive
- Highly efficient irrigation systems like micro drip and sprinklers are used for landscape irrigation
- 100% wastewater generated on site is treated with two STP's installed and treated water is reused for building & landscape water requirement.
- Rainwater is collected from roofs and site, the collected water is treated with WTP and used back for buildings and Landscape
- Rainwater recharge pits are constructed to recharge the local aquifer

DEMAND SIDE REDUCTION IN BUILDINGS:

- In the GRIHA documented case MUJ as whole project could achieve 52.7% water savings when compared with base case requirement.
  - MUJ HOSTELS : 52.54%
  - MUJ UNIVERSITY BLOCKS : 47.69%
- Water savings achieved based on the water use data recorded from water meters is 49%
  - MUJ HOSTELS : 51.3%
  - MUJ UNIVERISITY BLOCKS : 41%

SUPPLY SIDE MANAGEMENT:

- In order to reduce the demand on potable water MUJ uses treated wastewater for all its non-potable uses like flushing and landscaping
- Rainwater from roofs is treated on site and used for potable water uses
- Regular water audits are conducted and regular data monitoring is performed in any issues or leaks are identified in the water supply structure they are fixed immediately

RENEWABLE ENERGY UTLIZATION- SOLAR PV

- Base on the calculations performed by the energy model it is estimated that the total energy consumption of internal lighting and space conditioning for whole MUJ(University buildings & hostels) is **41,35,226kWh/year.**
- Renewable Energy generation on site at the current stage with an **850kWp** system is **12,86,854kWh/year**
- Renewable energy system installed in MUJ will offset **31.1%** of the energy required for internal lighting and space conditioning
- Operation capacity of solar P.V setup at the current stage is **850kWp** however additional **625kWp** is being installed and will be commissioned shortly

Contact details

- Contact person –
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  - Designation – Registrar
  - Organization – Manipal University Jaipur
  - Mobile no. – 8003599903
  - Email id – registrar@jaipur.manipal.edu
- Nominees (max. two attendees) for the Award Evening –

Sr. No.	Name	Designation	Organization	Mobile No.	Email id
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